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B-ISDN APPLICATION PROTOCOLS FOR ACCESS SIGNALLING

BROADBAND INTEGRATED SERVICES DIGITAL NETWORK (B-ISDN) – DIGITAL SUBSCRIBER SIGNALLING SYSTEM No. 2 (DSS 2) – USER-NETWORK INTERFACE (UNI) LAYER 3 SPECIFICATION FOR BASIC CALL/CONNECTION CONTROL

ITU-T Recommendation Q.2931

(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.2931 was prepared by ITU-T Study Group 11 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 7th of February 1995.

NOTE

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

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SUMMARY

This Recommendation specifies the procedures for the establishing, maintaining and clearing of network connections at the B-ISDN user network interface. The procedures are defined in terms of messages exchanged.

This Recommendation is intended to specify the essential features, procedures and messages required for call/connection control. However, there are some details of procedure which have not yet been specified, and which will be subject to further study.

Recommendation Q.2931

BROADBAND INTEGRATED SERVICES DIGITAL NETWORK (B-ISDN) – DIGITAL SUBSCRIBER SIGNALLING SYSTEM No. 2 (DSS 2) – USER-NETWORK INTERFACE (UNI) LAYER 3 SPECIFICATION FOR BASIC CALL/CONNECTION CONTROL

(Geneva, 1995)

1 Scope

This Recommendation specifies the procedures for the establishing, maintaining, and clearing of network connections at the B-ISDN user-network interface. The procedures are defined in terms of messages exchanged.

This Recommendation is intended to specify the essential features, procedures and messages required for call/connection control.

This Recommendation specifies the layer 3 call/connection states, messages, information elements, timers and procedures used for the control of B-ISDN point-to-point on-demand calls on virtual channels within the overall scope of Release 1 of B-ISDN as specified in Recommendation Q.2010.

The procedures specified by this Recommendation are applied at the interface between a B-ISDN terminal equipment and a B-ISDN public network (reference point S_B and T_B coincident) as well as at the interface between a B-ISDN customer network and a B-ISDN public network (i.e. at the T_B reference point).

Other Recommendations may use additional messages, additional operations (using Facility information element), additional information elements and/or modification of existing information elements to support additional capabilities in DSS 2.

1.1 Definitions, abbreviations and references

These are provided in Annex J.

1.2 Application to interface structure

The layer 3 procedures apply to the interface structures defined in Recommendation I.413. They use the functions and services provided by layer 2. The layer 3 procedures request the services of layer 2 and receive information from layer 2 using the primitives defined in Recommendation Q.2130. These primitives are used to illustrate the communication between the protocol layers and are not intended to specify or constrain implementations.

1.3 Capabilities supported by this Recommendation

The basic capabilities supported by the Release 1 Signalling specified in this Recommendation are listed below:

1) Demand (switched virtual) channel connections.

2) Point-to-point switched channel connections.

3) Connections with symmetric or asymmetric bandwidth requirements.

4) Single-connection (point-to-point) calls.

5) Basic signalling functions via protocol messages, information elements and procedures.

6) Class X, Class A and Class C ATM transport services.

7) Request and indication of signalling parameters.

8) VCI negotiation.

9) Out-of-band signalling for all signalling messages.

10) Error recovery.

11) Public UNI addressing formats for unique identification of ATM endpoints.

12) End-to-end compatibility parameter identification.

13) Signalling interworking with N-ISDN and provision of N-ISDN services.

14) Forward compatibility.

The following subclauses describe each capability in more detail.

1.3.1 Support of demand (switched) channel connections

The purpose of this specification is to support on-demand (switched) channel connections. These connections are established in real-time using signalling procedures. Demand connections can remain active for an arbitrary amount of time but would not automatically be re-established after a network failure.

In contrast, permanent connections are those that are set up and torn down via provisioning. Permanent connections generally remain established for long periods of time and should automatically be re-established in the event of network failure.

1.3.2 Support of point-to-point connections

A point-to-point connection is a collection of associated ATM virtual channel (VC) or virtual path (VP) links that connect two endpoints. The Release 1 Signalling specified in this Recommendation supports point-to-point virtual channel (VC) connections.

1.3.3 Support of connections with symmetric or asymmetric bandwidth

The Release 1 Signalling specified in this Recommendation supports point-to-point, bidirectional connections that have bandwidth specified independently in the forward and backward directions. The forward direction is from the calling party to the called party, while the backward direction is from the called party to the calling party.

1.3.4 Support of a single connection per call

The Release 1 Signalling specified in this Recommendation will support one and only one connection per call.

1.3.5 Protocol support for basic signalling functions

The signalling protocol supports the following basic functions at the UNI interface:

- *Call/Connection Set-up*

  This is the aspect of the protocol which supports the establishment of a call/connection between different parties. It includes Call/Connection Request and Call/Connection Answer.

- *Call/Connection Request*

  This protocol function allows an originating party to request the establishment of a call/connection to a certain destination. In this request, the originating party may provide information related to the call/connection.

- *Call/Connection Answer*

  This protocol function allows the destination party to respond to an incoming call/connection request. The destination party may include information related to the call/connection (rejecting the call/connection request is considered part of the Call/Connection Clearing function).

- *Call/Connection Clearing*

  This protocol function allows any party involved in a call/connection to initiate its removal from an already established call/connection. This function also allows a destination party to reject its inclusion in a call/connection.

- *Reason for Clearing*

  This protocol function allows the clearing party to indicate the cause for initiating its removal from a call/connection.

- *Out-of-Band Signalling*

  This function specifies that call/connection control information uses a channel different from the channels used for exchanging data information between the end-parties (i.e. a specific VPCI/VCI value will be used for the call/connection control signalling channel).

1.3.6 Support of Class A, Class C and Class X (see Recommendation I.211)

Class A service is a connection-oriented, constant bit rate ATM transport service. Class A service has end-to-end timing requirements. Class A service may require stringent cell loss, cell delay and cell delay variation performance. The user chooses the desired bandwidth and the appropriate QOS in the SETUP message to establish a Class A connection.

Class C service is a connection-oriented variable bit rate (see Note) ATM transport service. Class C service has no end-to-end timing requirements. The user chooses the desired bandwidth and QOS with appropriate information elements in a SETUP message to establish a Class C connection.

NOTE – For Bearer Class C, the network may allocate resources, as if Bearer Class A was requested.

Class X service is a connection-oriented ATM transport service where the AAL, traffic type (VBR or CBR) and timing requirements are user defined (i.e. transparent to the network). The user chooses only the desired bandwidth and QOS with appropriate information elements in a SETUP message to establish a Class X connection.

1.3.7 Support of signalling parameter request and indication

The Release 1 Signalling specified in this supports for the negotiation of some signalling parameters (e.g. B-LLI, AAL parameters).

1.3.8 VPCI/VCI support

The Release 1 Signalling specified in this Recommendation supports the VPCI as the way of identifying the virtual path across the UNI, with a restriction that there is a one-to-one mapping between VPCI and VPI.

The following list describes the Release 1 Signalling capabilities with respect to VPCI and VCIs. The Release 1 Signalling specified in this Recommendation:

1) provides for the identification of virtual path connections (using VPCIs) and virtual channel connections within virtual paths (using VCIs);

2) includes negotiation of VCIs.

1.3.9 Out-of-band signalling

VCI = 5 is reserved in every VPCI for the point-to-point signalling in Release 1. Meta-signalling is not supported in Release 1. (See Recommendation I.311 for the establishment of the association of signalling entities in absence of meta-signalling.) The broadcast signalling virtual channels are not supported.

1.3.10 Support of error recovery

The error recovery capabilities of the Release 1 Signalling specified in this Recommendation include:

1) Detailed error handling procedures, including means for one signalling entity to inform its peer when it has encountered a non-fatal error (i.e. insufficiently severe to force call clearing); examples of non-fatal errors are message format errors, message content errors and procedural errors (e.g. messages or message contents received in a state in which they are not expected).

2) Procedures for recovery from signalling AAL reset and failure (and, by extension, from Physical layer outages and glitches).

3) Mechanisms for signalling entities to exchange state information for calls and interfaces, and to recover gracefully if there is a disagreement; these procedures must operate both in error conditions as a side-effect of 1) and on request by either signalling entity (i.e. status enquiry).

4) Capability to force calls, VCCs, and interfaces to an idle state, either due to manual intervention or as a result of server errors.

5) Cause and diagnostic information for fault resolution provided with call clearing (see 5.1.3), non-fatal errors, and recovery from errors affecting the whole interface.

6) Mechanisms (e.g. timers and associated procedures) to recover from loss of individual messages.

1.3.11 Support of public UNI ATM addressing

The Release 1 Signalling specified in this Recommendation supports a number of ATM address formats to be used across the Public UNI to unambiguously identify the endpoints in an ATM connection.

1.3.12 Support of end-to-end compatibility parameter identification

On a per-connection basis, the following end-to-end compatibility parameters can be specified:

1) The AAL type (e.g. Types 1, 3/4, or 5).

2) The method of protocol multiplexing (e.g. LLC vs. VC) and AAL parameter.

3) For VC-based multiplexing, the protocol which is encapsulated (e.g. any of the list of known routed protocols or bridged protocols).

4) Protocols above the network layer.

1.3.13 Signalling interworking with N-ISDN and provision of N-ISDN services

The Release 1 Signalling supports interworking with N-ISDN. At the same time, signalling is specified to support N-ISDN services in a B-ISDN environment.

The following are the underlying assumptions:

1) B-ISDN should be able to provide N-ISDN services.

2) The originator/originating network does not know whether a call requesting a N-ISDN service will terminate on a N-ISDN or a B-ISDN network. (Only the requested service is known, e.g. 64 kbit/s unrestricted digital information, not the protocols supported by intervening networks.)

3) Signalling interworking should be as simple as possible. Complex protocol conversions should be avoided.

Consequently N-ISDN services in a B-ISDN environment obey the following rules:

1) Information items that have end-to-end significance should be indicated using the narrow-band versions and not the broadband versions. Examples: N-HLC, N-LLC (and not B-HLI, B-LLI).

2) Information items that have global significance about the requested service should be indicated using both the narrow-band and the broadband version. Example: N-BC and B-BC.

Clause 6 and Annex E contain the N-ISDN service provision and interworking procedures.

1.3.14 Forward compatibility

To support forward compatibility in the signalling protocol, a mechanism based on instruction indicators is specified in this Recommendation. This mechanism applies to both messages and information elements.

2 Overview of call/connection control

In this Recommendation, the terms “incoming” and “outgoing” are used to describe the Broadband ISDN call as viewed by the user side of the interface.

This clause defines B-ISDN call/connection control states that individual calls may have. These definitions do not apply to the state of the interface itself, any attached equipment, or the Signalling virtual channel. Because several B-ISDN calls/connections may exist simultaneously at a user-network interface, and each call/connection may be in a different state, the state of the interface itself cannot be unambiguously defined.

2.1 B-ISDN call/connection states

This subclause defines the call/connection control states for B-ISDN calls.

2.1.1 Call/connection states at the user side of the interface

The states which may exist on the user side of the user-network interface are defined in this subclause.

2.1.1.1 null (U0): No call exists.

2.1.1.2 call initiated (U1): This state exists for an outgoing call when the user requests call establishment from the network.

2.1.1.3 outgoing call proceeding (U3): This state exists for an outgoing call when the user has received acknowledgement that the network has received all call information necessary to effect call establishment.

2.1.1.4 call delivered (U4): This state exists for an outgoing call when the calling user has received an indication that remote user alerting has been initiated.

2.1.1.5 call present (U6): This state exists for an incoming call when the user has received a call establishment request but has not yet responded.

2.1.1.6 call received (U7): This state exists for an incoming call when the user has indicated alerting but has not yet answered.

2.1.1.7 connect request (U8): This state exists for an incoming call when the user has answered the call and is waiting to be awarded the call.

2.1.1.8 incoming call proceeding (U9): This state exists for an incoming call when the user has sent acknowledgement that the user has received all call information necessary to effect call establishment.

2.1.1.9 active (U10): This state exists for an incoming call when the user has received an acknowledgement from the network that the user has been awarded the call. This state exists for an outgoing call when the user has received an indication that the remote user has answered the call.

2.1.1.10 release request (U11): This state exists when the user has requested the network to clear the end-to-end connection (if any) and is waiting for a response.

2.1.1.11 release indication (U12): This state exists when the user has received an invitation to disconnect because the network has disconnected the end-to-end connection (if any).

2.1.2 Call/connection states at the network side of the interface

The states that may exist on the network side of the user-network interface are defined in this subclause.

2.1.2.1 null (N0): No call exists.

2.1.2.2 call initiated (N1): This state exists for an outgoing call when the network has received a call establishment request but has not yet responded.

2.1.2.3 outgoing call proceeding (N3): This state exists for an outgoing call when the network has sent acknowledgement that the network has received all call information necessary to effect call establishment.

2.1.2.4 call delivered (N4): This state exists for an outgoing call when the network has indicated that remote user alerting has been initiated.

2.1.2.5 call present (N6): This state exists for an incoming call when the network has sent a call establishment request but not yet received a satisfactory response.

2.1.2.6 call received (N7): This state exists for an incoming call when the network has received an indication that the user is alerting but has not yet received an answer.

2.1.2.7 connect request (N8): This state exists for an incoming call when the network has received an answer but the network has not yet awarded the call.

2.1.2.8 incoming call proceeding (N9): This state exists for an incoming call when the network has received acknowledgement that the user has received all call information necessary to effect call establishment.

2.1.2.9 active (N10): This state exists for an incoming call when the network has awarded the call to the called user. This state exists for an outgoing call when the network has indicated that the remote user has answered the call.

2.1.2.10 release request (N11): This state exists when the network has received a request from the user to clear the end-to-end connection (if any).

2.1.2.11 release indication (N12): This state exists when the network has disconnected the end-to-end connection (if any) and has sent an invitation to disconnect the user-network connection.

2.2 Additional B-ISDN call/connection states relating to interworking requirements

This subclause defines the additional call/connection control states for B-ISDN calls relating to interworking requirements.

2.2.1 Call/connection states at the user side of the interface

The states which may exist on the user side of the user-network interface are defined in this subclause.

2.2.1.1 overlap sending (U2): This state exists for an outgoing call when the user has received acknowledgement of the call establishment request which permits the user to send additional call information to the network in overlap mode.

2.2.1.2 overlap receiving (U25): This state exists for an incoming call when the user has acknowledged the call establishment request from the network and is prepared to receive additional call information (if any) in overlap mode.

2.2.2 Call/connection states at the network side of the interface

The states that may exist on the network side of the user-network interface are defined in this subclause.

2.2.2.1 overlap sending (N2): This state exists for an outgoing call when the network has acknowledged the call establishment request and is prepared to receive additional call information (if any) in overlap mode.

2.2.2.2 overlap receiving (N25): This state exists for an incoming call when the network has received acknowledgement request which permits the network to send additional call information (if any) in the overlap mode.

2.3 B-ISDN call/connection states for global call reference

This subclause defines the states that the protocol may adopt using the global call reference. The procedures for use of the global call reference for the RESTART message are contained in 5.5.

There is only one global call reference value per signalling virtual channel.

2.3.1 Call/connection states at the user side of the interface

The states which may exist on the user side of the user network interface are defined in this subclause.

2.3.1.1 null (Rest 0): No transaction exists.

2.3.1.2 restart request (Rest 1): This state exists for a restart transaction when the user has sent a restart request but has not yet received an acknowledgement response from the network.

2.3.1.3 restart (Rest 2): This state exists when a request for a restart has been received from the network and responses have not yet been received from all locally active call references.

2.3.2 Call/connection states at the network side of the interface

The states which may exist on the network side of the user-network interface are defined in this subclause.

2.3.2.1 null (Rest 0): No transaction exists.

2.3.2.2 restart request (Rest 1): This state exists for a restart transaction when the network has sent a restart request but has not yet received an acknowledgement response from the user.

2.3.2.3 restart (Rest 2): This state exists when a request for a restart has been received from the user and a response has not yet been received from all locally active call references.

3 Message functional definitions and content

This clause provides an overview of the message structure, which highlights the functional definition and information content (i.e. semantics) of each message. Each definition includes:

1) A brief description of the message direction and use, including whether the message has:

   a) local significance, i.e. relevant only in the originating or terminating access;

   b) access significance, i.e. relevant in the originating and terminating access, but not in the network;

   c) dual significance, i.e. relevant in either the originating or terminating access and in the network; or,

   d) global significance, i.e. relevant in the originating and terminating access and in the network.

2) A table listing the codeset 0 information elements. For each information element, the table indicates:

   a) the reference of this Recommendation describing the information element;

   b) the direction in which it may be sent; i.e. user to network ("u → n"), network to user ("n → u"), or both;

      NOTE 1 – The user-network terminology in this clause refers to the interface structures between B-ISDN terminal equipment and B-ISDN public network (TE – LCRF), and between B-ISDN customer network and B-ISDN public network (CN – LCRF); the terms TE, CN and LCRF being used as defined in Recommendation I.327.

   c) whether inclusion is mandatory ("M") or optional ("O"), with a reference to Notes explaining the circumstances under which the information element shall be included; and

   d) the length of the information element (or permissible range of lengths), in octets, where "∗" denotes an undefined maximum length, which may be network or service dependent.

3) Further explanatory Notes, as necessary.

   NOTE 2 – All messages may contain information elements from codesets 4, 5, 6 and 7 and corresponding Broadband locking shift and Broadband non-locking shift information elements which comply with the coding rules specified in 4.5.2 to 4.5.4. None of these information elements, however, are listed in clause 3.

   NOTE 3 – The notification indicator information element may be repeated in a message. The maximum length and the number of repetitions allowed is a network option.

3.1 Messages for B-ISDN call and connection control

Table 3-1 summarizes the messages for B-ISDN call or connection control.

TABLE 3-1/Q.2931

Messages for B-ISDN call and connection control

Message	Reference
Call establishment messages:	
ALERTING	3.1.1
CALL PROCEEDING	3.1.2
CONNECT	3.1.3
CONNECT ACKNOWLEDGE	3.1.4
SETUP	3.1.7
Call clearing messages:	
RELEASE	3.1.5
RELEASE COMPLETE	3.1.6
Miscellaneous messages:	
NOTIFY	3.1.10
STATUS	3.1.8
STATUS ENQUIRY	3.1.9

3.1.1 Alerting

This message is sent by the called user to the network and by the network to the calling user to indicate that the called user alerting has been initiated. See Table 3-2.

TABLE 3-2/Q.2931

ALERTING message content

Message type: ALERTING

Significance: Global

Direction: Both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Connection identifier	4.5	Both	O (Note 1)	4-9
Notification indicator	4.5	Both	O (Note 2)	4-*

NOTES

1 When Annex H is implemented, mandatory in the network-to-user direction if this message is the first message in response to a SETUP message. Mandatory in the user-to-network direction if this message is the first message in response to a SETUP message, unless the user accepts the connection identifier indicated in the SETUP message.

2 This indicator may be present whenever notification is delivered.

3.1.2 Call proceeding

This message is sent by the called user to the network or by the network to the calling user to indicate that the requested call establishment has been initiated and no more call establishment information will be accepted. See Table 3-3.

TABLE 3-3/Q.2931

CALL PROCEEDING message content

Message type: CALL PROCEEDING

Significance: Local

Direction: Both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Connection identifier	4.5	Both	O (Note 1)	4-9
Notification indicator	4.5	Both	O (Note 2)	4-*

NOTES

1 Mandatory in the network-to-user direction. When Annex H is implemented, mandatory in the network-to-user direction if this message is the first message in response to a SETUP message. Mandatory in the user-to-network direction if this message is the first message in response to a SETUP message, unless the user accepts the connection identifier indicated in the SETUP message.

2 This indicator may be present whenever notification is delivered.

3.1.3 Connect

This message is sent by the called user to the network and by the network to the calling user to indicate call acceptance by the called user. See Table 3-4.

TABLE 3-4/Q.2931

CONNECT message content

Message type: CONNECT

Significance: Global

Direction: Both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
AAL parameters	4.5	Both	O (Note 1)	4-21
Broadband low layer information	4.5	Both	O (Note 2)	4-17
Connection identifier	4.5	Both	O (Note 3)	4-9
End-to-end transit delay	4.5	Both	O (Note 4)	4-10
Notification indicator	4.5	Both	O (Note 5)	4-*
OAM traffic descriptor	4.5	Both	O (Note 6)	4-6

NOTES

1 Included in the user-to-network direction when the called user wants to pass ATM adaptation layer parameters information to the calling user, and the ATM adaptation layer parameters information element was present in the SETUP message. Included in the network-to-user direction if the called user included an ATM adaptation layer parameters information element in the CONNECT message. See Annex F.

2 Included in the user-to-network when the answering user wants to return low layer information to the calling user. Included in the network-to-user direction if the user awarded the call included a broadband low layer information information element in the CONNECT message. Optionally included for broadband low layer information negotiation, but some networks may not transport this information element to the calling user (see Annex C).

3 When Annex H is implemented, mandatory in the network-to-user direction if this message is the first message in response to a SETUP message. Mandatory in the user-to-network direction if this message is the first message in response to a SETUP message, unless the user accepts the connection identifier indicated in the SETUP message.

4 Included in the user-to-network direction when the responding user received the end-to-end transit delay information element in the SETUP message. Included in the network-to-user direction if the responding user included the end-to-end transit delay information element in the CONNECT message.

5 This indicator may be present whenever notification is delivered.

6 Included in the user-to-network direction when the responding user received the OAM traffic descriptor information element in the SETUP message. Included in the network-to-user direction if the responding user included the OAM traffic descriptor information element in the CONNECT message.

3.1.4 Connect acknowledge

This message is sent by the network to the called user to indicate the user has been awarded the call. It is also sent by the calling user to the network to allow symmetrical call control procedures. See Table 3-5.

TABLE 3-5/Q.2931

CONNECT ACKNOWLEDGE message content

Message type: CONNECT ACKNOWLEDGE Significance: Local Direction: Both				
Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Notification indicator	4.5	Both	O (Note)	4-*
NOTE – This indicator may be present whenever notification is delivered.				

3.1.5 Release

This message is sent by the user to request the network to clear the end-to-end connection (if any) or is sent by the network to indicate that the end-to-end connection is cleared and that the receiving equipment release the connection identifier and prepare to release its call reference value after sending RELEASE COMPLETE. See Table 3-6.

TABLE 3-6/Q.2931

RELEASE message content

Message type: RELEASE Significance: Global Direction: Both				
Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Cause	4.5	Both	M (Note 1)	6-34
Notification indicator	4.5	Both	O (Note 2)	4-*
NOTES 1 This information element may appear twice in the message. 2 This indicator may be present whenever notification is delivered.				

3.1.6 Release complete

This message is sent by the user or the network to indicate that the equipment sending the message has released its call reference value and, if appropriate, the connection identifier. The connection identifier, if released, is available for re-use. The receiving equipment shall release its call reference value. See Table 3-7.

TABLE 3-7/Q.2931

RELEASE COMPLETE message content

Message type: RELEASE COMPLETE

Significance: Local (Note 1)

Direction: Both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Cause	4.5	Both	O (Note 2)	4-34

NOTES

1 This message has local significance; however, it may carry information of global significance when used as the first call clearing message.

2 Mandatory in the first call clearing message, including when the RELEASE COMPLETE message is sent as a result of an error handling condition. This information element may appear twice in the message.

3.1.7 Set-up

This message is sent by the calling user to the network and by the network to the called user to initiate B-ISDN call and connection establishment. See Table 3-8.

TABLE 3-8/Q.2931

SETUP message content

Message type: SETUP

Significance: Global

Direction: Both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
AAL parameters	4.5	Both	O (Note 1)	4-21
ATM traffic descriptor	4.5	Both	M	12-20
Broadband bearer capability	4.5	Both	M	6-7
Broadband high layer information	4.5	Both	O (Note 2)	4-13
Broadband repeat indicator	4.5	Both	O (Note 3)	4-5
Broadband low layer information	4.5	Both	O (Note 4)	4-17
Called party number	4.5	Both	O (Note 5)	4-*
Called party sub-address	4.5	Both	O (Note 6)	4-25
Calling party number	4.5	Both	O (Note 7)	4-*
Calling party sub-address	4.5	Both	O (Note 8)	4-25
Connection identifier	4.5	Both	O (Note 9)	4-9
End-to-end transit delay	4.5	Both	O (Note 10)	4-10
Notification indicator	4.5	Both	O (Note 11)	4-*
OAM traffic descriptor	4.5	Both	O (Note 12)	4-6
QOS parameter	4.5	Both	M	6
Broadband sending complete	4.5	Both	O (Note 13)	4-5
Transit network selection	4.5	u → n	O (Note 14)	4-*

NOTES

1 Included in the user-to-network direction when the calling user wants to pass AAL information to the called user. Included in the network-to-user direction if the calling user included an AAL parameter information element in the SETUP message. See Annex F.

2 Included in the user-to-network direction when the calling user wants to pass broadband high layer information to the called user. Included in the network-to-user direction if the calling user included a broadband high layer information information element in the SETUP message.

3 Included when two or more broadband low layer information information elements are included for low layer information negotiation. The broadband repeat indicator information element is included immediately before the first broadband low layer information information element.

4 Included in the user-to-network direction when the calling user wants to pass broadband low layer compatibility information to the called user. Included in the network-to-user direction if the calling user included a broadband low layer information information element in the SETUP message. Two or three information elements may be included in descending order of priority, i.e. highest priority first, if the broadband low layer information negotiation procedures are used. See Annex C.

5 The called party number information element is included by the user to convey called party number information to the network. The called party number information element is included by the network when called party number information is conveyed to the user.

6 Included in the user-to-network direction when the calling user wants to indicate the called party sub-address. Included in the network-to-user direction if the calling user included a called party sub-address information element in the SETUP message.

7 May be included by the calling user or the network to identify the calling user.

NOTES *(continued)*

8 Included in the user-to-network direction when the calling user wants to indicate the calling party sub-address. Included in the network-to-user direction if the calling user included a calling party sub-address information element in the SETUP message.

9 Included in the user-to-network direction when a user wants to indicate a virtual channel. Included in the network-to-user direction when the network wants to indicate a virtual channel. If not included, its absence is interpreted as any virtual channel is acceptable. This information element may only be absent when using the non-associated signalling procedure.

10 Included in the user-to-network direction when the calling user wants to specify end-to-end transit delay requirements for this call and/or the cumulative transit delay expected for the transmission of user data from the calling user to the network boundary. When included, an end-to-end transit delay information element will be delivered to the called user. Included in the network-to-user direction if end-to-end transit delay information is to be delivered to the called user. See Annex K.

11 This indicator may be present whenever notification is delivered.

12 Included by the calling user to indicate additional information related to the OAM F5 end-to-end information flow. The absence of the OAM traffic descriptor information element does not in itself mean that no OAM flow will be used within this call.

13 It is mandatory for the user to include the broadband sending complete information element when *en bloc* sending procedures are used; its interpretation by the network is optional. It is mandatory for the network to include the broadband sending complete information element when *en bloc* receiving procedures are used. If the broadband sending complete information element is not included, missing mandatory information element error procedures need not be applied.

14 Included by the calling user to select a particular transit network (see Annex D). This information element may appear four times in the message.

3.1.8 Status

This message is sent by the user or the network in response to a STATUS ENQUIRY message or at any time to report certain error conditions as listed in clause 5. See Table 3-9.

NOTE – If this message is sent with the global call reference, the "global interface state" (see Table 4-11) is indicated by the call state information element.

TABLE 3-9/Q.2931

STATUS message content

Message type: STATUS

Significance: Local

Direction: Both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M (Note)	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Call state	4.5	Both	M	5
Cause	4.5	Both	M	6-34

NOTE – This message may be sent with the global call reference defined in 4.3.

3.1.9 Status enquiry

This message is sent by the user or the network at any time to solicit a STATUS message from the peer layer 3 entity. Sending a STATUS message in response to a STATUS ENQUIRY message is mandatory. See Table 3-10.

TABLE 3-10/Q.2931

STATUS ENQUIRY message content

Message type: STATUS ENQUIRY Significance: Local Direction: Both				
Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2

3.1.10 Notify

This message is sent by the user or the network to indicate information pertaining to a call/connection. See Table 3-11.

TABLE 3-11/Q.2931

NOTIFY message content

Message type: NOTIFY Significance: Access Direction: Both				
Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Notification indicator	4.5	Both	M	5-*

3.2 Additional or modified messages related for the support of 64 kbit/s based ISDN circuit-mode services

Table 3-12 summarizes the messages for B-ISDN call or connection control for the support of 64 kbit/s based ISDN circuit-mode services.

TABLE 3-12/Q.2931

Messages related to interworking requirements

Message	Reference
Call establishment messages:	
ALERTING	3.2.1
CALL PROCEEDING	3.2.2
CONNECT	3.2.3
CONNECT ACKNOWLEDGE	3.1.4
PROGRESS	3.2.5
SETUP	3.2.7
SETUP ACKNOWLEDGE	3.2.8
Call clearing messages:	
RELEASE	3.2.6
RELEASE COMPLETE	3.1.6
Miscellaneous messages:	
NOTIFY	3.1.10
INFORMATION	3.2.4
STATUS	3.1.8
STATUS ENQUIRY	3.1.9

3.2.1 Alerting

This message is sent by the called user to the network and by the network to the calling user to indicate that called user alerting has been initiated. See Table 3-13.

TABLE 3-13/Q.2931

ALERTING message content

Message type: ALERTING

Significance: Global

Direction: Both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Connection identifier	4.5	u → n	O (Note 1)	4-9
Narrow-band bearer capability	4.6	Both	O (Note 2)	4-14
Narrow-band high layer compatibility	4.6	Both	O (Note 3)	4-7
Notification indicator	4.5	Both	O (Note 4)	4-*
Progress indicator	4.6	Both	O (Note 5)	4-6

NOTES

1 Mandatory in the user-to-network direction if this message is the first message in response to a SETUP message, unless the user accepts the connection identifier indicated in the SETUP message.

2 The narrow-band bearer capability information element is included when procedures for bearer capability selection are used as defined in 5.11/Q.931. When present, progress description No. 5, "interworking has occurred and has resulted in a telecommunication service change" shall also be present.

3 The narrow-band high layer compatibility information element is included when the procedures of 5.12/Q.931 for high layer compatibility selection apply. When present, progress description No. 5, "interworking has occurred and has resulted in a telecommunication service change" shall also be present.

4 This indicator may be present whenever notification is delivered.

5 Included in the event of interworking. Included in the network-to-user direction in connection with the provision of in-band information/patterns. Included in the user-to-network direction in connection with the provision of in-band information/patterns if Annex K/Q.931 is implemented or in accordance with the procedures of 5.11.3/Q.931 and 5.12.3/Q.931. This information element may appear twice in the message.

3.2.2 Call proceeding

This message is sent by the called user to the network or by network to the calling user to indicate that the requested call establishment has been initiated and no more call establishment information will be accepted. See Table 3-14.

TABLE 3-14/Q.2931

CALL PROCEEDING message content

Message type: CALL PROCEEDING

Significance: Local

Direction: Both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Connection identifier	4.5	Both	O (Note 1)	4-9
Narrow-band bearer capability	4.6	Both	O (Note 2)	4-14
Narrow-band high layer compatibility	4.6	Both	O (Note 3)	4-7
Notification indicator	4.5	Both	O (Note 4)	4-*
Progress indicator	4.6	Both	O (Note 5)	4-6

NOTES

1 Mandatory in the network-to-user direction if this message is the first message in response to a SETUP message. It is mandatory in the user-to-network direction if this message is the first message in response to a SETUP message, unless the user accepts the connection identifier indicated in the SETUP message.

2 The narrow-band bearer capability information element is included when procedures for bearer capability selection are used as defined in 5.11/Q.931. When present, progress description No. 5, “interworking has occurred and has resulted in a telecommunication service change” shall also be present.

3 The narrow-band high layer compatibility information element is included when the procedures of 5.12/Q.931 for high layer compatibility selection apply. When present, progress description No. 5, “interworking has occurred and has resulted in a telecommunication service change” shall also be present.

4 This indicator may be present whenever notification is delivered.

5 Included in the event of interworking. Included in the network-to-user direction in connection with the provision of in-band information/patterns. Included in the user-to-network direction in connection with the provision of in-band information/patterns if Annex K/Q.931 is implemented or in accordance with the procedures of 5.11.3/Q.931 and 5.12.3/Q.931. This information element may appear twice in the message.

3.2.3 Connect

This message is sent by the called user to the network and by the network to the calling user to indicate call acceptance by the called user. See Table 3-15.

TABLE 3-15/Q.2931

CONNECT message content

Message type: CONNECT

Significance: Global

Direction: Both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
AAL parameters	4.5	Both	O (Note 1)	4-21
Connection identifier	4.5	u → n	O (Note 2)	4-9
End-to-end transit delay	4.5	Both	O (Note 3)	4-13
Narrow-band bearer capability	4.6	Both	O (Note 4)	4-14
Narrow-band high layer compatibility	4.6	Both	O (Note 5)	4-7
Narrow-band low layer compatibility	4.6	Both	O (Note 6)	4-20
Notification indicator	4.5	Both	O (Note 7)	4-*
OAM traffic descriptor	4.5	Both	O (Note 8)	4-6
Progress indicator	4.6	Both	O (Note 9)	4-8

NOTES

1 Included in the user-to-network direction when the called user wants to pass ATM adaptation layer parameters information to the calling user, and the ATM adaptation layer parameters information element was present in the SETUP message. Included in the network-to-user direction if the called user included an ATM adaptation layer parameters information element in the CONNECT message. See Annex F.

2 Mandatory in the user-to-network if this message is the first message in response to a SETUP message, unless the user accepts the connection identifier indicated in the SETUP message.

3 Included in the user-to-network direction when the responding user received the end-to-end transit delay information element in the SETUP message. Included in the network-to-user direction if the responding user included the end-to-end transit delay information element in the CONNECT message, as described in the procedures for bearer capability selection defined in 5.11/Q.931.

4 The narrow-band bearer capability information element can be included when procedures for bearer capability selection are used as defined in 5.11/Q.931.

5 The narrow-band high layer compatibility information element is included when the procedures of 5.12/Q.931 for high layer compatibility selection apply.

6 Included in the user-to-network direction when the answering user wants to return narrow-band low layer compatibility information to the calling user. Included in the network-to-user direction if the user awarded the call included a narrow-band low layer compatibility information element in the CONNECT message. Optionally included for low layer compatibility negotiation to the calling user (see Annex M/Q.931 – *Blue Book*).

7 This indicator may be present whenever notification is delivered.

8 Included in the user-to-network direction when the responding user received the OAM traffic descriptor information element in the SETUP message. Included in the network-to-user direction if the responding user included the OAM traffic descriptor information element in the CONNECT message.

9 Included in the event of interworking or in connection with the provision of in-band information/patterns. This information element may appear twice in the message.

3.2.4 Information

This message is sent by the user or the network to provide additional information. It may be used to provide information for call establishment (e.g. overlap sending) or miscellaneous call-related information. See Table 3-16.

TABLE 3-16/Q.2931

INFORMATION message content

Message type: INFORMATION Significance: Local (Note 1) Direction: Both				
Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Broadband sending complete	4.5	Both	O (Note 2)	4-5
Called party number	4.5	Both	O (Note 3)	4-*

NOTES

1 This message has local significance, but may also carry information of global significance.

2 Included if the user optionally indicates completion of overlap sending to the network, or if the network optionally indicates completion of overlap receiving to the user.

3 The called party number information element is included by the user to convey called party number information to the network during overlap sending. The called party number information element is included by the network to convey called party number information to the user during overlap receiving.

3.2.5 Progress

This message is sent by the user or the network to indicate the progress of a call in the event of interworking. See Table 3-17.

TABLE 3-17/Q.2931

PROGRESS message content

Message type: PROGRESS Significance: Global Direction: Both				
Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Narrow-band bearer capability	4.6	Both	O (Note 1)	4-14
Narrow-band high layer compatibility	4.6	Both	O (Note 2)	4-7
Notification indicator	4.5	Both	O (Note 3)	4-*
Progress indicator	4.6	Both	M (Note 4)	6

NOTES

1 The narrow-band bearer capability information element is included when the procedures for bearer capability selection are used as defined in 5.11/Q.931. The narrow-band bearer capability information element indicates the bearer service now being used for the call/connection.

2 The narrow-band high layer compatibility information element is included when the optional procedures of 5.12/Q.931 for high layer compatibility selection apply. The narrow-band high layer compatibility information element indicates the high layer compatibility now being used for the call.

3 This indicator may be present whenever notification is delivered.

4 This information element may appear twice in the message.

3.2.6 Release

This message is sent by the user or the network to indicate that the equipment sending the message has disconnected the B-ISDN connection and intends to release the connection identifier (if any) and the call reference, and that the receiving equipment should release the connection identifier and prepare to release the call reference after sending RELEASE COMPLETE. See Table 3-18.

TABLE 3-18/Q.2931

RELEASE message content

Message type: RELEASE

Significance: Global

Direction: Both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Cause	4.5	Both	M (Note 1)	6-34
Notification indicator	4.5	Both	O (Note 2)	4-*
Progress indicator	4.6	Both	O (Note 3)	4-6

NOTES

1 This information element may appear twice in the message.

2 This indicator may be present whenever notification is delivered.

3 Included by the network if in-band tones are provided. However, the user may include the progress indicator and provide in-band tones. In such cases, the network will ignore this information element and will not convey the in-band tones. This information element may appear twice in the message.

3.2.7 Set-up

This message is sent by the calling user to the network and by the network to the called user to initiate a call in B-ISDN for a 64 kbit/s based circuit-mode ISDN service. See Table 3-19.

TABLE 3-19/Q.2931

SETUP message content

Message type: SETUP

Significance: Global

Direction: Both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
AAL parameters	4.5	Both	O (Note 1)	4-21
ATM traffic descriptor	4.5	Both	M	12-20
Broadband bearer capability	4.5	Both	M	6-7
Called party number	4.5	Both	O (Note 2)	4-*
Called party sub-address	4.5	Both	O (Note 3)	4-25
Calling party number	4.5	Both	O (Note 4)	4-*
Calling party sub-address	4.5	Both	O (Note 5)	4-25
Connection identifier	4.5	Both	O (Note 6)	4-9
End-to-end transit delay	4.5	Both	O (Note 7)	4-10
Broadband repeat indicator	4.5	Both	O (Note 8)	4-5
Narrow-band bearer capability	4.6	Both	O (Note 9)	4-14
Narrow-band high layer compatibility	4.6	Both	O (Note 10)	4-7
Broadband repeat indicator	4.5	Both	O (Note 11)	4-5
Narrow-band low layer compatibility	4.6	Both	O (Note 12)	4-20
Notification indicator	4.5	Both	O (Note 13)	4-*
OAM traffic descriptor	4.5	Both	O (Note 14)	4-6
Progress indicator	4.6	Both	O (Note 15)	4-6
QOS parameter	4.5	Both	M	6
Broadband sending complete	4.5	Both	O (Note 16)	4-5
Transit network selection	4.5	u $\rightarrow$ n	O (Note 17)	4-*

NOTES

1 Included in the user-to-network direction when the calling user wants to pass AAL information to the called user. Included in the network-to-user direction if the calling user included an AAL parameter information element in the SETUP message. See Annex F.

2 The called party number information element is included by the user to convey called party number information to the network. The called party number information element is included by the network when called party number information is conveyed to the user.

3 Included in the user-to-network direction when the calling user wants to indicate the called party sub-address. Included in the network-to-user direction if the calling user included a called party sub-address information element in the SETUP message.

4 May be included by the calling user or the network to identify the calling user.

5 Included in the user-to-network direction when the calling user wants to indicate the calling party sub-address. Included in the network-to-user direction if the calling user included a calling party sub-address information element in the SETUP message.

6 Included in the user-to-network direction when a user wants to indicate a virtual channel. Included in the network-to-user direction when the network wants to indicate a virtual channel. If not included, its absence is interpreted as any virtual channel is acceptable. This information element may only be absent when using the non-associated signalling procedure.

NOTES *(continued)*

7 Included in the user-to-network direction when the calling user wants to specify end-to-end transit delay requirements for this call and/or the cumulative transit delay expected for the transmission of user data from the calling user to the network boundary. When included, an end-to-end transit delay information element will be delivered to the called user. Included in the network-to-user direction if end-to-end transit delay information is to be delivered to the called user (see Annex K).

8 The Broadband repeat indicator information element is included immediately before the first narrow-band bearer capability information element when the narrow-band bearer capability negotiation procedure is used (see Annex L/Q.931).

9 Mandatory for N-ISDN services (see clause 6). May be repeated if the narrow-band bearer capability negotiation procedure is used (see Annex L/Q.931). For narrow-band bearer capability negotiation, three narrow-band bearer capability information elements may be included in descending order of priority, i.e. highest priority first. Although support of multiple narrow-band bearer capability information elements may not be supported on all networks, on networks that do support it, and through suitable subscription arrangements, three narrow-band bearer capability information elements may be included (see 5.11/Q.931). When they are not preceded by a broadband repeat indicator information element, they are included in ascending order of priority.

10 Included in the user-to-network direction when the calling user wants to pass high layer compatibility information to the called user. Included in the network-to-user direction if the calling user included a narrow-band high layer compatibility information element in the SETUP message. Although support of multiple narrow-band high layer compatibility information elements may not be supported on all networks, on networks that do support it, and through suitable subscription arrangements, two narrow-band high layer compatibility information elements may be included (see 5.12/Q.931). They are not preceded by a broadband repeat indicator information element, they are included in ascending order of priority.

11 The broadband repeat indicator is included when two or more narrow-band low layer compatibility information element are included for low layer compatibility negotiation.

12 Included in the user-to-network direction when the calling user wants to pass narrow-band low layer compatibility information to the called user. Included in the network-to-user direction if the calling user included a narrow-band low layer compatibility information element in the SETUP message. Two, three or four information elements may be included in descending order of priority, i.e. highest priority first, if the low layer compatibility negotiation procedures are used (see Annex J/Q.931).

13 This indicator may be present whenever notification is delivered.

14 Included by the calling user to indicate additional information related to the OAM F5 end-to-end information flow. The absence of the OAM traffic descriptor information element does not in itself mean that no OAM flow will be used within this call. This assumes there is an end-to-end B-ISDN connection.

15 Included in the event of interworking or in connection with the provision of in-band information/patterns. This information element may appear twice in the message.

16 It is mandatory for the user to include the broadband sending complete information element when *en bloc* sending procedures are used; its interpretation by the network is optional. It is mandatory for the network to include the broadband sending complete information element when *en bloc* receiving procedures are used. If the broadband sending complete information element is not included, missing mandatory information element error procedures need not be applied.

17 Included by the calling user to select a particular transit network (see Annex D). This information may appear up to four times in the message.

3.2.8 Set-up acknowledge

This message is sent by the network to the calling user, or by the called user to the network, to indicate that call establishment has been initiated, but additional information may be required. See Table 3-20.

TABLE 3-20/Q.2931

SETUP ACKNOWLEDGE message content

Message type: SETUP ACKNOWLEDGE Significance: Local Direction: Both				
Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Connection identifier	4.5	Both	O (Note 1)	4-9
Notification indicator	4.5	Both	O (Note 2)	4-*
Progress indicator	4.6	Both	O (Note 3)	4-6

NOTES

1 Mandatory in the network-to-user direction if this message is the first message in response to a SETUP message. It is mandatory in the user-to-network direction if this message is the first message in response to a SETUP message, unless the user accepts the connection identifier indicated in the SETUP message.

2 This indicator may be present whenever notification is delivered.

3 Included in the event of interworking or in connection with the provision of in-band information/patterns. This information element may appear twice in the message.

3.3 Messages used with the global call reference

The global call reference is used in the message shown in Table 3-21.

TABLE 3-21/Q.2931

Messages used with the global call reference

Message	Reference
Messages:	
RESTART	3.3.1
RESTART ACKNOWLEDGE	3.3.2

NOTE – In addition, the STATUS message shall use the global call reference if it is sent in response to the receipt of a message with the global call reference.

3.3.1 Restart

This message is sent by the user or the network to request the recipient to restart (i.e. return to an idle condition) the indicated virtual channel, all virtual channels in the indicated virtual path connection, or all virtual channels controlled by the signalling virtual channel. See Table 3-22.

TABLE 3-22/Q.2931

RESTART message content

Message type: RESTART Significance: Local Direction: Both				
Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M (Note 1)	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Connection identifier	4.5	Both	O (Note 2)	4-9
Restart indicator	4.5	Both	M	5
NOTES 1 This message is sent with the global call reference defined in 4.3. 2 Included when necessary to indicate the particular virtual channel(s) to be restarted.				

3.3.2 Restart acknowledge

This message is sent to acknowledge the receipt of a RESTART message and to indicate that the requested restart is complete. See Table 3-23.

TABLE 3-23/Q.2931

RESTART ACKNOWLEDGE message content

Message type: RESTART ACKNOWLEDGE Significance: Local Direction: Both				
Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	Both	M	1
Call reference	4.3	Both	M (Note 1)	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Connection identifier	4.5	Both	O (Note 2)	4-9
Restart indicator	4.5	Both	M	5
NOTES 1 This message is sent with the global call reference defined in 4.3. 2 Included when necessary to indicate the particular virtual channel(s) which have been restarted.				

4 General message format and information elements coding

The figures and text in this clause describe message contents.

4.1 Overview

Within this protocol, every message shall consist of the following parts:

a) protocol discriminator;

b) call reference;

c) message type (including message compatibility instruction indicator);

d) message length;

e) variable length information elements, as required.

Information elements a), b), c) and d) are common to all the messages and shall always be present, while information elements e) are specific to each message type.

This organization is illustrated in the example shown in Figure 4-1. The first four information elements (protocol discriminator, call reference, message type, and message length) shall appear in the order specified in Figure 4-1.

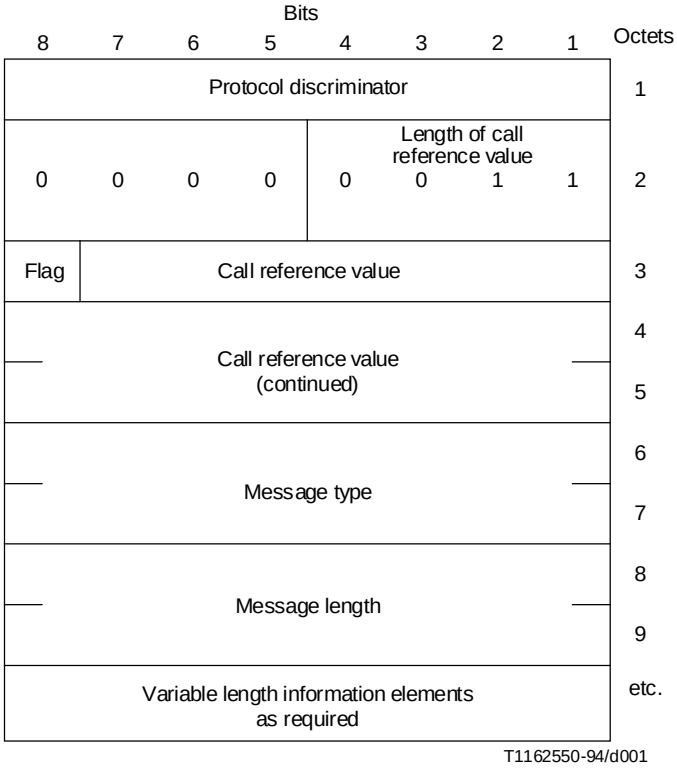


FIGURE 4-1/Q.2931

General message organization example

A particular message may contain more information than a particular (user or network) equipment needs or can understand. All equipment should be able to ignore any extra information, present in a message, which is not required for the proper operation of that equipment. For example, a user may ignore the calling party number if that number is of no interest to the user when a SETUP MESSAGE is received.

Unless specified otherwise, a particular information element shall not be present more than once in a given message.

The term “default” implies that the value defined shall be used in the absence of any assignment, or the negotiation of alternative values.

When a field, such as the call reference value, extends over more than one octet, the order of bit values progressively decreases as the octet number increases. The least significant bit of the field is represented by the lowest-numbered bit of the highest-numbered octet of the field.

4.2 Protocol discriminator

The purpose of the protocol discriminator is to distinguish messages for user-network call control from other messages (to be defined) within this Recommendation. It also distinguishes messages of this Recommendation from those OSI network layer protocol units which are coded according to other ITU-T Recommendations and other standards. See Figure 4-2.

The protocol discriminator is the first part of every message. The protocol discriminator is coded according to Table 4-1. The specification of the protocol discriminator does not imply that the protocol may share the signalling virtual channel with other layer 3 protocols (except when encapsulated in Q.2931 messages).

4.3 Call reference

The purpose of the call reference is to identify the call at the local user-network interface to which the particular message applies. The call reference does not have end-to-end significance across B-ISDNs.

The call reference is the second part of every message. The call reference is coded as shown in Figure 4-3. The length of the call reference value is indicated in octet 1, bits 1-4. The length of the call reference information element is 4 octets.

The call reference information element includes the call reference value and the call reference flag. The call reference value 0 (all bits = 0) is reserved for the global call reference, see Figure 4-4; the call reference value with all bits set to 1 is reserved for the dummy call reference, see Figure 4-5.

Call reference values are assigned by the originating side of the interface for a call. These values are unique to the originating side only assigned at the beginning of a call and remains fixed for the lifetime of a call. After a call ends, the associated call reference value may be reassigned to a later call. Two identical call reference values on the same signalling virtual channel may be used when each value pertains to a call originated at opposite ends of the signalling virtual channel link.

To avoid race conditions in certain error scenarios, it is suggested that implementors avoid immediate re-use of the call reference values after they are released.

The call reference flag can take the values “0” or “1”. The call reference flag is used to identify which end of the signalling virtual channel originated a call reference. The originating side always sets the call reference flag to “0”. The destination side always sets the call reference flag to a “1”.

Hence, the call reference flag identifies who allocated the call reference value, and the only purpose of the call reference flag is to resolve simultaneous attempts to allocate the same call reference value. The call reference flag also applies to functions which use the global call reference (e.g. restart procedures).

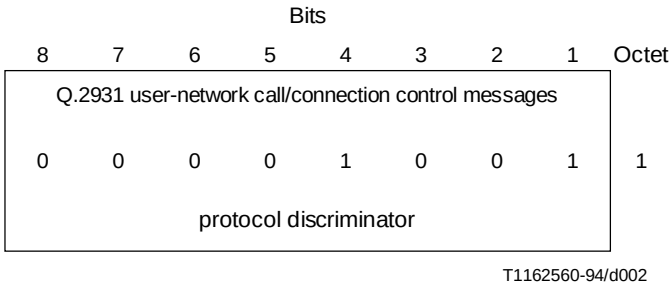


FIGURE 4-2/Q.2931

Protocol discriminator

TABLE 4-1/Q.2931

Protocole discriminator

Bits 8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0 through 0 0 0 0 0 1 1 1	assigned in clause 4/Q.931; not available for use in the message protocol discriminator
0 0 0 0 1 0 0 0	Q.931/(I.451) user-network call control messages
0 0 0 0 1 0 0 1	Q.2931 user-network call/connection control messages
0 0 0 1 0 0 0 0 through 0 0 1 1 1 1 1 1	reserved for other network layer or layer 3 protocols, including Recommendation X.25 (Note)
0 1 0 1 0 0 0 0 through 0 1 0 0 1 1 1 1	national use
0 1 0 1 0 0 0 0 through 1 1 1 1 1 1 1 0	reserved for other network layer or layer 3 protocols, including Recommendation X.25 (Note)
All other values are reserved.	

NOTE – These values are reserved to discriminate these protocol discriminators from the first octet of a X.25 packet including general format identifier.

The numerical value of the global call reference is zero. The equipment receiving a message containing the global call reference shall interpret the message as pertaining to all call references associated with the appropriate signalling virtual channel; see Figure 4-4.

For the global call reference, the flag is used as specified above. This means that in a RESTART message, it is set to 0; in case of a RESTART ACKNOWLEDGE or STATUS message with the global call reference sent in response to a RESTART message, it is set to 1.

The dummy call reference is coded with all bits of the call reference value set to 1; see Figure 4-5. In the future, the dummy call reference may be used for certain supplementary services. For the dummy call reference, the flag is also used as specified above.

The procedures in this Recommendation do not use the dummy call reference. Equipment conforming to this Recommendation shall discard messages received with the dummy call reference.

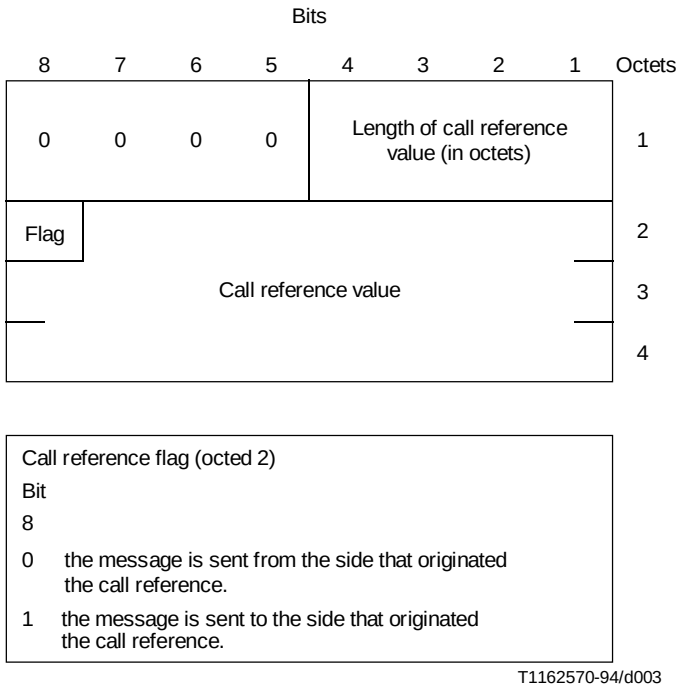


FIGURE 4-3/Q.2931

Call reference information element

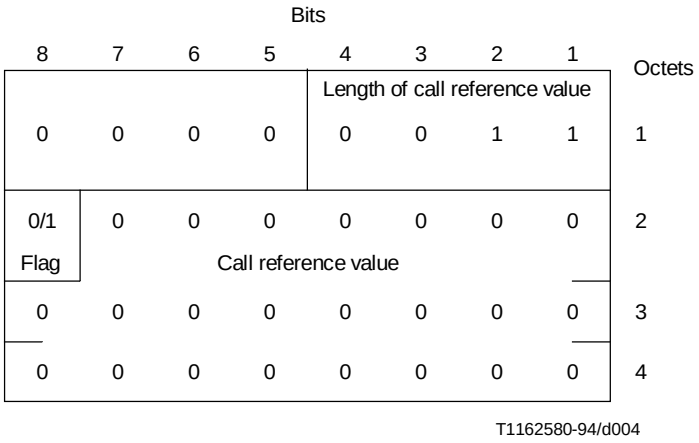


FIGURE 4-4/Q.2931

Encoding for global call reference

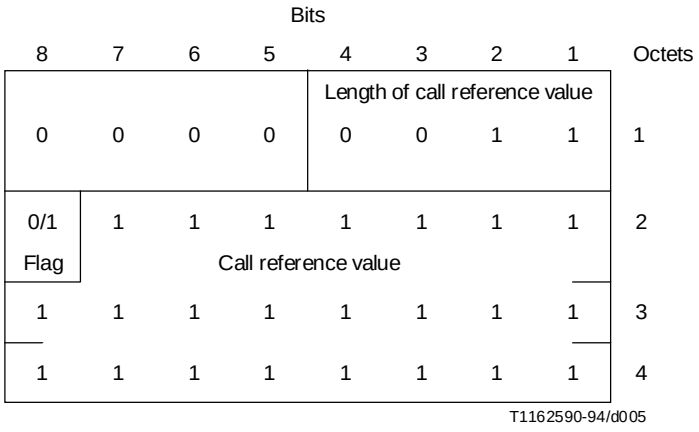


FIGURE 4-5/Q.2931

Encoding of the dummy call reference

4.4 Message type, and message length

4.4.1 Message type (including message compatibility instruction indicator)

The purpose of the message type is to identify the function of the message being sent.

The message type is the third part of every message. The message type is coded as shown in Figure 4-6 and Table 4-2.

The value “0000 0000” is used for escape to national specific messages (see Table 4-2).

The value “1111 1111” is reserved for an extension mechanism when all other message type values are exhausted (see Table 4-2).

The message compatibility instruction indicator allows the sender of a message to indicate explicitly the way the peer entity shall handle unrecognized messages. The format and coding of the message compatibility instruction indicator is shown in Figure 4-6 and Table 4-2.

The message compatibility instruction indicator is only of local significance. Unless specified otherwise, it is a network option to which value the instruction indicator is set for messages sent from the network to the user.

4.4.2 Message length

The purpose of the message length is to identify the length of the contents of a message. It is the binary coding of the number of octets of the message contents, i.e. excluding the octets used for “protocol discriminator”, “call reference”, “message type”, and for the message length indication itself.

The message length indication has a fixed length of 2 octets. The coding of the message length follows the coding rules for integer values outlined in 4.5.1.

The message length is the fourth part of every message. The message length is coded as shown in Figure 4-7. If the message contains no further octets, the message length is coded as all zeros.

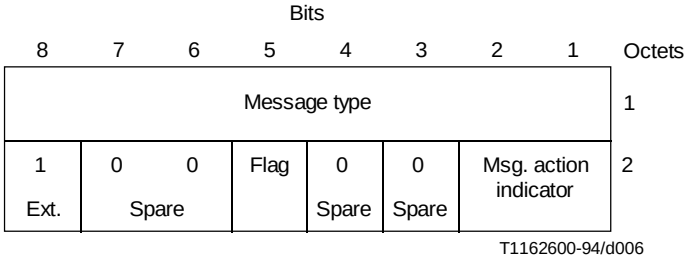


FIGURE 4-6/Q.2931

Message type

TABLE 4-2/Q.2931 (part 1 of 2)

Message types (including message compatibility instruction indicator)

– Message type (octet 1)

Bits								
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	escape to nationally specific message type (see Note 1)
0	0	0	–	–	–	–	–	Call establishment message:
			0	0	0	0	1	– ALERTING
			0	0	0	1	0	– CALL PROCEEDING
			0	0	1	1	1	– CONNECT
			0	1	1	1	1	– CONNECT ACKNOWLEDGE
			0	0	0	1	1	– PROGRESS
			0	0	1	0	1	– SETUP
			0	1	1	0	1	– SETUP ACKNOWLEDGE
0	1	0	–	–	–	–	–	Call clearing messages:
			0	1	1	0	1	– RELEASE
			1	1	0	1	0	– RELEASE COMPLETE
			0	0	1	1	0	– RESTART
			0	1	1	1	0	– RESTART ACKNOWLEDGE
0	1	1	–	–	–	–	–	Miscellaneous messages:
			1	1	0	1	1	– INFORMATION
			0	1	1	1	0	– NOTIFY
			1	1	1	0	1	– STATUS
			1	0	1	0	1	– STATUS ENQUIRY
1	1	1	1	1	1	1	1	reserved for extension mechanism when all other message type values are exhausted (see Note 2)

NOTE 1 – When used, the message type (excluding the message compatibility instruction indicator) is defined in octet 10 of the message, and the contents follows in the subsequent octets, both according to the national specification.

NOTE 2 – In this case, the message type (excluding the message compatibility instruction indicator) is defined in octet 10 of the message, and the contents follows in the subsequent octets.

TABLE 4-2/Q.2931 (part 2 of 2)

– Flag (octet 2)		
Bits		
5		
0		message instruction field not significant (= regular error handling procedures apply)
1		follow explicit instructions (these supersede the regular error handling procedures)
– Message action indicator (octet 2)		
Bits		
2	1	
0	0	clear call
0	1	discard and ignore (Note 3)
1	0	discard and report status
1	1	reserved
NOTE 3 – For the meaning of “ignore”, see Annex J.		

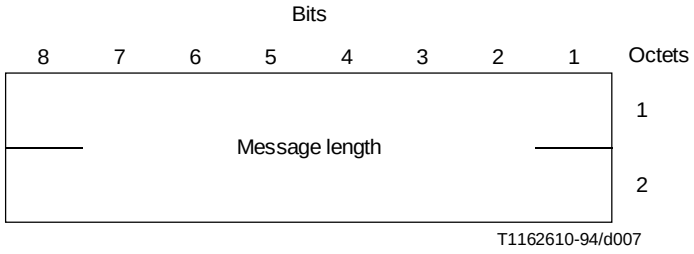


FIGURE 4-7/Q.2931

Message length

4.5 Variable length information elements for B-ISDN environment

4.5.1 Coding rules

The coding of variable length information elements follows the coding rules described below. These rules are formulated to allow each equipment which processes a message to find information elements important to it, and yet remain ignorant of information elements not important to that equipment.

For the information elements listed below, the coding of the information element identifier bits is summarized in Table 4-3 and Figure 4-8.

The value “1111 1111” for the information element identifier is reserved for an extension mechanism, when all other information element identifier values are exhausted (see Figure 4-9). This mechanism allows to identify 65 536 additional information elements.

TABLE 4-3/Q.2931 (part 1 of 2)

General information element format – Information element identifiers

Bits								
8	7	6	5	4	3	2	1	
0	1	1	1	0	0	0	0	Called party number
0	1	1	1	0	0	0	1	Called party sub-address
0	1	1	1	1	0	0	0	Transit network selection
0	1	1	1	1	0	0	1	Restart indicator
0	1	1	1	1	1	0	0	Narrow-band low layer compatibility
0	1	1	1	1	1	0	1	Narrow-band high layer compatibility
0	1	1	0	0	0	0	0	Broadband locking shift
0	1	1	0	0	0	0	1	Broadband non-locking shift
0	1	1	0	0	0	1	0	Broadband sending complete
0	1	1	0	0	0	1	1	Broadband repeat indicator
0	1	1	0	1	1	0	0	Calling party number
0	1	1	0	1	1	0	1	Calling party sub-address
0	1	0	1	1	0	0	0	ATM adaptation layer parameters
0	1	0	1	1	0	0	1	ATM traffic descriptor
0	1	0	1	1	0	1	0	Connection identifier
0	1	0	1	1	0	1	1	OAM traffic descriptor
0	1	0	1	1	1	0	0	Quality of Service parameter
0	1	0	1	1	1	1	0	Broadband bearer capability
0	1	0	1	1	1	1	1	Broadband Low Layer Information (B-LLI)
0	1	0	1	1	1	0	1	Broadband High Layer Information (B-HLI)
0	1	0	0	0	0	1	0	End-to-end transit delay
0	0	1	0	0	1	1	1	Notification indicator
0	0	0	1	0	1	0	0	Call state
0	0	0	1	1	1	1	0	Progress indicator
0	0	0	0	0	1	0	0	Narrow-band bearer capability
0	0	0	0	1	0	0	0	Cause

TABLE 4-3/Q.2931 (part 2 of 2)

General information element format – Compatibility instruction indicator octet

– Coding standard (octet 2)

Bits

7	6	
0	0	ITU-T standardized coding as described below
0	1	ISO/IEC standard (Note 1)
1	0	national standard (Note 1)
1	1	standard defined for the network (either public or private) present on the network side of the interface (Note 1)

– Flag (octet 2)

Bit

5	
0	IE instruction field not significant (= regular error handling procedures apply)
1	Follow explicit instructions (these supersede the regular error handling procedures)

– Reserved (octet 2)

Bit

4	this bit is reserved for a possible use to indicate a “pass along request”. It is currently coded as “0” (= no “pass along request” indicated)

– IE action indicator (octet 2)

Bits

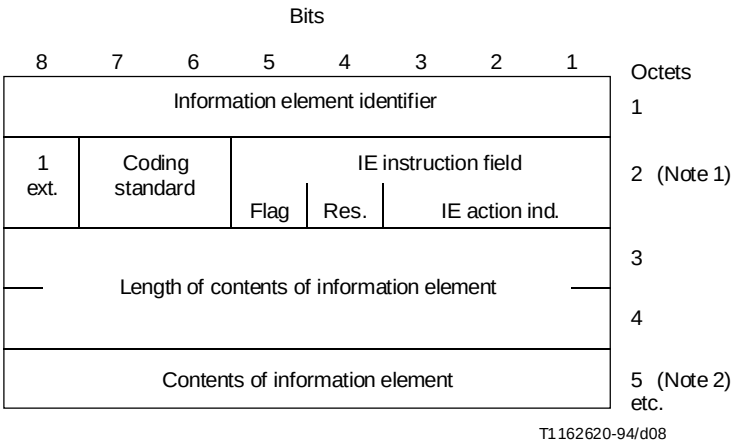
3	2	1	
0	0	0	clear call
0	0	1	discard information element and proceed
0	1	0	discard information element, proceed, and report status
1	0	1	discard message, and ignore (Note 2)
1	1	0	discard message, and report status

All other values are reserved.

NOTES

1 These other coding standards should be used only when the information element contents cannot be represented with the ITU-T standardized coding.

2 For the meaning of “ignore”, see Annex J.



NOTES

1 The IE instruction field (Bits 5-1 of octet 2) is only interpreted in case of unexpected information elements, unrecognized information element identifier or information elements with unrecognized contents. For some information elements of this Recommendation, the allocation of values to the IE instruction field may be restricted to a limited number of value combinations (see description of individual information elements below).

2 Annex L shows an example structure for an information element using subfield identifiers.

FIGURE 4-8/Q.2931

General information element format

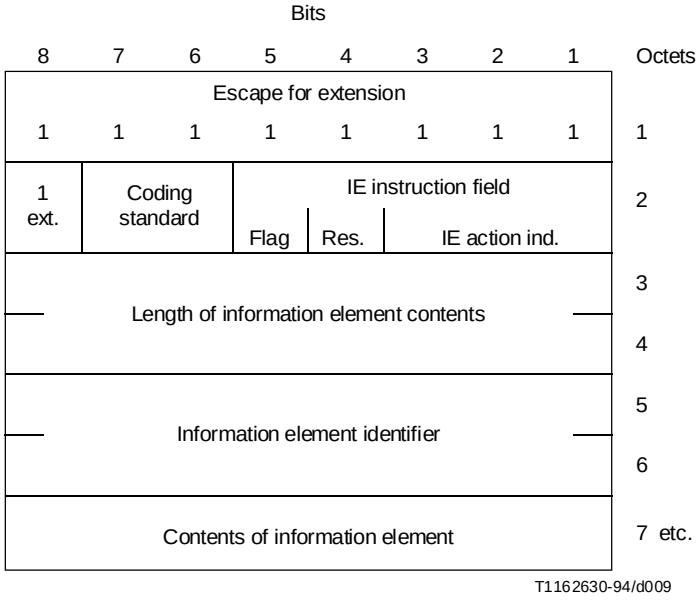


FIGURE 4-9/Q.2931

Information element format using escape for extension

The specific variable length information elements within a message may appear in any order except for the following cases:

a) If information elements are repeated without using the broadband repeat indicator information element, the following rule applies:

   – The second occurrence of a repeated information element must immediately follow the first occurrence of the repeated information element. The third occurrence of the repeated information element must immediately follow the second occurrence of the repeated information element, etc.

     This rule does not apply to the broadband locking shift information element and the broadband non-locking shift information element.

b) When information elements are repeated and the broadband repeat indicator information element is used, the following rules apply:

   – The broadband repeat indicator information element must immediately precede the first occurrence of the repeated information element.

   – The first occurrence of the repeated information element (immediately following the broadband repeat indicator information element) is interpreted as the highest priority. The second, third, fourth, etc., occurrences of the repeated information element are interpreted in descending order of priority.

   – The second occurrence of the repeated information element must immediately follow the first occurrence of the repeated information element. The third occurrence of the repeated information element must immediately follow the second occurrence of the repeated information element, etc.

     With regard to these rules, a broadband non-locking shift information element with the succeeding information element are regarded together as one "occurrence" in the sense of the text above.

     The use of the broadband repeat indicator information element in conjunction with an information element that occurs only once in a message shall not in itself constitute an error, i.e. the broadband repeat indicator information element shall then be ignored.

c) If a broadband locking shift information element is used, it applies only to all information elements following. The ordering of these information elements is as specified by the new codeset indicated in the broadband locking shift.

d) If a broadband non-locking shift information element is used, it shall immediately precede the information element it refers to.

Annex L shows an example message structuring following these rules.

Where the description of information elements in this Recommendation contains spare bits, these bits are indicated as being set to "0". On reception, no action is taken on spare bits, even if they are not set to "0".

The second octet of the information element identifier contains the information element compatibility instruction indicator. The coding of the information element compatibility instruction indicator is shown in Table 4-3.

The information element compatibility instruction indicator is only of local significance. Unless specified otherwise, it is a network option to which value the instruction indicator is set for information elements contained in messages sent from the network to the user.

The third and fourth octet of an information element indicates the length of that information element. The length of an information element does not include the length of the information element identifier field, the information element compatibility instruction indicator field or the length of the length field itself. It is the binary coding of the number of octets of the contents. The information element length indication has a fixed length of 2 octets. The coding of the information element length follows the coding rules for integer values outlined in this subclause.

An information element may be present, but empty. For example, a SETUP message may contain a Called party number information element, the contents of which is of zero length. This should be interpreted by the receiver as equivalent to that information element being absent. Similarly, an absent information element should be interpreted by the receiver as equivalent to that information element being empty.

An “Empty information element” is an information element satisfying the following conditions: has a (valid) Information Element Identifier, and has information element length set to 0.

The following rules apply for the coding of information elements:

a) Variable length information elements consist of octets or groups of octets. These octets or octet groups are numbered to facilitate referencing. The first digit in the octet number identifies one octet or a group of octets.

b) Each octet group is a self-contained entity. The internal structure of an octet group may be defined in alternative ways.

c) An octet group is formed by using some extension mechanism. The preferred extension mechanism is to extend an octet (N) through the next octet(s) (Na, Nb, etc.) by using bit 8 in each octet as an extension bit. The bit value “0” indicates that the octet continues through the next octet. The bit value “1” indicates that this octet is the last octet. If one octet (Nb) is present, also the preceding octets (N and Na) must be present.

   In the format descriptions appearing in 4.5.5, etc., bit 8 is marked as:

   – “0/1 ext.”, if another octet of this octet group may follow.

   – “1 ext.”, if this is the last octet in the extension domain.

   – “0 ext.”, if another octet of this octet group always follows.

   Additional octets may be defined later (“1 ext.” changed to “0/1 ext.”) and equipments shall be prepared to receive such additional octets although the equipment need not be able to interpret or act upon the content of these octets.

d) In addition to the extension mechanism defined above, an octet (N) may be extended through the next octet(s) (N.1, N.2, etc.) by indications in bits 8-1 (of octet N).

e) The mechanisms in c) and d) may be combined. Mechanism c) shall take priority in the ordering, such that all octets Na, Nb, etc. shall occur before octets N.1, N.2, etc. This rule shall apply even where the extension to octets N.1, N.2, etc. is indicated in one of octet Na, Nb, etc.; similar conventions apply even when mechanism d) is being repeated, i.e. octet N.1 shall occur before octets N.1.1, N.1.2, etc.

f) Optional octets are marked with asterisks (*).

g) If information elements are structured using subfield identifiers, these subfield identifiers are position independent, i.e. they need not appear in a certain order within the information element.

NOTE 1 – It is not possible to use mechanism c) repeatedly, i.e. it is not possible to construct an octet 4aa as this would become octet 4b.

NOTE 2 – Protocol designers should exercise care in using multiple extension mechanisms to insure that a unique interpretation of the resultant coding is possible.

NOTE 3 – For all information elements, there is a field that defines the coding standard. When the coding standard defines a national standard, it is recommended that the national standard be structured similar to the information element defined in this Recommendation.

The following rules apply for the coding of integers in this Recommendation. These rules apply if not indicated otherwise explicitly.

a) Where integer values are coded using more than 1 octet, octets with lower octet numbers contain the more significant bits. In particular, the octet with the lowest octet number contains the most significant bits, and the octet with the highest octet number contains the least significant bits.

b) Within one octet or within a field forming part of an octet, the following applies:

   – the bits with higher bit numbers contain the more significant bits;

   – in particular, the bit with the highest bit number of the integer coding denotes the most significant bit;

   – and the bit with the lowest bit number of the integer coding denotes the least significant bit;

   – the bit representation is “right-aligned”, i.e. aligned to the lowest bit numbers; therefore, if leading “zeros” are present, they have to appear on the “left-hand” side of the octet or field (i.e. on the side of the higher bit numbers).

c) Where integer values are represented by a fixed number of octets, the bit representation is aligned to the higher octet numbers, i.e. if leading "zeros" are present, they appear within the octets with the lowest octet numbers.

d) Where integer values are represented by a variable number of octets (e.g. by using bit 8 as an extension mechanism), the integer value shall be coded with a minimum number of octets, i.e. no leading all-zero octets are present.

NOTE 4 – The escape mechanism is applicable to codesets 0 to 7 (see 4.5.2). When the escape for extension is used, the information element identifier is contained in octets 5 and 6, and the contents of the information element follows in the subsequent octets as shown in Figure 4-9.

4.5.2 Extensions of codesets

There are a number of possible information element identifier values using the formatting rules described in 4.5.1.

It is possible to expand this structure to eight codesets. One common value of an information element identifier is employed in each codeset to facilitate shifting from one codeset to another. The contents of this shift information element identifies the codeset to be used for the next information element or elements. The codeset in use at any given time is referred to as the "active codeset". By convention, codeset 0 is the initially active codeset.

Two codeset shifting procedures are supported: locking shift and non-locking shift.

Codesets 1 to 3 are reserved for future ITU-use.

Codeset 4 is reserved for use by ISO/IEC standards.

Codeset 5 is reserved for information elements for national use.

Codeset 6 is reserved for information elements specific to the local network (either public or private).

Codeset 7 is reserved for user-specific information elements.

The coding rules specified in 4.5.1 shall apply for information elements belonging to any active codeset.

Transitions from one active codeset to another (i.e. by means of the locking shift procedure) may only be made to a codeset with a higher numerical value than the codeset being left.

An information element belonging to codesets 4, 5, 6, or 7, may appear together with information elements belonging to codeset 0 (being the active codeset) by using the non-locking shift procedure (see 4.5.4).

A user or network equipment shall have the capability to recognize a shift information element and to determine the length of the following information element, although the equipment need not be able to interpret and act upon the contents of the information element. This enables the equipment to determine the start of a subsequent information element.

Codeset 7 information elements shall be handled according to the procedures for unrecognized information elements (see 5.6.8.1) by the first exchange in the local network, unless allowed by a future service definition, bilateral agreement, or provision is made to support this across the local network for a specific user.

Codeset 6 is reserved for information elements specific to the local network (either public or private). As such they do not have significance across the boundaries between local networks, or across a national, or international boundary. Therefore, codeset 6 information elements shall be handled according to the procedures for unrecognized information elements (see 5.6.8.1) beyond the local network boundary, unless allowed by bilateral agreement.

Codeset 5 is reserved for information elements reserved for national use. As such they do not have significance across an international boundary. Therefore, codeset 5 information elements shall be handled according to the procedures for unrecognized information elements (see 5.6.8.1) at the first exchange beyond the international boundary, unless there are bilateral agreements to the contrary.

Codeset 4 is reserved for information elements specified in ISO/IEC standards.

Codesets 1 to 3 are reserved for future ITU-use.

4.5.3 Broadband locking shift procedure

The broadband locking shift procedure employs an information element to indicate the new active codeset. The specified codeset remains active until another broadband locking shift information element is encountered which specifies the use of another codeset. For example, codeset 0 is active at the start of message contents analysis. If a broadband locking shift to codeset 5 is encountered, the next information elements will be interpreted according to the information element identifiers assigned in codeset 5, until another shift information element is encountered.

This procedure is used only to shift to a higher order codeset than the one being left.

The broadband locking shift is valid only within that message which contains the broadband locking shift information element. At the start of every message contents analysis, the active codeset is codeset 0.

The broadband locking shift information element uses the information element format and coding shown in Figure 4-10 and Table 4-4.

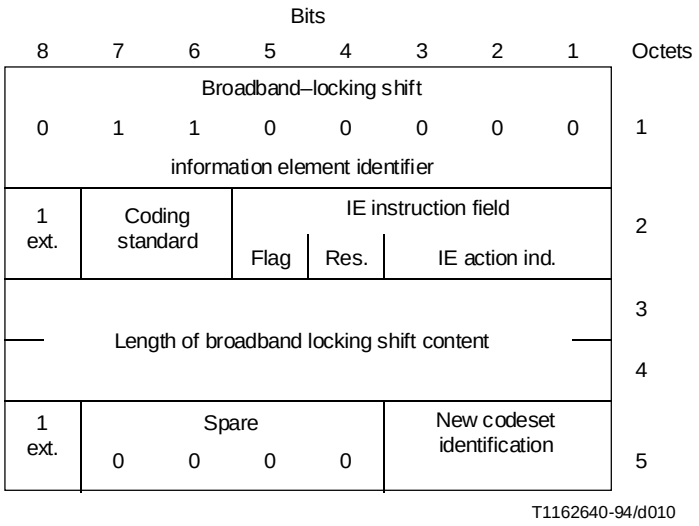


FIGURE 4-10/Q.2931

Broadband locking shift information element

TABLE 4-4/Q.2931

Broadband locking shift information element

– New codeset identification (octet 5)			
Bits			
3	2	1	
0	0	0	not applicable
0	0	1	reserved
	to		
0	1	1	
1	0	0	codeset 4: information elements for ISO/IEC use
1	0	1	codeset 5: information elements for national use
1	1	0	codeset 6: information elements specific to the local network (either public or private)
1	1	1	codeset 7: user-specific information elements

4.5.4 Broadband non-locking shift procedure

The broadband non-locking shift procedure provides a temporary shift to the specified lower or higher codeset. The broadband non-locking shift procedure uses a broadband non-locking shift information element to indicate the codeset to be used to interpret the next single information element. After the interpretation of the next single information element, the active codeset is again used for interpreting any following information elements. For example, codeset 0 is active at the beginning of message contents analysis. If a broadband non-locking shift to codeset 6 is encountered, only the next information element is interpreted according to the information element identifiers assigned in codeset 6. After this information element is interpreted, codeset 0 will again be used to interpret the following information elements. A broadband non-locking shift information element indicating the current codeset shall not be regarded as an error.

A broadband locking shift information element shall not follow directly on a broadband-non-locking shift information element. If this combination is received, it shall be interpreted as though a broadband locking shift information element only had been received.

The broadband non-locking shift information element uses the information element format and coding shown in Figure 4-11 and Table 4-5.

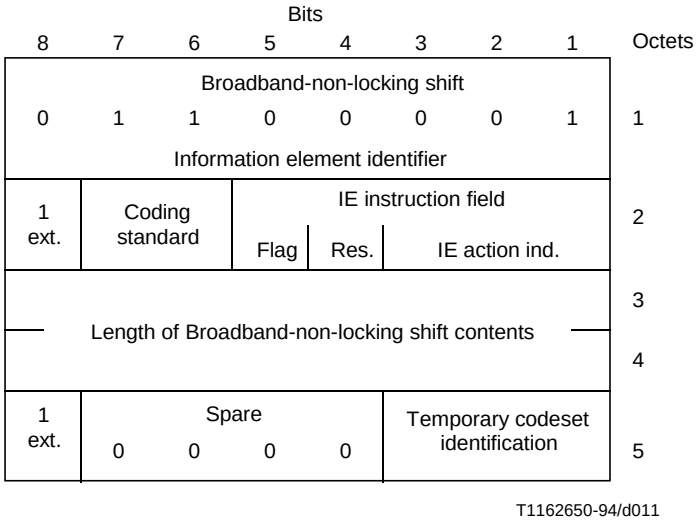


FIGURE 4-11/Q.2931

Broadband-non-locking shift information element

TABLE 4-5/Q.2931

Broadband non-locking shift information element

– Temporary codeset identification (octet 5)			
Bits			
3	2	1	
0	0	0	codeset 0 (initially active): Q.2931 information elements
0	0	1	reserved
	to		
0	1	1	
1	0	0	codeset 4: information elements for ISO/IEC use
1	0	1	codeset 5: information elements for national use
1	1	0	codeset 6: information elements specific to the local network (either public or private)
1	1	1	codeset 7: user-specific information elements

4.5.5 ATM adaptation layer parameters

The purpose of the ATM adaptation layer (AAL) parameters information element is to indicate the requested AAL parameter values (end-to-end significance) for the ATM adaptation layer elements of procedures to be used for the call. It contains the parameters selectable by the user for all AAL sublayers.

The contents of this information element is transparent for the network, except for the case of interworking.

The maximum length of this information element is 21 octets.

The AAL parameters information element is coded as shown in Figure 4-12 and Table 4-6.

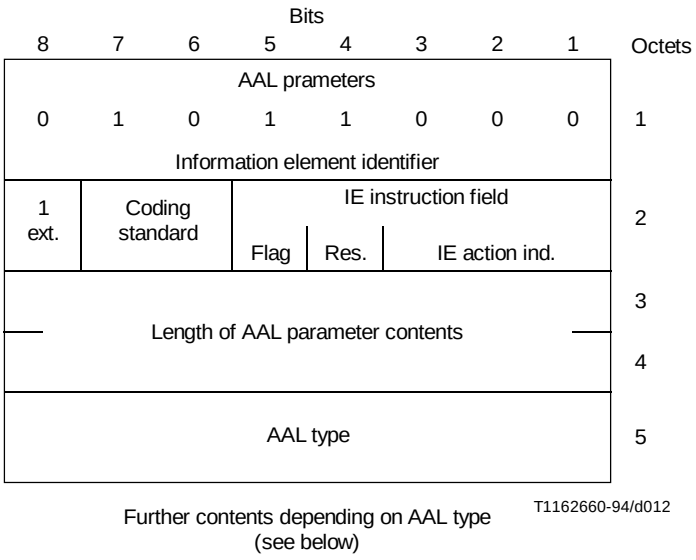
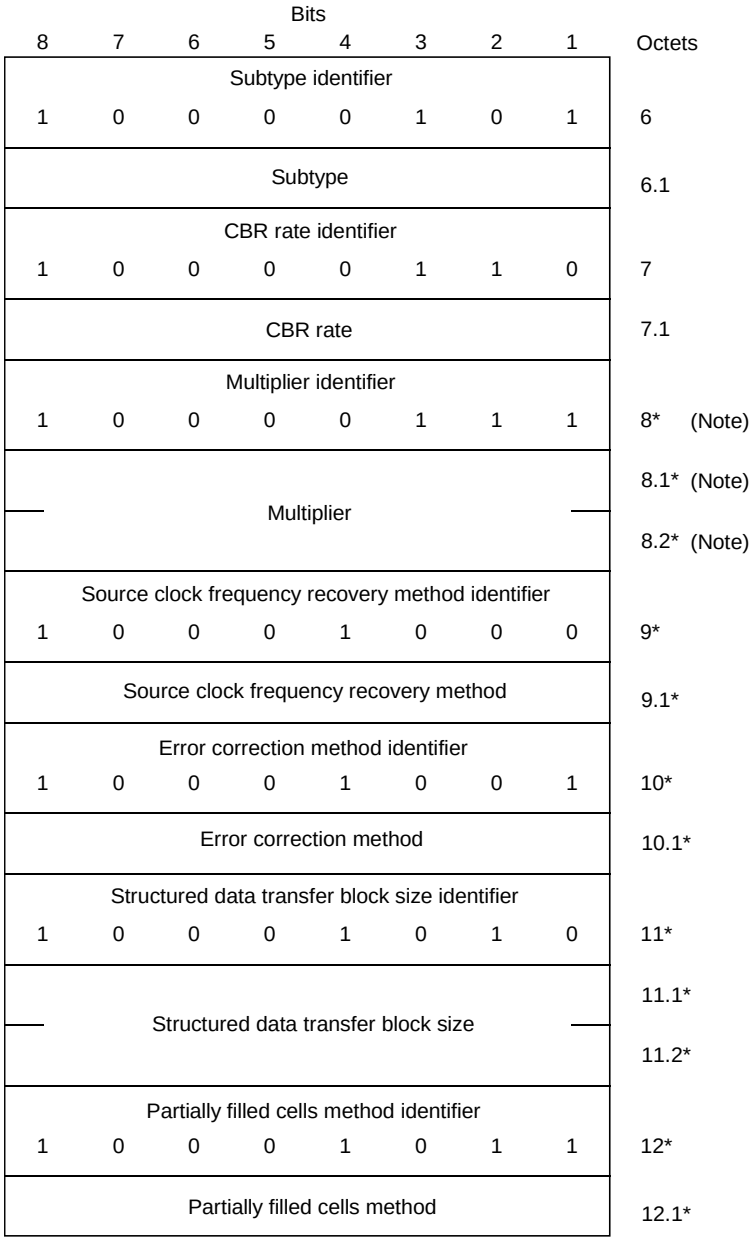


FIGURE 4-12/Q.2931 (part 1 of 5)

AAL parameters information element

(further contents for AAL type 1)

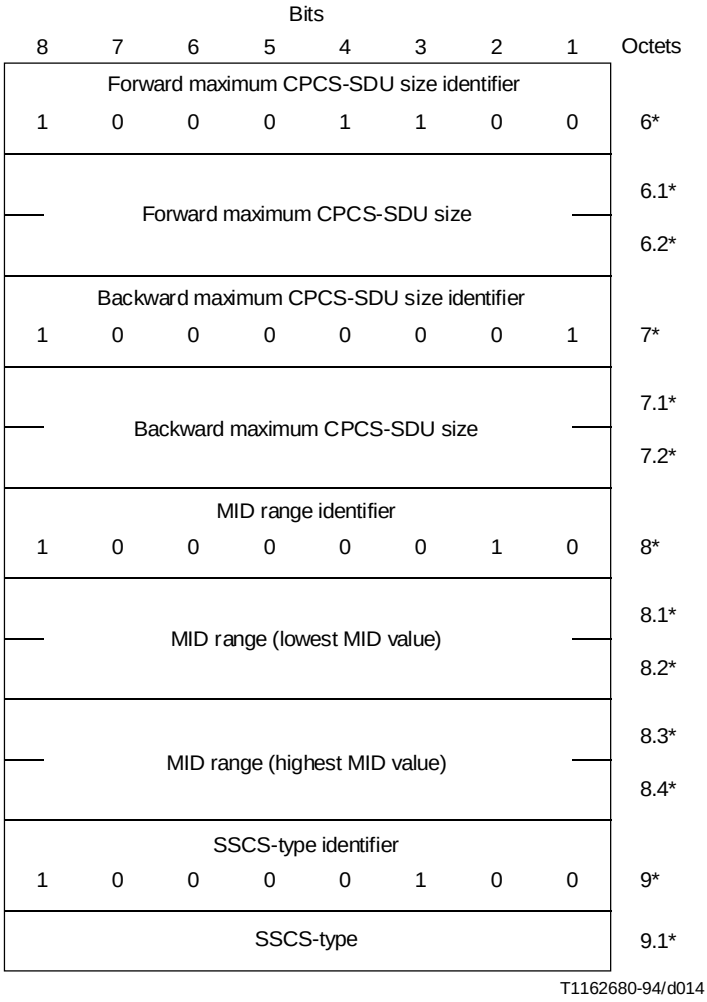


NOTE – These octets are only present if octet 7.1 indicates "n × 64 kbit/s or n × 8 kbit/s".

FIGURE 4-12/Q.2931 (part 2 of 5)

AAL parameters information element

(further contents for AAL type 3/4).

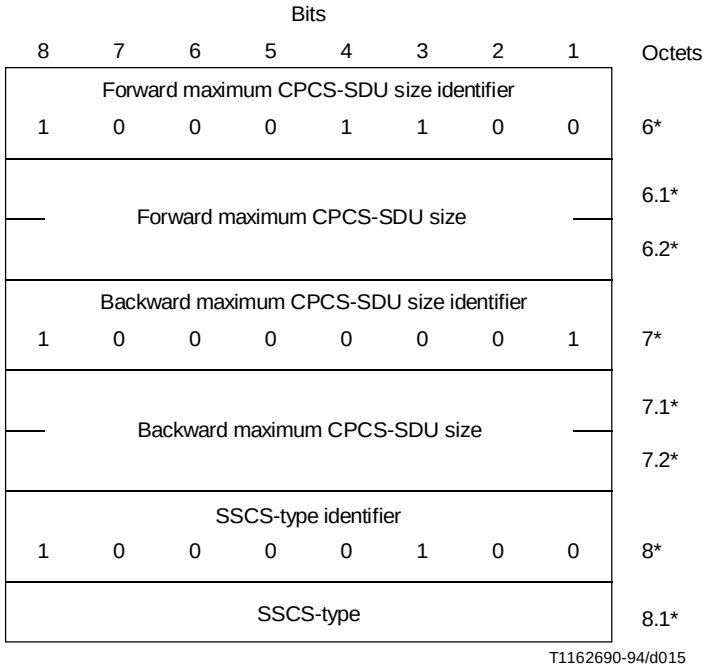


NOTE – The indication of values for octet groups 6-8 for use in the CONNECT message is specified in Annex F.

FIGURE 4-12/Q.2931 (part 3 of 5)

AAL parameters information element

(further contents for AAL type 5)



NOTE – The indication of values for octet groups 6-7 for use in the CONNECT message is specified in Annex F.

FIGURE 4-12/Q.2931 (part 4 of 5)

AAL parameters information element

(further contents for User-defined AAL)

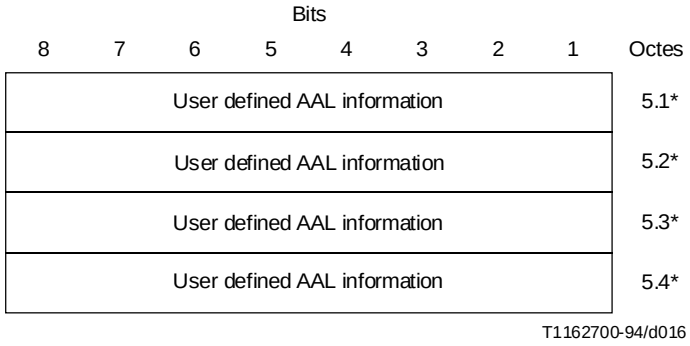


FIGURE 4-12/Q.2931 (part 5 of 5)

AAL parameters information element

TABLE 4-6/Q.2931 (sheet 1 of 3)

AAL parameters information element

– AAL type (octet 5)

Bits

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	AAL for voice (Note 1, Note 2)
0	0	0	0	0	0	0	1	AAL type 1
0	0	0	0	0	0	1	0	AAL type 2 (Note 2)
0	0	0	0	0	0	1	1	AAL type 3/4
0	0	0	0	0	1	0	1	AAL type 5
0	0	0	1	0	0	0	0	user defined AAL

All other values are reserved.

NOTE 1 – The default AAL for voice is the AAL specified in Recommendation I.363 for voice-band signal transport based on 64 kbit/s (see Recs. G.711/G.722).

NOTE 2 – For AAL type 2 and AAL for voice, no further parameters are specified beyond the ones given in part 1 of 5 of Figure 4-12.

– Subtype (octet 6.1 for AAL type 1)

Bits

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	null
0	0	0	0	0	0	0	1	voice-band signal transport based on 64 kbit/s (see Recs. G.711/G.722) (for further study, see Recommendation I.363)
0	0	0	0	0	0	1	0	circuit transport (see 2.5.1.1/I.363)
0	0	0	0	0	1	0	0	high-quality audio signal transport (for further study, see Recommendation I.363)
0	0	0	0	0	1	0	1	video signal transport (for further study, see Recommendation I.363)

All other values are reserved.

– CBR rate (octet 7.1 for AAL type 1)

Bits

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	64 kbit/s
0	0	0	0	0	1	0	0	1 544 kbit/s
0	0	0	0	0	1	0	1	6 312 kbit/s
0	0	0	0	0	1	1	0	32 064 kbit/s
0	0	0	0	0	1	1	1	44 736 kbit/s
0	0	0	0	1	0	0	0	97 728 kbit/s
0	0	0	1	0	0	0	0	2 048 kbit/s
0	0	0	1	0	0	0	1	8 448 kbit/s
0	0	0	1	0	0	1	0	34 368 kbit/s
0	0	0	1	0	0	1	1	139 264 kbit/s
0	1	0	0	0	0	0	0	n × 64 kbit/s
0	1	0	0	0	0	0	1	n × 8 kbit/s

All other values are reserved.

TABLE 4-6/Q.2931 (sheet 2 of 3)

AAL parameters information element

– Multiplier (octets 8.1 and 8.2 for AAL type 1 and n × 64 kbit/s or n × 8 kbit/s indication in octet 7.1)

Integer representation of multiplier values between 2 and $2^{16} - 1$ for n × 64 kbit/s.

Integer representation of multiplier values between 1 and 7 for n × 8 kbit/s.

– Source clock frequency recovery method (octet 9.1 for AAL type 1)

Bits

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	null (synchronous circuit transport)
0	0	0	0	0	0	0	1	Synchronous Residual Time Stamp (SRTS) method (asynchronous circuit transport) (see 2.5.2.2.1/I.363)
0	0	0	0	0	0	1	0	adaptive clock method (see 2.5.2.2.1/I.363)

All other values are reserved.

– Error correction method (octet 10.1 for AAL type 1)

Bits

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	null (no error correction is provided)
0	0	0	0	0	0	0	1	a forward error correction method for loss sensitive signal transport (see Recommendation I.363)
0	0	0	0	0	0	1	0	a forward error correction method for delay sensitive signal transport (for further study, see Recommendation I.363)

All other values are reserved.

– Structured data transfer block size (octet 11.1 and 11.2 for AAL type 1)

16 bit integer representation of values between 1 and 65 535, i.e.$2^{16} - 1$. This parameter represents the block size of SDT CBR service.

NOTE 3 – When provisioning ATM connections that support AAL type 1 SDT service, the SDT protocol may distinguish between SDT block sizes with a value of "1" and SDT block sizes ranging from 2 to $2^{16} - 1$. The special case using a block size of "1" is under study; see Recommendation I.363.

– Partially filled cells method (octet 12.1 for AAL type 1)

Bits

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	Integer representation of the number of leading octets of SAR-PDU payload in use (values between 1 and 47) (for further study, see Recommendation I.363)
			to					
0	0	1	0	1	1	1	1	

– Forward maximum CPCS-SDU size (octets 6.1 and 6.2 for AAL type 3/4 and 5)

16 bit integer representation of the values between 0 and 65 535, i.e. $2^{16} - 1$. This parameter refers to the forward direction (calling user to called user, see Annex J).

– Backward maximum CPCS-SDU size (octets 7.1 and 7.2 for AAL type 3/4 and 5)

16 bit integer representation of the values between 0 and 65 535, i.e. 2^{16}–1. This parameter refers to the backward direction (called user to calling user, see Annex J).

– MID range (octets 8.1, 8.2, 8.3 and 8.4 for AAL type 3/4)

Integer representation of the lowest MID value (octets 8.1 and 8.2) and of the highest MID value (octets 8.3 and 8.4) of the MID range, only values between 0 and 1023.

TABLE 4-6/Q.2931 (sheet 3 of 3)

AAL parameters information element

– SSCS type (octet 9.1 for AAL type 3/4; octet 8.1 for AAL type 5)

Bits

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	null
0	0	0	0	0	0	0	1	data SSCS based on SSCOP (assured operation)
0	0	0	0	0	0	1	0	data SSCS based on SSCOP (non-assured operation)
0	0	0	0	0	1	0	0	frame relay SSCS

All other values are reserved.

– User defined AAL information (octets 5.1 to 5.4 for user defined AAL)

Bits

8	7	6	5	4	3	2	1

The contents of this field are user-specified.

NOTE 4 – In case of the absence of AAL parameter subfields, the following default values will apply:

– Subtype: no default (mandatory for AAL type 1).
– CBR Rate: no default (mandatory for AAL type 1).
– Multiplier: no default (mandatory for CBR Rate n × 64 kbit/s and n × 8 kbit/s).
– Clock Frequency Recovery: default = null.
– Error Correction: default = null.
– SDT Block Size: default = no SDT is used.
– Partially Filled Cells: default = 47 octets.
– Forward max. CPCS-SDU size: default = 65 535 octets.
– Backward max. CPCS-SDU size: default = 65 535 octets.
– MID range: default = 0-0 (no multiplexing via MID field).
– SSCS-Type: default = null.

4.5.6 ATM traffic descriptor

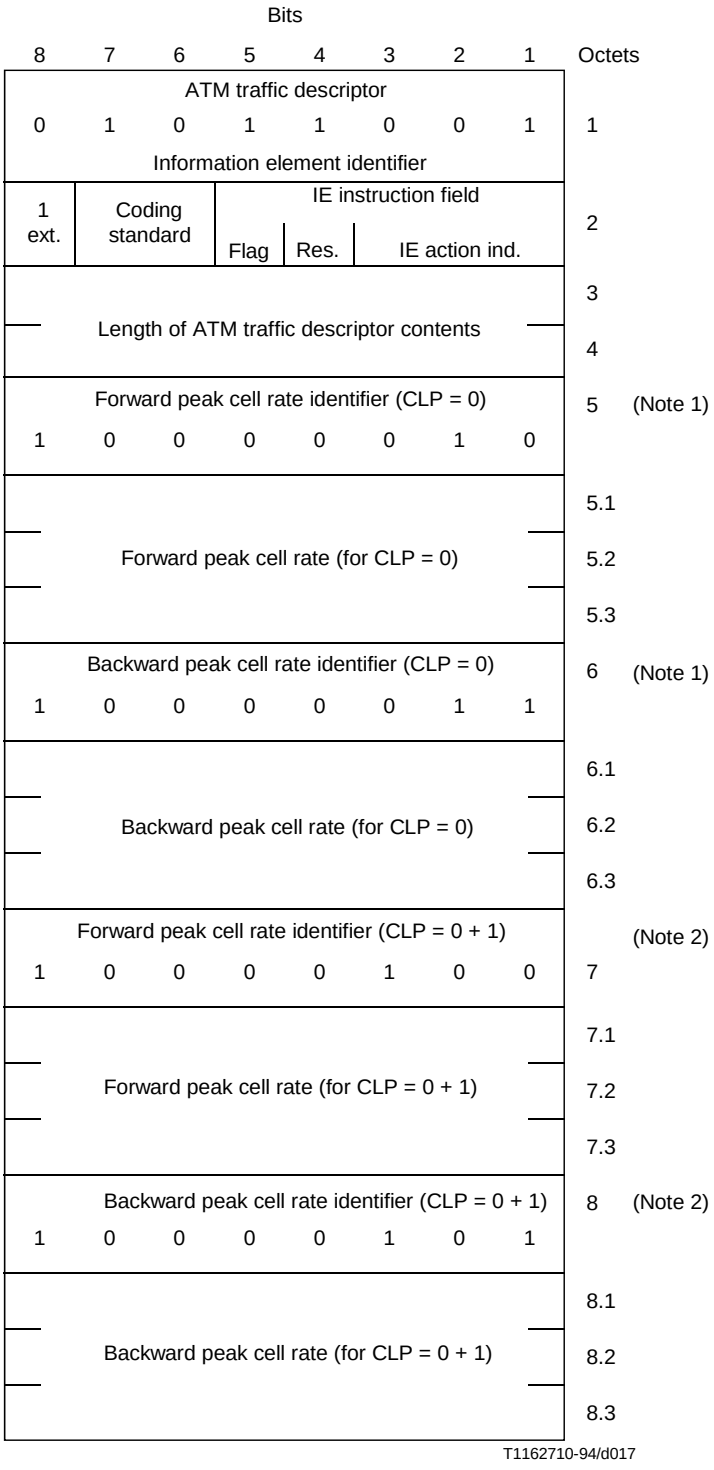
The purpose of the ATM traffic descriptor information element is to specify the set of traffic parameters which, together, specify a traffic control capability.

In Release 1, the ATM peak cell rate (see Recommendation I.371) values are indicated by the ATM traffic descriptor. The ATM peak cell rate values (indicated in the ATM traffic descriptor information element) specify the sum of both the user plane information rate and all end-to-end user originated OAM F5 flow.

If the user intends to use end-to-end OAM F5 flow messages, the peak cell rate for the reverse direction of a unidirectional connection should not be indicated with the value “0”.

The peak cell rate is described using subfield identifiers followed by a pure 3 octet integer representation of the cells per second.

The ATM traffic descriptor information element is coded as shown in Figure 4-13 and Table 4-7. The maximum length of this information element is 20 octets.



NOTES

1 If peak cell rate for CLP = 0 is present, the network resource allocation shall assume that the difference between the indicated peak cell rate for CLP = 0 + and the peak cell rate for CLP = 0 may be used for CLP = 1.

2 If only Peak cell rate for CLP = 0 + 1 is specified, the network resource allocation shall assume that the entire peak cell rate can be used for CLP = 0.

FIGURE 4-13/Q.2931

ATM traffic descriptor information element

TABLE 4-2/Q.2931

ATM traffic descriptor information element

– Forward/backward peak cell rate (octets i.1-i.3, where i may have the values 5, 6, 7, or 8)
A code expressing in pure 3 octet integer representation the number of cells per second, with bit 8 of the first octet being the most significant bit, and bit 1 of the third octet being the least significant bit.
The “forward” direction is defined as that from the calling user to the called user.
The “backward” direction is the reverse, i.e. from the called user to the calling user (see Annex J).

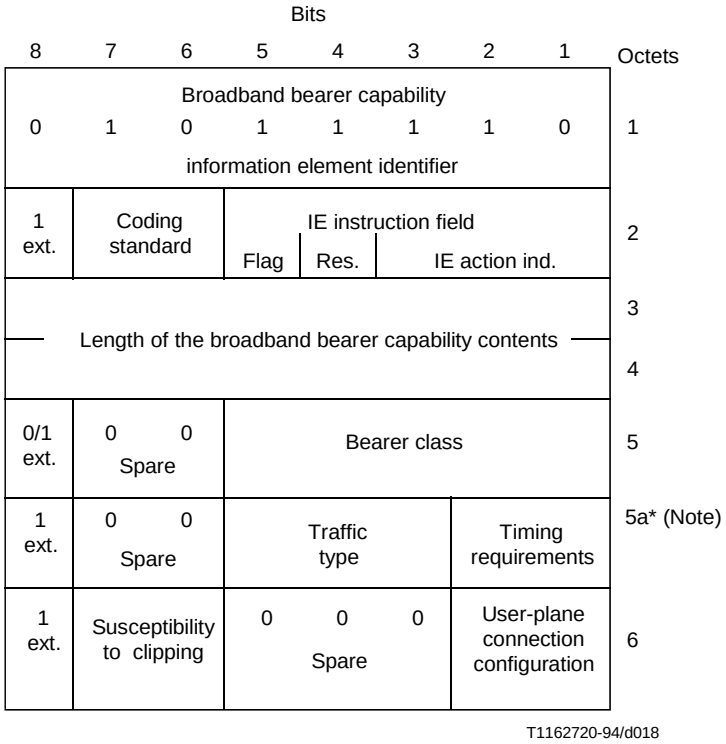
4.5.7 Broadband bearer capability

The purpose of the broadband bearer capability information element is to indicate a requested broadband connection-oriented bearer service (see Recommendation F.811) to be provided by the network. It contains only information that may be used by the network. The use of the broadband bearer capability information element in relation to compatibility checking is described in Annex B.

No default broadband bearer capability may be assumed by the absence of this information element.

The broadband bearer capability information element will be examined by both the network and the customer equipment.

The broadband bearer capability information element is coded as shown in Figure 4-14 and Table 4-8. The maximum length of this information element is 7 octets.



NOTE – This octet may only be present if Bearer Class “X” is indicated in octet 5.

FIGURE 4-14/Q.2931

Broadband bearer capacity information element

TABLE 4-8/Q.2931

Broadband bearer capability information element

– Bearer class (octet 5)

Bits

5	4	3	2	1	
0	0	0	0	1	BCOB-A
0	0	0	1	1	BCOB-C (Note 1)
1	0	0	0	0	BCOB-X

All other values are reserved.

– Traffic type (octet 5a)

Bits

5	4	3	
0	0	0	no indication
0	0	1	constant bit rate
0	1	0	variable bit rate

All other values are reserved.

– Timing requirements (octet 5a)

Bits

2	1	
0	0	no indication
0	1	end-to-end timing required
1	0	end-to-end timing not required
1	1	reserved

– Susceptibility to clipping (octet 6)

Bits

7	6	
0	0	not susceptible to clipping
0	1	susceptible to clipping

All other values are reserved.

– User-plane connection configuration (octet 6)

Bits

2	1	
0	0	point-to-point
0	1	point-to-multipoint (Note 2)

All other values are reserved.

NOTES

1 If bearer class BCOB-C is indicated, the network may allocate resources, as if bearer class BCOB-A was requested, and allocate resources on the basis of the peak cell rate only.

2 Procedures for point-to-multipoint connections are not provided in Release 1. However, the support of this codepoint may allow a user to participate via a point-to-point connection segment in a point-to-multipoint connection (e.g. when a user, implementing Release 1 procedures, receives a SETUP message with the user-plane connection configuration coding set to "point-to-multipoint", it shall treat it as if the coding were "point-to-point". This will allow the user to be a "leaf" of a point-to-multipoint connection).

4.5.8 Broadband High Layer Information

The purpose of the broadband high layer information information element is to provide a means which should be used for compatibility checking by an addressed entity (e.g. a remote user, an interworking unit or a high layer function network node addressed by the calling user). The broadband high layer information information element is transferred transparently by a B-ISDN between the call originating entity (e.g. the calling user) and the addressed entity.

The broadband high layer information information element is coded as shown in Figure 4-15 and in Table 4-9. The maximum length of this information element is 13 octets.

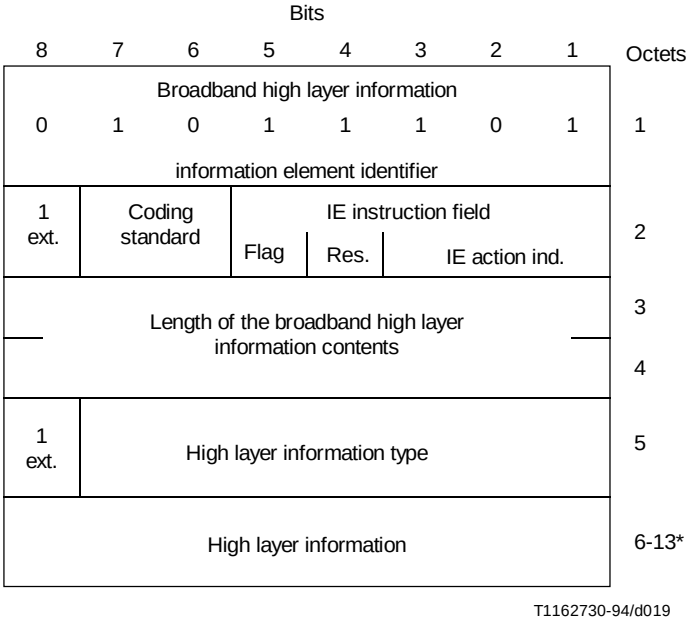


FIGURE 4-15/Q.2931

Broadband high layer information

TABLE 4-9/Q.2931

Broadband high layer information

– High layer information type (octet 5)

Bits

7	6	5	4	3	2	1	
0	0	0	0	0	0	0	ISO/IEC (Note 1)
0	0	0	0	0	0	1	user-specific (Note 2)
0	0	0	0	0	1	1	vendor-specific application identifier (Note 3)
0	0	0	0	1	0	0	reference to ITU-T SG 1 B-ISDN teleservice recommendation (Note 4)

Other values reserved.

NOTES

1 This codepoint is reserved for use as specified in ISO/IEC standards.

2 The exact coding of octets 6-13, when this higher layer information type is used, is user-defined. The use of this codepoint requires bilateral agreement between the two end users.

3 When this high layer information type is used, octets 6-12 are coded as follows: octets 6-8 contain a globally-administered Organizationally Unique Identifier (OUI) (as specified in IEEE 802-1990; section 5.1); octet 0 of the OUI is mapped to octet 6 of the broadband high layer information, and so on; the LSB of the OUI is mapped to bit 8 of the B-HLI, the MSB of the OUI is mapped to bit 1 of the B-HLI; bit 7 of octet 6 is always set to "0"; octets 9-12 contain an application identifier which is administered by the vendor identified by the OUI.

Octet 13 is not used for this high layer information type.

4 Codepoints for these Recommendations will be indicated in octet 6. The specific codepoints will be added at the time when ITU-T SG 1 has completed the corresponding Recommendations.

– High layer information (octets 6-13)

The content of these octets depends on the high layer information type.

4.5.9 Broadband Low Layer Information

The purpose of the broadband low layer information information element is to provide a means which should be used for compatibility checking by an addressed entity (e.g. a remote user or an interworking unit or a high layer function network node addressed by the calling user). The broadband low layer information information element is transferred transparently by a B-ISDN between the call originating entity (e.g. the calling user) and the addressed entity.

For broadband low layer information negotiation (see Annex C), the broadband low layer information information element is also passed transparently from the addressed entity to the originating entity.

The broadband low layer information information element is coded as shown in Figure 4-16 and in Table 4-10. The maximum length of this information element is 17 octets.

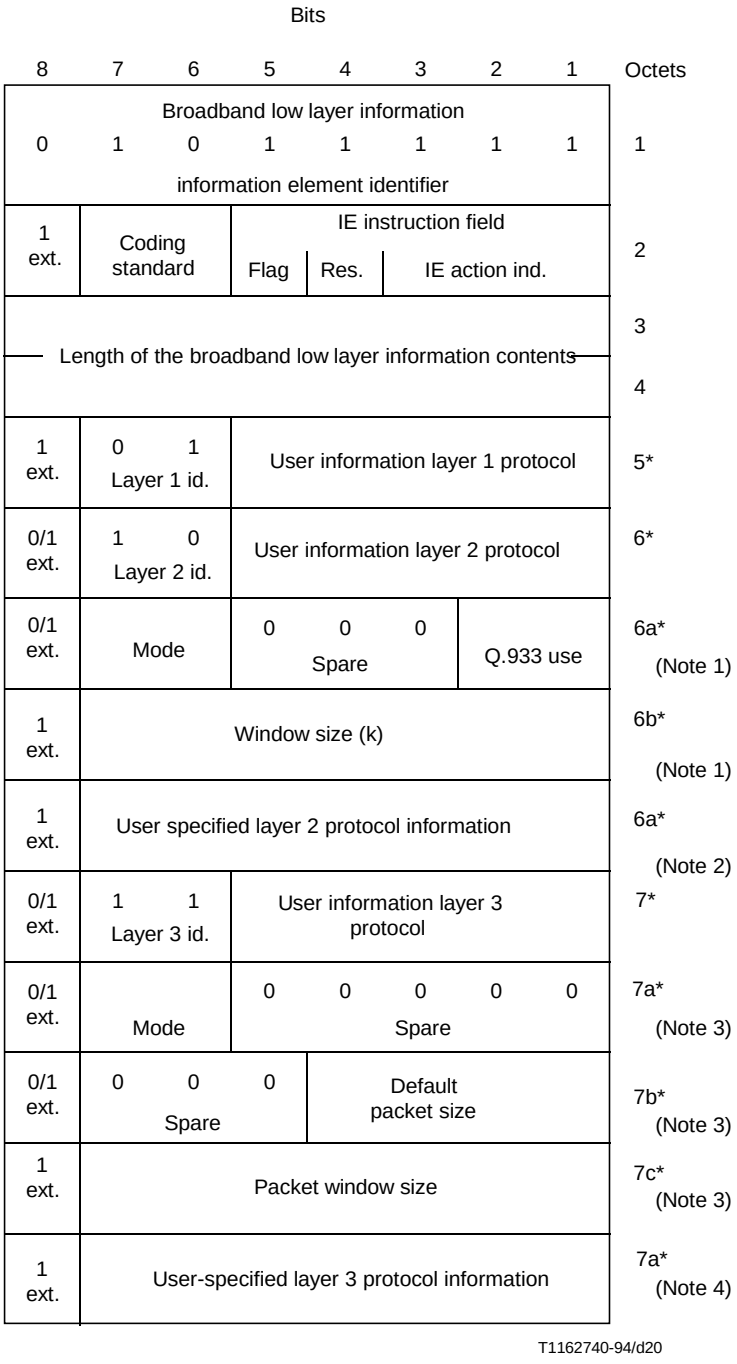
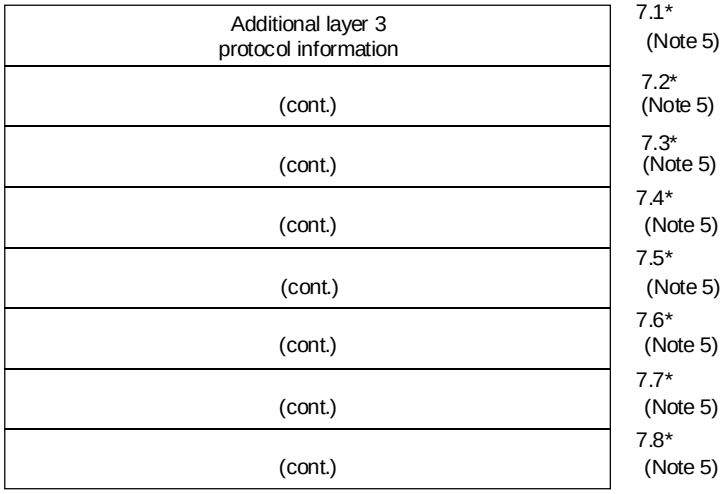


FIGURE 4-16/Q.2931 (part 1 of 2)

Broadband low layer information



NOTES

1 This octet may be present only if octet 6 indicates certain HDLC acknowledged-mode elements of procedure as indicated in Table 4-10.

2 This octet may be present only if octet 6 indicates user-specified layer 2 protocol.

3 This octet may be present only if octet 7 indicates a layer 3 protocol based on Recommendation X.25, ISO/IEC 8208 or X.223/ISO/IEC 8878 as indicated in Table 4-10.

4 This octet may be present only if octet 7 indicates user specified layer 3 protocol.

5 These octets may be present only if octet 7 indicates ISO/IEC TR 9577.

FIGURE 4-16/Q.2931 (part 2 of 2)

Broadband low layer information

TABLE 4-10/Q.2931 (sheet 1 of 3)

Broadband low layer information element

– User information layer 1 protocol (octet 5)

All values are reserved.

– User information layer 2 protocol (octet 6)

Bits

5	4	3	2	1	
0	0	0	0	1	Basic mode ISO 1745
0	0	0	1	0	ITU-T Recommendation Q.921 (Rec. I.441)
0	0	1	1	0	ITU-T Recommendation X.25, link layer (Note 1, Note 4)
0	0	1	1	1	ITU-T Recommendation X.25 multilink (Note 4)
0	1	0	0	0	extended LAPB; for half-duplex operation (Rec. T.71)
0	1	0	0	1	HDLC ARM (ISO/IEC 4335) (Note 4)
0	1	0	1	0	HDLC NRM (ISO/IEC 4335) (Note 4)
0	1	0	1	1	HDLC ABM (ISO/IEC 4335) (Note 4)
0	1	1	0	0	LAN logical link control (ISO/IEC 8802-2)
0	1	1	0	1	ITU-T Recommendation X.75. Single Link Procedure (SLP) (Note 4)
0	1	1	1	0	ITU-T Recommendation Q.922 (Note 4)
1	0	0	0	0	user-specified (Note 2)
1	0	0	0	1	ISO/IEC 7776 DTE-DTE operation (Note 3, Note 4)

All other values are reserved.

NOTE 1 – This Recommendation is compatible with ISO/IEC 7776 DTE-DCE operation.

NOTE 2 – When this coding is included, octet 6a will include user coding for the user-specified layer 2 protocol.

NOTE 3 – This standard is compatible with Recommendation X.75 modified by the application rules defined in Recommendation T.90.

NOTE 4 – When this coding is included, octets 6a and 6b with ITU-T encoding may be included.

– Octet 6a for ITU-T codings

– Mode of operation (octet 6a)

Bits

7	6	
0	1	normal mode of operation
1	0	extended mode of operation

All other values are reserved.

– Q.933 use (octet 6a)

Bits

2	1	
0	0	for use when the coding defined in Recommendation Q.933 is not used

All other values are reserved.

– Octet 6a for user protocol

– User-specified layer 2 protocol information (octet 6a)

The use and coding of octet 6a is according to user defined requirements.

TABLE 4-10/Q.2931 (sheet 2 of 3)

Broadband low layer information element

– Window size (k) (octet 6b)

Bits 7 to 1 are coded as a binary coding of k parameter value in the range from 1 to 127.

– User information layer 3 protocol (octet 7)

Bits

5	4	3	2	1	
0	0	1	1	0	ITU-T Recommendation X.25, packet layer (Note 6)
0	0	1	1	1	ISO/IEC 8208 (X.25 packet level protocol for data terminal equipment) (Note 6)
0	1	0	0	0	Rec. X.223 | ISO/IEC 8878 (use of ISO/IEC 8208 and ITU-T Rec. X.25 to provide the OSI-CONS) (Note 6)
0	1	0	0	1	Rec. X.233 | ISO/IEC 8473 (OSI connectionless mode protocol)
0	1	0	1	0	ITU-T Recommendation T.70 [40] minimum network layer
0	1	0	1	1	ISO/IEC TR 9577 (Note 7)
1	0	0	0	0	user-specified (Note 5)

All other values are reserved.

NOTE 5 – When this coding is included, octet 7a will include user coding for the user-specified layer 3 protocol.

NOTE 6 – When this coding is included, octets 7a, 7b and 7c with ITU-T encoding may be included.

NOTE 7 – If extension octets (7.1-7.8) are included, they will identify the layer 3 protocol identification according to ISO/IEC TR 9577 (e.g. see Annexes C and D of ISO/IEC TR 9577); otherwise, the Network Layer Protocol Identification (NLPID) carried on a connection, as defined in ISO/IEC TR 9577, is supported.

– Octet 7a for ITU-T codings

– Mode of operation (octet 7a)

Bits

7	6	
0	1	normal packet-sequence numbering
1	0	extended packet-sequence numbering

All other values are reserved.

– Octet 7a for user protocol

– User-specified layer 3 protocol information (octet 7a)

The use and coding of octet 7a is according on user defined requirements.

TABLE 4-10/Q.2931 (sheet 3 of 3)

Broadband low layer information element

– Default packet size (octet 7b)				
Bits				
4	3	2	1	
0	1	0	0	default packet size 16 octets
0	1	0	1	default packet size 32 octets
0	1	1	0	default packet size 64 octets
0	1	1	1	default packet size 128 octets
1	0	0	0	default packet size 256 octets
1	0	0	1	default packet size 512 octets
1	0	1	0	default packet size 1024 octets
1	0	1	1	default packet size 2048 octets
1	1	0	0	default packet size 4096 octets
All other values are reserved.				
– Packet window size (octet 7c)				
Bits 7 to 1 are coded as a binary coding of packet window size value in the range from 1 to 127.				
– Additional layer 3 protocol information (octets 7.1-7.8) for ISO/IEC TR 9577: as specified in ISO/IEC TR 9577				

4.5.10 Call state

The purpose of the call state information element is to describe the current status of a call/connection (see 2.1), or of a call/connection with regard to interworking (see 2.2) or of a call/connection with regard to the global call reference (see 2.3).

The call state information element is coded as shown in Figure 4-17 and Table 4-11.

The maximum length of this information element is 5 octets when ITU-T standard coding is used.

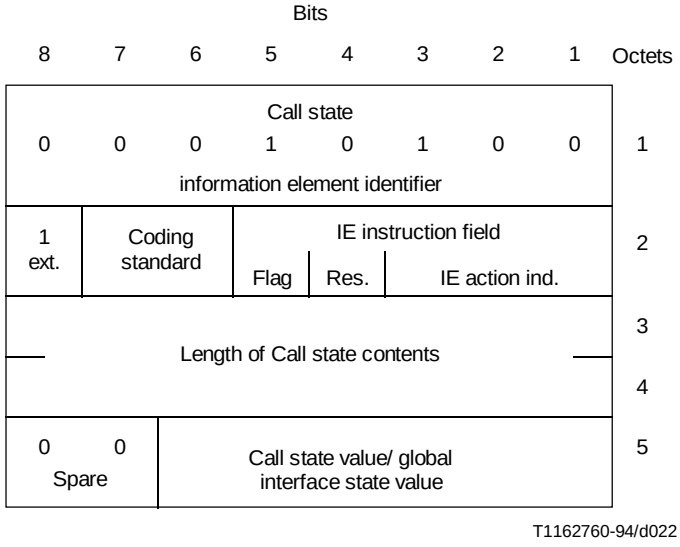


FIGURE 4-17/Q.2931

Call state information element

TABLE 4-11/Q.2931

Call state information element

– Call state value (octet 5)

Bits

6	5	4	3	2	1	User state		Network state	
0	0	0	0	0	0	U0	– Null	N0	– Null
0	0	0	0	0	1	U1	– Call Initiated	N1	– Call Initiated
0	0	0	0	1	0	U2	– Overlap Sending	N2	– Overlap Sending
0	0	0	0	1	1	U3	– Outgoing Call Proceeding	N3	– Outgoing Call Proceeding
0	0	0	1	0	0	U4	– Call Delivered	N4	– Call Delivered
0	0	0	1	1	0	U6	– Call Present	N6	– Call Present
0	0	0	1	1	1	U7	– Call Received	N7	– Call Received
0	0	1	0	0	0	U8	– Connect Request	N8	– Connect Request
0	0	1	0	0	1	U9	– Incoming Call Proceeding	N9	– Incoming Call Proceeding
0	0	1	0	1	0	U10	– Active	N10	– Active
0	0	1	0	1	1	U11	– Release Request	N11	– Release Request
0	0	1	1	0	0	U12	– Release Indication	N12	– Release Indication
0	1	1	0	0	1	U25	– Overlap Receiving	N25	– Overlap Receiving

– Global interface state value (octet 5)

Bits

6	5	4	3	2	1	State	
0	0	0	0	0	0	REST 0	– Null
1	1	1	1	0	1	REST 1	– Restart Request
1	1	1	1	1	0	REST 2	– Restart

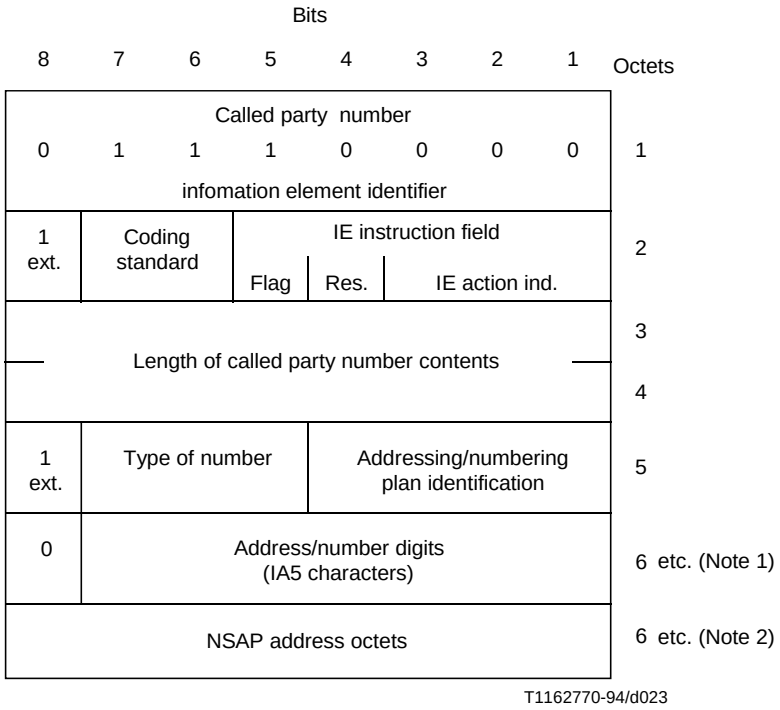
All other values are reserved.

4.5.11 Called party number

The purpose of the called party number information element is to identify the called party of a call.

The called party number information element is coded as shown in Figure 4-18 and Table 4-12.

The maximum length of this information element is network dependent.



NOTES

1 The number digits appear in multiple octet 6's in the same order in which they would be entered, that is, the number digit which would be entered first is located in the first octet 6. Digits are coded in IA5 characters. Bit 8 is set to 0.

2 If the use of NSAP addressing is indicated in the addressing/numbering plan identification, the address is coded as described in Rec. X.213 | ISO/IEC 8348.

FIGURE 4-18/Q.2931

Called party number information element

TABLE 4-12/Q.2931

Called party number information element

– Type of number (octet 5)

Bits

7	6	5	
0	0	0	unknown (Note 2)
0	0	1	international number (Note 1, Note 3, Note 6)
0	1	0	national number (Note 1, Note 3, Note 6)
0	1	1	network specific number (Note 4, Note 6)
1	0	0	subscriber number (Note 1, Note 3, Note 6)
1	1	0	abbreviated number (Note 5)
1	1	1	reserved for extension

All other values are reserved.

NOTE 1 – For the definition of international, national and subscriber number, see Recommendation I.330.

NOTE 2 – The type of number "unknown" is used when NSAP addressing is indicated in the addressing/numbering plan identification or when the user or the network indicates the type of number using the number digits field. In the latter case, the number digits field is organized according to the network dialling plan; e.g. prefix digits might be present; in addition, escape digits may also be present.

NOTE 3 – Prefix digits shall not be included.

NOTE 4 – The type of number "network specific number" is used to indicate administration/service number specific to the serving network, e.g. used to access an operator.

NOTE 5 – The support of this code is network dependent. The number provided in this information element presents a shorthand representation of the complete number in the specified numbering plan as supported by the network.

NOTE 6 – The use of these codepoints applies only when the ISDN numbering plan (Rec. E.164) is being used, either by explicit indication or because it is the default numbering plan of the network indicated by the numbering plan identification equal to "unknown".

– Addressing/numbering plan identification (octet 5) (Note 11)

Bits

4	3	2	1	
0	0	0	0	unknown (Note 7)
0	0	0	1	ISDN numbering plan (Recommendation E.164)
0	0	1	0	NSAP addressing (ISO/IEC 8348) (Note 8, Note 9)
1	0	0	1	private numbering plan (Note 8, Note 10)
1	1	1	1	reserved for extension

All other values are reserved.

NOTE 7 – The numbering plan identification "unknown" indicates the default numbering plan of the network. In the absence of bilateral agreement, or alternative specification in other Recommendations, the default numbering plan of the network shall be "ISDN numbering plan (Recommendation E.164)".

NOTE 8 – The use of this codepoint is a network option and requires bilateral agreement/arrangements between the network operator and the user, subject to both network and user supporting the identified numbering plan.

NOTE 9 – If this codepoint is used, the type of number is coded as "unknown".

NOTE 10 – If this codepoint is used, the type of number used is outside the scope of this Recommendation.

NOTE 11 – All networks and users shall support the ISDN numbering plan. For the use of other numbering plans, see the Notes on the relevant numbering plan identification value.

– Address/number digits (octets 6, etc.), used unless an alternative is specified

This field is coded with IA5 characters, according to the formats specified in the appropriate numbering/dialling plan.

– NSAP address octets (octets 6, etc. for NSAP addressing)

If the use of NSAP addressing is indicated in the addressing/numbering plan identification, the address is coded as described in ISO/IEC 8348.

4.5.12 Called party sub-address

The purpose of the called party sub-address information element is to identify the sub-address of the called party of a call. For the definition of subaddress, see Recommendation I.330.

The called party sub-address is coded as shown in Figure 4-19 and Table 4-13.

The maximum length of this information element is 25 octets.

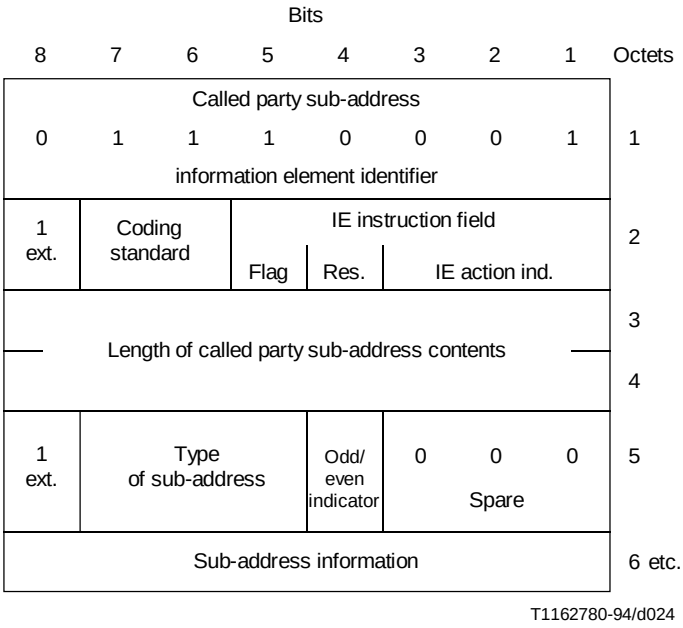


FIGURE 4-19/Q.2931

Called party sub-address information element

TABLE 4-13/Q.2931

Called party sub-address information element

– Type of sub-address (octet 5)

Bits

7	6	5	
0	0	0	NSAP (Rec. X.213 | ISO/IEC 8348)
0	0	1	user-specified ATM endsystem address
0	1	0	user-specified

All other values are reserved.

– Odd/even indicator (octet 5) (Note 1)

Bit

4	
0	Even number of address signals
1	Odd number of address signals

– Sub-address information (octet 6, etc.)

The NSAP Rec. X.213 | ISO/IEC 8348 address, shall be formatted as specified by octet 6 which contains the Authority and Format Identifier (AFI). The encoding is made according to the "preferred binary encoding" as defined in Rec. X.213 | ISO/IEC 8348 except when used for terminal selection (Note 3).

For the definition of this type of sub-address, see Recommendation I.334.

For the "user-specified ATM endsystem address", this field is encoded according to the user specification, subject to a maximum length of 20 octets (Note 4).

For user-specified sub-address, this field is encoded according to the user specification, subject to a maximum length of 20 octets. When interworking with X.25 networks BCD coding should be applied.

NOTES

1 The odd/even indicator is used when the type of sub-address is "user-specified" and the coding is BCD.

2 It is recommended that users apply the NSAP sub-address type since this sub-address type allows the use of decimal, binary and IA5 characters in a standardized manner.

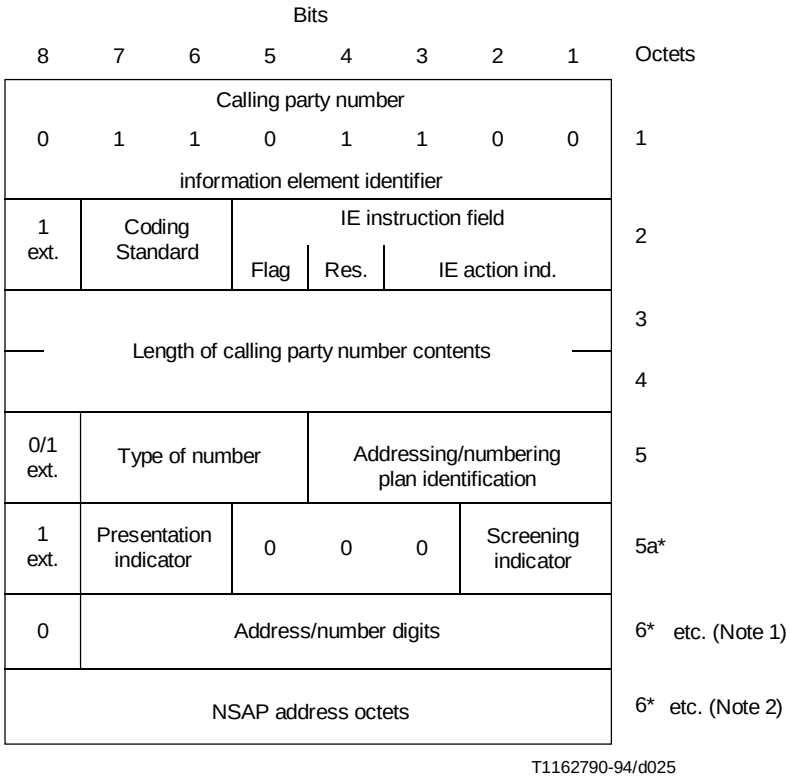
3 It is recommended that users apply the Local IDI format (the AFI field is coded 50 in BCD) when the sub-address is used for terminal selection. In this case, the IA5 character syntax using only digits 0 to 9 shall be used for the DSP. Each character is the coded in one octet according to Rec. T.50 | ISO/IEC 646, with zero parity in the most significant position.

4 The "user-specified ATM endsystem address" can be used between two ATM terminal equipments when the NSAP codepoint is not appropriate.

4.5.13 Calling party number

The purpose of the calling party number information element is to identify the origin of a call.

The calling party number information element is coded as shown in Figure 4-20, and Table 4-14. The maximum length of this information element is network dependent.



NOTES

1 The number digits appear in multiple octet 6's in the same order in which they would be entered, that is, the number digit which would be entered first is located in the first octet 6. Digits are coded in IA5 characters. Bit 8 is set to 0.

2 If the use of NSAP addressing is indicated in the addressing/numbering plan identification, the address is coded as described in Rec. X.213 | ISO/IEC 8348.

FIGURE 4-20/Q.2931

Calling party number information element

TABLE 4-14/Q.2931 (sheet 1 of 2)

Calling party number information element

– Type of number (octet 5)

Bits

7	6	5	
0	0	0	unknown (Note 2)
0	0	1	international number (Note 1, Note 3, Note 6)
0	1	0	national number (Note 1, Note 3, Note 6)
0	1	1	network specific number (Note 4, Note 6)
1	0	0	subscriber number (Note 1, Note 3, Note 6)
1	1	0	abbreviated number (Note 5)
1	1	1	reserved for extension

All other values are reserved.

NOTE 1 – For the definition of international, national and subscriber number, see Recommendation I.330.

NOTE 2 – The type of number "unknown" is used when NSAP addressing is indicated in the addressing/numbering plan identification or when the user or the network indicates the type of number using the number digits field. In the latter case, the number digits field is organized according to the network dialling plan; e.g. prefix digits might be present; in addition, escape digits may also be present.

NOTE 3 – Prefix digits shall not be included.

NOTE 4 – The type of number "network specific number" is used to indicate administration/service number specific to the serving network, e.g. used to access an operator.

NOTE 5 – The support of this code is network dependent. The number provided in this information element presents a shorthand representation of the complete number in the specified numbering plan as supported by the network.

NOTE 6 – The use of these codepoints applies only when the ISDN numbering plan (Recommendation E.164) is being used, either by explicit indication or because it is the default numbering plan of the network indicated by the numbering plan identification equal to "unknown".

– Addressing/numbering plan identification (octet 5) (Note 11)

Bits

4	3	2	1	
0	0	0	0	unknown (Note 7)
0	0	0	1	ISDN numbering plan (Recommendation E.164)
0	0	1	0	NSAP addressing (ISO/IEC 8348) (Note 8, Note 9)
1	0	0	1	private numbering plan (Note 8, Note 10)
1	1	1	1	reserved for extension

All other values are reserved.

NOTE 7 – The numbering plan identification "unknown" indicates the default numbering plan of the network. In the absence of bilateral agreement, or alternative specification in other Recommendations, the default numbering plan of the network shall be "ISDN numbering plan (Recommendation E.164)".

NOTE 8 – The use of this codepoint requires bilateral agreement between the network and the user, supporting the identified numbering plan.

NOTE 9 – If this codepoint is used, the type of number is coded as "unknown".

NOTE 10 – If this codepoint is used, the type of number used is outside the scope of this Recommendation.

NOTE 11 – All networks and users shall support the ISDN numbering plan. For the use of other numbering plans, see the Notes on the relevant numbering plan identification value.

TABLE 4-14/Q.2931 (sheet 2 of 2)

Calling party number information element

– Presentation indicator (octet 5a)

Bits

7	6	
0	0	presentation allowed
0	1	presentation restricted
1	0	number not available
1	1	reserved

NOTE 12 – At the originating user-network interface, the presentation indicator is used for indicating the intention of the calling user for the presentation of the calling party number to the called user. This may also be requested on a subscription basis. If octet 5a is omitted, and the network does not support subscription information for the calling party number information restrictions, the value "00 – presentation allowed" is assumed.

– Screening indicator (octet 5a)

Bits

2	1	
0	0	user-provided, not screened
0	1	user-provided, verified and passed
1	0	user-provided, verified and failed
1	1	network provided

NOTE 13 – If octet 5a is omitted, "00 – User provided, not screened" is assumed.

– Address/number digits (octets 6, etc.), used unless an alternative is specified

This field is coded with IA5 characters, according to the formats specified in the appropriate numbering/dialling plan.

– NSAP address octets (octets 6, etc. for NSAP addressing)

If the use of NSAP addressing is indicated in the addressing/numbering plan identification, the address is coded as described in Rec. X.213 | ISO/IEC 8348 (for details, see also the description of sub-address information in Table 4-15).

4.5.14 Calling party sub-address

The purpose of the calling party sub-address is to identify a sub-address associated with the origin of a call. For the definition of sub-address, see Recommendation I.330.

The calling party sub-address information element is coded as shown in Figure 4-21 and Table 4-15.

The maximum length of this information element is 25 octets.

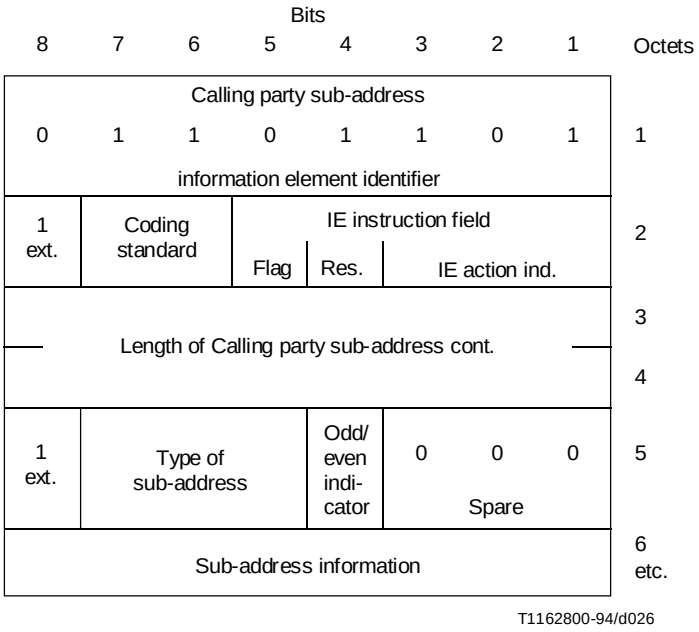


FIGURE 4-21/Q.2931

Calling party sub-address information element

TABLE 4-15/Q.2931

Calling party sub-address information element

– Type of sub-address (octet 5) Bits 7 6 5 0 0 0 NSAP (Rec. X.213 | ISO/IEC 8348) 0 0 1 user-specified ATM endsystem address 0 1 0 user-specified All other values are reserved. – Odd/even indicator (octet 5) Bit 4 0 Even number of address signals (Note 1) 1 Odd number of address signals (Note 1) – Sub-address information (octet 6, etc.) The NSAP Rec. X.213 | ISO/IEC 8348 address, shall be formatted as specified by octet 6 which contains the Authority and Format Identifier (AFI). The encoding is made according to the "preferred binary encoding" as defined in Rec. X.213 | ISO/IEC 8348 except when used for terminal selection (Note 3). For the definition of this type of sub-address, see Recommendation I.334. For the "user-specified ATM endsystem address", this field is encoded according to the user specification, subject to a maximum length of 20 octets (Note 4). For user specified sub-address, this field is encoded according to the user specification, subject to a maximum length of 20 octets. When interworking with X.25 networks, BCD coding should be applied.
NOTES 1 The odd/even indicator is used when the type of sub-address is "user-specified" and the coding is BCD. 2 It is recommended that users apply the NSAP sub-address type since this sub-address type allows the use of decimal, binary and IA5 characters in a standardized manner. 3 It is recommended that users apply the Local IDI format (the AFI field is coded 50 in BCD) when the sub-address is used for terminal selection. In this case, the IA5 character syntax using only digits 0 to 9 shall be used for the DSP. Each character is the coded in one octet according to Rec. T.50 | ISO/IEC 646, with zero parity in the most significant position. 4 The "user-specified ATM endsystem address" can be used between two ATM terminal equipments when the NSAP codepoint is not appropriate.

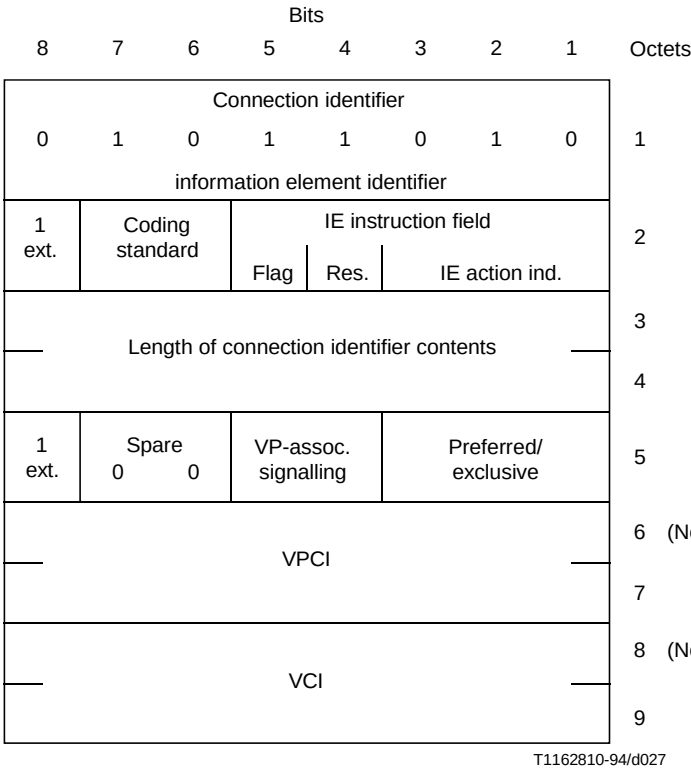
4.5.15 Cause

The contents and use of the cause information element is defined in Recommendation Q.2610.

4.5.16 Connection identifier

The connection identifier information element identifies the local ATM connection resources on the interface. This information element is optionally present in the SETUP message, and optionally in the first response to the SETUP message.

The connection identifier information element is coded as shown in Figure 4-22 and Table 4-16. The length of this information element is 9 octets.



NOTES

1 If the preferred/exclusive field indicates “any VCI”, the VCI field shall be ignored.

2 In case of the restart class “001” (see Table 4-20 and 3.3),
the VCI fied shall be ignored.

3 When VP-associated signalling is indicated in octet 5, the VPCI field shall be ignored.

FIGURE 4-22/Q.2931

Connection identifier information element

TABLE 4-16/Q.2931

Connection identifier information element

– VP-associated signalling (VP-associated signalling) (octet 5)
Bits
5 4
0 0 VP-associated signalling (same VPI for user information as for signalling)
0 1 explicit indication of VPCI
All other values reserved.
– Pref./Ex. (preferred/exclusive), (octet 5)
Bits
3 2 1
0 0 0 exclusive VPCI; exclusive VCI
0 0 1 exclusive VPCI; any VCI
All other values are reserved.
– Virtual Path Connection Identifier (octets 6 and 7)
The values 0 through 65 535 are a code representing the identifier of the virtual path connection (Note 1)
– Virtual Channel Identifier (octets 8 and 9) (Note 2)
0 through 31 not used for on-demand user plane connections
32 through 65 535 identifier of the virtual channel (Note 3)
NOTES 1 For the use of VPCIs see 5.1.2.2. The range of VPI values available will be determined at subscription time. 2 The value of the VCI field is the same as the value used in the VCI field of the corresponding ATM cell headers. 3 Some values in the range may not be available for use for user-plane connections.

4.5.17 End-to-end transit delay

The purpose of the end-to-end transit delay information element is to indicate the nominal maximum end-to-end transit delay acceptable on a per-call basis, and to indicate the cumulative transit delay to be expected for a virtual channel connection.

Transit delay is the end-to-end one-way transit delay of user data transferred during the data transfer phase on the user plane, between the calling user and the called user. It includes:

- the total processing time in the end user systems (e.g. processing time, AAL handling delay, ATM cell assembly delay, and possibly any additional processing delay); and
- the network transfer delay (e.g. propagation delay, ATM layer transfer delay, possibly any additional processing delay in the network).

The cumulative transit delay value indicated by the calling user in the SETUP message (if present) includes the cumulative transit delay from the calling user to the network boundary.

The cumulative transit delay value indicated by the network in the SETUP message sent to the called user is the sum of the value which was indicated at the originating UNI and the expected transfer delay accumulated within the network. It does not include further transfer delay on the way from the network boundary to the called user.

The cumulative transit delay value which is transferred over both UNIs in the CONNECT message is the expected total end-to-end transit delay value for user data transfer over the related virtual channel connection as provided for a given call.

The maximum end-to-end transit delay value may be indicated by the calling user to specify end-to-end transit delay requirements for this call. This field is included by the network in the SETUP message to indicate that the calling user has specified end-to-end transit delay requirements for this call.

The procedures which are applicable are described in Annex K.

The maximum end-to-end transit delay is not included in the CONNECT message.

The end-to-end transit delay is coded as shown in Figure 4-23 and Table 4-17.

The maximum length of this information element is 10 octets.

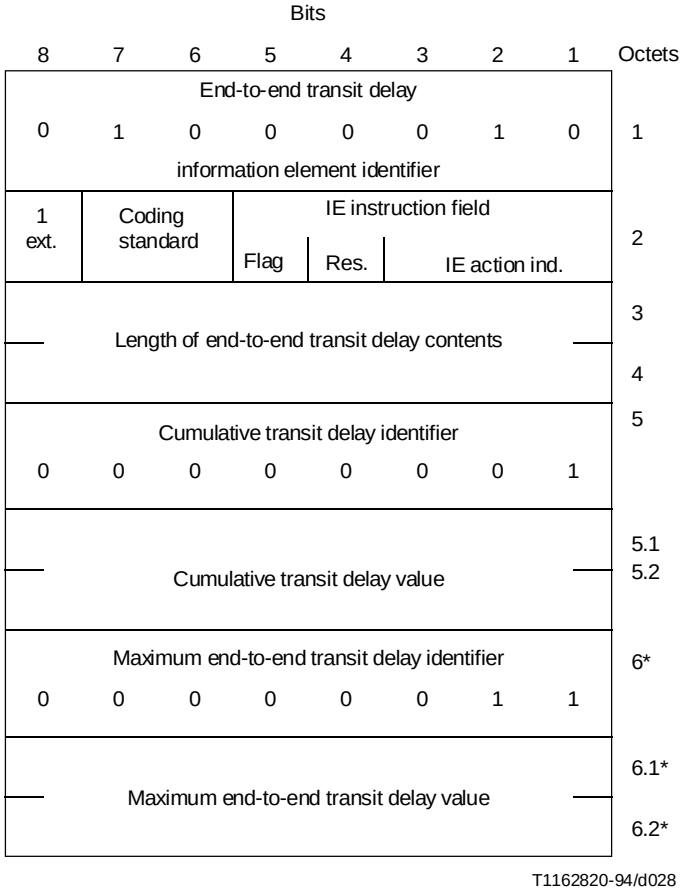


FIGURE 4-23/Q.2931

End-to-end transit delay information element

TABLE 4-17/Q.2931

End-to-end transit delay information element

– Cumulative transit delay value (octets 5.1 and 5.2)
The cumulative transit delay value is binary encoded in milliseconds. The coding rules for integer values described in 4.5.1 apply.
The cumulative transit delay value occupies 16 bits total.
– Maximum end-to-end transit delay value (octets 6.1 and 6.2)
The maximum end-to-end transit delay value is binary encoded in milliseconds. The coding rules for integer values described in 4.5.1 apply.
The maximum end-to-end transit delay value occupies 16 bits total.
The value “1111 1111 1111 1111”, however, is not to be interpreted as a maximum end-to-end transfer delay value. This codepoint indicates: “any end-to-end transit delay value acceptable; deliver cumulative end-to-end transit delay value to the called user”.

4.5.18 Quality of Service parameter

In addition to end-to-end transit delay information element, the Quality of Service parameter information element is specified. The purpose of the Quality of Service parameter information element is to indicate a certain Quality of Service (QOS) class.

The Quality of Service parameter information element will not be supported by B-ISUP Release 1, i.e. some networks will not transfer the Quality of Service parameter information element. These networks will generate the default value (unspecified QOS class) for the Quality of Service parameter information element for the transfer to the called user at the terminating interface.

The Quality of Service parameter information element is coded as shown in Figure 4-24 and Table 4-18. The length of this information element is 6 octets.

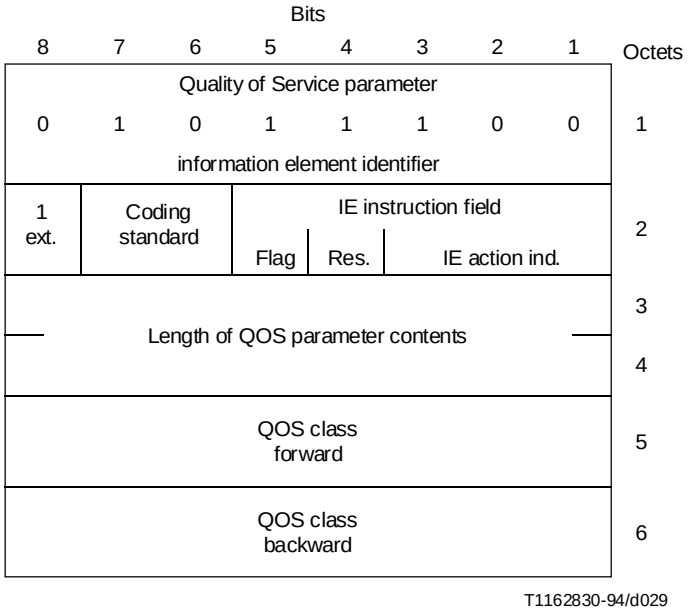


FIGURE 4-24/Q.2931

Quality of Service parameter information element

TABLE 4-18/Q.2931

Quality of service parameter information element

– QOS class forward (octet 5)								
Bits								
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	unspecified QOS class (Note 1)
1	1	1	1	1	1	1	1	reserved for future indications of parameterized QOS (Note 2)
All other values are reserved.								
– QOS class backward (octet 6)								
Bits								
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	unspecified QOS class (Note 1)
1	1	1	1	1	1	1	1	reserved for future indications of parameterized QOS (Note 2)
All other values are reserved.								

NOTES

1 If this class is indicated, the network does not guarantee any specific Quality of Service.

2 This codepoint is reserved for use when individual QOS parameters are defined. The individual parameters would then be contained in octets 7 and higher.

4.5.19 Broadband repeat indicator

The purpose of the broadband repeat indicator information element is to indicate how repeated information elements shall be interpreted, when included in a message. The broadband repeat indicator information element is included before the first occurrence of the information element which will be repeated in a message. The broadband repeat indicator information element is coded as shown in Figure 4-25 and Table 4-19. The length of this information element is 5 octets.

NOTE – Use of the broadband repeat indicator information element in conjunction with an information element that occurs only once in a message shall not in itself constitute an error.

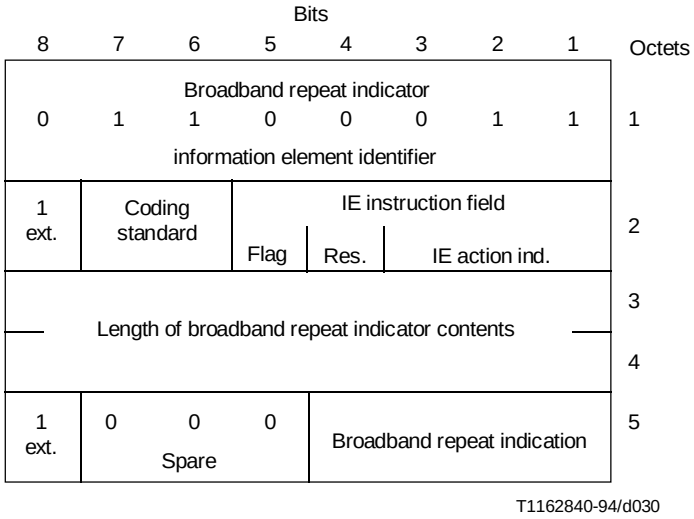


FIGURE 4-25/Q.2931

Broadband repeat indicator information element

TABLE 4-19/Q.2931

Broadband repeat indicator information element

– Broadband repeat indication (octet 5)				
Bits				
4	3	2	1	
0	0	0	0	reserved for use by Recommendation Q.2763 (B-ISUP)
0	0	0	1	reserved for use by Recommendation Q.2763 (B-ISUP)
0	0	1	0	prioritized list for selecting one possibility (descending order of priority)
All other values are reserved.				

4.5.20 Restart indicator

The purpose of the restart indicator information element is to identify the class of the facility to be restarted.

The restart indicator information element is coded as shown in Figure 4-26 and Table 4-20. The length of this information element is 5 octets.

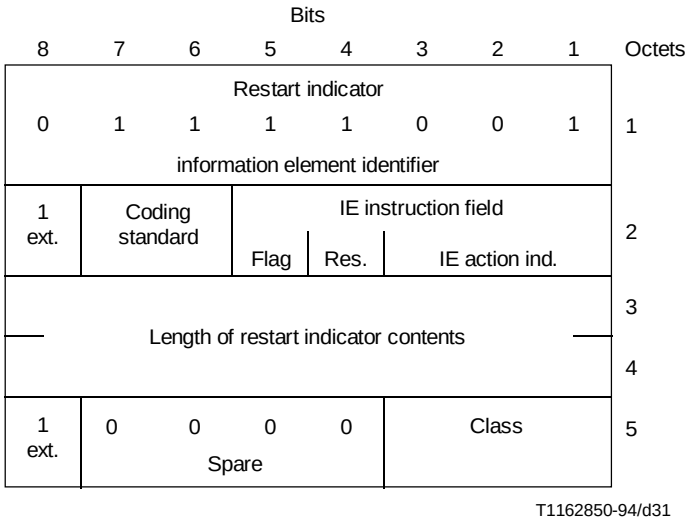


FIGURE 4-26/Q.2931

Restart indicator information element

TABLE 4-20/Q.2931

Restart indicator information element

– Class (octet 5)			
Bits			
3	2	1	
0	0	0	indicated virtual channel (Note 1)
0	0	1	all virtual channels in the indicated VPC which are controlled via the signalling virtual channel on which the RESTART message is sent (Note 2)
0	1	0	all virtual channels controlled by the layer 3 entity which sends the RESTART message (Note 3)
All other values are reserved.			

NOTES

1 The connection identifier information element shall be included and indicates the virtual channel to be restarted.

2 The connection identifier information element shall be included and indicates the Virtual Path Connection in which all virtual channels are to be restarted. The virtual channel identification field in the connection identifier information element is ignored.

3 The connection identifier information element is not included. All virtual channels controlled by the point-to-point signalling channel are to be restarted.

4.5.21 Broadband sending complete

The purpose of the broadband sending complete information element is to optionally indicate completion of called party number, see clauses 5 and 6.

This information element is mandatory if operating in *en bloc* mode; however, if missing, regular error handling procedures for "mandatory information element missing" need not be applied.

The broadband sending complete information element is coded as shown in Figure 4-27. The length of this information element is 5 octets.

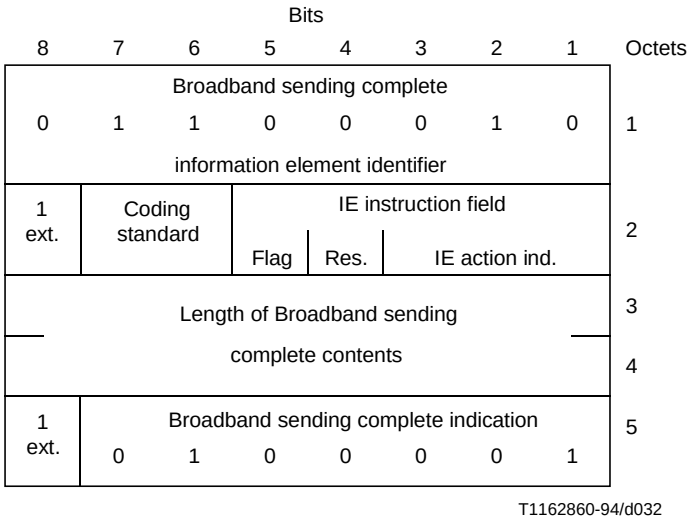


FIGURE 4-27/Q.2931

Broadband sending complete information element

4.5.22 Transit network selection

The purpose of the transit network selection information element is to identify one requested transit network. The transit network selection information element may be repeated in a message to select a sequence of transit networks through which a call must pass. See Annex D.

The transit network selection information element is coded as shown in Figure 4-28 and Table 4-21. The maximum length of this information element is network dependent.

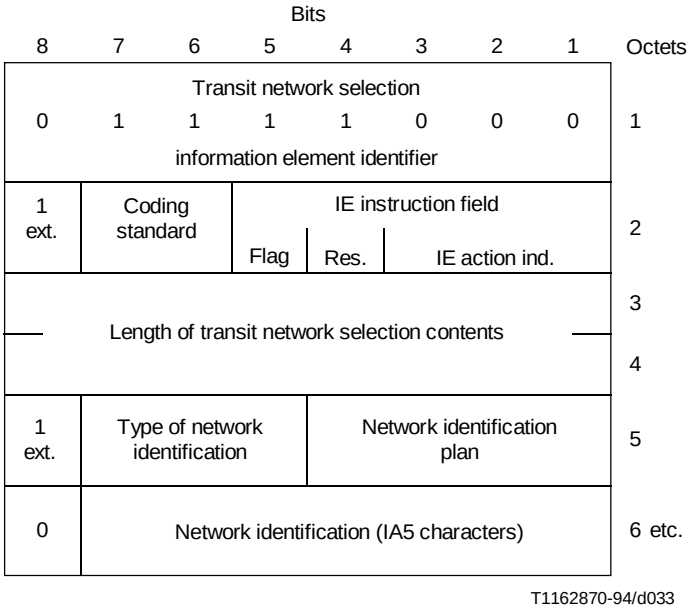


FIGURE 4-28/Q.2931

Transit network selection information element

TABLE 4-21/Q.2931

Transit network selection information element

– Type of network identification (octet 5)

Bits

7	6	5	
0	0	0	user-specified
0	1	0	national network identification (Note 1)
0	1	1	international network identification

All other values are reserved.

NOTE 1 – In the case that type of network identification is coded as 010, national network identification, "national identification plan" is coded according to national specification.

– Network identification plan (octet 5)

Bits

4	3	2	1	
0	0	0	0	unknown
0	0	0	1	carrier identification code (Note 2)
0	0	1	1	data network identification code (Recommendation X.121)

All other values are reserved.

NOTE 2 – Carrier identification codes may be an appropriate method of identifying the network serving the remote user.

– Network identification (octet 6)

These IA5 characters are organized according to the network identification plan specified in octet 5.

4.5.23 Notification indicator

The purpose of the notification indicator information element is to indicate information pertaining to a call. The notification indicator information element is coded as shown in Figure 4-29.

The maximum length of this information element is application dependent consistent with the maximum length of the message.

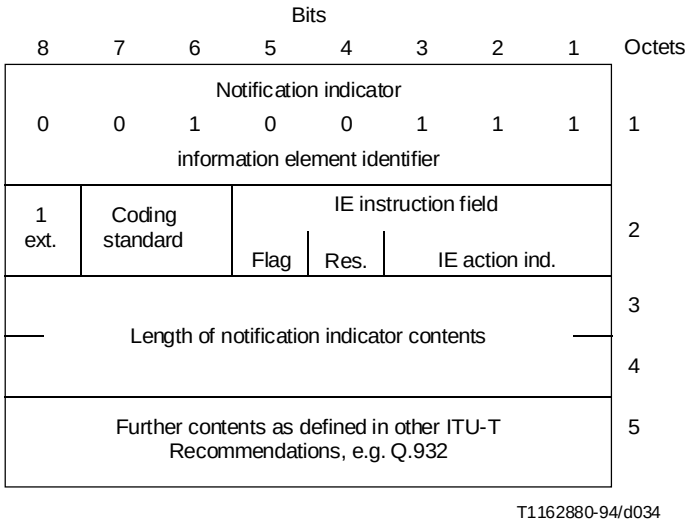


FIGURE 4-29/Q.2931

Notification indicator information element

4.5.24 OAM traffic descriptor

The purpose of the OAM traffic descriptor information element is to provide information relating to the end-to-end OAM F5 information flow for performance management and user-originated fault management associated with the user connection involved in the call.

The handling of the OAM traffic descriptor information element is specified in Annex I.

The length of this information element is 6 octets. The format of this information element is shown in Figure 4-30 and in Table 4-22.

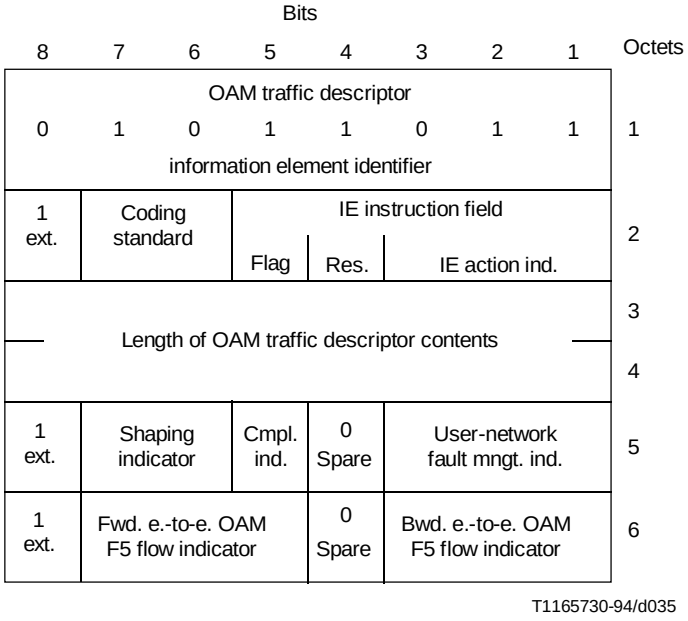


FIGURE 4-30/Q.2931

OAM traffic descriptor

TABLE 4-22/Q.2931

OAM traffic descriptor information element

– Shaping indicator (octet 5)

Bits

7	6	
0	0	no user specified requirement on shaping by the network, if shaping is applied by the network
0	1	aggregate shaping of user and OAM cells is not allowed, if shaping is applied by the network

All other values are reserved.

– Cmpl. ind. (Compliance Indicator) (octet 5)

Bit

5	
0	the use of end-to-end OAM F5 flow is optional
1	the use of end-to-end OAM F5 flow is mandatory

– User-network fault management indicator (octet 5)

Bits

3	2	1	
0	0	0	no user-originated fault management indications (Note 1)
0	0	1	use of user-originated fault management indications with a cell rate of 1 cell/s (Note 1)

All other values are reserved.

– Fwd. e-to-e. (Forward end-to-end) OAM F5 flow indicator (octet 6) (Note 1, Note 2)

Bits

7	6	5	
0	0	0	0% of the forward cell rate (CLP = 0 + 1) specified by the ATM traffic descriptor information element (forward direction)
0	0	1	0.1% of the forward cell rate (CLP = 0 + 1) specified by the ATM traffic descriptor information element (forward direction)
1	0	0	1% of the forward cell rate (CLP = 0 + 1) specified by the ATM traffic descriptor information element (forward direction)

All other values are reserved.

– Bwd. e-to-e. (Backward end-to-end) OAM F5 flow indicator (octet 6) (Note 1, Note 2)

Bits

3	2	1	
0	0	0	0% of the backward cell rate (CLP = 0 + 1) specified by the ATM traffic descriptor information element (backward direction)
0	0	1	0.1% of the backward cell rate (CLP = 0 + 1) specified by the ATM traffic descriptor information element (backward direction)
1	0	0	1% of the backward cell rate (CLP = 0 + 1) specified by the ATM traffic descriptor information element (backward direction)

All other values are reserved.

NOTES

1 Fault management indications originating in the network (e.g. alarm indications) will always be transferred to the user, independent of the codepoint used in the user-network fault management indicator field.

2 The cell rate allocated in both the forward and the backward direction is the sum of the following:

- the cell rate indicated in the user-network fault management indicator;
- the percentage of the forward cell rate indicated by the forward end-to-end OAM F5 flow indicator;
- the percentage of the backward cell rate indicated by the backward end-to-end OAM F5 flow indicator.

4.6 Information elements for the support of 64 kbit/s based ISDN circuit-mode services

4.6.1 Coding rules

The information elements described in 4.6 use the general information element format as described in Figure 4-8. The coding of these information elements follows the coding rules of this Recommendation and those of Recommendation Q.931.

4.6.2 Narrow-band bearer capability

The purpose of the narrow-band bearer capability information element is to indicate a requested circuit-mode N-ISDN bearer service to be provided by the network. It contains only information that may be used by the network (see Annex I/Q.931). The use of the narrow-band bearer capability information element in relation to compatibility checking is described in Annex B/Q.931.

The narrow-band bearer capability is transferred transparently through the B-ISDN.

The narrow-band bearer capability information element is coded as shown in Figure 4-31.

No default narrow-band bearer capability may be assumed by the absence of this information element.

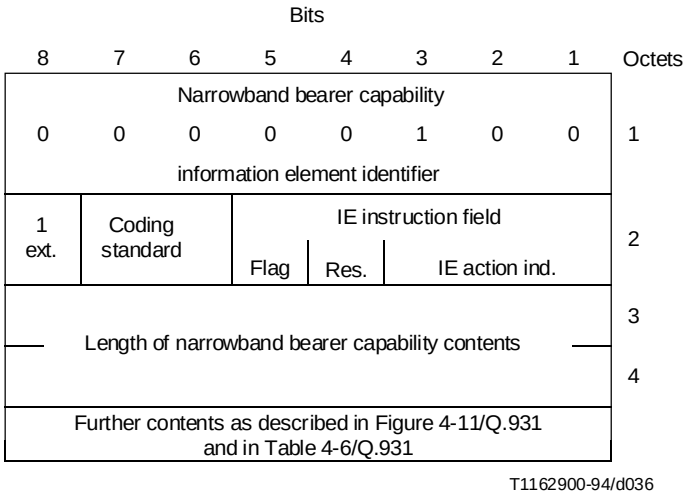


FIGURE 4-31/Q.2931

Narrowband bearer capability information element

4.6.3 Narrow-band high layer compatibility

The purpose of the narrow-band high layer compatibility information element is to provide a means which should be used by the remote user for compatibility checking. See Annex B/Q.931.

The narrow-band high layer compatibility information element is coded as shown in Figure 4-32.

The maximum length of this information element is 7 octets.

NOTE – The narrow-band high layer compatibility information element is transported transparently by a B-ISDN between a call originating entity, e.g. a calling user and the addressed entity; a remote user or a high layer function network node addressed by the call originating entity. However, if explicitly requested by the user (at subscription time), a network which provides some capabilities to realize teleservices may interpret this information to provide a particular service.

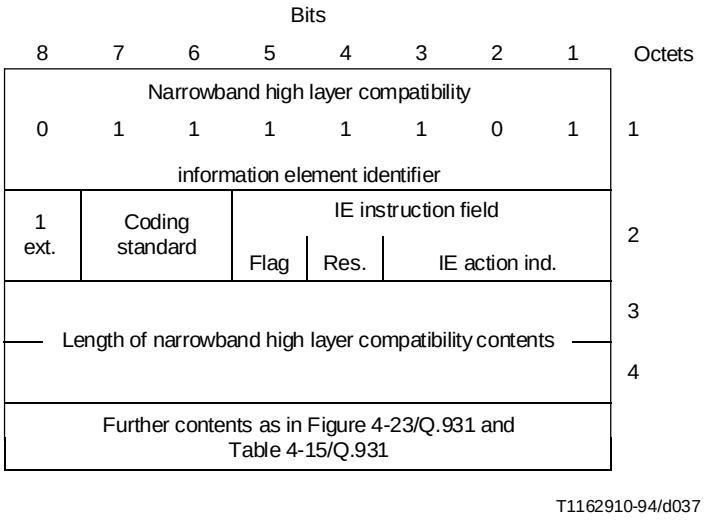


FIGURE 4-32/Q.2931

Narrowband high layer compatibility information element

4.6.4 Narrow-band low layer compatibility

The purpose of the narrow-band low layer compatibility information element is to provide a means which should be used for compatibility checking by an addressed entity (e.g. a remote user or an interworking unit or a high layer function network node addressed by the calling user). The low layer compatibility information element is transferred transparently by a B-ISDN between the call originating entity (e.g. the calling user) and the addressed entity.

For narrow-band low layer compatibility negotiation (see Annex J/Q.931), the narrow-band low layer compatibility information element is also passed transparently from the addressed entity to the originating entity.

The narrow-band low layer compatibility information element is coded as shown in Figure 4-33. The maximum length of this information element is 20 octets.

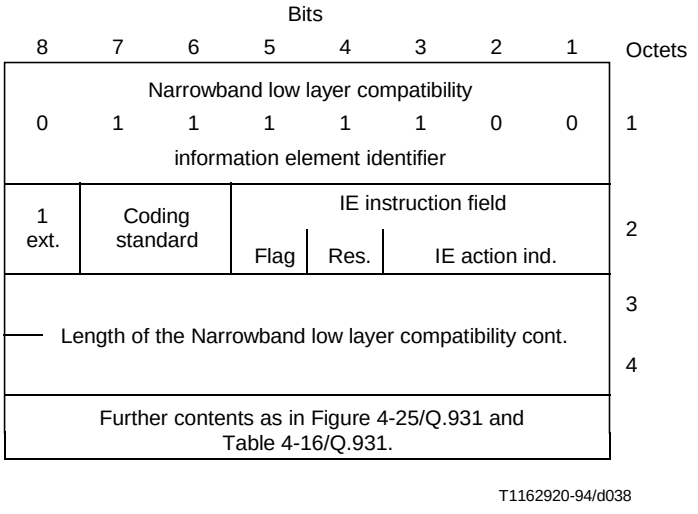


FIGURE 4-33/Q.2931

Narrowband low layer compatibility information element

4.6.5 Progress indicator

The purpose of the progress indicator information element is to describe an event which has occurred during the life of a call. The information element may occur twice in a message.

The progress indicator information element is coded as shown in Figure 4-34. The maximum length of this information element is 6 octets.

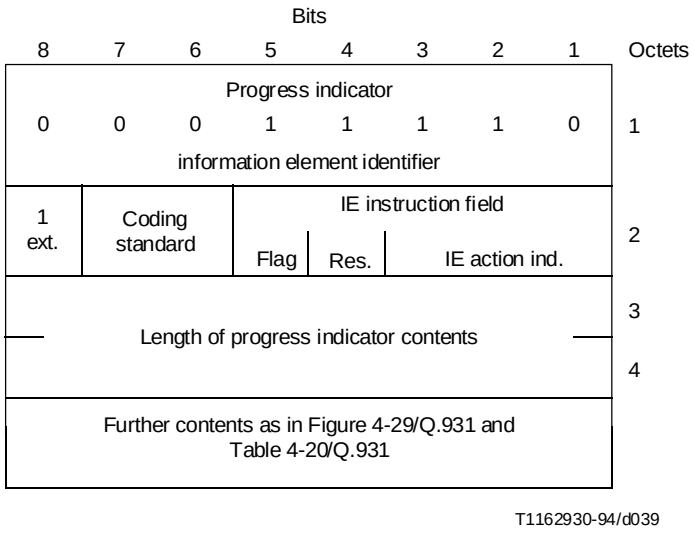


FIGURE 4-34/Q.2931

Progress indicator information element

5 B-ISDN call/connection control procedures

This clause describes the general procedures for call/connection control in B-ISDN. Clause 6 specifies the particular features required to provide 64 kbit/s based circuit-mode ISDN services in B-ISDN and to support access signalling interworking between B-ISDN and N-ISDN.

These procedures apply only to the point-to-point access configuration. For point-to-point access configurations, VCI = 5 is used as the signalling channel.

This Recommendation's procedures are used to establish B-ISDN connections over a signalling virtual channel that has already been established. Subsequent connections controlled by the same signalling virtual channel are distinguished through different call reference values.

For call/connection to be established, it must satisfy the following general criteria determined by the network and end systems:

- basic service support;
- VC availability;
- physical and virtual network resource availability to provide Quality of Service requested;
- end system resource availability to provide Quality of Service requested;
- end-to-end compatibility.

NOTE – Annex H contains extensions to the call/connection establishment procedures described in this clause for symmetrical operations.

PAS DE TABLE DE MATIÈRES (PAS DE HEADING 1) DANS CE FICHIER

The call states referred to in this clause cover the states perceived by the network, states perceived by the user and states which are common to both user and network. Unless specifically qualified, all states described in the following text should be understood as common.

Detailed Specification and Description Language (SDL) diagrams for the procedures specified in this clause are contained in Annex A. When there is an ambiguity in the narrative text, the SDL diagrams should be used to resolve the conflict. Where the text and the SDL are in disagreement, the text should be used as the prime source.

5.1 Call/connection establishment at the originating interface

Before these procedures are invoked, an assured mode Signalling AAL connection must be established between the user and the network. All layer 3 messages shall be sent to the Signalling AAL using a AAL-DATA-request primitive. The data link services described in Recommendation Q.2130 are assumed.

Establishment of Signalling AAL connections is initiated by transferring an AAL_ESTABLISH-request primitive to the Signalling AAL.

On receipt of an AAL_ESTABLISH-confirm or AAL_ESTABLISH-indication primitive from the SAAL, access signalling procedures may begin. The AAL_ESTABLISH-indication primitive will be received in the case of SAAL establishment request by the peer entity, and AAL_ESTABLISH-confirm in response to a local request to establish an SAAL connection.

5.1.1 Call/connection request

The calling party initiates call establishment by transferring a SETUP message on the assigned signalling virtual channel across the interface and starts timer T303. Following the transmission of the SETUP message, the call is considered by the calling party to be in the Call Initiated state. The message shall always contain a call reference, selected according to the procedures given in 4.3. In selecting a call reference, the dummy call reference value shall not be used. The ATM traffic descriptor, Broadband bearer capability, and QOS parameter information elements are mandatory in the SETUP message.

Furthermore, the SETUP message may also contain all or part of the call information (i.e. address) necessary for call establishment depending on whether *en bloc* or overlap procedures (see clause 6) are being used respectively.

If *en bloc* sending is used, the SETUP message shall contain all the information required by the network to process the call. In particular, the called party address information, if present, is contained in the Called party number information element possibly supplemented by the Called party sub-address information element. The Broadband sending complete information shall be included by the B-TEs.

If no response to the SETUP message is received by the user before the first expiry of timer T303, the SETUP message shall be retransmitted and timer T303 restarted. If the user has not received any response to the SETUP message after the final expiry of timer T303, the user shall clear the call internally.

5.1.2 Connection identifier (VPCI/VCI) allocation/selection – Origination

Two cases exist:

i) *associated signalling*

The layer 3 signalling entity exclusively controls the VCs in the VPC which carries its signalling VC.

ii) *non-associated signalling*

The layer 3 signalling entity controls the VCs in the VPC which carries its signalling VC and may control VCs in other VPCs.

The network and user shall support the non-associated signalling procedures and may as an option support the associated signalling procedures. The associated signalling procedures are used only by bilateral agreement between the user and the network.

When the network receives a connection identifier information element with the VP-associated signalling field (see Table 4-16) coded with a value not supported by the network, the call shall be rejected with cause No. 36, "VPCI/VCI assignment failure".

5.1.2.1 Associated signalling

For associated signalling, the user requests a VC in the VPC carrying the signalling VC. The VPC carrying the signalling VC is implicitly indicated.

In the Connection identifier information element, the VP-associated signalling field is coded as "VP-associated signalling" and one of the following values is indicated in the preferred/exclusive field:

a) "exclusive VPCI; any VCI"; or

b) "exclusive VPCI; exclusive VCI".

In case a), the network selects any available VCI within the VPC carrying the signalling VC.

In case b), if the indicated VCI within the VPC carrying the signalling VC is available, the network selects it for the call.

The selected VCI value is indicated in the Connection identifier information element in the first message returned by the network in response to the SETUP message (e.g. CALL PROCEEDING message). The VP-associated signalling field is coded as "VP-associated signalling". The preferred/exclusive field is coded as "exclusive VPCI; exclusive VCI".

In case a), if no VCI is available, a RELEASE COMPLETE message with cause No. 45, "no VPCI/VCI available", is sent by the network.

In case b), if the indicated VCI is not available, a RELEASE COMPLETE message with the cause No. 35, "requested VPCI/VCI not available", is sent by the network.

5.1.2.2 Non-associated signalling

In the user's request for a VC in the SETUP message, the user shall indicate one of the following:

a) "exclusive VPCI; any VCI";

b) "exclusive VPCI; exclusive VCI"; or

c) no indication is included (i.e. the Connection identifier information element is not included in the SETUP message).

In cases a) and b), the VP-associated signalling field is coded as "explicit indication of VPCI" in the Connection identifier information element.

In cases a) and b), if the indicated VPCI is available, the network selects it for the call. In case a), the network selects any available VCI in the VPCI. In case b), if the indicated VCI is available within the VPCI, the network selects it for the call.

In case c), the network selects any available VPCI and VCI.

The selected VPCI/VCI value is indicated in the Connection identifier information element in the first message returned by the network in response to the SETUP message (e.g. CALL PROCEEDING message). The VP-associated signalling field is coded as "explicit indication of VPCI". The preferred/exclusive field is coded as "exclusive VPCI; exclusive VCI".

In cases a) and b), if the specified VPCI is not available, a RELEASE COMPLETE message with cause No. 35, "requested VPCI/VCI not available", is sent by the network.

In case a), if no VCI is available, a RELEASE COMPLETE message with cause No. 45, "no VPCI/VCI available", is sent by the network.

In case b), if the VCI in the indicated VPCI is not available, a RELEASE COMPLETE message with cause No. 35, "requested VPCI/VCI not available", is sent by the network.

In case c), if the network is not able to allocate a VCI in any VPCI, a RELEASE COMPLETE message with cause No. 45, "no VPCI/VCI available", is sent by the network.

In case a), if the VPCI values in the first response message is not the VPCI value indicated by the user, a RELEASE message with cause No. 36, "VPCI/VCI assignment failure", shall be sent to the network.

In case b), if the VPCI and VCI values in the first response message are not the VPCI and VCI values indicated by the user, a RELEASE message with cause No. 36, “VPCI/VCI assignment failure”, shall be sent to the network.

5.1.2.3 Use of VPCI

The Connection identifier information element is used in signalling messages to identify the corresponding user information flow. The Connection identifier information element contains the Virtual Path Connection Identifier (VPCI) and the Virtual Channel Identifier (VCI). The VPCI is used instead of the Virtual Path Identifier (VPI) since virtual path cross connects may be used in the access and multiple interfaces could be controlled by the signalling virtual channel.

Both the user and the network must understand the relationship between the VPCI used in the signalling protocol and the actual VPI used for the user information flow. VPCIs only have significance with regard to a given signalling virtual channel.

If the signalling virtual channel only controls a single interface at the user side, the VPI and the VPCI have the same numerical value at the user side. Figure 5-1 below illustrates this.

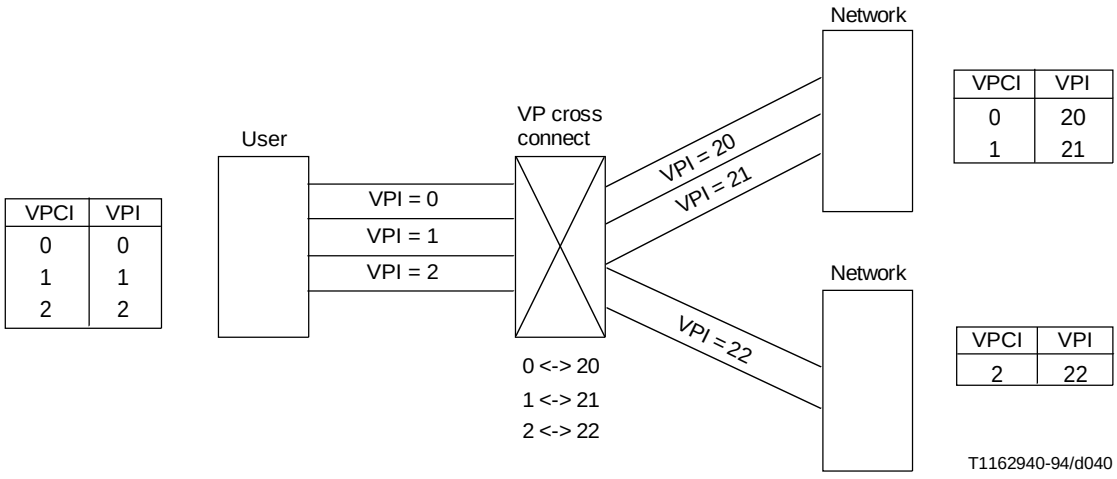


FIGURE 5-1/Q.2931

Single interface controlled by SVC

If the signalling channel controls multiple interfaces at the user side, the VPCI corresponds to both the interface and a VPI on the interface. See Figure 5-2.

5.1.2.4 VCI range

The range of valid VCI values is indicated below:

– 0 through 31 not used for on-demand user plane connections;

– 32 through 65 535 identifier of the virtual channel (Note).

NOTE – Some values in the range may not be available for use (e.g. some values may be used for permanent connections). The range of values available for use are determined at the subscription time.

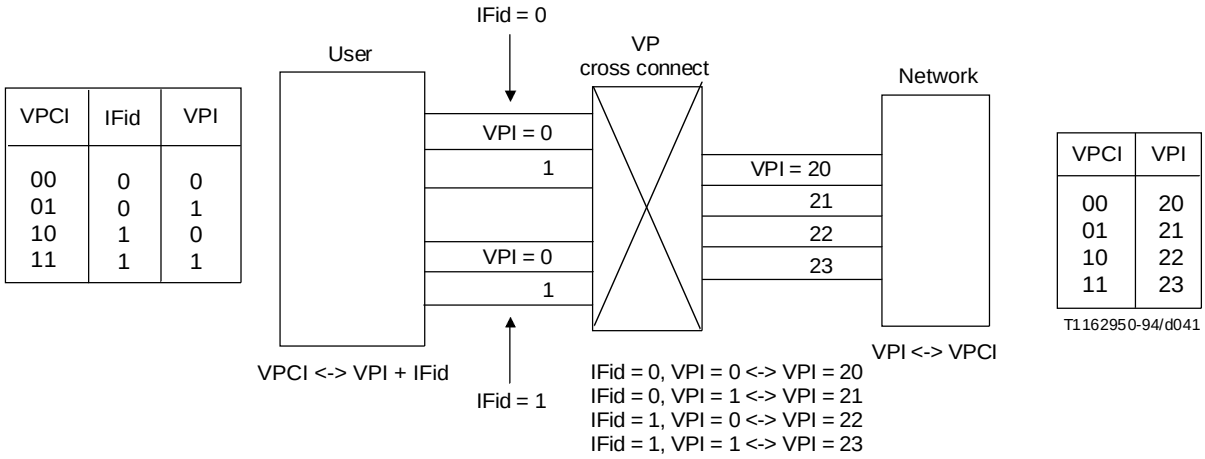


FIGURE 5-2/Q.2931

Multiple interfaces controlled by SVC

5.1.3 QOS and traffic parameters selection procedures

The user shall indicate the QOS class in the Quality of Service parameter information element.

If the network is able to provide the requested QOS class, the network shall progress the call to the called user. If the network is not able to provide the requested QOS class, the network shall reject the call, returning a RELEASE COMPLETE message with cause No. 49, "Quality of Service unavailable".

The user shall indicate the requested peak cell rate in the ATM user cell rate information element.

If the network is able to provide the requested peak cell rate, the network shall progress the call to the called user. If the network is not able to provide the requested peak cell rate, the network shall reject the call, returning a RELEASE COMPLETE message with cause No. 37, "user cell rate unavailable".

5.1.4 Invalid call/connection control information

If upon receiving the SETUP message, the network determines that the call information received from the user is invalid (e.g. invalid number), then the network shall initiate call clearing in accordance with 5.4 with a cause such as the following:

- No. 1 "unassigned (unallocated) number";
- No. 3 "no route to destination";
- No. 22 "number changed"; or
- No. 28 "invalid number format (address incomplete)".

5.1.5 Call/connection proceeding

If the network can determine that access to the requested service is authorized and available, the network shall send a CALL PROCEEDING message to the user to acknowledge the SETUP message and to indicate that the call is being processed and enter the Outgoing Call Proceeding state. When the user receives the CALL PROCEEDING message, the user shall stop timer T303, start timer T310, and enter the Outgoing Call Proceeding state.

If the network determines that a requested service is not authorized or is not available, the network shall initiate call clearing in accordance with 5.4 with one of the following causes:

- No. 57 "bearer capability not authorized";
- No. 58 "bearer capability not presently available";
- No. 63 "service or option not available, unspecified"; or
- No. 65 "bearer service not implemented".

If the user has received a CALL PROCEEDING message, but does not receive an ALERTING, CONNECT, or RELEASE message prior to the expiration of timer T310, then the user shall initiate clearing procedures towards the network with cause No. 102, "recovery on timer expiry".

5.1.6 Call/connection confirmation indication

Upon receiving an indication that user alerting has been initiated at the called address, the network shall send an ALERTING message across the user-network interface of the calling address and enter the Call Delivered state. When the user receives the ALERTING message, the user may begin an internally-generated alerting indication; shall stop timer T310 and shall enter the Call Delivered state.

5.1.7 Call/connection acceptance

Upon receiving an indication that the call has been accepted, the network shall send a CONNECT message across the user-network interface to the calling user and enter the Active state.

This message indicates to the calling user that a connection has been established through the network and stops a possible local indication of alerting.

On receipt of the CONNECT message, the calling user shall stop timer T310 (if running); stop any user-generated alerting indication; attach to the user plane virtual channel if not already done; send a CONNECT ACKNOWLEDGE message; and enter the Active state.

At this point, an end-to-end connection is established.

The network shall not take any action on receipt of a CONNECT ACKNOWLEDGE message when it perceives the call to be in the Active state.

5.1.8 Call/connection rejection

Upon receiving an indication that the network or the called user is unable to accept the call, the network shall initiate clearing at the originating user-network interface as described in 5.4, using the cause provided by the terminating network or the called user.

5.1.9 Transit network selection

When a Transit network selection information element is present, the call shall be processed according to Annex D. Some networks may not support transit network selection.

5.2 Call/connection establishment at the destination interface – Point-to-point access configuration call offering

Before these procedures are invoked, an assured mode Signalling AAL connection must be established between the user and the network. All layer 3 messages shall be sent to the Signalling AAL using an AAL-DATA-request primitive.

5.2.1 Incoming call/connection request

The network will indicate the arrival of a call at the user-network interface by transferring a SETUP message across the interface. The message shall always contain a call reference, selected according to the procedures given in 4.3. The network shall start timer T303 and enter the Call Present state. This message is sent by the network only if resources for the call are available; otherwise, the call is cleared towards the calling user with cause No. 47, "resources unavailable, unspecified".

If *en bloc* receiving is used, the SETUP message shall contain all the information required by the called user to process the call. In this case, the SETUP message may contain the Broadband sending complete information element.

Upon receipt of a SETUP message, the user shall enter the Call Present state.

If the SETUP message includes the Broadband sending complete information element, *en bloc* receiving procedure shall be followed. Therefore, those users who support overlap receiving procedure shall recognize the Broadband sending complete information element.

If timer T303 expires for the first time (i.e. no response is received by the network to the first SETUP message transmitted), the network shall retransmit the SETUP message and restart timer T303. If timer T303 expires for the second time (i.e. a response is also not received by the network to the second SETUP message transmitted), the network shall follow the procedures of 5.2.5.4.

5.2.2 Address and compatibility check

5.2.2.1 Address check

If an address check is not possible because address information is not included, the user shall perform compatibility checking.

The user shall evaluate called party addressing information received in the SETUP message and proceed as described in B.3.1.

5.2.2.2 Compatibility check

5.2.2.2.1 General principles

The user shall perform the compatibility check based on the compatibility information received in the SETUP message. In B-ISDN, there are two categories of compatibility information:

– Broadband category 1 compatibility information is provided for both the network and the user to determine the attributes of the ATM connection. The broadband category 1 compatibility information is:

  • broadband bearer capability information;

  • end-to-end transit delay information;

  • ATM traffic descriptor;

  • Quality of Service parameter; and

  • OAM traffic descriptor.

  Broadband category 1 compatibility information is always checked by the called user; if the compatibility check fails, the user is incompatible.

– Broadband category 2 compatibility information is provided for the called user. The broadband category 2 compatibility information is:

  • ATM adaptation layer parameter information (describing the user plane AAL);

  • optional broadband low layer information; and

  • optional broadband high layer information.

  Broadband category 2 compatibility information is always checked by the called user; if the compatibility check fails, the user is incompatible.

NOTE – In this subclause, the term "called user" is the endpoint entity which is explicitly addressed. This may be an addressed interworking unit (IWU).

5.2.2.2.2 Point-to-point call/connection offering

A user receiving a SETUP message shall perform compatibility checking before responding to that SETUP message. Any reference to "user" in 5.2.3 through 5.2.7 implicitly refers to a compatible user equipment. Annex B defines compatibility checking to be performed by users upon receiving a SETUP message.

An incompatible user shall respond with a RELEASE COMPLETE message with cause No. 88, "incompatible destination", and enter the Null state. The network shall process this RELEASE COMPLETE message in accordance with 5.2.5.3.

5.2.3 Connection identifier (VPCI/VCI) allocation/selection – Destination

Two cases exist:

1) *associated signalling*

   The layer 3 signalling entity exclusively controls the VCs in the VPC which carries its signalling VC.

2) *non-associated signalling*

   The layer 3 signalling entity controls the VCs in the VPC which carries its signalling VC and may control VCs in other VPCs.

The user shall support the non-associated signalling procedures and may as an option support the associated signalling procedures. A subscription option is necessary if the network supports both non-associated and associated signalling.

When the network receives a Connection identifier information element with the VP-associated signalling field (see Table 4-16) coded with a value not supported by the network, the call shall be rejected with cause No. 36, "VPCI/VCI assignment failure".

5.2.3.1 Associated signalling

For associated signalling, the network indicates a VC in the VPC carrying the signalling VC. The VPC carrying the signalling VC is implicitly indicated.

In the Connection identifier information element, the VP-associated signalling field is coded as "VP-associated signalling" in the Connection identifier information element and one of the following values is indicated in the preferred/exclusive field:

a) "exclusive VPCI; any VCI"; or

b) "exclusive VPCI; exclusive VCI".

In case a), the user selects any available VCI within the VPC carrying the signalling VC. The selected VCI value is indicated in the Connection identifier information element in the first message returned by the user in response to the SETUP message (e.g. CALL PROCEEDING message). The VP-associated signalling field is coded as "VP-associated signalling". The preferred/exclusive field is coded as "exclusive VPCI; exclusive VCI".

In case b), if the indicated VCI within the VPC carrying the signalling VC is available, the user selects it for the call. If the Connection identifier information element is not present in the first response message, the connection identifier in the SETUP message shall be assumed.

In case a), if no VCI is available, a RELEASE COMPLETE message with cause No. 45, "no VPCI/VCI available", is sent by the user.

In case b), if the indicated VCI is not available, a RELEASE COMPLETE message with the cause No. 35, "requested VPCI/VCI not available", is sent by the user.

5.2.3.2 Non-associated signalling

For non-associated signalling, the network shall indicate one of the following in the SETUP message:

a) "exclusive VPCI; any VCI";

b) "exclusive VPCI; exclusive VCI"; or

c) no indication is included (i.e. the Connection identifier information element is not included in the SETUP message).

In cases a) and b), if the indicated VPCI is available, the user selects it for the call. In case a), the user selects any available VCI in the VPCI. In case b), if the indicated VCI is available within the VPCI, the user selects it for the call. In case c), the user selects any available VPCI and VCI.

In cases a) and c), the selected VPCI/VCI value is indicated in the Connection identifier information element in the first message returned by the user in response to the SETUP message (e.g. CALL PROCEEDING message). The VP-associated signalling field is coded as "explicit indication of VPCI". The preferred/exclusive field is coded as "exclusive VPCI; exclusive VCI".

In case b), if the Connection identifier information element is not present in the first response message, the connection identifier in the SETUP message shall be assumed.

In cases a) and b), if the specified VPCI is not available, a RELEASE COMPLETE message with cause No. 35, "requested VPCI/VCI not available", is sent by the user.

In case a), if no VCI is available, a RELEASE COMPLETE message with cause No. 45, "no VPCI/VCI available", is sent by the user.

In case b), if the VCI in the indicated VPCI is not available, a RELEASE COMPLETE message with cause No. 35, "requested VPCI/VCI not available", is sent by the user.

In case c), if the user is not able to allocate a VCI in any VPCI, a RELEASE COMPLETE message with cause No. 45, "no VPCI/VCI available", is sent by the user.

In case a), if the VPCI value in the first response message is not the VPCI value indicated by the network, a RELEASE message with cause No. 36, "VPCI/VCI assignment failure", shall be sent to the user.

In case b), if the VPCI and VCI values in the first response message are not the VPCI and VCI values indicated by the network, a RELEASE message with cause No. 36, "VPCI/VCI assignment failure", shall be sent to the user.

5.2.4 QOS and traffic parameter selection procedures

The network shall indicate the QOS class in the Quality of Service parameter information element.

If the user is not able to provide the requested QOS class, the user shall reject the call, returning a RELEASE COMPLETE message with cause No. 49, "Quality of Service unavailable".

The cumulative end-to-end transit delay is indicated in the end-to-end transit delay information element. If the user is not able to accept the indicated end-to-end transit delay, the user shall reject the call, returning a RELEASE COMPLETE message with cause No. 49, "Quality of Service unavailable"

The network shall indicate the peak cell rate in the ATM traffic descriptor information element.

If the user is not able to provide the indicated peak cell rate, the user shall reject the call, returning a RELEASE COMPLETE message with cause No. 47, "resources unavailable, unspecified".

5.2.5 Call/connection confirmation

5.2.5.1 Response to *en bloc* SETUP or completion of overlap receiving

When the user determines that sufficient call set-up information has been received and compatibility requirements (see Annex B) have been satisfied, the user responds with either a CALL PROCEEDING, ALERTING, or CONNECT message (see Note), and enters the Incoming Call Proceeding, Call Received, or Connect Request state, respectively.

NOTE – The CALL PROCEEDING message may be sent by the user that cannot respond to a SETUP message with an ALERTING, CONNECT, or RELEASE COMPLETE message before expiry of timer T303.

An incompatible user shall respond by sending a RELEASE COMPLETE message with a cause value as specified in Annex B, and enter the Null state. The network processes this RELEASE COMPLETE message in accordance with 5.2.5.3.

A busy user that satisfies the compatibility requirements indicated in the SETUP message shall normally respond with a RELEASE COMPLETE message with a cause No. 17, "user busy". The network processes this RELEASE COMPLETE message in accordance with 5.2.5.3.

If the user wishes to refuse the call, a RELEASE COMPLETE message shall be sent with cause No. 21, "call rejected", and the user returns to the Null state. The network processes this RELEASE COMPLETE message in accordance with 5.2.5.3.

5.2.5.2 Receipt of CALL PROCEEDING and ALERTING

Upon receipt of the CALL PROCEEDING message from a user, the network shall stop timer T303; start timer T310; and enter the Incoming Call Proceeding state.

Upon receipt of the ALERTING message from a user, the network shall stop timers T303 or T310 (if running); start timer T301 (unless another internal alerting supervision timer function exists; e.g. incorporated in-call control); enter the Call Received state; and send a corresponding ALERTING message to the calling user.

5.2.5.3 Called user clearing during incoming call establishment

If a RELEASE COMPLETE or RELEASE message is received before a CONNECT message has been received, the network shall stop timer T303, timer T310 or timer T301 (if running); continue to clear the call to the called user as described in 5.4.3; and clear the call to the calling user with the cause received in the RELEASE COMPLETE or RELEASE message.

5.2.5.4 Call failure

If the network does not receive any response to the retransmitted SETUP message prior to the expiration of timer T303, then the network shall enter the Null state and initiate clearing procedures towards the calling user with cause No. 18, "no user responding".

If the network has received a CALL PROCEEDING message, but does not receive an ALERTING, CONNECT, or RELEASE message prior to the expiration of timer T310, then the network shall initiate clearing procedures towards the calling user with cause No. 18, "no user responding", and initiate clearing procedures towards the called user with cause No. 102, "recovery on timer expiry".

If the network has received an ALERTING message, but does not receive a CONNECT or RELEASE message prior to the expiration of timer T301 (or a corresponding internal alerting supervision timing function), then the network shall initiate clearing procedures towards the calling user with cause No. 19, "no answer from user (user alerted)", and initiate clearing procedures towards the called user with cause No. 102, "recovery on timer expiry".

5.2.6 Call/connection acceptance

A user indicates acceptance of an incoming call by sending a CONNECT message to the network. Upon sending the CONNECT message, the user shall start timer T313 and enter the Connect Request state. If an ALERTING message had previously been sent to the network, the CONNECT message may contain only the call reference.

If a call can be accepted, and no user alerting is required, a CONNECT message may be sent without a previous ALERTING message.

5.2.7 Active indication

On receipt of the CONNECT message, the network shall stop (if running) timers T301, T303 and T310; enter the Connect Request state; send a CONNECT ACKNOWLEDGE message to the user; initiate procedures to send a CONNECT message towards the calling user; and enter the Active state.

The CONNECT ACKNOWLEDGE message indicates completion of the connection establishment procedures. There is no guarantee of an end-to-end connection until a CONNECT message is received at the calling user. Upon receipt of the CONNECT ACKNOWLEDGE message, the called user shall stop timer T313; attach to the user plane virtual channel; and enter the Active state.

When timer T313 expires prior to receipt of a CONNECT ACKNOWLEDGE message, the called user shall initiate clearing with cause No. 102, "recovery on timer expiry", in accordance with 5.4.3.

5.3 Call/connection establishment at the destination – Point-to-multipoint access arrangement call offering

This capability is outside the scope of this Recommendation.

5.4 Call/connection clearing

5.4.1 Terminology

The following terms are used in this Recommendation in the description of clearing procedures:

- a VC channel is connected when the VC is part of a B-ISDN virtual connection established according to this Recommendation;
- a VC is disconnected when the VC is no longer part of a B-ISDN virtual connection, but is not yet available for use in a new virtual connection;
- a VC is released when the VC is not part of a B-ISDN virtual connection and is available for use in a new virtual connection. Similarly, a call reference that is released is available for re-use.

5.4.2 Exception conditions

Under normal conditions, call clearing is usually initiated when the user or the network sends a RELEASE message and follows the procedures defined in 5.4.3 and 5.4.4 respectively. The only exception to the above rule is in response to a SETUP message, the user or network can reject a call/connection (e.g. because of the unavailability of a suitable virtual channel) by responding with a RELEASE COMPLETE message provided no other response has previously been sent; releasing the call reference; and entering the Null state.

5.4.3 Clearing initiated by the user

Apart from the exceptions identified in 5.4.2 and 5.6, the user shall initiate clearing by sending a RELEASE message; starting timer T308; disconnecting the virtual channel; and entering the Release Request state.

The network shall enter the Release Request state upon receipt of a RELEASE message. This message then prompts the network to disconnect the virtual channel, and to initiate procedures for clearing the network connection to the remote user. Once the virtual channel used for the call has been disconnected, the network shall send a RELEASE COMPLETE message to the user; release both the call reference and virtual channel (i.e. connection identifier); and enter the Null state.

NOTE – The RELEASE COMPLETE message has only local significance and does not imply an acknowledgement of clearing from the remote user.

On receipt of the RELEASE COMPLETE message, the user shall stop timer T308; release the virtual channel; release the call reference; and return to the Null state.

If timer T308 expires for the first time, the user shall retransmit a RELEASE message to the network with the cause number originally contained in the first RELEASE message; restart timer T308 and remain in the Release Request state. In addition, the user may indicate a second Cause information element with cause No. 102, "recovery on timer expiry". If no RELEASE COMPLETE message is received from the network before timer T308 expires a second time, the user shall place the virtual channel in a maintenance condition; release the call reference; and return to the Null state. Equipment shall perform implementation dependent recovery, such as initiating restart procedures.

When user initiates normal call/connection clearing, cause No. 16, "normal clearing" is used in the first clearing message.

5.4.4 Clearing initiated by the network

Apart from the exception conditions identified in 5.4.2 and 5.6, the network shall initiate clearing by sending a RELEASE message; starting T308; disconnecting the virtual channel; and entering the Release Indication state.

The user shall enter the Release Indication state upon receipt of a RELEASE message. Once the virtual channel used for the call has been disconnected, the user shall send a RELEASE COMPLETE message to the network; release both its call reference and the virtual channel; and return to the Null state.

On receipt of the RELEASE COMPLETE message, the network shall stop timer T308; release both the virtual channel and call reference; and return to the Null state.

If timer T308 expires for the first time, the network shall retransmit the RELEASE message to the user with the cause number originally contained in the first RELEASE message; start timer T308; and remain in the Release Indication state. In addition, the network may indicate a second Cause information element with cause No. 102, "recovery on timer expiry". If no RELEASE COMPLETE message is received from the user before timer T308 expires a second time, the network shall place the virtual channel in a maintenance condition; release the call reference; and return to the Null state. Equipment shall perform implementation dependent recovery, such as initiating restart procedures.

5.4.5 Clear collision

Clear collision can occur when both sides simultaneously transfer RELEASE messages related to the same call reference value. If the user receives a RELEASE message while in the Release Request state, the user shall stop timer T308; release the call reference and virtual channel; and enter the Null state (without sending or receiving a RELEASE COMPLETE message). If the network receives a RELEASE message while in the RELEASE Indication state, the network shall stop timer T308, release the call reference and virtual channel; and enter the Null state (without sending or receiving a RELEASE COMPLETE message).

5.5 Restart procedure

When a point-to-point configuration exists, then the user and the network shall implement these procedures.

The restart procedure is used to return a virtual channel, all virtual channels in a virtual path, or all virtual channels controlled by the signalling virtual channel to the idle condition. The procedure is usually invoked when the other side of the interface does not respond to other call control messages or a failure has occurred (e.g. following the expiry of

timer T308 due to the absence of response to a clearing message). It may also be initiated as a result of local failure, maintenance action or mis-operation.

NOTE – The call reference flag of the global call reference applies to restart procedures. In the case when both sides of the interface initiate simultaneous restart requests, they shall be handled independently. In the case when the same user plane virtual channel(s) are specified, they shall not be considered free for re-use until all the relevant restart procedures are completed. In the RESTART message, the call reference flag of the global call reference is set to "0", in the RESTART ACKNOWLEDGE message sent in response to a RESTART message, the call reference flag of the global call reference is set to "1".

The STATUS message shall use the global call reference, if it is sent in response to the receipt of a message with the global call reference. The call reference flag in this STATUS message shall be coded to "0" if the call reference flag in the received message was set to "1" and shall be coded to "1" if the call reference flag in the received message was set to "0".

5.5.1 Sending RESTART

5.5.1.1 Normal procedure

A RESTART message is sent by the network or user equipment in order to return virtual channels to the idle condition. The Restart indicator information element shall be present in the RESTART message to indicate whether an "indicated virtual channel", "all user plane virtual channels in the indicated VPC controlled via signalling virtual channel in which the RESTART message is sent", or "all virtual channels controlled by the layer 3 entity" are to be restarted. If the Restart indicator information element is coded as "indicated virtual channel" or "all user plane virtual channels in the indicated VPC controlled via signalling virtual channel in which the RESTART message is sent", then the Connection identifier information element shall be present to indicate which virtual channel or virtual path is to be returned to the idle condition. If the Restart indicator information element is coded as "all virtual channels controlled by layer 3 entity which sends the RESTART message", then the Connection identifier information element shall not be included.

Upon transmitting the RESTART message, the sender enters the Restart Request state, starts timer T316, and waits for a RESTART ACKNOWLEDGE message. Also, no further RESTART messages shall be sent until a RESTART ACKNOWLEDGE is received or timer T316 expires. Receipt of a RESTART ACKNOWLEDGE message stops timer T316 and indicates that the virtual channel(s) and associated resources [e.g. call reference value(s)] can be freed for re-use. The Null state shall be entered after the virtual channel and call reference value are released.

The RESTART and RESTART ACKNOWLEDGE message shall contain the global call reference value (all zeros) to which the Restart Request state is associated. These messages are transferred using the AAL-DATA-request primitive.

Calls associated with restart user plane virtual channels shall be cleared towards the remote parties using cause No. 41, "temporary failure".

5.5.1.2 Exceptional procedures

If a RESTART ACKNOWLEDGE message, is not received prior to the expiry of timer T316, one or more subsequent RESTART messages may be sent until a RESTART ACKNOWLEDGE message is returned. While timer T316 is running, the virtual channel(s) being restarted shall not be used to support new calls requested using the call set-up procedures. The number of consecutive unsuccessful restart attempts has a default limit of two. When this limit is reached, the originator of RESTART message shall make no further restart attempts and shall enter the Null state (REST 0). An indication will be provided to the appropriate maintenance entity. The virtual channel(s) is considered to be in an out-of-service condition until maintenance action has been taken.

If a RESTART ACKNOWLEDGE message is received indicating a different set of virtual channels from the set indicated in the RESTART message, the RESTART ACKNOWLEDGE message shall be discarded.

5.5.2 Receipt of RESTART

5.5.2.1 Normal procedures

Upon receiving a RESTART message, the recipient shall enter the Restart state associated to the global call reference and start timer T317; it shall then initiate the appropriate internal actions to return the specified virtual channels to the idle condition and release all call references associated with the specified virtual channels. Upon completion of internal clearing, timer T317 shall be stopped and a RESTART ACKNOWLEDGE message transmitted to the originator, and the Null state (REST 0) entered. The RESTART ACKNOWLEDGE message shall indicate a Restart indicator information element containing the same information as received in the related RESTART message. In addition, the RESTART ACKNOWLEDGE message shall contain a Connection identifier information element containing the same information as received in the related RESTART message, if this is included.

Calls associated with restart user plane virtual channels shall be cleared towards the remote parties using cause No. 41, "temporary failure".

Even if all the specified virtual channels are in the idle condition or already in the process of restart to the idle condition, receiving entity shall transmit a RESTART ACKNOWLEDGE message to the originator upon receiving a RESTART message.

If the Restart indicator information element is coded as "all virtual channels controlled by the layer 3 entity which sends the RESTART message", then all calls on all interfaces associated with the signalling virtual channel shall be cleared.

If semi-permanent connections established by management procedures are implicitly specified (by specifying "all virtual channels that are controlled by the layer 3 entity which sends the RESTART message" or "all user plane virtual channels in the indicated VPC controlled via the signalling virtual channel in which the RESTART message is sent"), no action shall be taken on these virtual channels, but a RESTART ACKNOWLEDGE message shall be returned containing the appropriate indications (i.e. "all virtual channels controlled by the layer 3 entity which sends the RESTART message" or "all user plane virtual channels in the indicated VPC controlled via the signalling virtual channel in which the RESTART message is sent").

If semi-permanent connections established by management procedures or reserved VPCI/VCIs (e.g. the point-to-point signalling virtual channel) are explicitly specified (by including a Connection identifier information element in the RESTART message), no action shall be taken on these virtual channels and a STATUS message may as an option be returned with cause No. 82, "identified channel does not exist", optionally indicating in the diagnostic field the virtual channel or virtual path that could not be handled.

The following entities are released as a result of the Restart procedures:

- virtual channels established by this Recommendation's procedures;
- all resources associated with the released virtual channel (e.g. call reference value).

The following entities are not released as a result of the Restart procedures:

- permanent connections established by a network;
- management system reserved virtual channels (e.g. point-to-point signalling virtual channel).

5.5.2.2 Exceptional procedures

If timer T317 expires prior to completion of internal clearing, an indication shall be sent to the maintenance entity (i.e. a primitive shall be transmitted to the system management entity) and the Null state (REST 0) shall be entered.

If the Restart indicator information element is coded as "all virtual channels controlled by the layer 3 entity which sends the RESTART message" and a Connection identifier information element is included, the Connection identifier information element is treated as described in 5.6.8.3.

If the Restart indicator information element is coded as "indicated virtual channel" and the Connection identifier information element is not included, then the procedures in 5.6.7.1 shall be followed.

If the Restart indicator information element is coded as "indicated virtual channel" or "all user plane virtual channels in the indicated VPC controlled via the signalling virtual channel in which the RESTART message is sent" and the Connection identifier information element contains an unrecognized VPCI, then the procedures in 5.6.7.2 shall be followed.

If the RESTART message is received in the Restart state, then the procedures in 5.6.4 shall be followed.

5.6 Handling of error conditions

All messages which use the protocol discriminator Q.2931 user-network call control message must pass the checks described in 5.6.1 through 5.6.8.

Detailed error handling procedures are implementation dependent and may vary from network to network. However, capabilities facilitating the orderly treatment of error conditions are provided for in this subclause and shall be provided in each implementation.

Subclauses 5.6.1 through 5.6.8 are listed in order of precedence.

5.6.1 Protocol discrimination error

When a message is received with a protocol discriminator coded other than Q.2931 user-network call control message, that message shall be ignored. “Ignore” means to do nothing, as if the message had never been received.

5.6.2 Message too short

When a message is received that is too short to contain a complete Message length information element, that message shall be ignored.

5.6.3 Call reference error

5.6.3.1 Invalid call reference format

If the Call reference information element octet 1, bits 5 through 8 do not equal 0000, then the message shall be ignored.

If the Call reference information element octet 1, bits 1 through 4 indicate a length other than 3 octets (see 4.3), then the message shall be ignored.

5.6.3.2 Call reference procedural errors

a) Whenever any message except SETUP, RELEASE COMPLETE, STATUS ENQUIRY, or STATUS, is received specifying a call reference which is not recognized as relating to an active call or to a call in progress, the receiver shall initiate clearing by sending a RELEASE COMPLETE message with cause No. 81,“invalid call reference value”, specifying the call reference in the received message and shall remain in the Null state.

b) When a RELEASE COMPLETE message is received specifying a call reference which is not recognized as relating to an active call or to a call in progress, no action should be taken.

c) When a SETUP message is received specifying a call reference which is not recognized as relating to an active call or to a call in progress, and with a call reference flag incorrectly set to “1”, this message shall be ignored.

d) When a SETUP message is received specifying a call reference which is recognized as relating to an active call or to a call in progress, this SETUP message shall be ignored.

e) When any message except RESTART, RESTART ACKNOWLEDGE, or STATUS is received using the global call reference, no action should be taken on this message and a STATUS message using the global call reference with a call state indicating the current state associated with the global call reference and cause No. 81, “invalid call reference”, shall be returned.

f) When a STATUS message is received specifying a call reference which is not recognized as relating to an active call or to a call in progress, the procedures of 5.6.12 shall apply.

g) When a STATUS ENQUIRY message is received specifying a call reference which is not recognized as relating to an active call or to a call in progress, the procedures of 5.6.11 shall apply.

h) When a RESTART message is received specifying the global call reference with a call reference flag incorrectly set to “1” or a RESTART ACKNOWLEDGE message is received specifying the global call reference with a call reference flag incorrectly set to “0”, no action should be taken on this message and a STATUS message with a call state indicating the current state associated with the global call reference and cause No. 81, “invalid call reference”, shall be returned.

5.6.4 Message type or message sequence errors

The error procedures in this subclause apply only if the flag in the message compatibility instruction indicator is set to "message instruction field not significant". If it is set to "follow explicit instructions", the procedures in 5.7 take precedence.

Whenever an unexpected message, except RELEASE, RELEASE COMPLETE, or an unrecognized message is received in any state other than the Null state, no state change shall occur and a STATUS message shall be returned with one of the following causes:

a) No. 97 message type non-existent or not implemented; or

b) No. 101 message not compatible with call state.

However, two exceptions to this procedure exist. The first exception is when the network or the user receives an unexpected RELEASE message in response to a SETUP message. In this case no STATUS or STATUS ENQUIRY message is sent. Whenever the network receives an unexpected RELEASE message, the network shall release the virtual channel; clear the network connection and the call to the remote user with the cause in the RELEASE message sent by the user or, if not included, cause No. 31, "normal, unspecified"; return a RELEASE COMPLETE message to the user; release the call reference; stop all timers; and enter the Null state. Whenever the user receives an unexpected RELEASE message, the user shall release the virtual channel; return a RELEASE COMPLETE message to the network; release the call reference; stop all timers; and enter the Null state.

The second exception is when the network or the user receives an unexpected RELEASE COMPLETE message. Whenever the network receives an unexpected RELEASE COMPLETE message, the network shall disconnect and release the virtual channel; clear the network connection and the call to the remote user with the cause indicated by the user or, if not included, cause No. 111, "protocol error, unspecified"; release the call reference; stop all timers; and enter the Null state. Whenever the user receives an unexpected RELEASE COMPLETE message, the user shall disconnect and release the virtual channel; release the call reference; stop all timers; and enter the Null state.

5.6.5 Message length error

If the message length indicated in the Message length information element is inconsistent with the length of the message actually received, the message shall be handled normally as far as possible and, if necessary, the error handling procedures of 5.6.6 shall be followed.

5.6.6 General information element errors

The general information element error procedures may also apply to information elements in codesets other than 0. In that case, the diagnostics in the Cause information element may indicate information elements other than those in codeset 0 by applying the locking or non-locking shift procedures as described in 4.5.

5.6.6.1 Information element sequence

Variable length information elements may appear in any order within a message except for cases described in 4.5.1. If more than one information element of the same type is included in a message, and the repeated information elements do not immediately follow the preceding occurrence of this information element type (see 4.5.1), the receiving entity shall ignore subsequent information element of this type.

5.6.6.2 Duplicated information elements

If an information element is repeated in a message in which repetition of the information element is not permitted, only the contents of the information element appearing first shall be handled and where all subsequent repetitions of the information element shall be ignored. When repetition of information elements is permitted, and when the limit on repetition of information elements is exceeded, the contents of information elements appearing first up to the limit of repetitions shall be handled and all subsequent repetitions of the information element shall be ignored.

5.6.6.3 Coding standard error

If the user or the network receives an information element with the coding standard field indicating a coding standard that is not supported by the receiver, this information element shall be treated as an information element with a content error. Depending on the information element, the procedures as described in 5.6.7.2 or 5.6.8.2 shall be followed.

5.6.7 Mandatory information element error

5.6.7.1 Mandatory information element missing

When a message other than SETUP, RELEASE, or RELEASE COMPLETE is received which has one or more mandatory information elements missing, no action shall be taken on the message and no state change should occur. A STATUS message is then returned with cause No. 96, "mandatory information element is missing".

When a SETUP message is received which has one or more mandatory information elements missing, a RELEASE COMPLETE message with cause No. 96, "mandatory information element is missing", shall be returned.

When a RELEASE message is received with the Cause information element missing, the actions taken shall be the same as if a RELEASE message with cause No. 31, "normal, unspecified", was received (see 5.4), with the exception that the RELEASE COMPLETE message sent on the local interface contains cause No. 96, "mandatory information element is missing".

When a RELEASE COMPLETE message is received with a Cause information element missing, it will be assumed that a RELEASE COMPLETE message was received with cause No. 31, "normal, unspecified".

5.6.7.2 Mandatory information element content error

The error procedures in this subclause apply only if the flag (bit 5) in the instruction field is set to "IE instruction field not significant". If it is set to "follow explicit instruction", the procedures in 5.7 take precedence.

When a message other than SETUP, RELEASE, or RELEASE COMPLETE is received which has one or more mandatory information elements with invalid content, no action shall be taken on the message and no state change shall occur. A STATUS message is then returned with cause No. 100, "invalid information element contents".

When a SETUP message is received which has one or more mandatory information elements with invalid content, a RELEASE COMPLETE message with cause No. 100, "invalid information element contents", shall be returned.

When a RELEASE message is received with invalid content of the Cause information element, the actions taken shall be the same as if a RELEASE message with cause No. 31, "normal, unspecified", was received (see 5.4), with the exception that the RELEASE COMPLETE message sent on the local interface contains cause No. 100, "invalid information element contents".

When a RELEASE COMPLETE message is received with invalid content of the Cause information element, it will be assumed that a RELEASE COMPLETE message was received with cause No. 31, "normal, unspecified".

Information elements with a length exceeding the maximum length (given in clause 3) will be treated as information element with content error.

NOTE – As an option of user equipment (e.g. B-NT2), cause values, location codes, and diagnostics which are not understood by the B-NT2 may be passed on to another entity (e.g. user or B-NT2) instead of treating the cause value as if it were cause No. 31, "normal, unspecified", and sending cause No. 100, "invalid information element contents", with the RELEASE COMPLETE message. This option is intended to aid user equipment to be compatible to future additions of cause values, location codes and diagnostics to the Recommendation.

5.6.8 Non-mandatory information element errors

The error procedures in this subclause apply only if the flag (bit 5) in the instruction field is set to "IE instruction field not significant". If it is set to "follow explicit instruction", the procedures in 5.7 take precedence.

The following subclauses identify actions on information elements not recognized as mandatory.

5.6.8.1 Unrecognized information element

When a message is received that has one or more unrecognized information elements, then the receiving entity shall proceed as follows.

Action shall be taken on the message and those information elements which are recognized and have valid content. When the received message is other than RELEASE or RELEASE COMPLETE, a STATUS message may be returned containing one Cause information element. The STATUS message indicates the call state of the receiver after taking action on the message. The Cause information element shall contain cause No. 99, "information element non-existent or

not implemented", and the diagnostic field, if present, shall contain the information element identifier for each information element which was unrecognized. Subsequent actions are determined by the sender of the unrecognized information elements.

If a clearing message contains one or more unrecognized information elements, the error is reported to the local user in the following manner:

a) when a RELEASE message is received which has one or more unrecognized information elements, a RELEASE COMPLETE message with cause No. 99, "information element non-existent or not implemented", shall be returned. The Cause information element diagnostic field, if present, shall contain the information element identifier for each information element which was unrecognized;

b) when a RELEASE COMPLETE message is received which has one or more unrecognized information elements, no action shall be taken on the unrecognized information.

NOTE – The diagnostic(s) of cause No. 99 facilitates the decision in selecting an appropriate recovery procedure at the reception of a STATUS message. Therefore, it is recommended to provide cause No. 99 with diagnostic(s) if a layer 3 entity expects the peer to take an appropriate action at the receipt of a STATUS message, although inclusion of diagnostic(s) is optional.

5.6.8.2 Non-mandatory information element content error

When a message is received which has one or more non-mandatory information elements with invalid content, action shall be taken on the message and those information elements which are recognized and have valid content. A STATUS message may be returned containing one Cause information element. The STATUS message indicates the call state of the receiver after taking action on the message. The Cause information element shall contain cause No. 100, "invalid information element contents", and the diagnostic field, if present, shall contain the information element identifier for each information element which has invalid contents.

Information elements with a length exceeding the maximum length (given in clause 3) will be treated as an information element with content error. But for access information elements (see Annex J), cause No. 43, "access information discarded" is used instead of cause No. 100, "invalid information element contents".

5.6.8.3 Unexpected recognized information element

When a message is received with a recognized information element that is not defined to be contained in that message, the receiving entity shall (except as noted below) treat the information element as an unrecognized information element and follow the procedures defined in 5.6.8.1.

NOTE – Some implementations may choose to process unexpected recognized information elements when the procedure for processing the information element is independent of the message in which it is received.

5.6.9 Signalling AAL connection reset

Whenever a Q.2931 entity is informed of a spontaneous Signalling AAL reset by means of the AAL-ESTABLISH-indication primitive, the following procedures apply:

a) for calls in the clearing phase (states N11, N12, U11 and U12), no action shall be taken;

b) for calls in the establishment phase (states N1, N3, N4, N6, N7, N8, N9, U1, U3, U4, U6, U7, U8 and U9) shall be maintained. Optionally, the status enquiry procedure may be invoked;

c) calls in the Active state shall be maintained, and the entity shall invoke the status enquiry procedures described in 5.6.11.

5.6.10 Signalling AAL connection release

Whenever a Q.2931 entity is notified by its Signalling AAL connection release by means of the AAL-RELEASE-indication primitive, the following procedure shall apply:

a) any calls not in the Active state shall be cleared locally;

b) if there is at least one call in the Active state controlled by the released Signalling AAL connection, then timer T309 shall be started. If timer T309 is already running, it shall not be restarted.

The Q.2931 entity shall request Signalling AAL re-establishment by sending an AAL-ESTABLISH-request primitive.

When informed of Signalling AAL re-establishment by means of the AAL-ESTABLISH-confirm primitive, the following procedure shall apply:

- stop timer T309; and
- perform the status enquiry procedure according to 5.6.11 to verify the call state of the peer entity per each call/connection.

If timer T309 expires prior to Signalling AAL re-establishment, the network shall clear the network connection and call to the remote user with cause No. 27, "destination out of order"; disconnect and release the bearer virtual channel; release the call reference; and enter the Null state.

If timer T309 expires prior to Signalling AAL re-establishment, the user shall disconnect and release the virtual channel; release the call reference; and enter the Null state. The user may clear the attached internal connection (if any) with cause No. 27, "destination out of order".

5.6.11 Status enquiry procedure

To check the correctness of a call state at a peer entity, a STATUS ENQUIRY message may be sent requesting the call state. This may, in particular, apply to procedural error conditions described in 5.6.9 and 5.6.10.

In addition, whenever indication is received from the Signalling AAL that a disruption has occurred at the data link layer, a STATUS ENQUIRY message shall be sent to check the correctness of the call state at the peer entity.

Upon sending the STATUS ENQUIRY message, timer T322 shall be started in anticipation of receiving a STATUS message. While timer T322 is running, only one outstanding request for call state information shall exist. Therefore, if timer T322 is already running, it shall not be restarted. If a clearing message is received before timer T322 expires, timer T322 shall be stopped and call clearing shall continue.

Upon receipt of a STATUS ENQUIRY message, the receiver shall respond with a STATUS message, reporting the current call state (the current state of an active call or a call in progress, or the Null state if the call reference does not relate to an active call or to a call in progress) and cause No. 30, "response to STATUS ENQUIRY" (see 5.6.4). Receipt of the STATUS ENQUIRY message does not result in a state change.

The sending or receipt of the STATUS message in such a situation will not directly affect the call state of either the sender or receiver. The side having received the STATUS message shall inspect the Cause information element. If a STATUS message is received that contains cause No. 30, "response to STATUS ENQUIRY", timer T322 shall be stopped and the appropriate action taken, based on the information in that STATUS message, relative to the current state of the receiver.

If timer T322 expires, and no STATUS message was received, the STATUS ENQUIRY message may be retransmitted one or more times until a response is received. The number of times the STATUS ENQUIRY message is retransmitted is an implementation dependent value. If following the maximum number of retransmissions of the STATUS ENQUIRY message, no STATUS message is received before expiry of T322 for the last time, the call shall be cleared to the local interface with cause No. 41, "temporary failure". If appropriate, the network shall also clear the network connection, using cause No. 41, "temporary failure".

5.6.12 Receiving a STATUS message

On receipt of a STATUS message reporting an incompatible state, the receiving entity shall:

a) clear the call by sending the appropriate clearing message with cause No. 101, "message not compatible with call state"; or

b) take other actions which attempt to recover from a mismatch and which are an implementation option.

Except for the following rules, the determination of which states are incompatible is left as an implementation decision:

a) If a STATUS message indicating any call state except the Null state is received in the Null state, then the receiving entity shall send a RELEASE COMPLETE message with cause No. 101, "message not compatible with call sate"; and remain in the Null state.

b) If a STATUS message indicating any call state except the Null state is received in the Release Request or Release Indication state, no action shall be taken.

c) If a STATUS message indicating the Null state is received in any state except the Null state, the receiver shall release all resources and move into the Null state.

When in the Null state, the receiver of a STATUS message indicating the Null state shall take no action other than to discard the message and shall remain in the Null state.

A STATUS message may be received indicating a compatible call state but containing one of the following causes:

– No. 96 mandatory information element is missing;

– No. 97 message type non-existing or not implemented;

– No. 99 information element non-existent or not implemented;

– No. 100 invalid information element contents; or

– No. 101 message not compatible with call state.

In this case, the actions to be taken are an implementation option. If other procedures are not defined, the receiver shall clear the call with the appropriate procedure defined in 5.4, using the cause specified in the received STATUS message.

On receipt of a STATUS message specifying the global call reference and reporting an incompatible state in the Restart Request or Restart state, the receiving Q.2931 entity shall inform layer management and take no further action on this message.

When in the Null state, then on receipt of a STATUS message with the global call reference no action shall be taken.

NOTE – Further actions as a result of higher layer activity (e.g. system or layer management) are implementation dependent (including the retransmission of RESTART).

Except for the above case, the error handling procedures when receiving a STATUS message specifying the global call reference are an implementation option.

5.7 Error procedures with explicit action indication

The procedures of this subclause shall only be used if the flag of the message compatibility instruction indicator or information element instruction field is set to “follow explicit instructions”.

5.7.1 Unexpected or unrecognized message type

If an unexpected or unrecognized message type is received in any state other than the Null state, the following procedures are applicable.

If the action indicator bits of the instruction field of a Message type information element are set to “clear call” in any state other than the Release Request and Release Indication state, the call shall be cleared in accordance with procedures of 5.4.3 or 5.4.4, except that a Cause information element indicating cause No. 97, “message type non-existent or not implemented”, or cause No. 101, “message not compatible with call state”, shall be sent. When in the Release Request or in the Release Indication state, the receiver shall take no action and remain in the same state.

If the action indicator bits of the instruction field of a Message type information element are set to “discard and ignore”, the message shall be ignored.

If the action indicator bits of the instruction field of a Message type information element are set to “discard, and report status”, no action shall be taken on the message but a STATUS message shall be sent with a Cause information element indicating cause No. 97, “message type non-existent or not implemented” or cause No. 101, “message not compatible with call state”.

If the message action indicator bits are set to an undefined (reserved) value, the receiver shall handle the message as if the message action indicator bits had been set to “discard and report status”.

5.7.2 Information element errors

When a message other than a RELEASE or RELEASE COMPLETE message is received which has one or more unexpected information elements, unrecognized information elements or information elements with unrecognized contents, the receiving entity shall examine the information element action indicator, and follow the procedures described in a), b), c), d) or e) below as appropriate.

When a RELEASE message is received with one or more information elements in error, a RELEASE COMPLETE message with cause No. 99, "information element non-existent or not implemented" or with cause No. 100, "invalid information element contents", shall be returned.

When a RELEASE COMPLETE message is received with one or more information elements in error, no action shall be taken on the information elements in error. The message shall be processed as if received without the information elements in error.

If more than one information element is received in error, only one response shall be given. The response shall be according to the handling of the action indicator field according to the following order of priority: "clear call" (highest priority), "discard message and report status", "discard message, and ignore", "discard information element, proceed, and report status", "discard information element and proceed".

a) Action indicator field = clear call

   If the action indicator field is equal to "clear call", the call shall be cleared according to the procedures defined in 5.4 except that the Cause information element shall contain cause No. 99, "information element non-existent or not implemented" or cause No. 100, "invalid information element contents".

b) If the action indicator field = discard message and report status

   The message shall be ignored and a STATUS message shall be sent with a cause No. 99 "information element non-existent or not implemented" or cause No. 100 "invalid information element contents".

c) If the action indicator field = "discard message"

   The message shall be ignored.

d) Action indicator field = discard information element, proceed and report status

   If the message contains sufficient information to proceed, the following shall apply:

   if the action indicator field specifies "discard information element, proceed and report status", the information element shall be discarded, the handling of the message shall proceed and a STATUS message shall be returned indicating the call state of the receiver after taking action on the message and containing cause No. 99, "information element non-existent or not implemented" or cause No. 100, "invalid information element contents".

e) Action indicator field = discard information element and proceed

   If the action indicator field is equal to "discard information element and proceed", the information element shall be ignored and the message shall be processed as if the information element was not received. No STATUS message shall be sent.

f) Action indicator field = undefined (reserved) value

   The receiver shall handle the information element as if the action indicator field had been set to "discard information element, proceed, and report status".

5.8 Handling of messages with insufficient information

If insufficient information for the protocol entity to act upon a message is available, the procedures of 5.6.7.1 shall apply if the flag of the message compatibility instruction indicator is set to "message instruction field not significant" or the procedures of 5.7.1 shall apply if the flag of the message compatibility instruction indicator is set to "follow explicit instruction" with the difference that when a Cause information element is to be returned, it shall include cause No. 96 "mandatory information element is missing".

5.9 Notification procedures

The delivery of bearer-related notifications shall use an active call reference of the call/connection the notification is associated with. In this context, a call reference shall be active from the initiation of call establishment (i.e. the SETUP message) to the initiation of call clearing (i.e. the RELEASE message).

If the delivery of the notification coincides with call/connection establishment or clearing procedures, the notification information can be carried in the associated call control messages. In all other cases, the notification information shall be delivered in a NOTIFY message. In addition, a NOTIFY message may be sent or received by the user or by the network only after the first response to a SETUP message has been sent or received and before clearing of the call reference is initiated.

If a notification is received by the network, the network shall optionally ensure that the contents of the notification are a valid coding; and forward the notification to the other user involved in the call.

No call state change shall occur at either side of the interface following the sending or receipt of a NOTIFY message.

6 Procedures for the support of 64 kbit/s based circuit-mode lSDN services in B-ISDN and access signalling interworking between N-ISDN and B-ISDN

This clause specifies the particular features required to provide 64 kbit/s based circuit-mode ISDN services in B-ISDN and to support access signalling interworking between B-ISDN and N-ISDN. For the 64 kbit/s based circuit-mode ISDN services also the term “N-ISDN services” is used. This term includes the circuit-mode services described in the I.200-Series of Recommendations and supported by the DSS 1 signalling protocol. For these services interworking with N-ISDN is possible.

The description of service provision and interworking in this clause assumes the communication scenario B as defined in Annex A/I.580 [58].

6.1 Introduction

The procedures defined in this Recommendation are based on the principle that no difference is made between the provision of N-ISDN services in a pure B-ISDN environment and the provision of these services in the case of interworking with the N-ISDN.

In order to allow signalling interworking between B-ISDN and N-ISDN, separate service related information elements are defined for N-ISDN services and for B-ISDN services.

For the provision of N-ISDN services, basically the DSS 1 information elements Bearer capability, High layer compatibility and Low layer compatibility are defined in B-ISDN. In DSS 2 these information elements are designated as Narrow-band Bearer Capability (N-BC), Narrow-band Low Layer Compatibility (N-LLC) and Narrow-band High Layer Compatibility (N-HLC). For their application in B-ISDN, the DSS 1 information elements are modified according to the DSS 2 coding rules, i.e. octet 2 contains the information element instruction field with the Flag bit set to “0” (see also 6.3.2) and octets 3 and 4 indicate the length of contents. These information elements are specified in 4.6.

NOTE – The benefit of taking the DSS 1 service related information elements nearly unchanged in DSS 2 is that it significantly simplifies interworking between B-ISDN and N-ISDN (see 6.3 and 6.4). Another important benefit is that by dividing the service related attributes into N-ISDN and B-ISDN related parts, a decoupling of the DSS 2 specific information elements from the evolution of the DSS 1 based information elements is achieved.

The reason for taking the DSS 1 information elements even for the provision of N-ISDN services in a pure B-ISDN environment is that a B-ISDN user cannot know in advance whether the destination of a call will be a B-ISDN (DSS 2) or a N-ISDN (DSS 1) user.

Table 6-1 shows the information elements required for the provision of N-ISDN services in B-ISDN.

TABLE 6-1/Q.2931

Information elements in B-ISDN to provide N-ISDN services

	Information elements used to describe network relevant bearer attributes	Information elements used to describe lower layer attributes (transparent for B-ISDN)	Information elements used to describe high layer attributes
N-ISDN related information elements (see 4.6)	Narrow-band Bearer Capability (N-BC)	Narrow-band Low Layer Compatibility (N-LLC)	Narrow-band High Layer Compatibility (N-HLC)
B-ISDN related information elements (see 4.5)	– Broadband Bearer Capability (B-BC) – ATM traffic descriptor – QOS parameter – End-to-end transit delay (optional) – OAM traffic descriptor (optional)	– ATM adaptation layer parameters (AAL parameters)	–

Subclause 6.2 describes which N-ISDN service-related information elements are included in this Recommendation. Subclauses 6.3 and 6.4 specify the interworking functions between B-ISDN and N-ISDN. These subclauses specify the interworking between the DSS 2 and the DSS 1 protocol. Interworking functions within the public network (i.e. between N-ISUP and B-ISUP) are outside the scope of this Recommendation.

6.2 Information elements for N-ISDN services in B-ISDN

6.2.1 General aspects

When N-ISDN services are requested in a B-ISDN environment, in principle the information elements of this Recommendation (e.g. “Called party number”, see 4.5) are used in the same manner as for B-ISDN specific services. However, for the service-related attributes listed in Table 6-1, specific information elements (see upper line of Table 6-1) are re-used for compatibility checking as described in Annex B and for the provision of the N-ISDN services as described below.

The following subclauses (see 6.2.2 to 6.2.4) only describe the use of the service-related information elements in the SETUP message. However, in the case of service negotiation they may also be included in the first response message returned to the call initiating entity.

6.2.2 Bearer-service related information

The B-BC information element is always included in the SETUP message. This information element is mandatory for all services. It is interpreted by the B-ISDN. For N-ISDN services, the N-BC information element is also mandatory in the SETUP message. Unlike the B-BC information element, however, the N-BC information element is only interpreted when tones/announcements according to 6.7.1 have to be provided.

The N-BC information element is included in the SETUP message even if no interworking takes place, since the user is not able to know in advance whether the receiver of the SETUP message will be a B-ISDN (DSS 2) or a N-ISDN (DSS 1) user.

The ATM traffic descriptor information element is always included in the SETUP message.

For N-ISDN services, a value for the ATM user cell rate is selected such, that the bit rate of the N-ISDN service (64 kbit/s or n × 64 kbit/s) can be transported as the cell payload of the ATM cells, i.e. excluding the overhead of the ATM cell and the AAL header.

The Quality of Service parameter information element is always included in the SETUP message indicating the unspecified QOS class.

The end-to-end transit delay information element may be included in the SETUP message and coded according to 4.5.17.

The OAM traffic descriptor information element may be included in the SETUP message and coded according to 4.5.24.

6.2.3 Low layer related information

If required for the description of a particular N-ISDN service, the N-LLC information element is included in the SETUP message.

The B-LLI information element is only used for B-ISDN specific services.

The N-LLC and the B-LLI information elements shall be used according to the following rules:

1) The N-LLC information element is used to describe end-to-end attributes of N-ISDN circuit-mode services supported in B-ISDN. This information element shall not be used for B-ISDN specific services. In particular, this information element is used by:

   – a B-ISDN terminal emulating a N-ISDN service; and

   – between a TA (connecting a N-ISDN-TE to B-ISDN) and a B-ISDN network.

2) For B-ISDN specific services, the B-LLI information element is used as described in the main part of this Recommendation.

3) Either the N-LLC or the B-LLI information element can be used in a call, not both.

4) If B-ISDN specific user equipment are connected to B-ISDN which do not support emulation of N-ISDN services, only the B-LLI information element is to be used (not the N-LLC information element).

The use of the N-LLC and B-LLI information elements is illustrated in Figure 6-1.

The N-LLC information element is transported transparently through the B-ISDN.

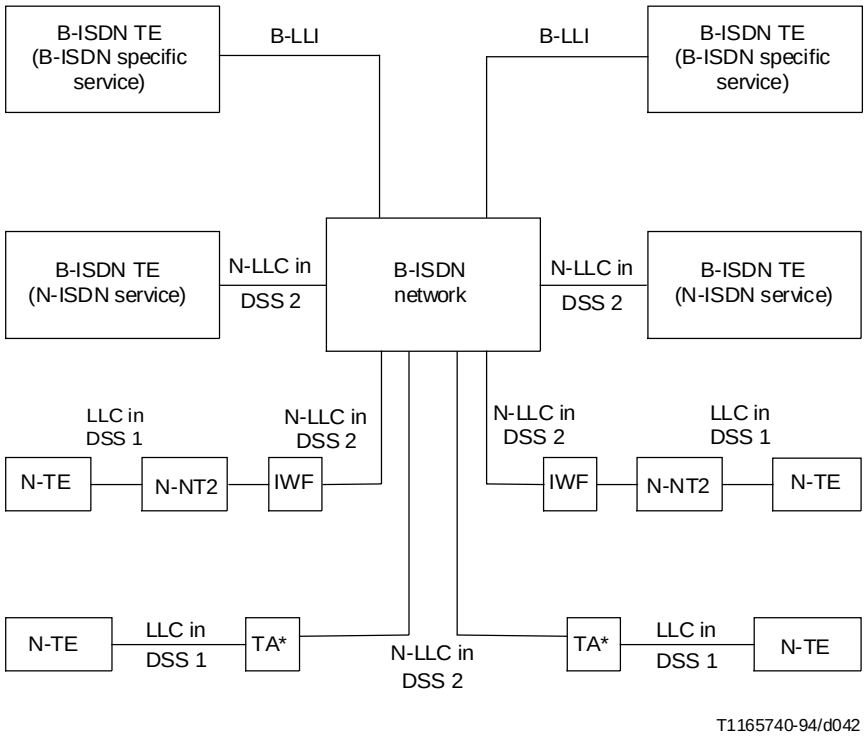
The destination user shall ignore the conflicting information in the N-LLC information element if it detects a contradiction between the N-BC information element and N-LLC information element.

NOTE – It is expected that some B-ISDNs will support only A-law and some others only μ-law coding; with conversion provided by the μ-law network (see Recommendation G.711 [3]) for the provision of emulated N-ISDN services. If the encoding scheme is specified in both the N-BC information element and the N-LLC information element, interworking between two B-ISDNs might require a change of the user information layer 1 protocol in the N-BC information element (e.g. from A-law to μ-law), while the encoding scheme specified in the N-LLC information element would presumably be forwarded unchanged to the destination. Since, to determine compatibility, the destination terminal examines both the N-BC information element and the N-LLC information element, it would receive conflicting information regarding the encoding scheme used.

For the provision of N-ISDN services, the inclusion of the AAL parameters information element in the SETUP message is required, specifying either AAL type 1 or the AAL for voice.

6.2.4 High layer related information

If required for the description of a particular N-ISDN service, the N-HLC information element is included in the SETUP message. The N-HLC information element is transported transparently through the B-ISDN. No specific B-ISDN information element describing high layer attributes is required.



* The LLC information is transferred transparently across the Terminal Adapter (TA) or Interworking Function (IWF), except for the changes required by the different coding rules.

FIGURE 6-1/Q.2931

Illustration of the use of the N-LLC and B-LLI information elements in this Recommendation

6.2.5 Handling of inconsistent combination of service parameters

If the network receives a SETUP message with an inconsistent combination of broadband (i.e. B-HLI and B-LLI information elements) and narrow-band service parameters (i.e. N-BC, N-HLC and N-LLC information elements), the network may clear the call with cause No. 79, "service or option not implemented, unspecified".

6.3 Interworking N-ISDN → B-ISDN

6.3.1 Introduction

This subclause describes the functions performed by a Terminal Adapter (TA) or an Interworking Function (IWF) in the case of a call originated in the N-ISDN and routed to the B-ISDN according to scenario B/Recommendation I.580 [58]. For the detailed mapping of code points, see Annex E.

6.3.2 Bearer-service related information

The DSS 1-BC information element is mapped to the N-BC information element by the TA or the IWF by simply inserting the second octet containing the IE instruction field and changing the length indication from one to two octets. The Flag bit in the second octet is set to "0", i.e. the normal error handling procedures as defined in 5.6 apply.

In addition to the N-BC information element, the B-BC information element is created by the TA or IWF, indicating BCOB-A and the value susceptible to clipping in the susceptibility to clipping field.

The ATM traffic descriptor and the QOS parameter information elements are also generated by the TA or IWF, evaluating the information of the DSS 1-BC information element.

The end-to-end transit delay information element and the OAM traffic descriptor information element are not created by the TA or IWF.

For further details, see Annex E.

6.3.3 Low layer compatibility information

The DSS 1-LLC information element (if included) is mapped to the N-LLC information element by the TA or IWF without change of contents. Simply, the new octet 2 is inserted in the same way as described in 6.3.2 for the N-BC information element and the length indication is adapted.

The AAL parameters information element is generated by the TA or IWF, indicating either AAL-type 1 or the AAL for voice. For further details, see Annex E.

6.3.4 High layer compatibility information

The DSS 1-HLC information element (if included) is mapped to the N-HLC information element by the TA or IWF without change of contents. Simply, the new octet 2 is inserted in the same way as described in 6.3.2 for the N-BC information element and the length indication is adapted.

6.3.5 Cause information

The DSS 1 Cause information element is mapped to the DSS 2 Cause information element by the TA or IWF by simply inserting the second octet containing the IE instruction field and changing the length indication from one to two octets.

The Flag bit in the second octet is set to "0", i.e. the normal error handling procedures as defined in 5.6 apply.

6.4 Interworking B-ISDN → N-ISDN

This subclause describes the functions to be performed by a Terminal Adapter (TA) or an Interworking Function (IWF) in the case of a call originated in the B-ISDN and routed to the N-ISDN according to scenario B/Recommendation I.580 [58].

6.4.1 Introduction

If a B-TE initiates a call to a N-TE, only N-ISDN service related information elements will be processed by the IWF or TA. If a B-ISDN specific service is selected by the B-TE and routed towards the N-ISDN, then the call shall be rejected by the IWF or TA with cause No. 63, "service or option not available, unspecified".

6.4.2 Bearer-service related information

The B-BC, the ATM traffic descriptor, the QOS parameter, the end-to-end transit delay and the OAM traffic descriptor information elements are discarded by the IWF or TA.

The N-BC information element is mapped to the DSS 1-BC information element by the IWF or TA, by simply removing its second octet and adjusting the length indication, without causing other changes to the contents.

If no N-BC information element is included in the SETUP message, then a B-ISDN service shall be assumed and the call shall be rejected by the IWF or TA, with cause No. 63, "service or option not available, unspecified".

6.4.3 Low layer compatibility information

The AAL parameter information element is discarded by the IWF or TA.

The N-LLC information element (if included) is mapped to the DSS 1-LLC information element by the IWF or TA by simply removing its second octet and adjusting the length indication without causing other changes to the contents.

If a B-LLI information element is detected by the IWF or TA, and service interworking for the indicated service is not provided, then the call shall be rejected by the IWF or TA, with cause No. 63, "service or option not available, unspecified".

6.4.4 High layer compatibility information

The N-HLC information element (if included) is mapped to the DSS 1-HLC information element by the IWF or TA by simply removing its second octet and adjusting the length indication without causing other changes to the contents.

If a B-HLI information element is detected by the IWF or TA, then the call shall be rejected with cause No. 63, "service or option not available, unspecified".

6.4.5 Cause information

For the mapping of the DSS 2 Cause information element to the DSS 1 Cause information element, the following rules shall apply:

a) Any broadband specific cause value where there is no equivalent value in the DSS 1 protocol is mapped to the unspecified value of the same class, e.g. the DSS 2 cause values:

– 35 – 36 – 37 – 45	Requested VPCI/VCI not available VPCI/VCI assignment failure User cell rate not available and No VPCI/VCI available	Are mapped to the DSS 1 cause value 47: Resource unavailable, unspecified
– 73 – 93	Unsupported combination of traffic parameters AAL parameters cannot be supported	Are mapped to the DSS 1 cause value 79: Service or option not implemented, unspecified

b) Any cause value and diagnostic used in both DSS 2 and DSS 1 protocol is not changed by the TA or IWF.

c) If any cause value used in the DSS 2 protocol is received by the TA or IWF for which a diagnostic field may be present (e.g. cause value 82) while the same cause value of the DSS 1 protocol does not allow for a diagnostic field, then the TA or IWF shall discard the diagnostic field and leave the cause value unchanged.

d) In addition to the actions described in items a) to c), the DSS 2 Cause information element is changed in the same manner as the other DSS 2 information elements, i.e. the second octet is discarded and the length indication is adjusted.

6.5 Overlap sending and receiving

6.5.1 Objectives

B-ISDN terminal equipment (B-TE) shall use *en bloc* sending in B-ISDN. This implies, from the B-TE perspective, the mandatory inclusion of the Broadband sending complete information element in the SETUP message.

Since overlap receiving is an allowed procedure in N-ISDN, this procedure is also supported in B-ISDN for incoming calls originating in the N-ISDN.

In order to allow also terminal equipment designed for the N-ISDN to be connected to the B-ISDN via a terminal adapter or via a customer's network, the DSS 2 protocol supports also overlap sending.

The procedures of DSS 2 for overlap sending and receiving are specified in 6.5.2 and 6.5.3.

6.5.2 Overlap sending

If overlap sending is used, the SETUP message contains either:

a) no called number information; or

b) incomplete called number information; or

c) called number information which the network cannot determine to be complete.

On receipt of such a SETUP message, the network starts timer T302 (the value of this timer is specified in 7.1), sends a SETUP ACKNOWLEDGE message to the user, and enters the Overlap Sending state.

When the SETUP ACKNOWLEDGE message is received, the user enters the Overlap Sending state and optionally starts timer T304 (the value of this timer is specified in 7.2).

After receiving the SETUP ACKNOWLEDGE message, the user sends the remainder of the call information (if any) in one or more INFORMATION messages.

The called party number information shall be provided by the user in the Called party number information element.

If, for symmetry purposes, the user employs timer T304, the user restarts T304 when each INFORMATION message is sent.

The call information in the message that completes the information sending may contain a "sending complete" indication (i.e. the Broadband sending complete information element). The network restarts timer T302 on the receipt of every INFORMATION message not containing a sending complete indication.

6.5.3 Overlap receiving

When a user determines that a received message contains either:

a) no called number information; or

b) incomplete called number information; or

c) called number information which the user cannot determine to be complete;

and when the user:

– is compatible with the other call characteristics (see Annex B); and

– implements overlap receiving;

the user shall start timer T302; send a SETUP ACKNOWLEDGE message to the network; and enter the Overlap Receiving state.

When the SETUP ACKNOWLEDGE message is received, the network shall stop timer T303; start timer T304; enter the Overlap Receiving state; and send the remainder of the call information (if any) in one or more INFORMATION messages, starting timer T304 when each INFORMATION message is sent.

The called party number information is provided in the Called party number information element.

The called address information may contain a sending complete indication (i.e. the Broadband sending complete information element).

NOTE 1– It is recommended that the network inserts the Broadband sending complete information element in the INFORMATION message which is delivered to the called user if the network can determine that this message contains the last digit(s) of the called party number.

The user shall start timer T302 on receipt of every INFORMATION message not containing a sending complete indication.

Following the receipt of a sending complete indication, or the determination that sufficient call information has been received, the user shall stop timer T302 (if implemented) and send a CALL PROCEEDING message to the network. Alternatively, depending on internal events, the user may send an ALERTING or CONNECT message to the network.

NOTE 2 – The CALL PROCEEDING message in this case will cause the originating exchange to send a CALL PROCEEDING message to the originating user, if not already sent.

At the expiration of timer T302, the user shall either:

a) send a CALL PROCEEDING, ALERTING or CONNECT message as appropriate if sufficient information has been received; or

b) initiate clearing in accordance with 5.4 with cause No. 28, "invalid number format (incomplete number)" if it determines that the call information is definitely incomplete.

At the expiration of timer T304, the network initiates call clearing in accordance with 5.4 with cause No. 28, "invalid number format (incomplete number)" sent to the calling user, and cause No. 102, recovery on timer expiry, sent to the called user.

If, following the receipt of a SETUP message or during overlap receiving, the user determines that the received call information is invalid (e.g. invalid called party number), it shall initiate call clearing in accordance with 5.4 with a cause such as one of the following:

– No. 1 unassigned (unallocated) number;

– No. 3 no route to destination;

– No. 22 no route to destination;

– No. 28 invalid number format (incomplete number).

Upon receipt of the complete call information, the user may further perform compatibility checking functions, as outlined in Annex B.

6.6 Notification of interworking

Interworking of B-ISDN with N-ISDN requires the support of the progress indicator values specified in Recommendation Q.931 [33] by the B-ISDN.

The following principles shall apply:

1) Interworking with a non-ISDN may occur in the case where an emulated N-ISDN service is requested and interworking with N-ISDN has occurred. In this case, all progress indicator values applying for N-ISDN interworking with non-ISDN shall be relayed to B-ISDN, transported transparently through the B-ISDN and then be indicated to the calling user.

2) In the case of a call leaving or entering the B-ISDN at the IWF or TA, the IWF/TA shall not generate a DSS 1- or DSS 2-Progress indicator information element.

The DSS 1-Progress indicator information element shall be mapped to the DSS 2-Progress indicator information element by adding or removing octet 2, dependent on the direction of the call and adjusting the coding of the length indication.

6.6.1 Notification of interworking at the originating interface

If the Progress indicator information element is included in a call control message, the procedures as described in 5.1 apply. If the Progress indicator information element is included in the PROGRESS message, no state change will occur but the network shall stop any supervisory timers except network timers T302 and T322 if the progress description is No. 1, No. 2 or, optionally, No. 4. In both cases, if indicated by the Progress indicator information element, the user shall connect to (if not connected already) and then monitor the user virtual channel for further in-band information.

6.6.2 Notification of interworking at the terminating interface

If the Progress indicator information element is included in a call control message, the procedures as described in 5.2 apply. If the Progress indicator information element is included in the PROGRESS message, no state change will occur but the network shall stop any supervisory timers except network timers T301, T304, T312 and T322 if the progress description is No. 1, No. 2 or, optionally, No. 4.

6.7 Additional features with regard to the provision of N-ISDN services

6.7.1 Tones and announcements

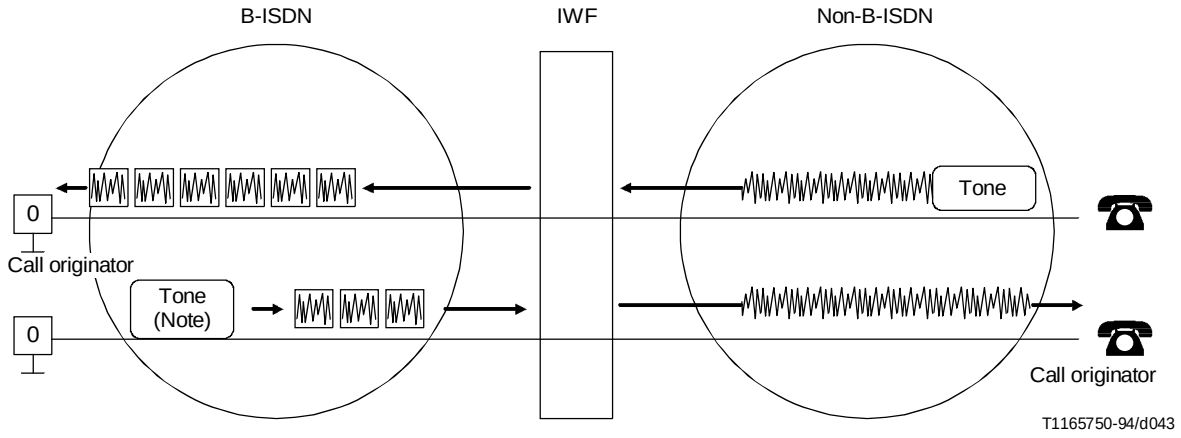
6.7.1.1 General principle

For the provision of tones and announcements, the following principles shall apply:

- Tones and announcements are provided by the network only if the N-BC information element is present and indicates speech, 3.1 kHz audio or Unrestricted digital information with tones and announcements.
- Tones and announcements are coded according to Recommendation G.711 [3] (i.e. these are basically 3.1 kHz audio signals).
- Tones and announcements are conveyed through the B-ISDN using the connection-oriented bearer service, Class A.
- Tones and announcements generated in a non-B-ISDN are converted into ATM cells (using the AAL for voice) at the IWF.
- Tones and announcements generated in the B-ISDN are converted into the 64 kbit/s stream at the IWF.

The traffic and protocol parameters for the provision of tones and announcements with ATM cells shall have the same code point values as those for speech or 3.1 kHz audio services defined in E.4.

Figure 6-2 illustrates a possible scenario for the provision of the ringback tone. The provision of other tones is not shown.



NOTE – This tone shall be provided by the terminating exchange but may be provided by a non-B-ISDN functional entity of that exchange.

FIGURE 6-2/Q.2931

Possible scenario for the provision of the ringback tone

6.7.1.2 Provision of tones at call establishment

On receipt of a SETUP message with no called number information, the network will return dial tone, if required by the tone option. In this case, it may include progress indicator No. 8 in-band information or appropriate pattern now available in the SETUP ACKNOWLEDGE message.

The user need not attach to the virtual channel until receiving a CALL PROCEEDING / SETUP ACKNOWLEDGE / PROGRESS / ALERTING message with the progress indicator No. 8 in-band information or appropriate pattern now available or progress indicator No. 1 call is not end-to-end ISDN; further call progress information may be available in-band. Prior to this time, the network cannot assume that the user has attached to the virtual channel. After this time, the user shall be connected to the virtual channel, provided the equipment does not generate the tone locally. Upon receipt of the CONNECT message, the user shall attach to the virtual channel (if it has not already done so).

6.7.1.3 Clearing when tones and announcements are provided

When in-band tones/announcements are provided, the RELEASE message sent by the network shall contain progress indicator No. 8 in-band information or appropriate pattern now available. The network shall initiate clearing by sending the RELEASE message; starting timer T306; and entering the Release Indication state.

On receipt of the RELEASE message with progress indicator No. 8, the user may connect (if not already connected) to the virtual channel to receive the in-band tone/announcement; and enter the Release Indication state. Alternatively, to continue clearing without connecting to the in-band tone/announcement, the user shall release the virtual channel and the call reference; send a RELEASE COMPLETE message; and return to the Null state.

If the user connects to the in-band tone/announcement, the user may subsequently continue clearing (before receipt of a RELEASE COMPLETE message from the network) by: releasing the user virtual channel and the call reference; sending a RELEASE COMPLETE message and returning to the Null state.

On receipt of the RELEASE COMPLETE message, the network shall stop timer T306; release both the user virtual channel and the call reference; and return to the Null state.

If timer T306 expires, the network shall continue clearing by releasing the user virtual channel and the call reference; sending a RELEASE COMPLETE message with the cause number originally contained in the RELEASE message; and returning to the Null state. In addition to the original clearing cause, the RELEASE COMPLETE message may contain a second Cause information element with cause No. 102, “recovery on timer expiry”; this cause may optionally contain a diagnostic field identifying the timer that expired.

6.7.2 Fall-back procedure

The B-ISDN does not provide any particular function or procedure to explicitly support the procedures for bearer capability and high layer compatibility selection as defined in 5.10/Q.931 to 5.12/Q.931 [33]. It provides the transparent transfer of the N-BC and N-HLC information elements required for the support of this N-ISDN capability, e.g. in a N-BC CONNECT message.

7 List of timers

The description of timers in the following tables is considered a brief summary. The precise details are found in clauses 5 and 6 which contain the definitive description.

7.1 Timers in the network side

The timers specified in clause 5 and summarized in Table 7-1 are maintained in the network side of the interface.

The timers specified in clause 6 and summarized in Table 7-2 are maintained in the network side of the interface.

7.2 Timers in the user side

The timers specified in clause 5 and summarized in Table 7-3 are maintained in the user side of the interface.

The timers specified in clause 6 and summarized in Table 7-4 are maintained in the user side of the interface.

TABLE 7-1/Q.2931

Timers in the network side defined in clause 5

Timer	Default value	Call state	Cause for start	Cause for normal stop	Action at the first expiry	Action at the second expiry	Implementation
T301	Minimum 3 min.	Call received	ALERT received	CONN received	Clear call	Not applicable	Mandatory (Note 1)
T303	4 sec.	Call present	SETUP sent	ALERT, CONN, REL COMP or CALL PROC received	Resend SETUP; restart T303	Clear network connection; enter Null state	Mandatory
T308	30 sec.	Release indication	REL sent	REL COMP or REL received	Resend REL; restart T308	Place bearer virtual channel in maintenance condition. Release call reference and enter Null state (Note 2)	Mandatory
T309	10 sec.	Any stable state	SAAL disconnection. Calls in stable states are not lost	SAAL reconnected	Clear network connection; release connection and call reference	Not applicable	Mandatory
T310	10 sec. (Note 3)	Incoming call proceeding	CALL PROC received	ALERT, CONN or REL received	Clear call in accordance with 5.4	Not applicable	Mandatory
T316	2 min.	Restart request	RESTART sent	REST ACK received	RESTART may be sent several times	RESTART may be sent several times	Mandatory for point-to-point access configuration
T317	(Note 4)	Restart	RESTART received	Internal clearing of call references	Maintenance notification	Not applicable	Mandatory for point-to-point access configuration
T322	4 sec.	Any call state	STAT ENQ sent	STAT, REL or REL COMP received	STAT ENQ may be resent several times	STAT ENQ may be resent several times	Mandatory

NOTES

1 The network may already have applied an internal alerting supervision timing function; e.g. incorporated within call control. If such a function is known to be operating on the call, then timer T301 is not used.

2 The restart procedures in 5.5 may be used.

3 The default value of this timer has been aligned with the default value specified in Recommendation Q.931 for the equivalent timer. If these values are different, then Recommendation Q.931 shall take precedence.

4 The value of timer T317 is implementation dependent but a value that is less than the likely values of T316 in peer implementations shall be chosen.

TABLE 7-2/Q.2931

Timers in the network side defined in clause 6

Timer	Default value	Call state	Cause for start	Cause for normal stop	Action at the first expiry	Action at the second expiry	Implementation
T302	10-15 sec. (Note 1)	Overlap sending	SETUP ACK sent. Restart when INFO received	With sending complete indication, or network alert or connect request received	Clear if call information determined to be definitely incomplete; else send CALL PROC	Not applicable	Mandatory only if 6.5 is implemented
T303	4 sec.	Call present	SETUP sent	ALERT, CONN, CALL PROC, SETUP ACK or REL COMP received	Resend SETUP; restart T303	Clear network connection; enter Null state	Mandatory
T304	20 sec. (Note 1)	Overlap receiving	SETUP ACK received. Restart when INFO sent	INFO sent or CALL PROC, ALERT or CONN received	Clear the call	Not applicable	Mandatory only if 6.5 is implemented
T306	30 sec. (Note 2)	Release indication	REL with progress indicator No. 8 sent	REL COMP received	Stop the tone/announcement. Send REL COMP	Not applicable	Mandatory when in-band tones/ announcements are provided. See clause 6

NOTES

1 The default value of this timer has been aligned with the default value specified in Recommendation Q.931 for the equivalent timer. If these values are different, then Recommendation Q.931 shall take precedence.

2 The value of timer T306 may depend on the length of the announcement.

TABLE 7-3/Q.2931

Timers in the user side defined in clause 5

Timer	Default value	Call state	Cause for start	Cause for normal stop	Action at the first expiry	Action at the second expiry	Implementation
T301	Minimum 3 min.	Call delivered	ALERT received	CONN received	Clear call	Not applicable	Mandatory if Annex H is supported
T303	4 sec.	Call initiated	SETUP sent	ALERT, CONN, CALL PROC or REL COMP received	SETUP resent; restart T303	Clear internal connection; enter Null state	Mandatory
T308	30 sec.	Release request	REL sent	REL COMP or REL received	REL resent; restart T308	Place bearer virtual channel in maintenance condition. Release call reference and enter Null state (Note 1)	Mandatory
T309	10 sec.	Any stable state	SAAL disconnection. Calls in stable states are not lost	SAAL reconnected	Clear internal connection; release connection and call reference	Not applicable	Mandatory
T310	30-120 sec. (Note 2)	Outgoing call proceeding	CALL PROC received	ALERT, CONN or REL received	REL sent	Not applicable	Mandatory
T313	4 sec.	Connect request	CONN sent	CONN ACK received	REL sent	Not applicable	Mandatory
T316	2 min.	Restart request	RESTART sent	REST ACK received	RESTART may be sent several times	RESTART may be sent several times	Mandatory for point-to-point access configuration
T317	(Note 3)	Restart	RESTART received	Internal clearing of call references	Maintenance notification	Not applicable	Mandatory for point-to-point access configuration
T322	4 sec.	Any call state	STAT ENQ sent	STAT, REL or REL COMP received	STAT ENQ may be resent several times	STAT ENQ may be resent several times	Mandatory

NOTES

1 The restart procedures of 5.5 may be used.

2 The default value of this timer has been aligned with the default value specified in Recommendation Q.931 for the equivalent timer. If these values are different, then Recommendation Q.931 shall take precedence.

3 The value of timer T317 is implementation dependent but a value that is less than the likely values of T316 in peer implementations shall be chosen.

TABLE 7-4/Q.2931

Timers in the user side defined in clause 6

Timer	Default value	Call state	Cause for start	Cause for normal stop	Action at the first expiry	Action at the second expiry	Implementation
T302	10-15 sec. (Note)	Overlap receiving	SETUP ACK sent. Restart when INFO received	With sending complete indication, or network alert or connect request received	Clear if call information determined to be definitely incomplete; else send CALL PROC	Not applicable	Mandatory only if 6.5 implemented
T304	30 sec. (Note)	Overlap sending	SETUP ACK received. Restart when INFO sent	CALL PROC, ALERT or CONN received	Clear the call	Not applicable	Optional

NOTE – The default value of this timer has been aligned with the default value specified in Recommendation Q.931 for the equivalent timer. If these values are different, then Recommendation Q.931 shall take precedence.

8 Primitives

8.1 Introduction

This subclause describes only the interaction between a Q.2931 entity and the SAAL. There are also interactions between Q.2931 and its layer management and between Q.2931 and the user of Q.2931. These interactions are not described here.

A Q.2931 entity requests and accepts services from the SAAL via service primitives. The primitives represent in an abstract way, the logical exchange of information and control between a Q.2931 entity and the SAAL. They do not specify nor constrain implementation; this means that they are only a suggestion of how layers within an equipment should interact; they are not tested for conformance.

In general, the following four types of primitives are used (see also Figure 8-1):

a) Request;

b) Indication;

c) Response; and

d) Confirm.

The *request* primitive type is used when a higher layer is requesting a service from the next lower layer.

The *indication* primitive type is used by a layer providing a service to notify the next higher layer of any specific activity which is service related. The indication primitive may be the result of an activity of the lower layer related to the primitive type request at the peer entity.

The *response* primitive type is used by a layer to acknowledge receipt, from a lower layer, of the primitive type indication.

The *confirm* primitive type is used by the layer providing the requested service to confirm that the activity has been completed.

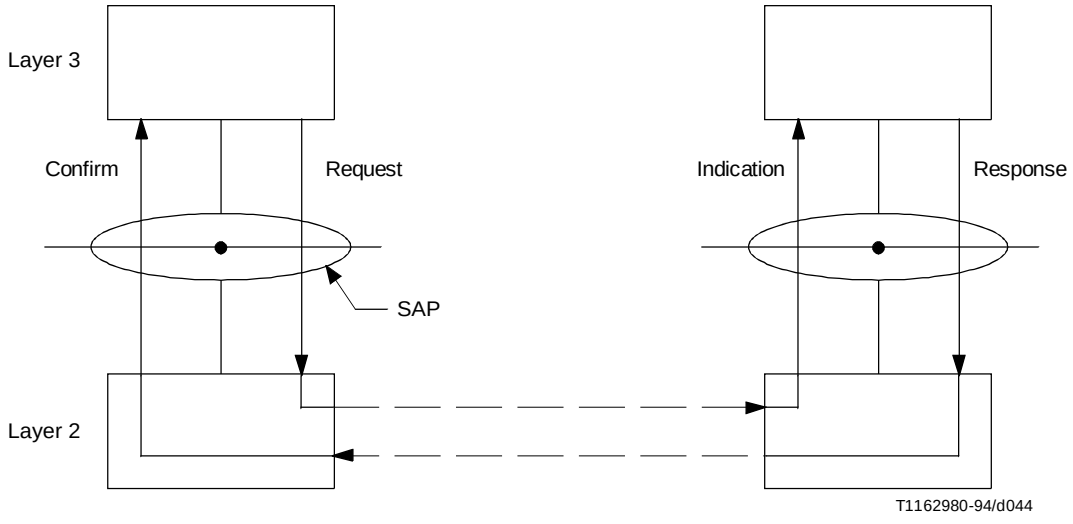


FIGURE 8-1/Q.2931

Primitive action sequence

8.2 Description of the primitives

The primitives exchanged between Q.2931 and the SAAL to support Q.2931 services are shown in Table 8-1.

TABLE 8-1/Q.2931

Primitives between Q.2931 and SAAL

Generic name	Type				Parameters
	Req.	Ind.	Resp.	Conf.	
AAL-ESTABLISH	(Note 1) X	(Note 1) X		(Note 1) X	Q.2931 messages
AAL-RELEASE	(Note 1) X	(Note 1) X		(Note 2) X	Q.2931 messages
AAL-DATA	(Note 3) X	(Note 3) X			Q.2931 messages
AAL-UNIT_DATA	(Note 4) X	(Note 4) X			Q.2931 messages

X Indicates that primitive is implemented.

NOTES

1 This primitive may contain a Q.2931 message as a Parameter Data. This parameter shall not be used by a sending entity complying with this Recommendation, but its use by future extensions of this signalling protocol is not exclude. A receiving entity need not process a Q.2931 message received in this primitive; when it chooses to do so, as an implementation option, the processing of the received message is implementation dependent.

2 This primitive does not have a parameter.

3 This primitive has a parameter data containing a Q.2931 message.

4 This primitive has a parameter data containing a Q.2931 message. The use of this primitive to include a Q.2931 call/connection control message is not defined within this Recommendation, however its use by future extensions of this signalling protocol is not precluded. A receiving entity need not process a Q.2931 message received in this primitive; when it chooses to do so, as an implementation option, the processing of the received message is implementation dependent.

8.2.1 AAL-ESTABLISH-request

Issued by a Q.2931 entity to the SAAL to request it to establish an assured Signalling AAL connection between a user and the network. The assured Signalling AAL connection must be established before an AAL-DATA-request can be issued.

8.2.2 AAL-ESTABLISH-indication

Issued by the SAAL to a Q.2931 entity to inform it that it has established an assured Signalling AAL connection between a user and the network. This primitive may be due to an AAL-ESTABLISH-request having been issued by a peer Q.2931 entity or due to a re-establishment with a possible loss of data. If the Q.2931 entity receiving this primitive is not in the NULL state, it should do a status enquiry.

8.2.3 AAL-ESTABLISH-confirm

Issued by the SAAL to a Q.2931 entity to inform it that it has established an assured Signalling AAL connection between a user and the network. The establishment of this Signalling AAL connection had been previously requested by the Q.2931 entity with an AAL-ESTABLISH-request.

8.2.4 AAL-RELEASE-request

Issued by a Q.2931 entity to the SAAL to request it to release an assured Signalling AAL connection. If a previous AAL-STABLISH-indication returned an identifier for this Signalling AAL connection, then it must be passed as a parameter with this primitive.

8.2.5 AAL-RELEASE-indication

Issued by the SAAL to a Q.2931 entity to inform it that it has released an assured Signalling AAL connection. If a previous AAL-ESTABLISH-indication returned an identifier for this Signalling AAL connection, then it must be passed as a parameter with this primitive. This primitive may be due to an AAL-RELEASE-request having been issued by a peer Q.2931 entity or due to an error.

8.2.6 AAL-RELEASE-confirm

Issued by the SAAL to a Q.2931 entity to inform it that it has released an assured Signalling AAL connection between a user and the network. The release of this Signalling AAL connection had been previously requested by the Q.2931 entity with an AAL-RELEASE-request.

8.2.7 AAL-DATA-request

Issued by a Q.2931 entity to the SAAL to request it to send a message across an established assured Signalling AAL connection.

8.2.8 AAL-DATA-indication

Issued by the SAAL to a Q.2931 entity to deliver it a message that was sent by a peer Q.2931 entity using an AAL-DATA-request primitive.

8.2.9 AAL-UNIT_DATA-request

Issued by a Q.2931 entity to the SAAL to request it to send a message to one or more peer Q.2931 entities. It is sent using unacknowledged, unassured data transfer.

8.2.10 AAL-UNIT_DATA-indication

Issued by the SAAL to a Q.2931 entity to deliver it a message that was sent by a peer Q.2931 entity using an AAL-UNIT_DATA-request primitive.

Annex A

Network side and user side SDL diagrams

(This annex forms an integral part of this Recommendation)

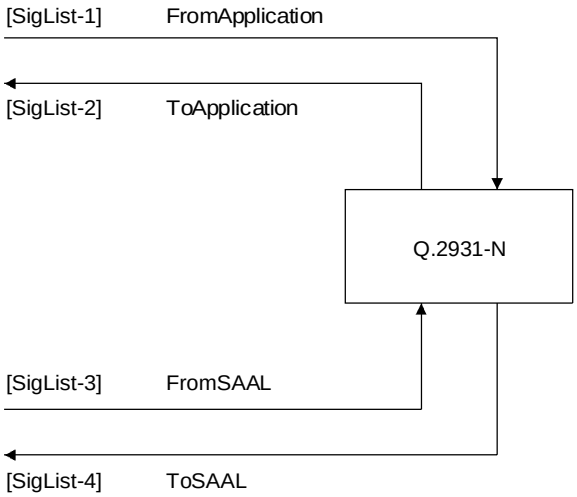
This annex provides System Diagrams and SDL process description for User and Network side entities implementing the processes using the procedures defined in clauses 5 and 6. Figure A.1 gives a list of the symbols used in the SDL processes definition.

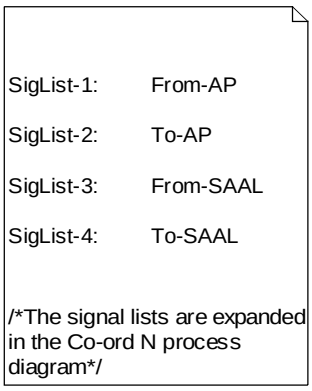
A.1 Network side SDL diagrams

The Network Side SDL diagrams are structured as follows:

Reference	Length (Network Side)
System diagram	1 page
Block diagram	1 page
Co-ord-N process	10 pages
Reset-Start-N process	2 pages
Reset-Response-N process	2 pages
Q.2931-N process:	31 pages, comprises:
Procedures for B-ISDN calls (See clause 5)	pp. 1-18
Extensions for symmetric call operation (See Annex H)	p. 19
Additional procedures related to interworking (See clause 6)	pp. 20-31

SYSTEM Q.2931 – Network Side





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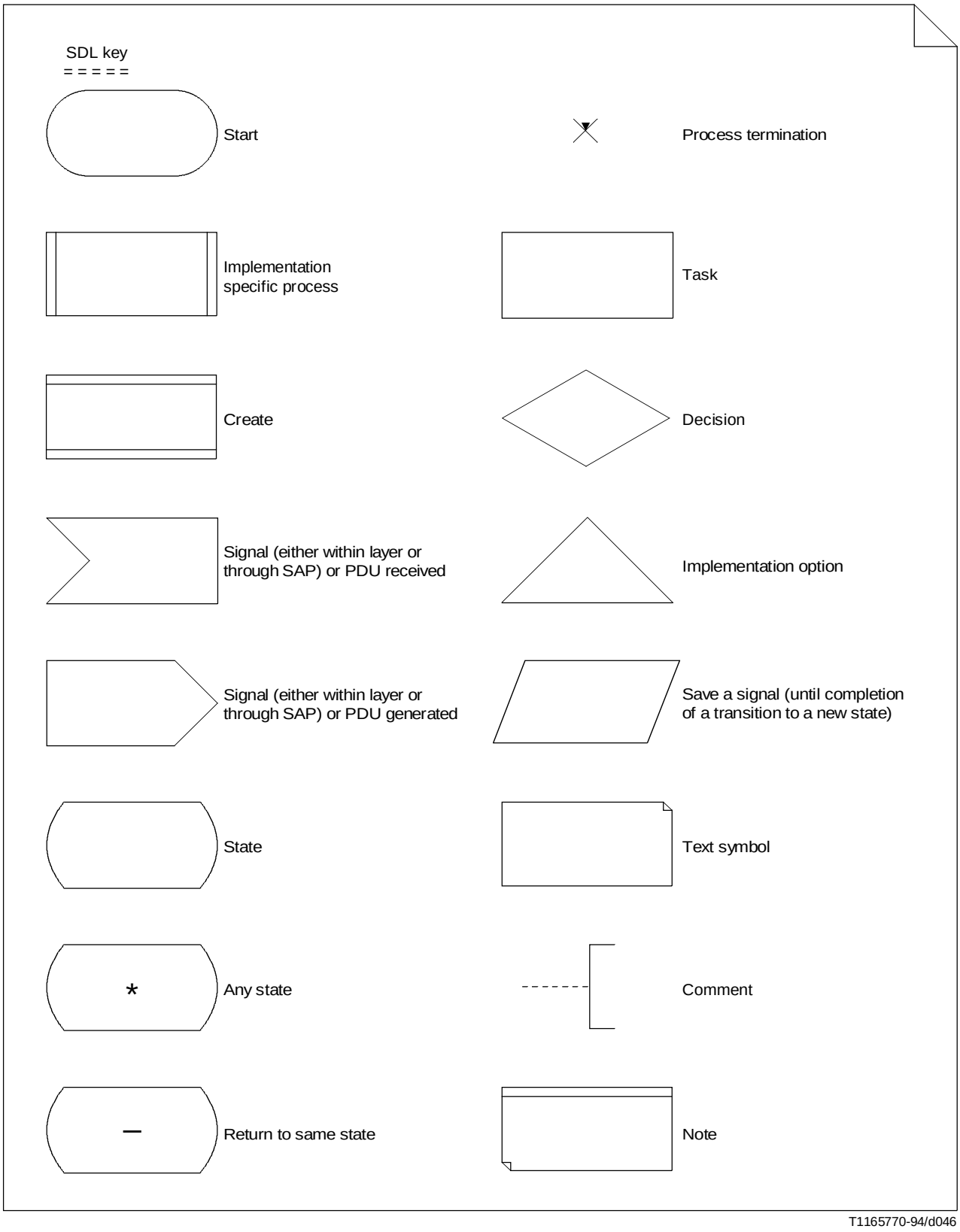
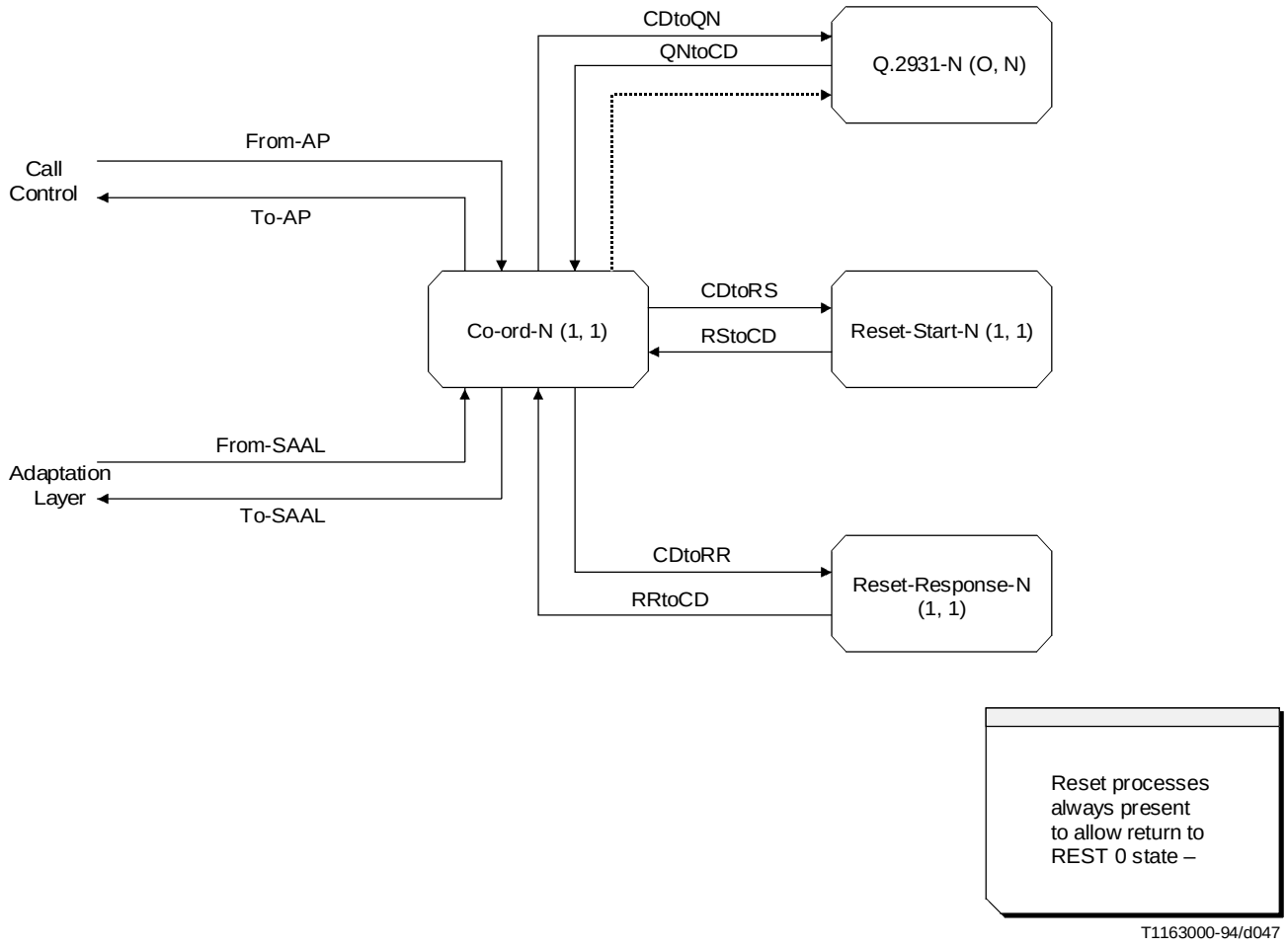
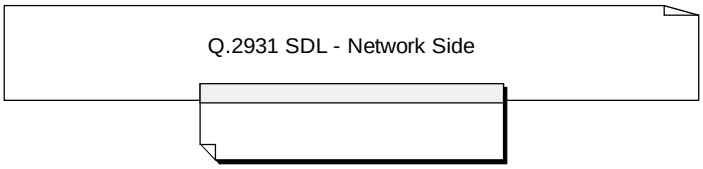


FIGURE A.1/Q.2931

Key to symbols used in SDL representation of procedures

BLOCK Q.2931 Network Side





Acronyms

Processes

Co-ord-N	=	Coordination function for all Q.2931 processes (ASEs) and performs "common" functions on the network side.
Q.2931-N	=	Process that performs the Call/Bearer specific signalling functions.
Reset-Start-N	=	Process that starts the RESTART procedure on the network side.
Reset-Respond-N	=	Process that responds to a RESTART message on the network side.

Other Entities

AP	=	Signalling Application Process
SAAL	=	Signalling ATM Adaption Layer Process

Others

§ x.x	=	Reference to relevant Section x.x of Q.2931
Cause	=	Cause field contents in Cause IE
CS	=	Call State value in Call State IE
#	=	Indicates all IEs in a primitive or message except those explicitly identified (e.g. (Cause, #))
CD	=	Coordination Process
CLR	=	Release Call
I	=	Ignore
IE	=	Information Element
OK	=	Okay (proceed)
QN	=	Q.2931-N
RAI	=	Report And Ignore
RAP	=	Report And Proceed
RR	=	Reset-Respond-N
RS	=	Reset-Start-N
SC	=	Sending Complete

The List of IEs possible for each message and the contents of the IEs are defined in clauses 3 and 4

T1163010-94/d048

Signal lists

Signal for B-ISDN Calls

Primitives to/from SAAL

From-SAAL	To-SAAL
AAL-DATA-ind. – Includes Message from point-to-point signalling virtual channel connection	AAL-DATA-req. – Message sent to specific point-to-point signalling virtual channel connection
AAL-ESTABLISH-ind., AAL-ESTABLISH-conf.	AAL-ESTABLISH-req. – SAAL link establishment
AAL-RELEASE-ind., AAL-RELEASE-conf.	AAL-RELEASE-req. – SAAL link reset or release

Primitives to/from Application Process

From AP	To AP
Setup-req.	Setup-ind.
Proceeding-req.	Proceeding-ind.
Alerting-req.	Alerting-ind.
Setup-resp.	Setup-conf.
Setup-complete-req.	
Release-req.	Release-ind.
Release-resp.	Release-conf.
Reset-req.	Reset-ind.
Reset-resp.	Reset-conf.
Reset-error-response	Reset-error-ind.
Notify-req.	Notify-ind.
Link Establish-req.	Link Establish-conf.
Link Release-req.	Link Release-conf.

Signal lists

Additional signals related to interworking

Primitives to/from Application Process

From AP	To AP
More-info-req.	More-info-ind.
Info-req.	Info-ind.
Progress-req.	Progress-ind.

Signal lists

Additional signals related to interworking

Primitives to/from Application Process

From AP	To AP
These primitives are listed in the relevant broadband supplementary service Recommendations (Q.295x. – Series)	

T1163020-94/d049

Primitives to/from Q.2931-N

Signal lists

CDtoQN	QNtoCD
Setup-req.	Setup-ind.
Proceeding-req.	Proceeding-ind.
Alerting-req.	Alerting-ind.
Setup-resp.	Setup-conf.
Setup-complete-req.	
Release-req.	Release-ind.
Release-resp.	Release-conf.
	Status-ind.
Notfiy-req.	Notify-ind.
Link Establish confirm	Link Establish request
Link Establish indication	
Link Release indication	
Link Establish error	

Primitives to/from Reset-Start-N

Signal lists

CDtoRS	CDtoRS
Reset-req.	Reset-error-ind.
	Reset-conf.

Primitives to/from Reset-Respond-N

Signal lists

CDtoRR	RRtoCD
Reset-resp.	Reset-ind.
Reset-error-resp.	Reset-error-ind.

Additional Primitives to/from Q.2931-N related to interworking

Signal lists

CDtoQN	QNtoCD
More-info-req.	More-info-ind.
Infor-req.	Info-ind.
Progress-req.	Progress-ind.

Additional Primitives to/from Q.2931-N related to supplementary services

Signal lists

CDtoQN	QNtoCD
These primitives are listed in the relevant broadband supplementary service Recommendations (Q.295x. – Series)	

Messages to/from Q.2931-N for B-ISDN calls

Signal lists

CDtoQN	QNtoCD
SETUP	SETUP
CALL-PROCEEDING	CALL-PROCEEDING
ALERTING	ALERTING
CONNECT	CONNECT
CONNECT-ACK	CONNECT-ACK
RELEASE	RELEASE
RELEASE-COMPLETE	RELEASE-COMPLETE
STATUS	STATUS
STATUS-ENQUIRY	STATUS-ENQUIRY
NOTIFY	NOTIFY

Messages to/from Reset-Start-N

Signal lists

CDtoRS	RStoCD
RESTART-ACK	RESTART
	STATUS

Messages to/from Reset-Respond-N

Signal lists

CDtoRR	RRtoCD
RESTART	RESTART-ACK
	STATUS

Additional Messages to/from Q.2931-N related to interworking

Signal lists

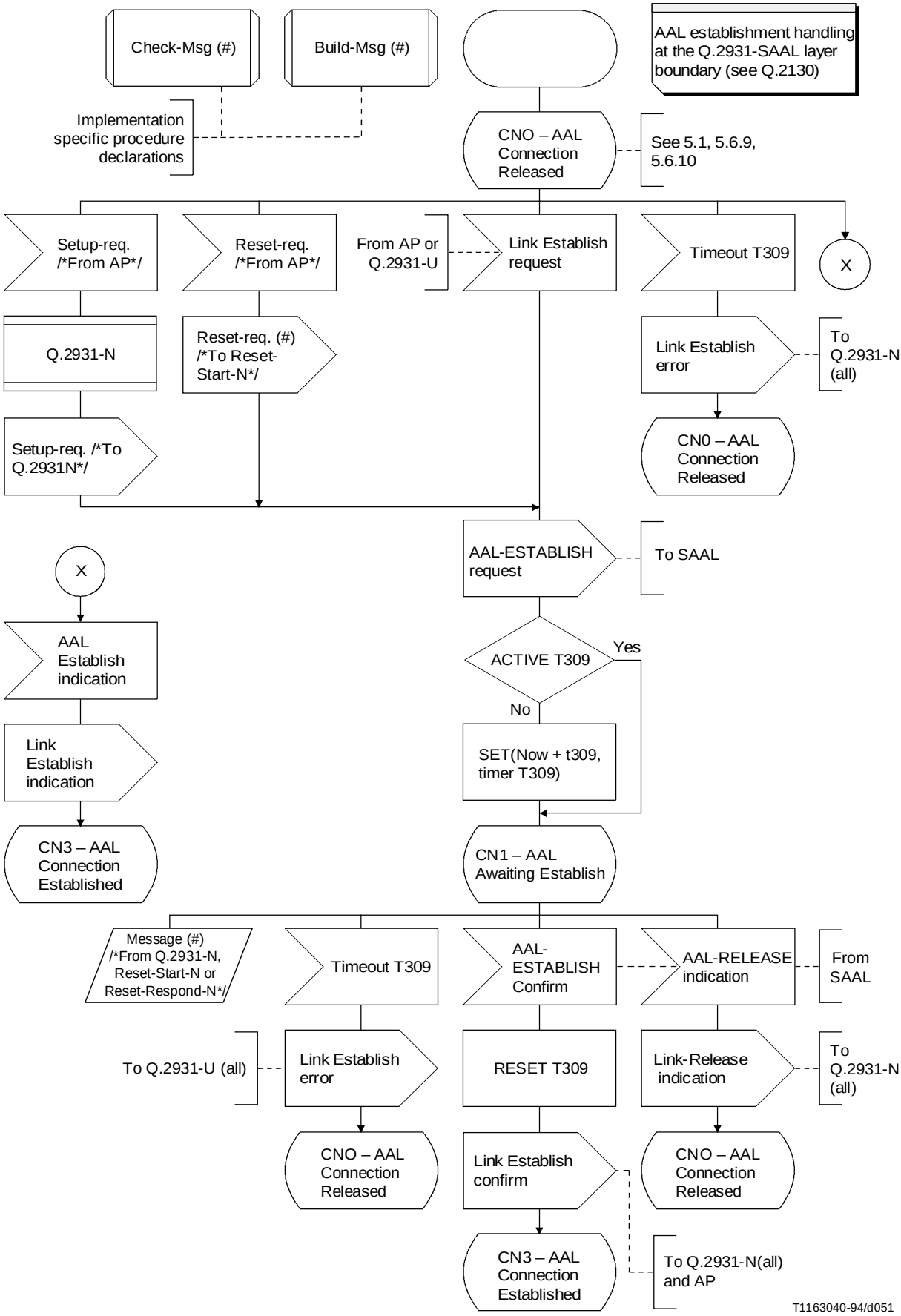
CDtoQN	QNtoCD
SETUP-ACKNOWLEDGE	SETUP-ACKNOWLEDGE
INFORMATION	INFORMATION
PROGRESS	PROGRESS

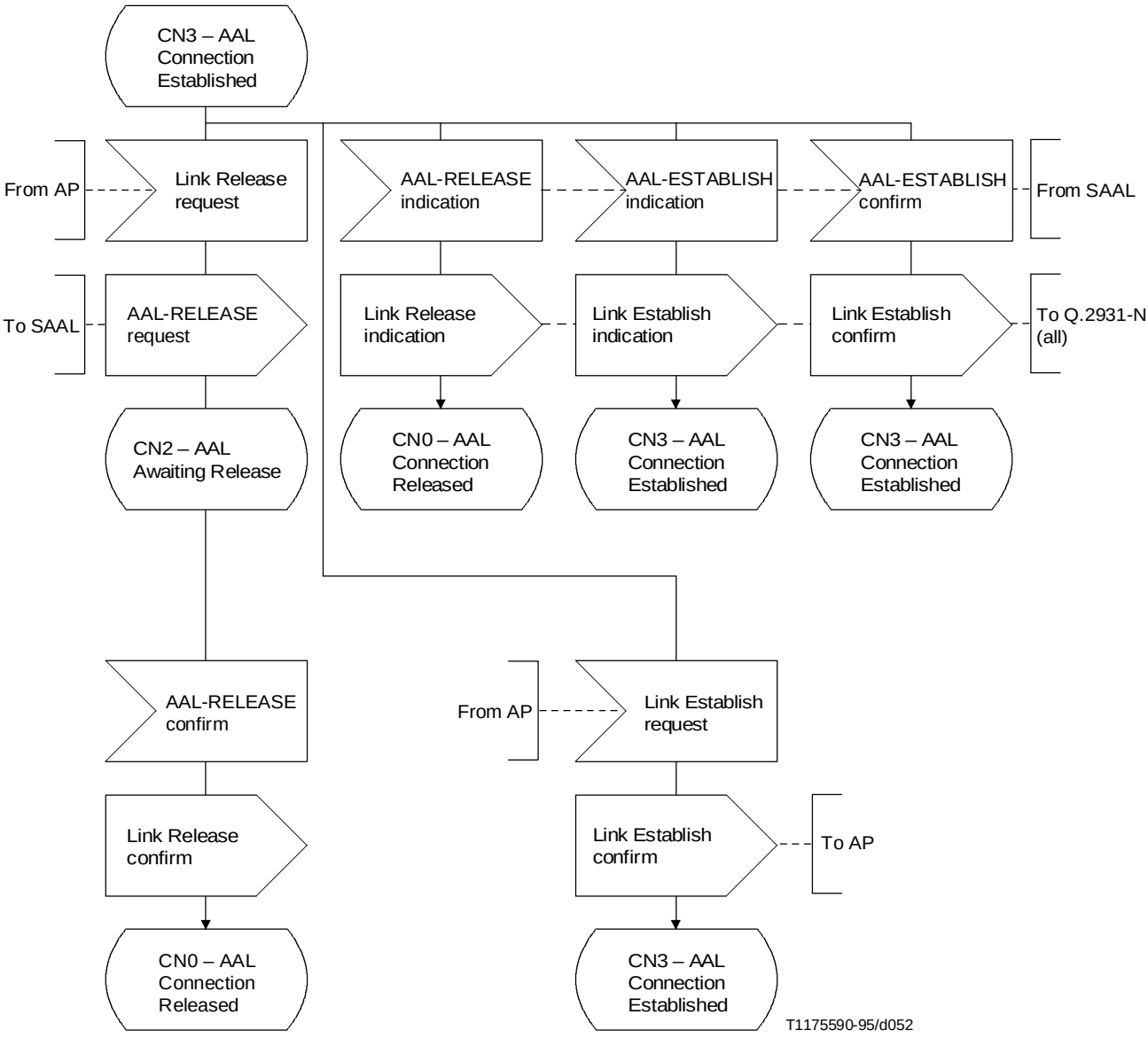
Additional Messages to/from Q.2931-N related to Supplementary Services

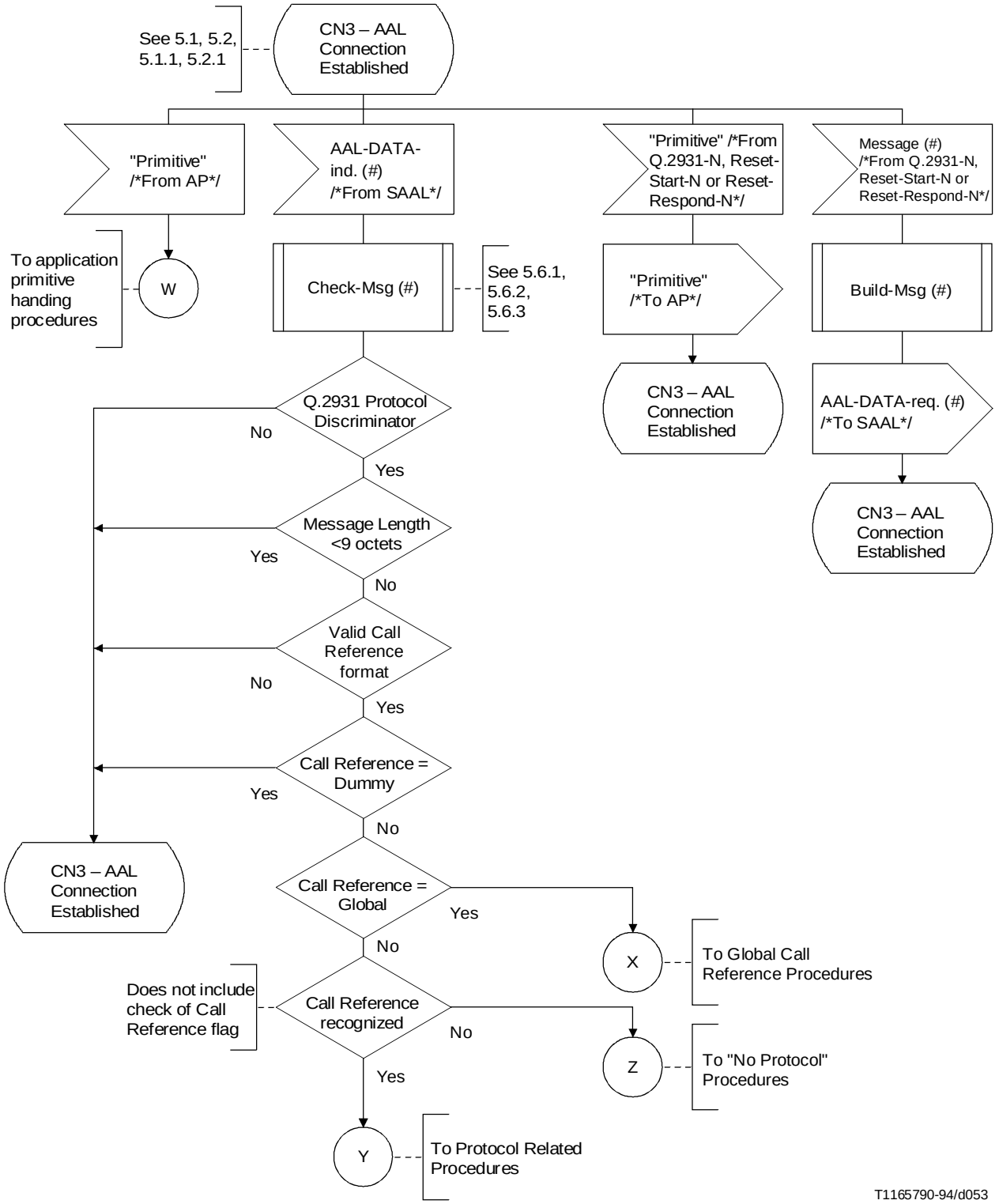
Signal lists

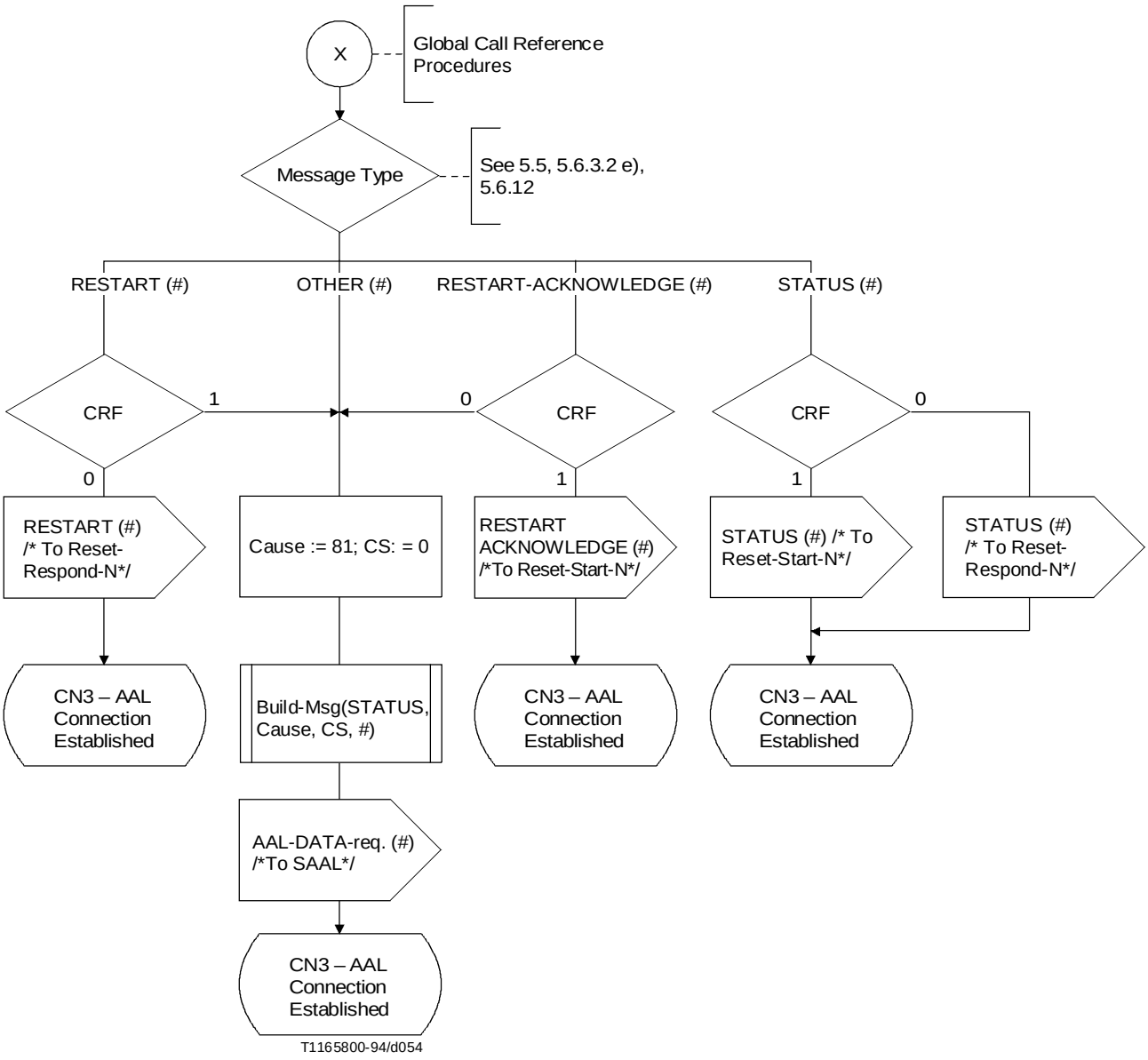
CDtoQN	QNtoCD
These primitives are listed in the relevant broadband supplementary service Recommendations (Q.295x. – Series)	

T1163030-94/d050

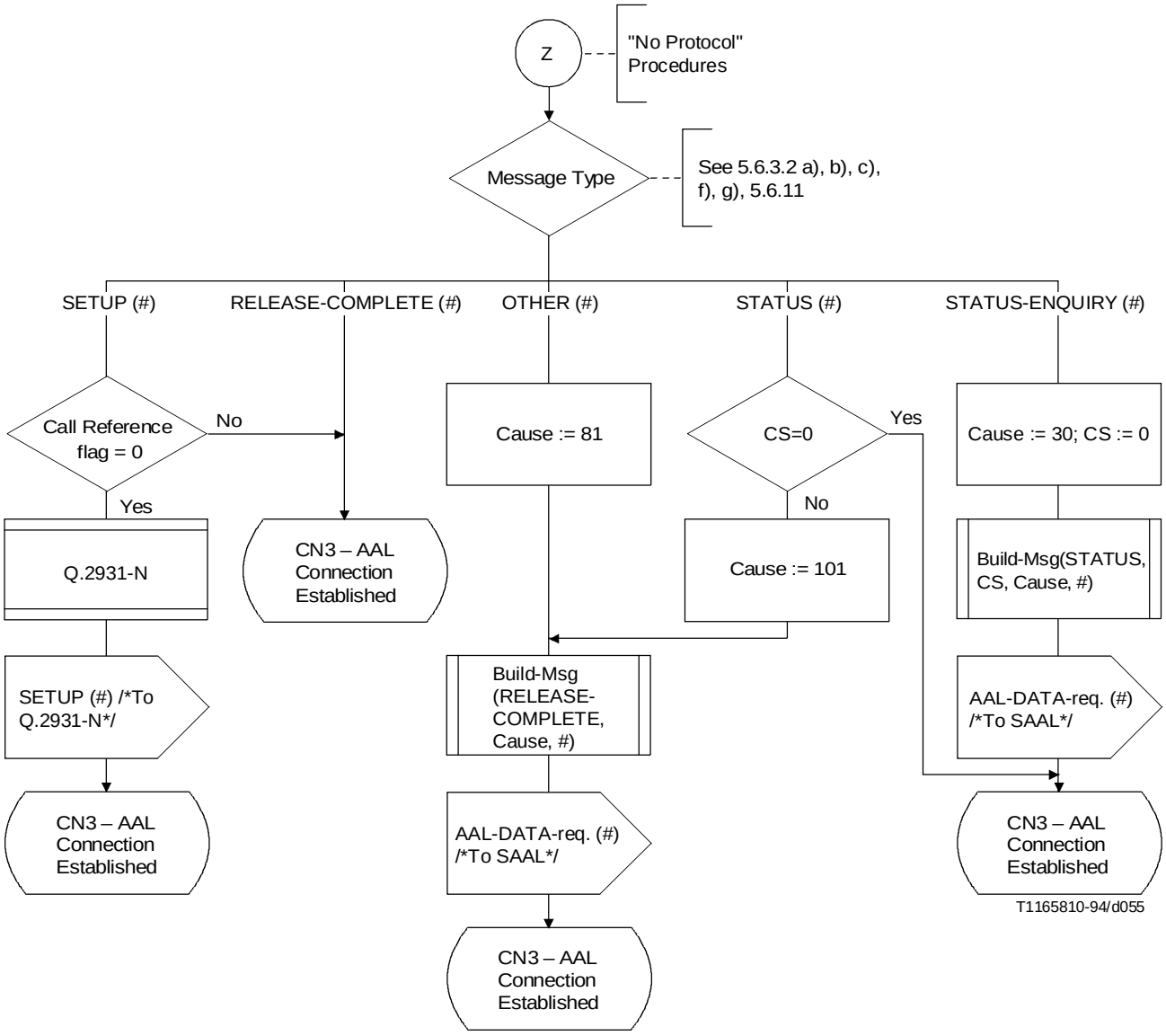

Check-Msg (#)
Build-Msg (#)
AAL establishment handling at the Q.2931-SAAL layer boundary (see Q.2130)
Implementation specific procedure declarations
CNO – AAL Connection Released
See 5.1, 5.6.9, 5.6.10
Setup-req. /*From AP*/
Reset-req. /*From AP*/
From AP or Q.2931-U
Link Establish request
Timeout T309
X
Q.2931-N
Reset-req. (#) /*To Reset-Start-N*/
Link Establish error
To Q.2931-N (all)
Setup-req. /*To Q.2931N*/
CN0 – AAL Connection Released
AAL-ESTABLISH request
To SAAL
X
AAL Establish indication
ACTIVE T309
Yes
No
Link Establish indication
SET(Now + t309, timer T309)
CN3 – AAL Connection Established
CN1 – AAL Awaiting Establish
Message (#) /*From Q.2931-N, Reset-Start-N or Reset-Respond-N*/
Timeout T309
AAL-ESTABLISH Confirm
AAL-RELEASE indication
From SAAL
To Q.2931-U (all)
Link Establish error
RESET T309
Link-Release indication
To Q.2931-N (all)
CNO – AAL Connection Released
Link Establish confirm
CNO – AAL Connection Released
CN3 – AAL Connection Established
To Q.2931-N(all) and AP
T1163040-94/d051

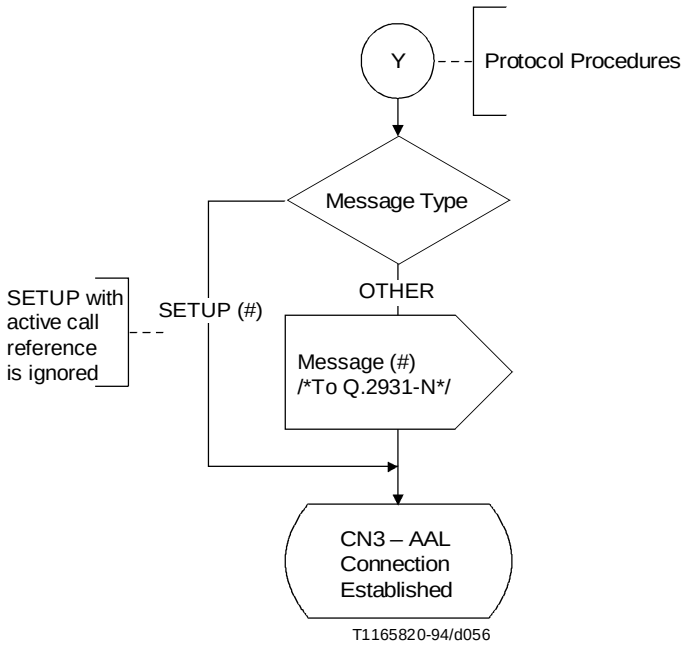

CN3 – AAL Connection Established
From AP
Link Release request
AAL-RELEASE indication
AAL-ESTABLISH indication
AAL-ESTABLISH confirm
From SAAL
To SAAL
AAL-RELEASE request
Link Release indication
Link Establish indication
Link Establish confirm
To Q.2931-N (all)
CN2 – AAL Awaiting Release
CN0 – AAL Connection Released
CN3 – AAL Connection Established
CN3 – AAL Connection Established
AAL-RELEASE confirm
From AP
Link Establish request
Link Release confirm
Link Establish confirm
To AP
CN0 – AAL Connection Released
CN3 – AAL Connection Established
T1175590-95/d052

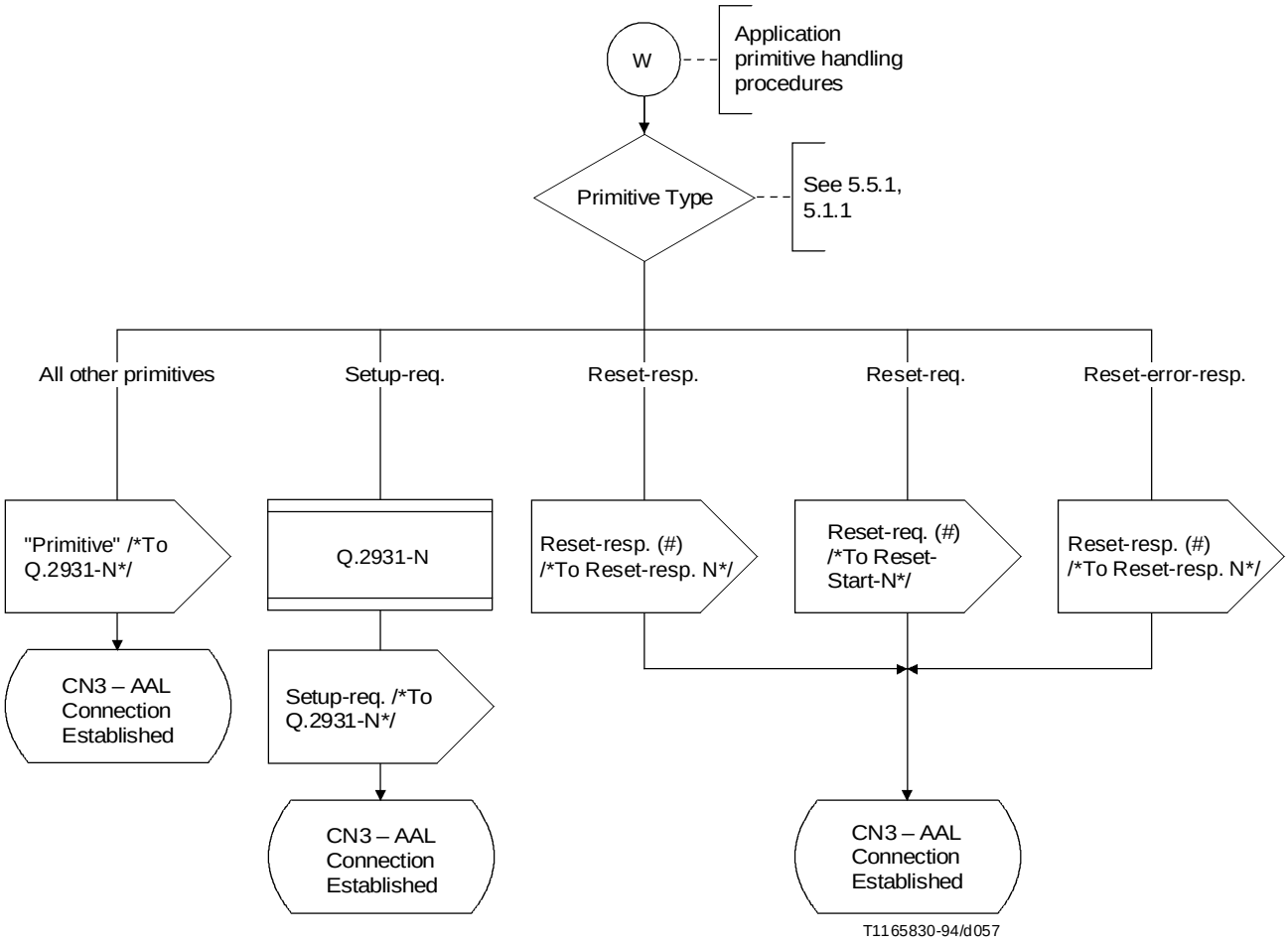

See 5.1, 5.2, 5.1.1, 5.2.1
CN3 – AAL Connection Established
"Primitive" /*From AP*/
AAL-DATA-ind. (#) /*From SAAL*/
"Primitive" /*From Q.2931-N, Reset-Start-N or Reset-Respond-N*/
Message (#) /*From Q.2931-N, Reset-Start-N or Reset-Respond-N*/
To application primitive handing procedures
W
Check-Msg (#)
See 5.6.1, 5.6.2, 5.6.3
"Primitive" /*To AP*/
Build-Msg (#)
CN3 – AAL Connection Established
AAL-DATA-req. (#) /*To SAAL*/
CN3 – AAL Connection Established
Q.2931 Protocol Discriminator
No
Yes
Message Length <9 octets
Yes
No
Valid Call Reference format
No
Yes
Call Reference = Dummy
Yes
No
CN3 – AAL Connection Established
Call Reference = Global
Yes
No
X
To Global Call Reference Procedures
Does not include check of Call Reference flag
Call Reference recognized
No
Yes
Z
To "No Protocol" Procedures
Y
To Protocol Related Procedures
T1165790-94/d053

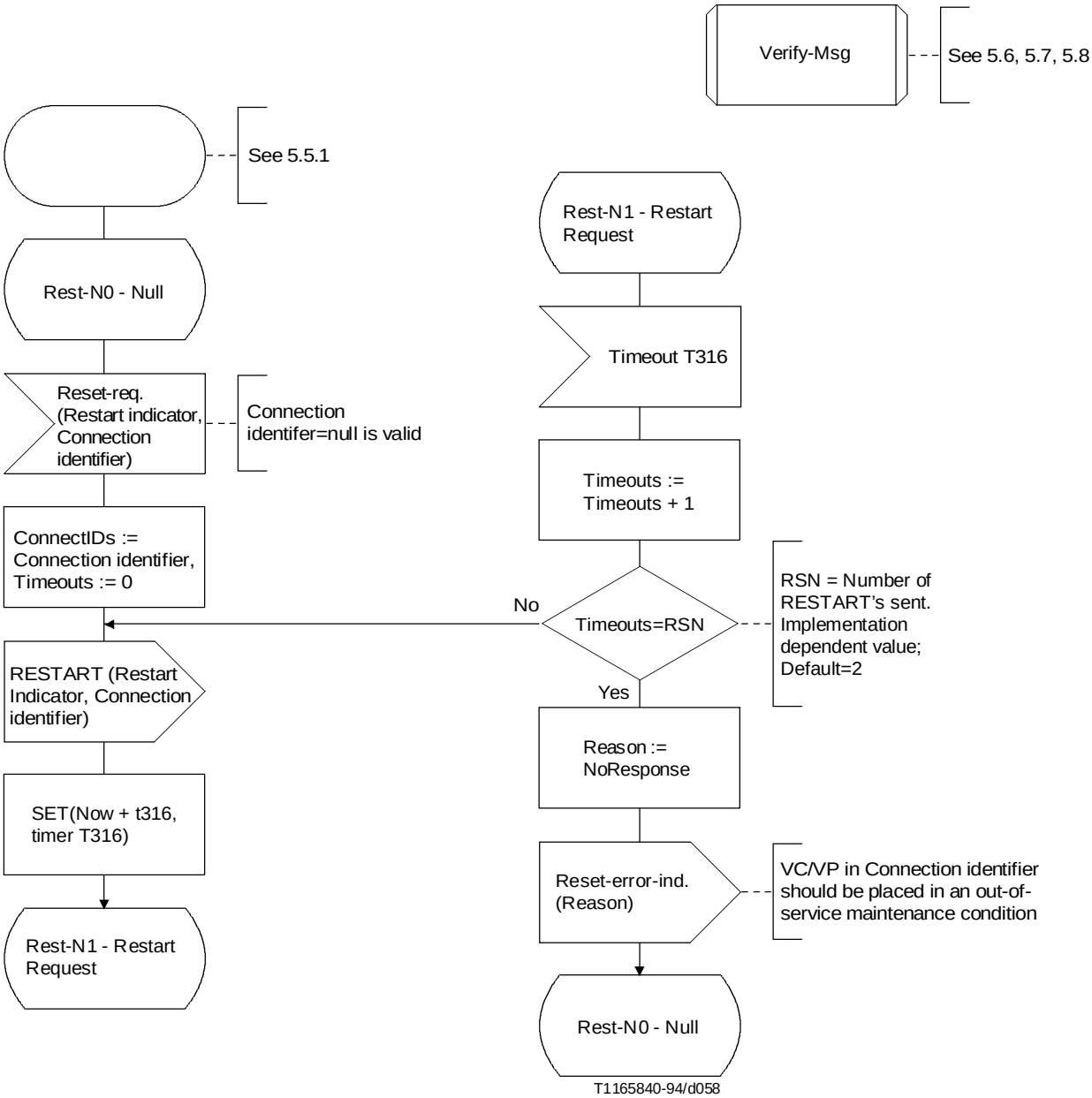


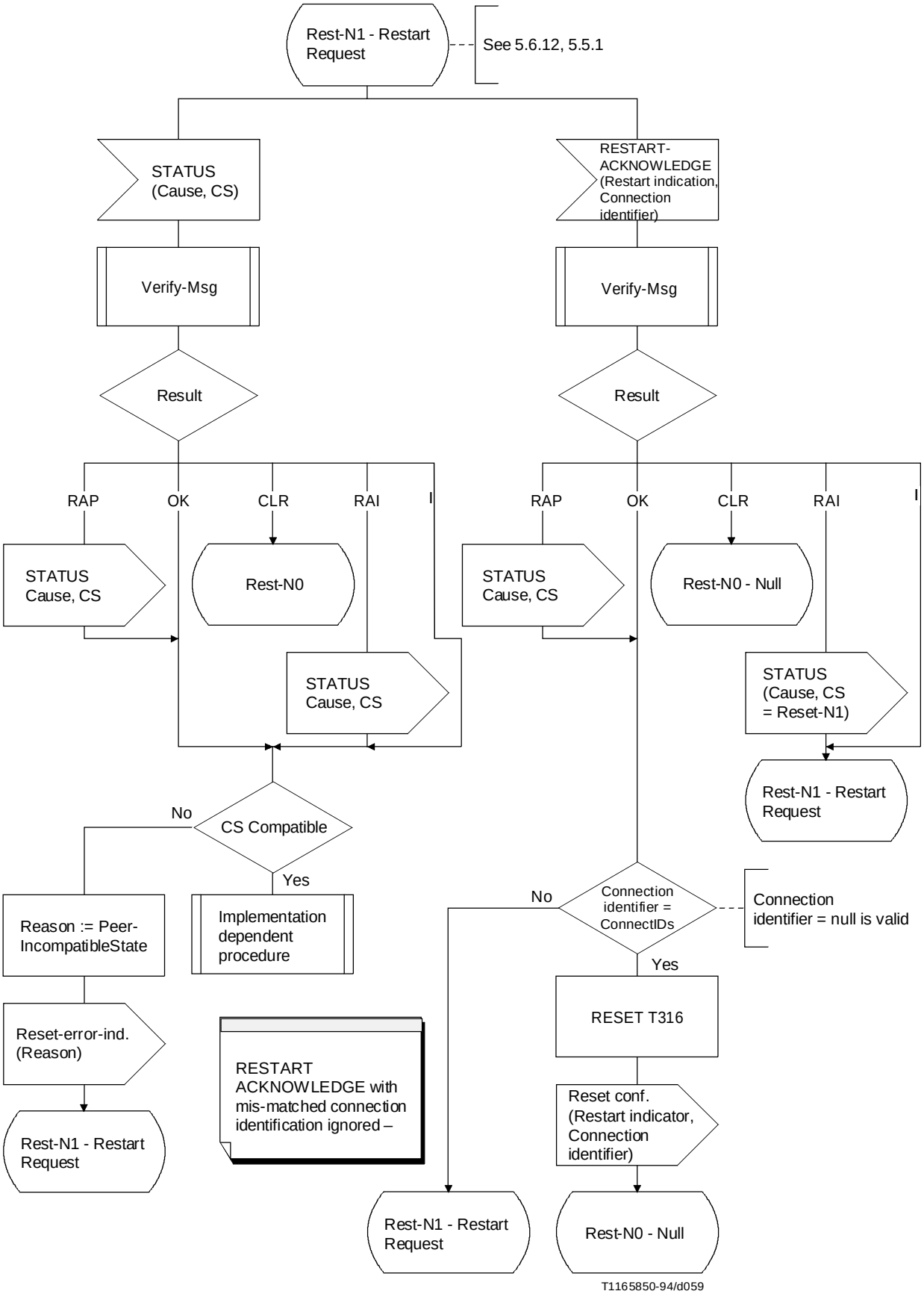
CRF = Call Reference Flag

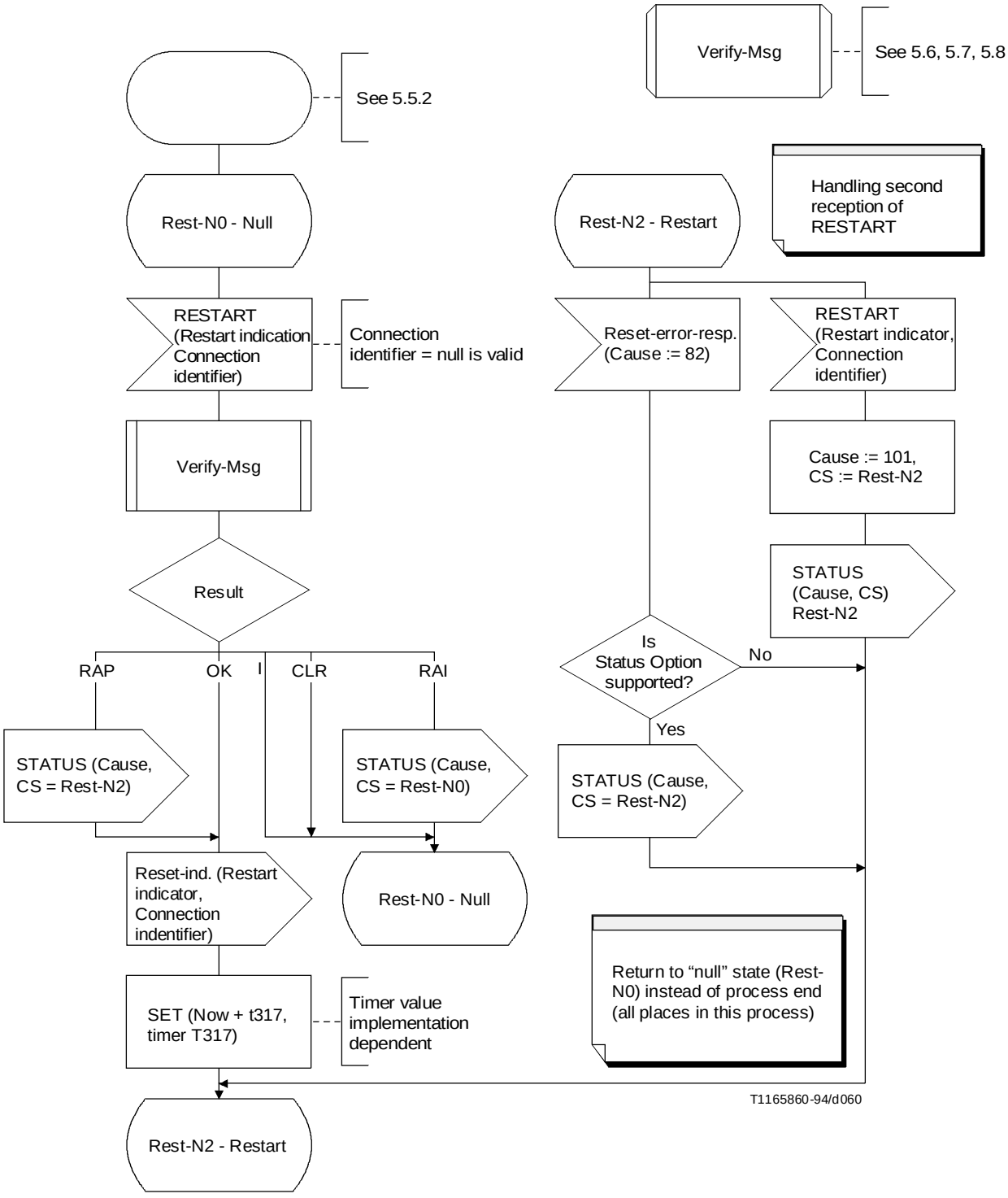

Z
"No Protocol" Procedures
Message Type
See 5.6.3.2 a), b), c), f), g), 5.6.11
SETUP (#)
RELEASE-COMPLETE (#)
OTHER (#)
STATUS (#)
STATUS-ENQUIRY (#)
Call Reference flag = 0
No
Yes
Q.2931-N
SETUP (#) /*To Q.2931-N*/
CN3 – AAL Connection Established
CN3 – AAL Connection Established
Cause := 81
Build-Msg (RELEASE-COMPLETE, Cause, #)
AAL-DATA-req. (#) /*To SAAL*/
CN3 – AAL Connection Established
CS=0
Yes
No
Cause := 101
Cause := 30; CS := 0
Build-Msg(STATUS, CS, Cause, #)
AAL-DATA-req. (#) /*To SAAL*/
CN3 – AAL Connection Established
T1165810-94/d055

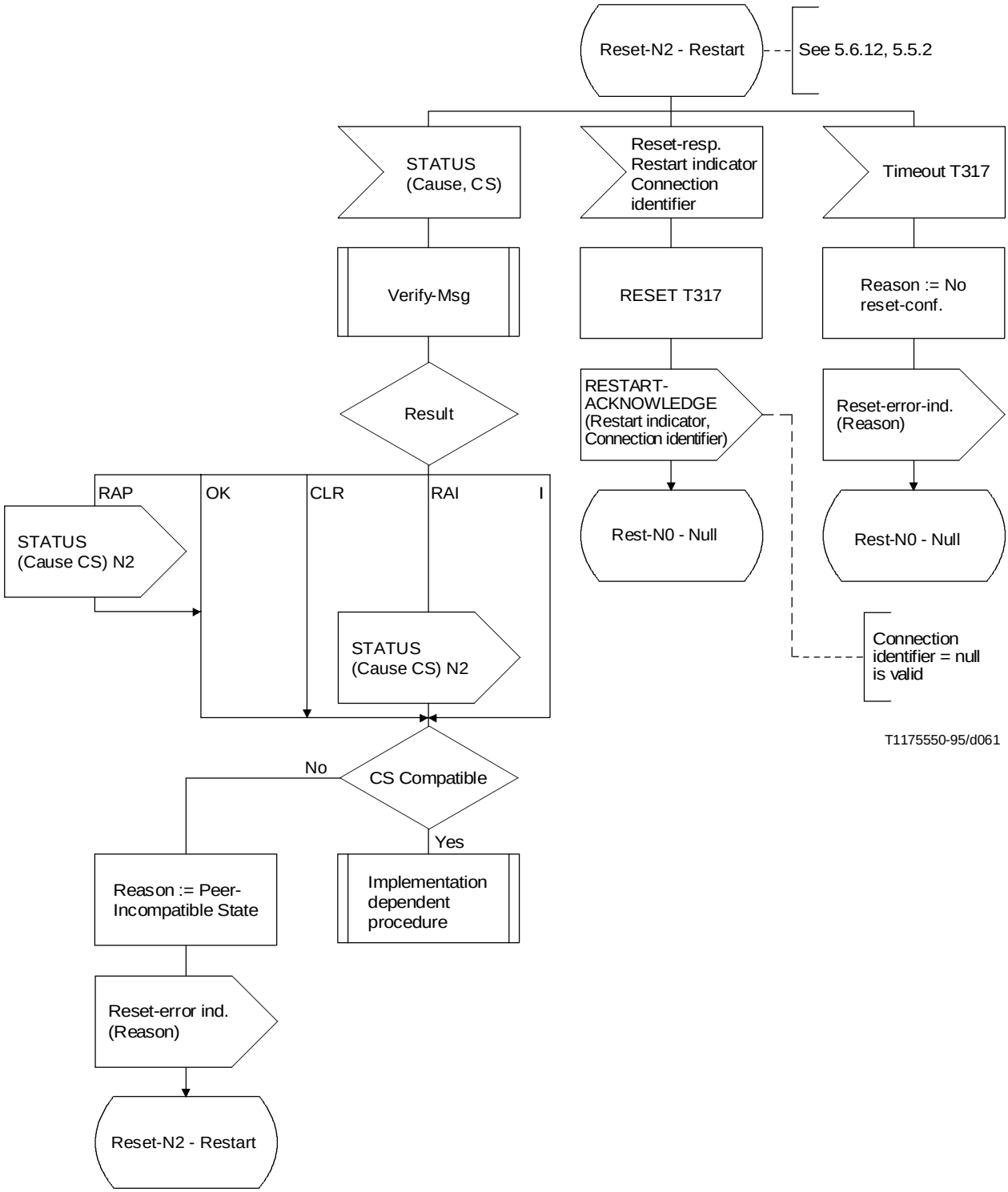

Y
Protocol Procedures
Message Type
OTHER
SETUP with active call reference is ignored
SETUP (#)
Message (#) /*To Q.2931-N*/
CN3 – AAL Connection Established
T1165820-94/d056

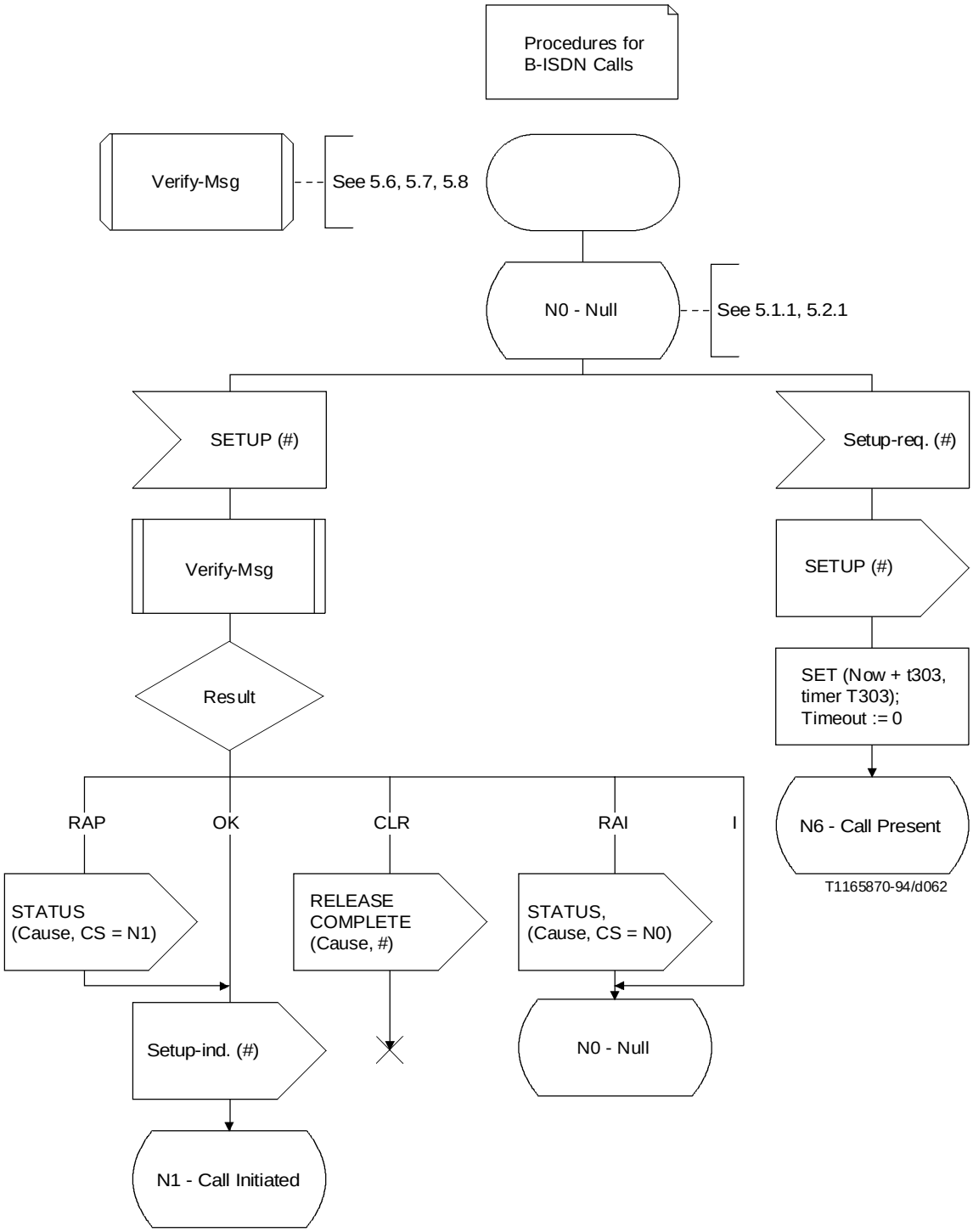

W
Application primitive handling procedures
Primitive Type
See 5.5.1, 5.1.1
All other primitives
Setup-req.
Reset-resp.
Reset-req.
Reset-error-resp.
"Primitive" /*To Q.2931-N*/
Q.2931-N
Reset-resp. (#) /*To Reset-resp. N*/
Reset-req. (#) /*To Reset-Start-N*/
Reset-resp. (#) /*To Reset-resp. N*/
CN3 – AAL Connection Established
Setup-req. /*To Q.2931-N*/
CN3 – AAL Connection Established
CN3 – AAL Connection Established
T1165830-94/d057

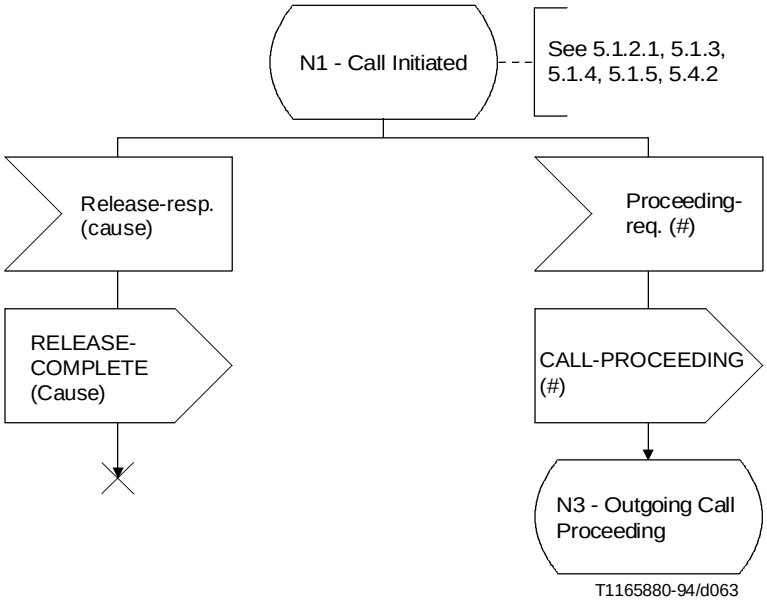

Verify-Msg
See 5.6, 5.7, 5.8
See 5.5.1
Rest-N0 - Null
Reset-req. (Restart indicator, Connection identifier)
Connection identifer=null is valid
ConnectIDs := Connection identifier, Timeouts := 0
RESTART (Restart Indicator, Connection identifier)
SET(Now + t316, timer T316)
Rest-N1 - Restart Request
Rest-N1 - Restart Request
Timeout T316
Timeouts := Timeouts + 1
Timeouts=RSN
No
Yes
RSN = Number of RESTART's sent. Implementation dependent value; Default=2
Reason := NoResponse
Reset-error-ind. (Reason)
VC/VP in Connection identifier should be placed in an out-of-service maintenance condition
Rest-N0 - Null
T1165840-94/d058

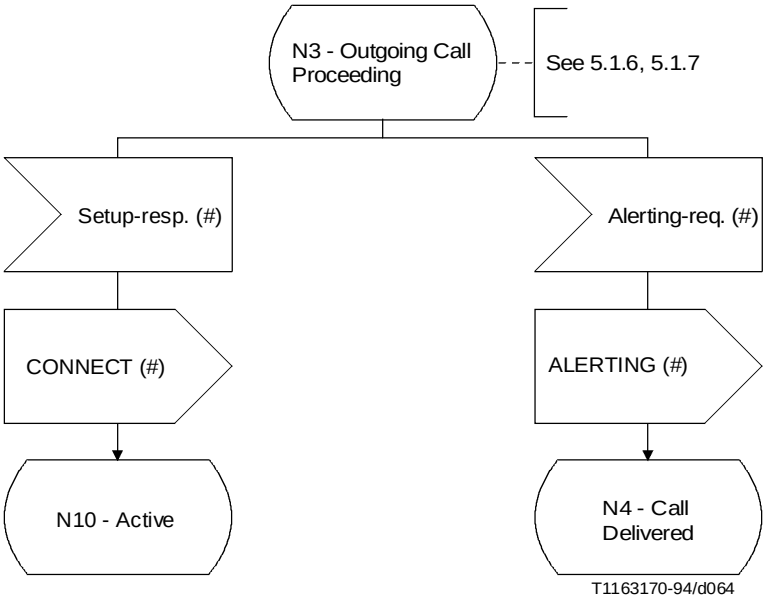

Rest-N1 - Restart Request
See 5.6.12, 5.5.1
STATUS (Cause, CS)
RESTART-ACKNOWLEDGE (Restart indication, Connection identifier)
Verify-Msg
Verify-Msg
Result
Result
RAP
OK
CLR
RAI
I
RAP
OK
CLR
RAI
I
STATUS Cause, CS
Rest-N0
STATUS Cause, CS
Rest-N0 - Null
STATUS Cause, CS
STATUS (Cause, CS = Reset-N1)
Rest-N1 - Restart Request
No
CS Compatible
Yes
No
Connection identifier = ConnectIDs
Connection identifier = null is valid
Yes
Reason := Peer-IncompatibleState
Implementation dependent procedure
RESET T316
Reset-error-ind. (Reason)
RESTART ACKNOWLEDGE with mis-matched connection identification ignored –
Reset conf. (Restart indicator, Connection identifier)
Rest-N1 - Restart Request
Rest-N1 - Restart Request
Rest-N0 - Null
T1165850-94/d059

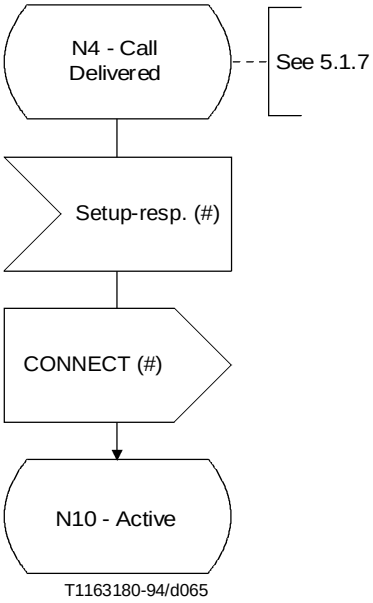

Verify-Msg
See 5.6, 5.7, 5.8
See 5.5.2
Rest-N0 - Null
Rest-N2 - Restart
Handling second reception of RESTART
RESTART (Restart indication Connection identifier)
Connection identifier = null is valid
Reset-error-resp. (Cause := 82)
RESTART (Restart indicator, Connection identifier)
Verify-Msg
Cause := 101, CS := Rest-N2
Result
STATUS (Cause, CS) Rest-N2
RAP
OK
CLR
RAI
Is Status Option supported?
No
Yes
STATUS (Cause, CS = Rest-N2)
STATUS (Cause, CS = Rest-N0)
STATUS (Cause, CS = Rest-N2)
Reset-ind. (Restart indicator, Connection indentifier)
Rest-N0 - Null
Return to “null” state (Rest-N0) instead of process end (all places in this process)
SET (Now + t317, timer T317)
Timer value implementation dependent
T1165860-94/d060
Rest-N2 - Restart

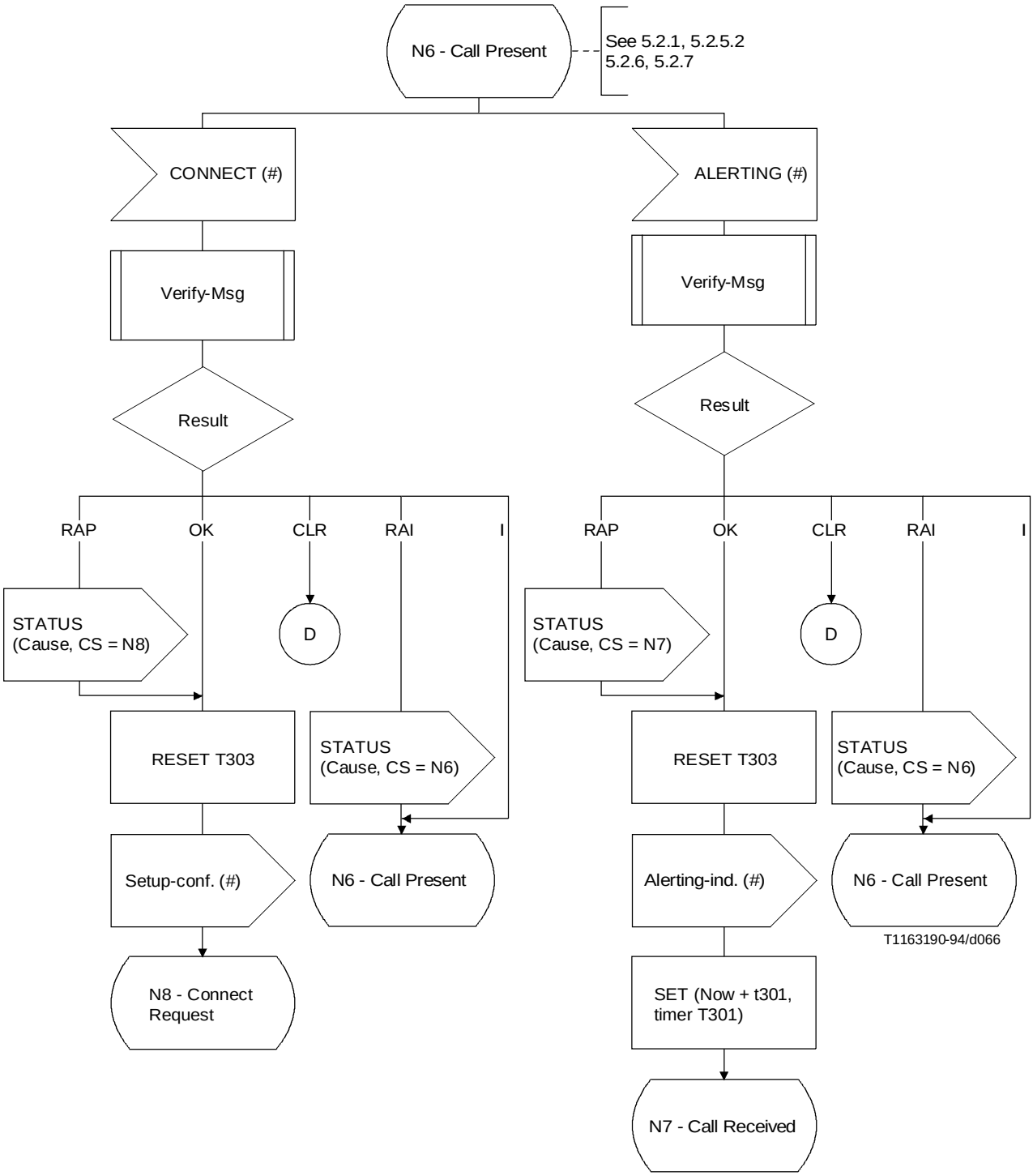

Reset-N2 - Restart
See 5.6.12, 5.5.2
STATUS (Cause, CS)
Reset-resp. Restart indicator Connection identifier
Timeout T317
Verify-Msg
RESET T317
Reason := No reset-conf.
Result
RESTART-ACKNOWLEDGE (Restart indicator, Connection identifier)
Reset-error-ind. (Reason)
RAP
OK
CLR
RAI
I
STATUS (Cause CS) N2
Rest-N0 - Null
Rest-N0 - Null
STATUS (Cause CS) N2
Connection identifier = null is valid
T1175550-95/d061
No
CS Compatible
Yes
Reason := Peer-Incompatible State
Implementation dependent procedure
Reset-error ind. (Reason)
Reset-N2 - Restart

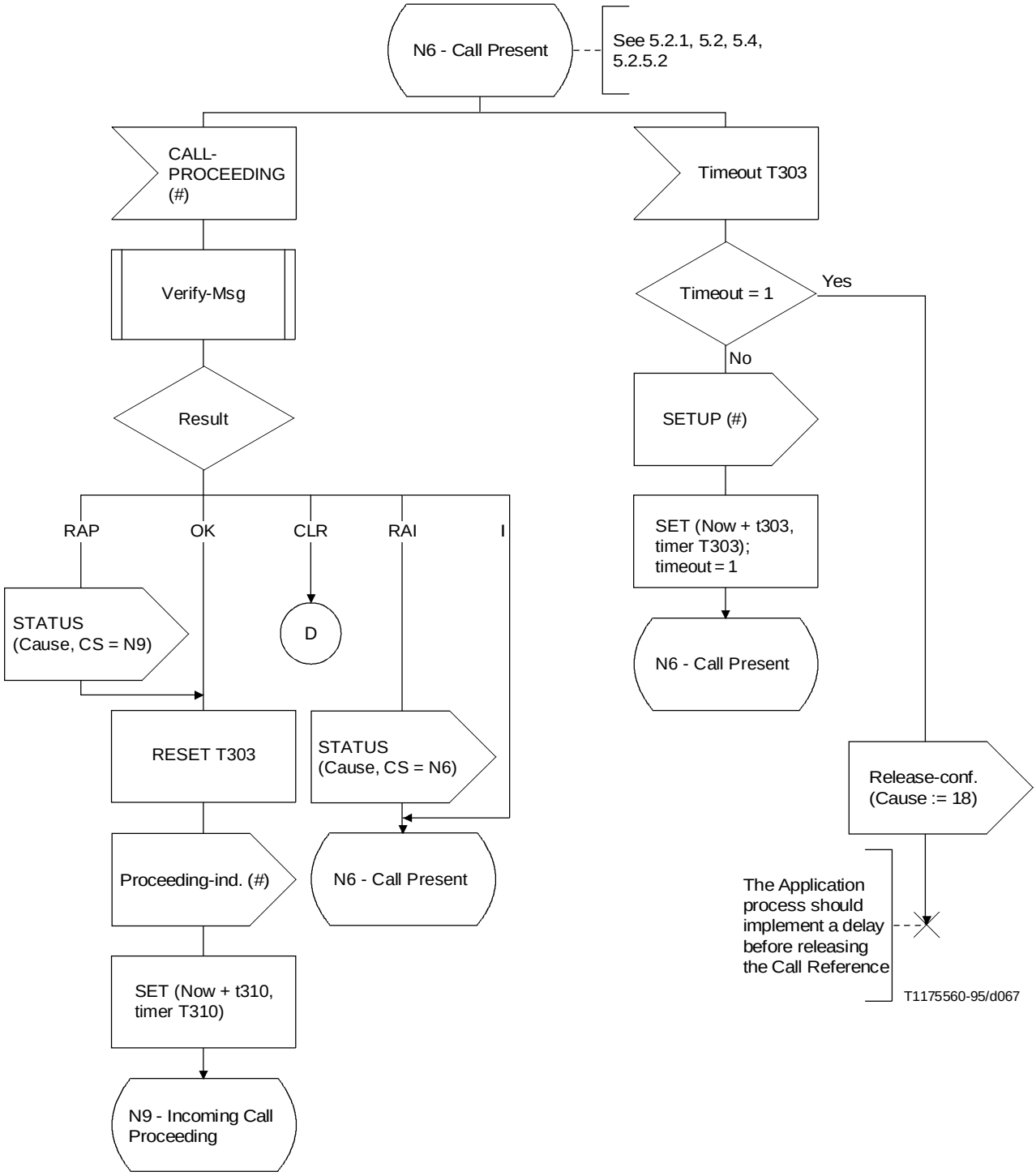

Procedures for B-ISDN Calls
Verify-Msg
See 5.6, 5.7, 5.8
N0 - Null
See 5.1.1, 5.2.1
SETUP (#)
Setup-req. (#)
Verify-Msg
SETUP (#)
Result
SET (Now + t303, timer T303); Timeout := 0
RAP
OK
CLR
RAI
I
N6 - Call Present
STATUS (Cause, CS = N1)
RELEASE COMPLETE (Cause, #)
STATUS, (Cause, CS = N0)
Setup-ind. (#)
N0 - Null
N1 - Call Initiated
T1165870-94/d062

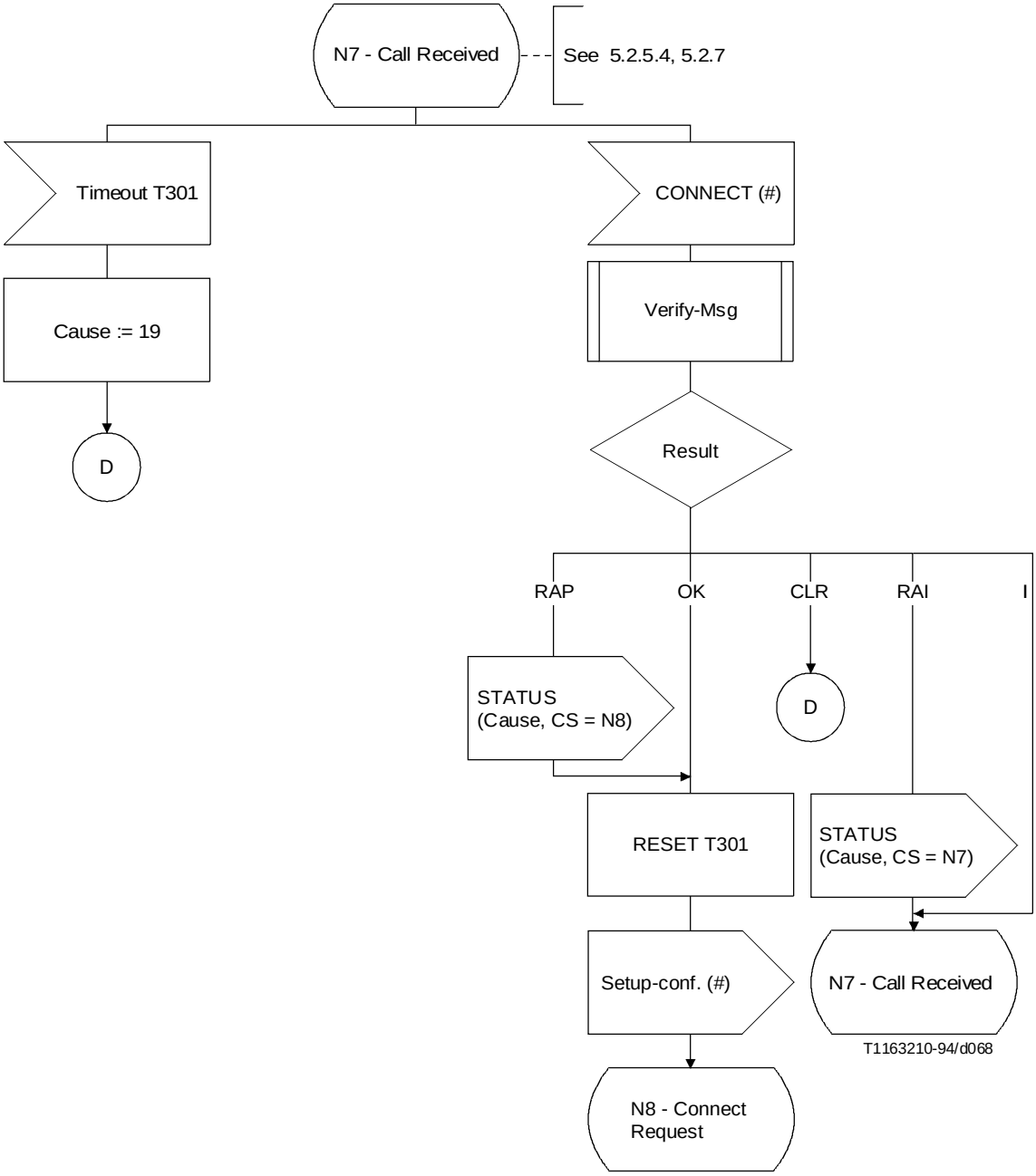

N1 - Call Initiated
See 5.1.2.1, 5.1.3, 5.1.4, 5.1.5, 5.4.2
Release-resp. (cause)
Proceeding-req. (#)
RELEASE-COMPLETE (Cause)
CALL-PROCEEDING (#)
N3 - Outgoing Call Proceeding
T1165880-94/d063

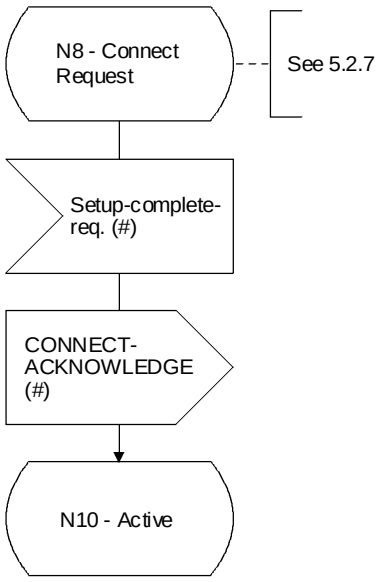

N3 - Outgoing Call Proceeding
See 5.1.6, 5.1.7
Setup-resp. (#)
Alerting-req. (#)
CONNECT (#)
ALERTING (#)
N10 - Active
N4 - Call Delivered
T1163170-94/d064

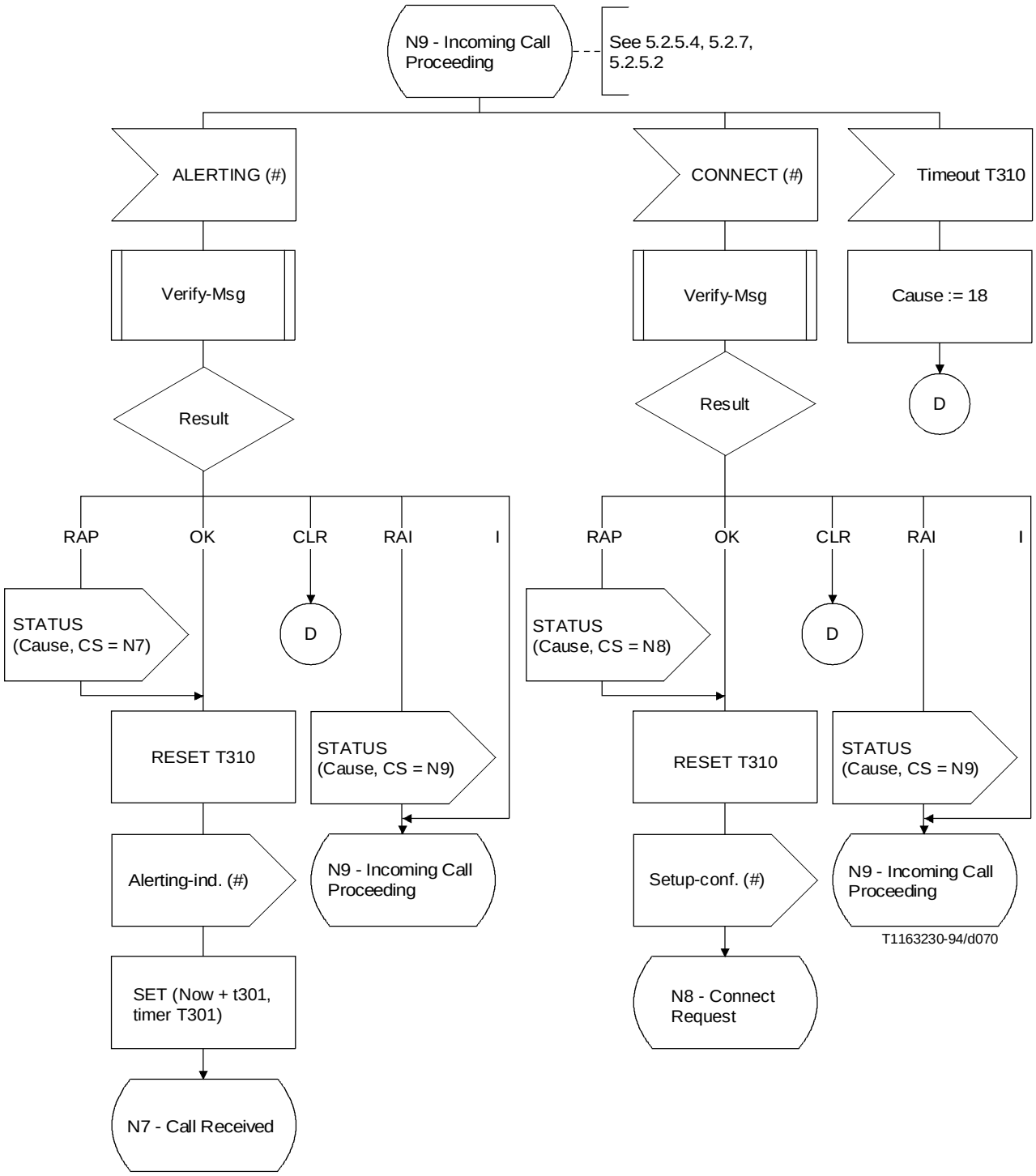

N4 - Call Delivered
See 5.1.7
Setup-resp. (#)
CONNECT (#)
N10 - Active
T1163180-94/d065

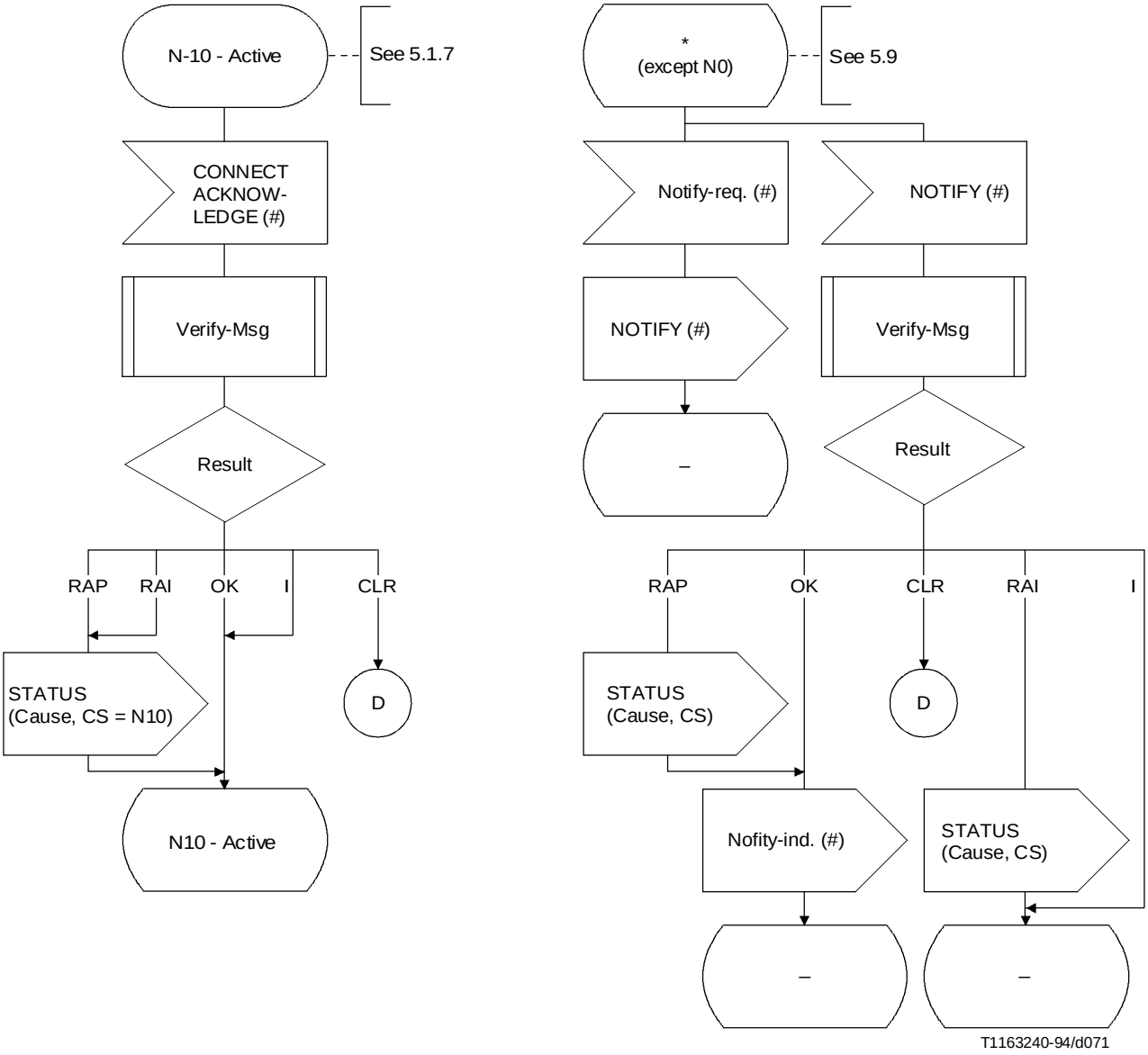

N6 - Call Present
See 5.2.1, 5.2.5.2
5.2.6, 5.2.7
CONNECT (#)
ALERTING (#)
Verify-Msg
Verify-Msg
Result
Result
RAP
OK
CLR
RAI
I
RAP
OK
CLR
RAI
I
STATUS
(Cause, CS = N8)
D
STATUS
(Cause, CS = N7)
D
RESET T303
STATUS
(Cause, CS = N6)
RESET T303
STATUS
(Cause, CS = N6)
Setup-conf. (#)
N6 - Call Present
Alerting-ind. (#)
N6 - Call Present
N8 - Connect
Request
SET (Now + t301,
timer T301)
N7 - Call Received
T1163190-94/d066

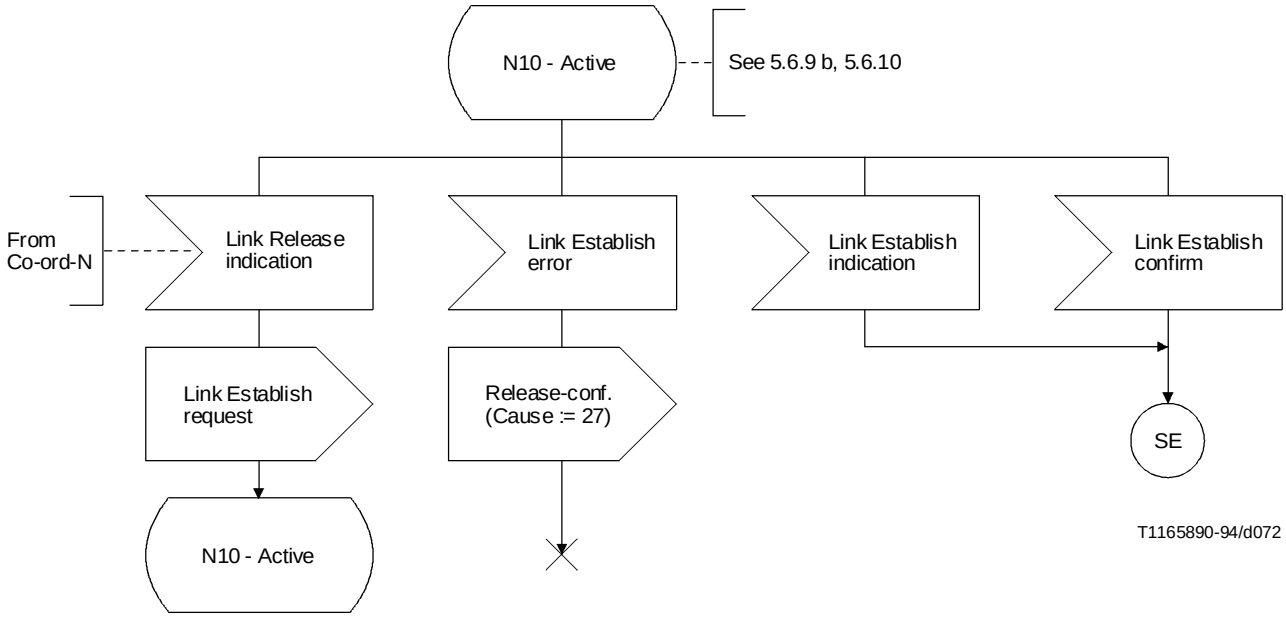

N6 - Call Present
See 5.2.1, 5.2, 5.4, 5.2.5.2
CALL-PROCEEDING (#)
Timeout T303
Verify-Msg
Timeout = 1
Yes
No
Result
SETUP (#)
RAP
OK
CLR
RAI
I
SET (Now + t303, timer T303); timeout = 1
STATUS (Cause, CS = N9)
D
N6 - Call Present
RESET T303
STATUS (Cause, CS = N6)
Release-conf. (Cause := 18)
Proceeding-ind. (#)
N6 - Call Present
The Application process should implement a delay before releasing the Call Reference
SET (Now + t310, timer T310)
N9 - Incoming Call Proceeding
T1175560-95/d067

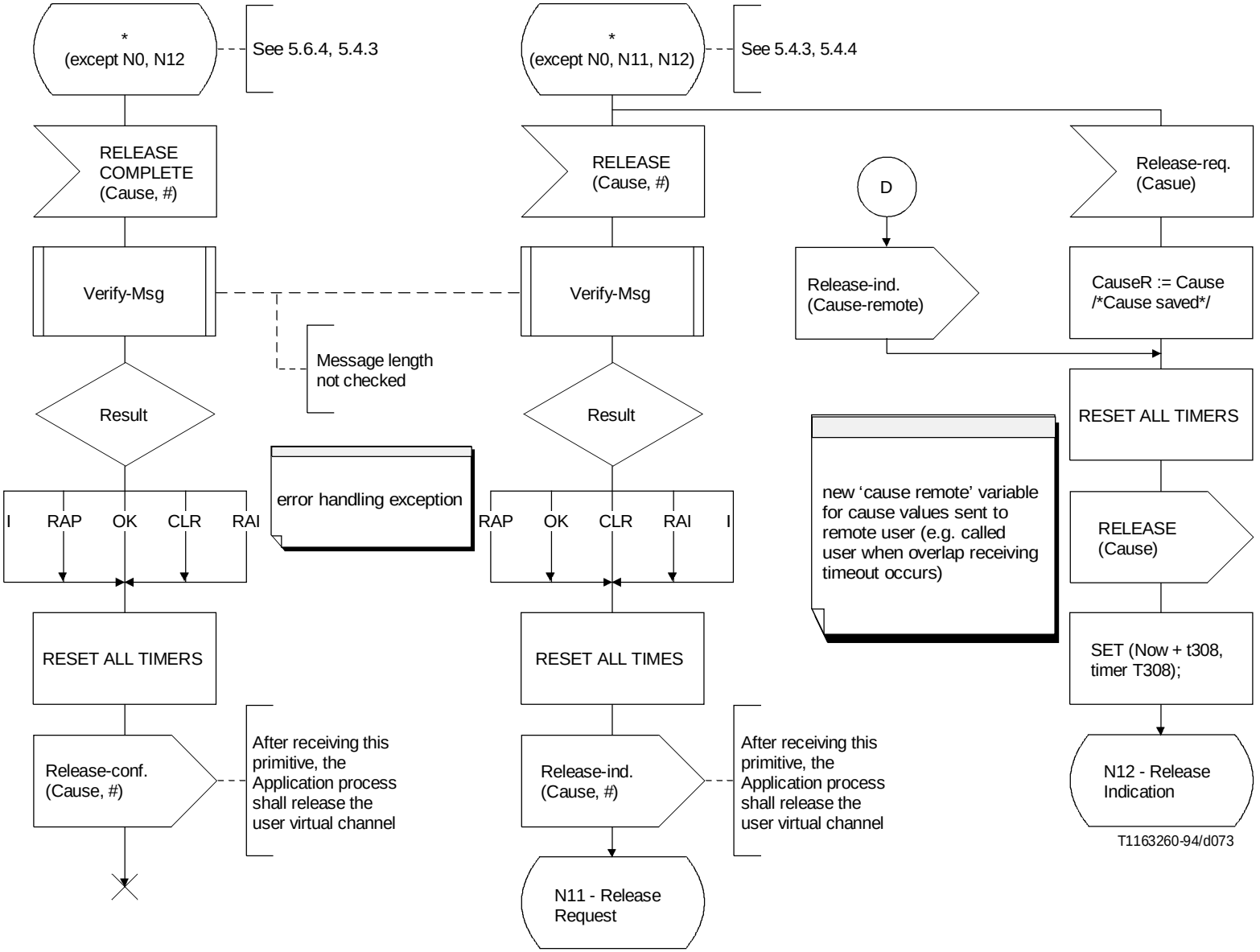

N7 - Call Received
See 5.2.5.4, 5.2.7
Timeout T301
CONNECT (#)
Cause := 19
Verify-Msg
D
Result
RAP
OK
CLR
RAI
I
STATUS
(Cause, CS = N8)
D
RESET T301
STATUS
(Cause, CS = N7)
Setup-conf. (#)
N7 - Call Received
N8 - Connect
Request
T1163210-94/d068

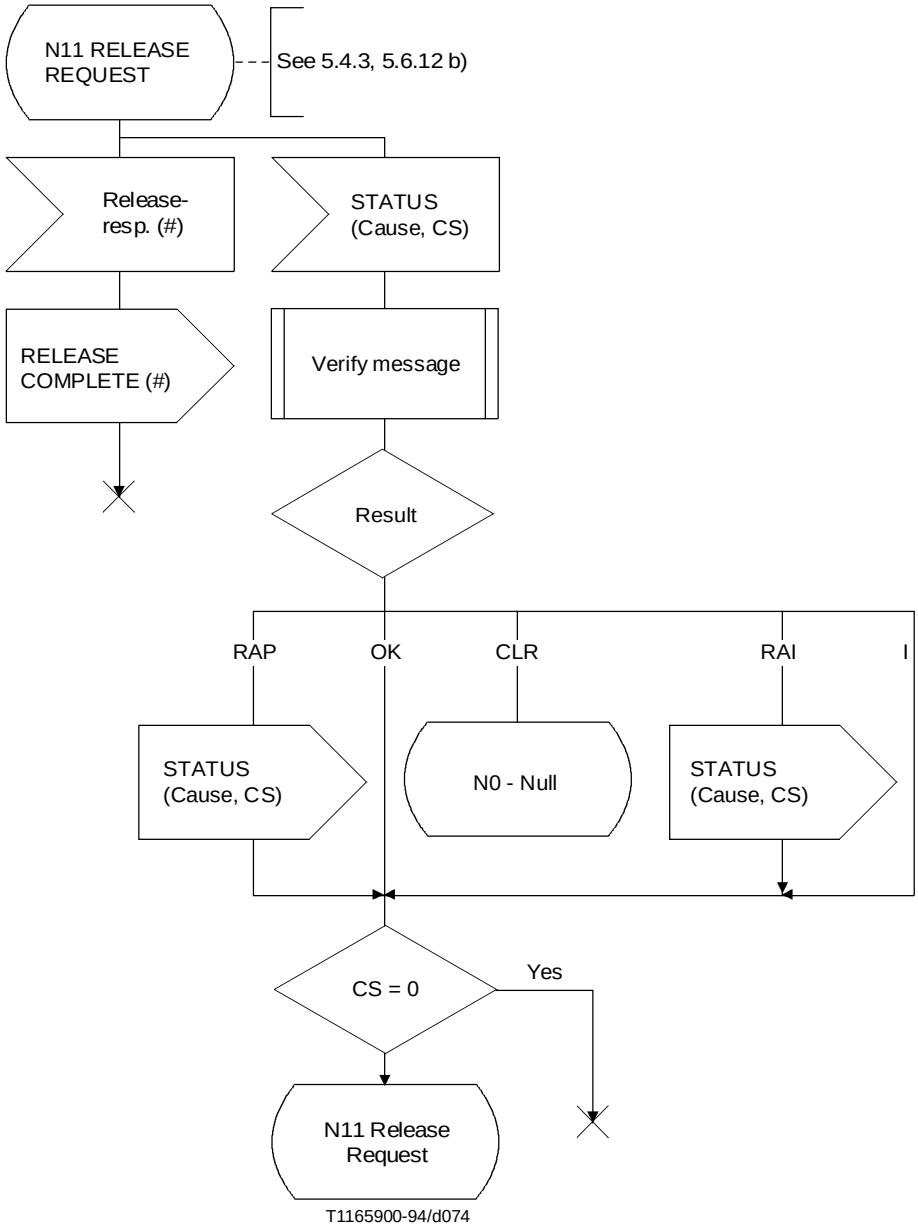

N8 - Connect Request
See 5.2.7
Setup-complete-req. (#)
CONNECT-ACKNOWLEDGE (#)
N10 - Active
T1163220-94/d069

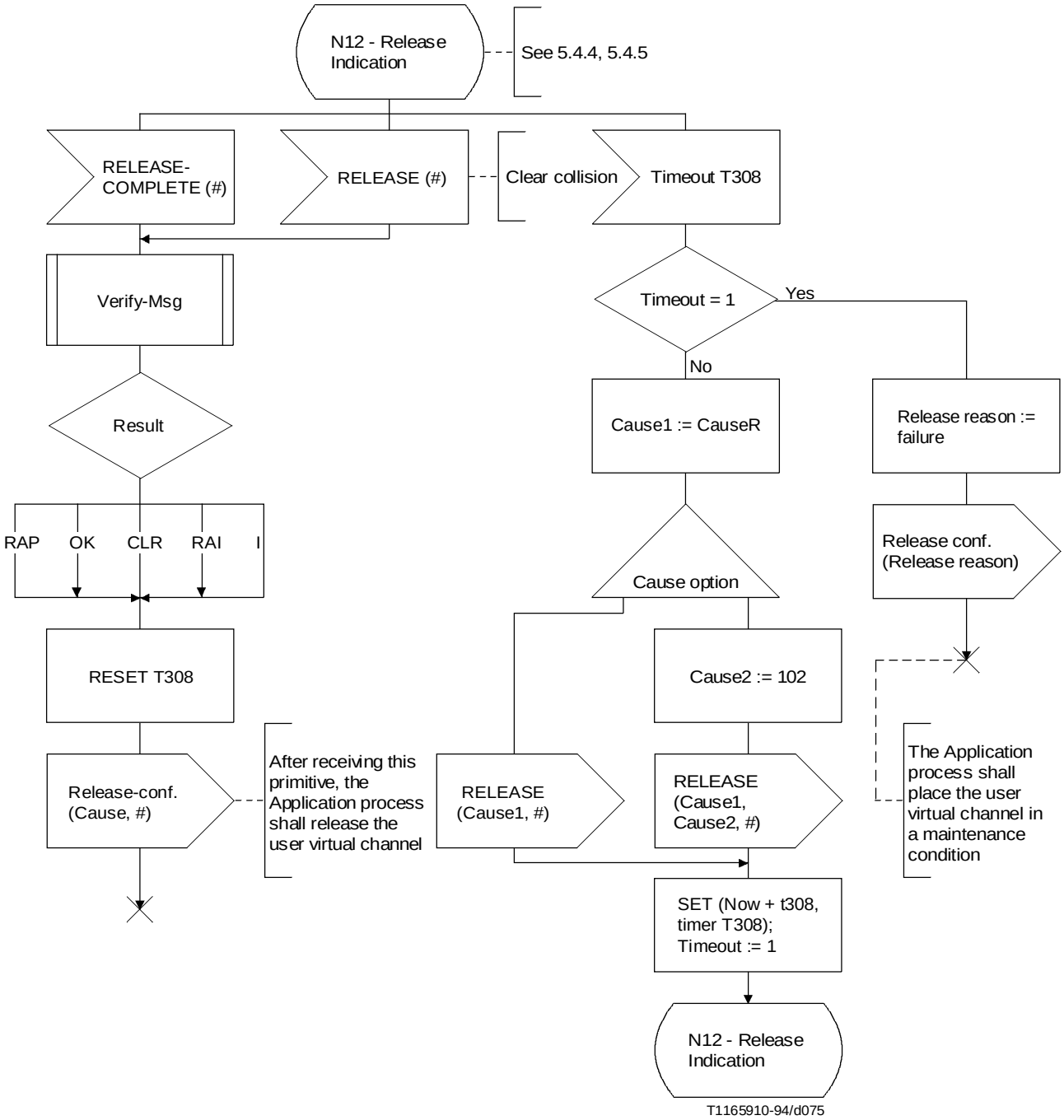

N9 - Incoming Call Proceeding
See 5.2.5.4, 5.2.7, 5.2.5.2
ALERTING (#)
CONNECT (#)
Timeout T310
Verify-Msg
Verify-Msg
Cause := 18
Result
Result
D
RAP
OK
CLR
RAI
I
RAP
OK
CLR
RAI
I
STATUS (Cause, CS = N7)
D
STATUS (Cause, CS = N8)
D
RESET T310
STATUS (Cause, CS = N9)
RESET T310
STATUS (Cause, CS = N9)
Alerting-ind. (#)
N9 - Incoming Call Proceeding
Setup-conf. (#)
N9 - Incoming Call Proceeding
T1163230-94/d070
SET (Now + t301, timer T301)
N8 - Connect Request
N7 - Call Received

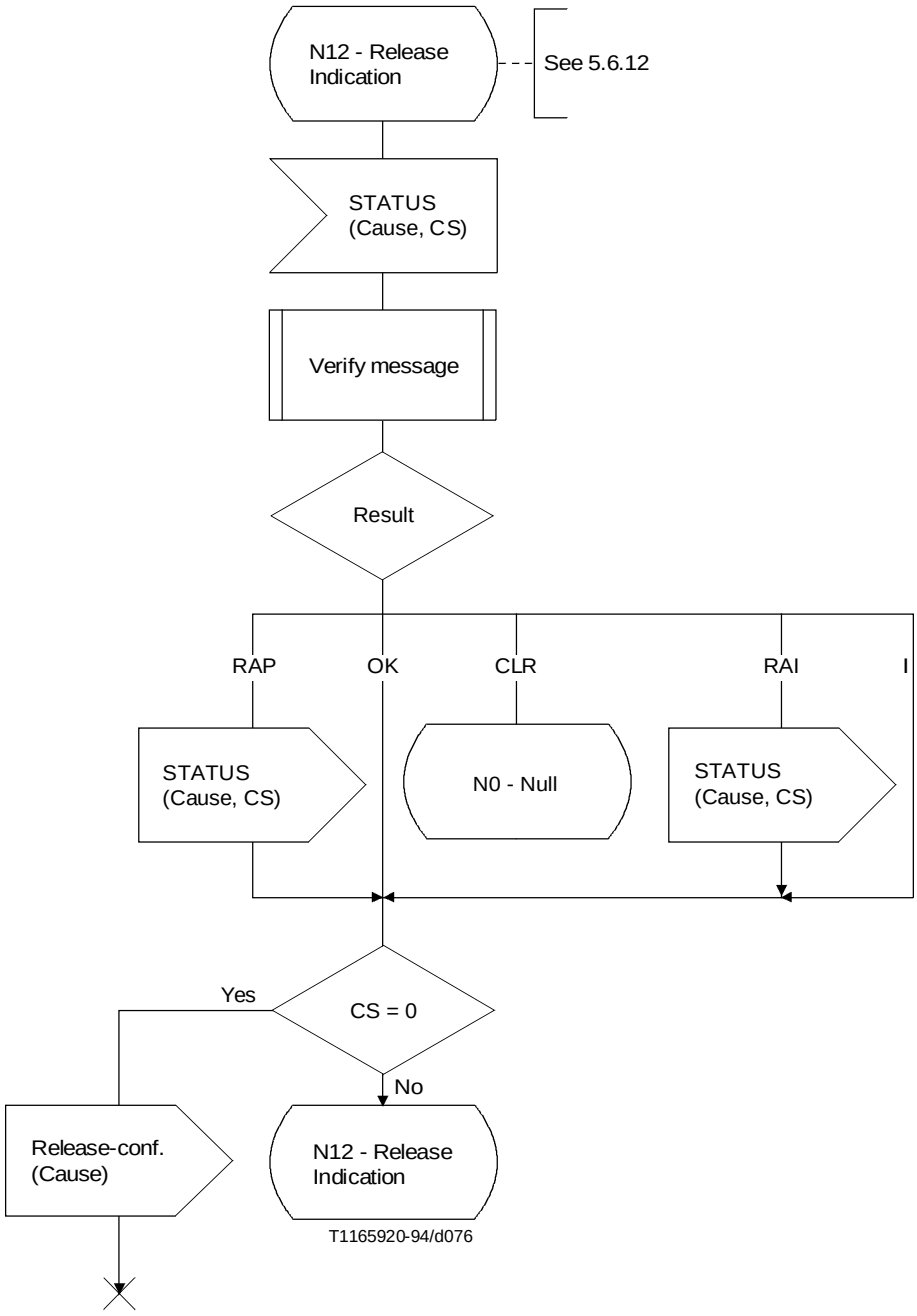

N-10 - Active
See 5.1.7
CONNECT ACKNOW-LEDGE (#)
Verify-Msg
Result
RAP
RAI
OK
I
CLR
STATUS (Cause, CS = N10)
D
N10 - Active
*
(except N0)
See 5.9
Notify-req. (#)
NOTIFY (#)
NOTIFY (#)
Verify-Msg
–
Result
RAP
OK
CLR
RAI
I
STATUS (Cause, CS)
D
Nofity-ind. (#)
STATUS (Cause, CS)
–
–
T1163240-94/d071

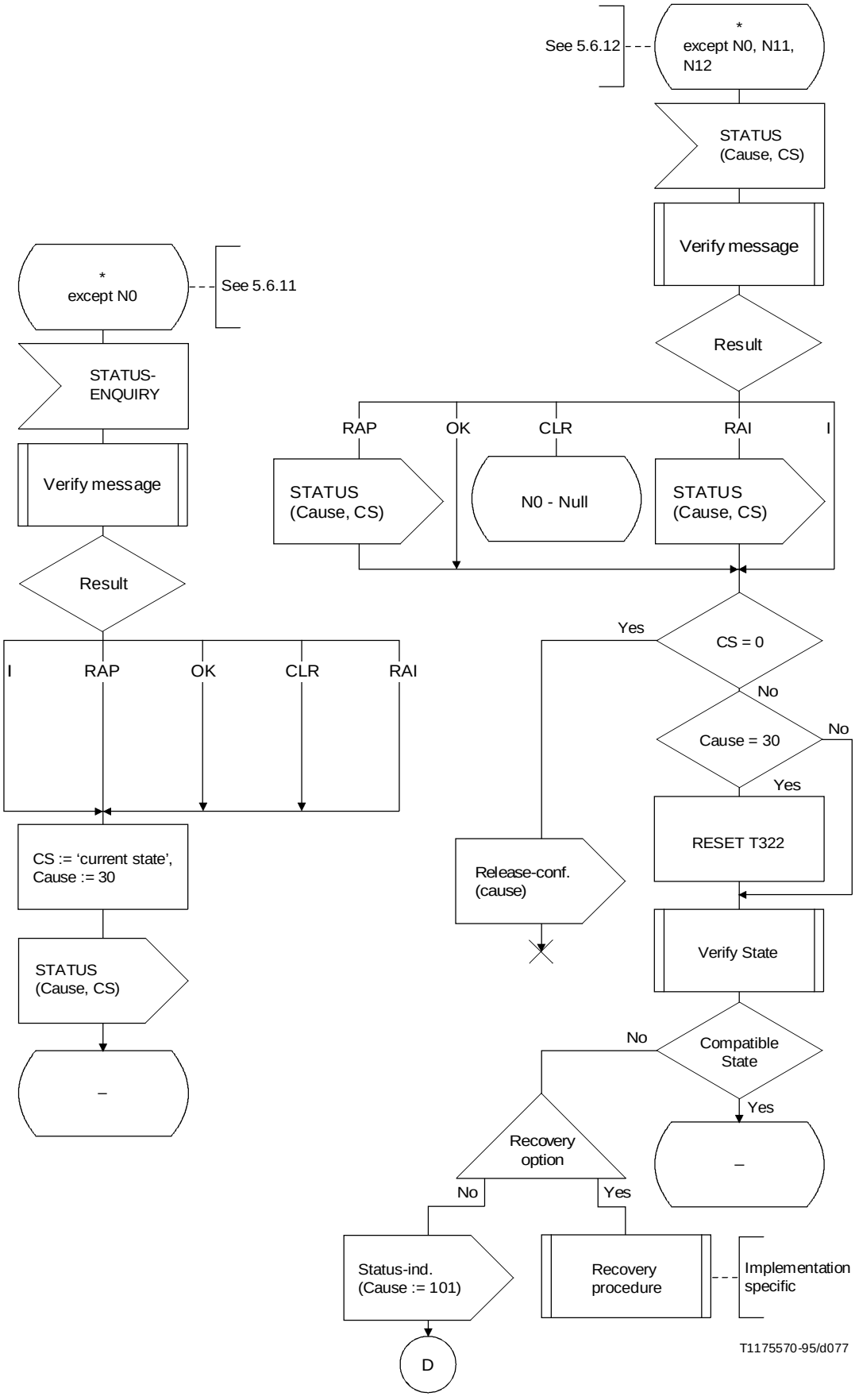

N10 - Active
See 5.6.9 b, 5.6.10
From Co-ord-N
Link Release indication
Link Establish error
Link Establish indication
Link Establish confirm
Link Establish request
Release-conf. (Cause := 27)
SE
N10 - Active
T1165890-94/d072

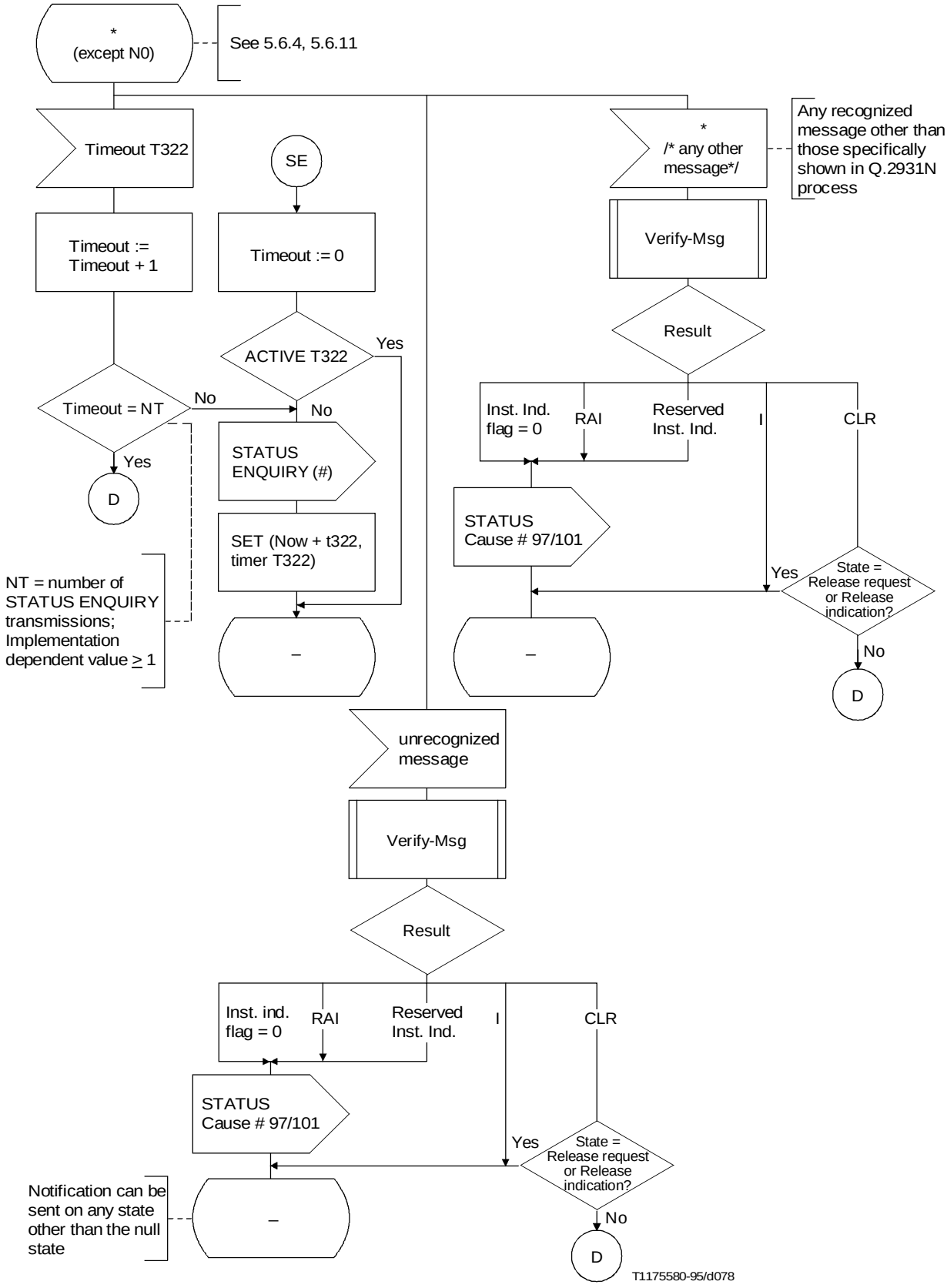

*
(except N0, N12
See 5.6.4, 5.4.3
RELEASE
COMPLETE
(Cause, #)
Verify-Msg
Message length
not checked
Result
I
RAP
OK
CLR
RAI
error handling exception
RESET ALL TIMERS
Release-conf.
(Cause, #)
After receiving this
primitive, the
Application process
shall release the
user virtual channel
*
(except N0, N11, N12)
See 5.4.3, 5.4.4
RELEASE
(Cause, #)
Verify-Msg
Result
RAP
OK
CLR
RAI
I
RESET ALL TIMES
Release-ind.
(Cause, #)
After receiving this
primitive, the
Application process
shall release the
user virtual channel
N11 - Release
Request
D
Release-ind.
(Cause-remote)
new ‘cause remote’ variable
for cause values sent to
remote user (e.g. called
user when overlap receiving
timeout occurs)
Release-req.
(Casue)
CauseR := Cause
/*Cause saved*/
RESET ALL TIMERS
RELEASE
(Cause)
SET (Now + t308,
timer T308);
N12 - Release
Indication
T1163260-94/d073

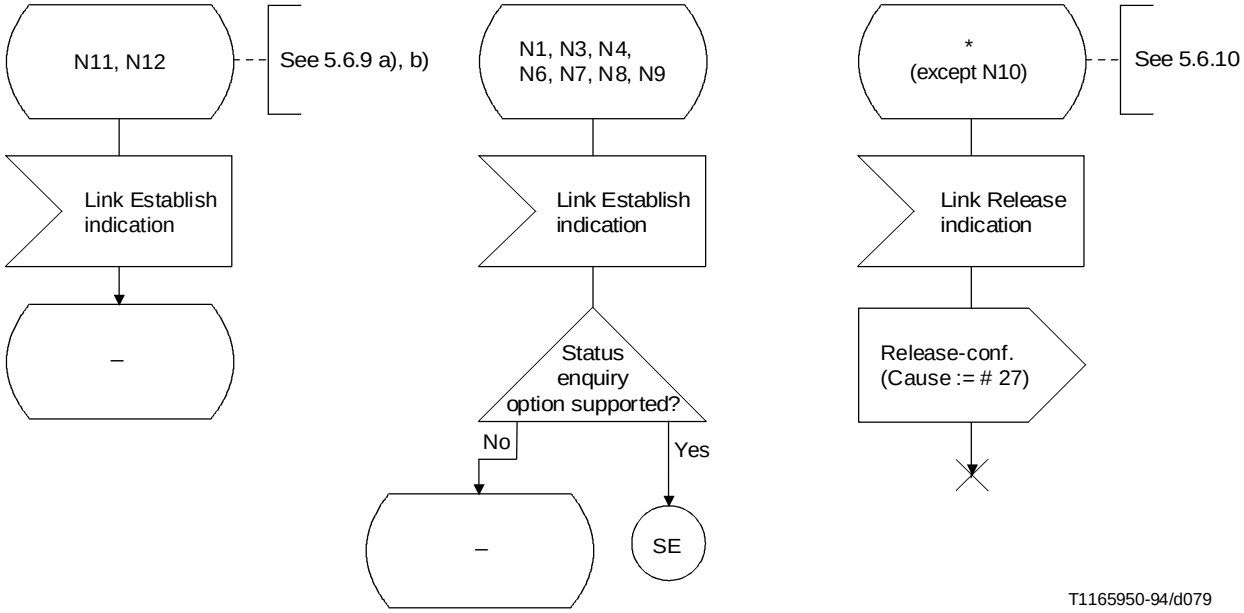

N11 RELEASE REQUEST
See 5.4.3, 5.6.12 b)
Release-resp. (#)
STATUS (Cause, CS)
RELEASE COMPLETE (#)
Verify message
Result
RAP
OK
CLR
RAI
I
STATUS (Cause, CS)
N0 - Null
STATUS (Cause, CS)
CS = 0
Yes
N11 Release Request
T1165900-94/d074

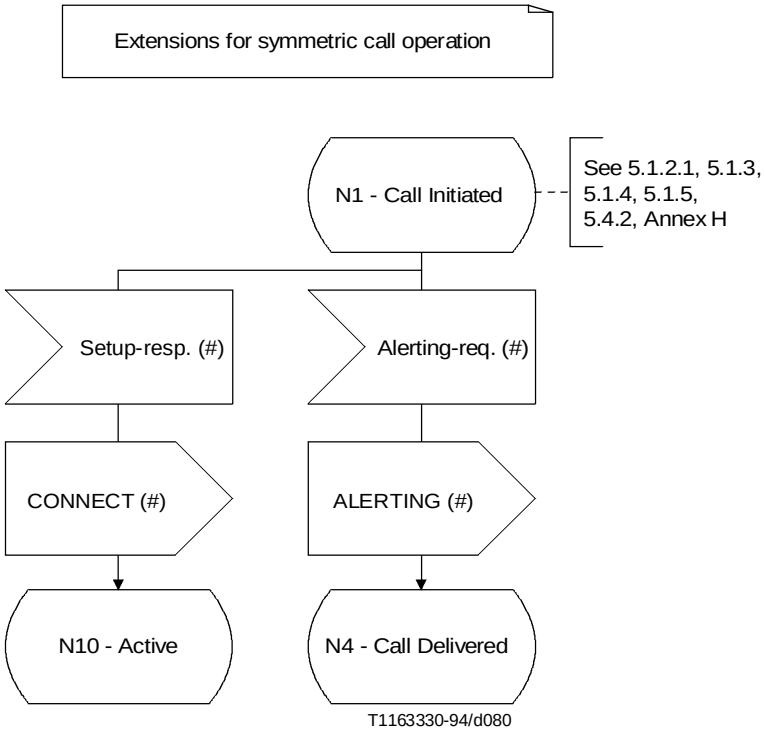

N12 - Release Indication
See 5.4.4, 5.4.5
RELEASE-COMPLETE (#)
RELEASE (#)
Clear collision
Timeout T308
Verify-Msg
Timeout = 1
Yes
No
Result
Cause1 := CauseR
Release reason := failure
RAP
OK
CLR
RAI
I
Cause option
Release conf. (Release reason)
RESET T308
Cause2 := 102
Release-conf. (Cause, #)
After receiving this primitive, the Application process shall release the user virtual channel
RELEASE (Cause1, #)
RELEASE (Cause1, Cause2, #)
The Application process shall place the user virtual channel in a maintenance condition
SET (Now + t308, timer T308); Timeout := 1
N12 - Release Indication
T1165910-94/d075

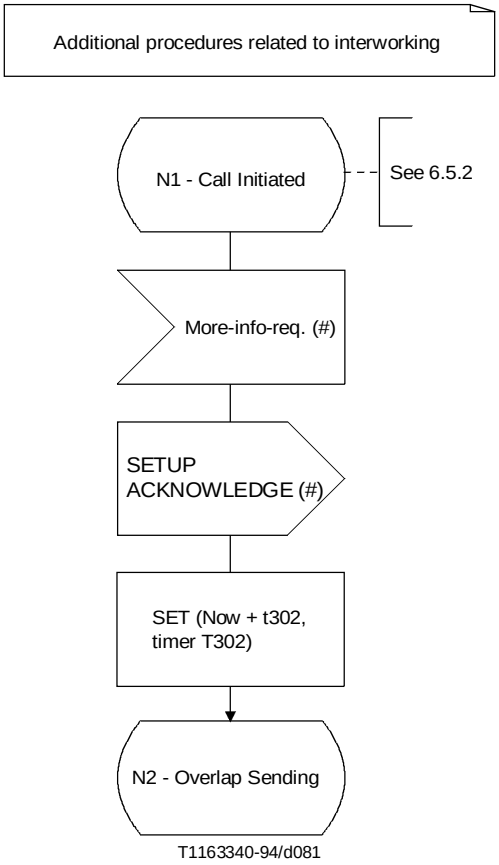

N12 - Release Indication
See 5.6.12
STATUS (Cause, CS)
Verify message
Result
RAP
OK
CLR
RAI
I
STATUS (Cause, CS)
N0 - Null
STATUS (Cause, CS)
Yes
CS = 0
No
Release-conf. (Cause)
N12 - Release Indication
T1165920-94/d076

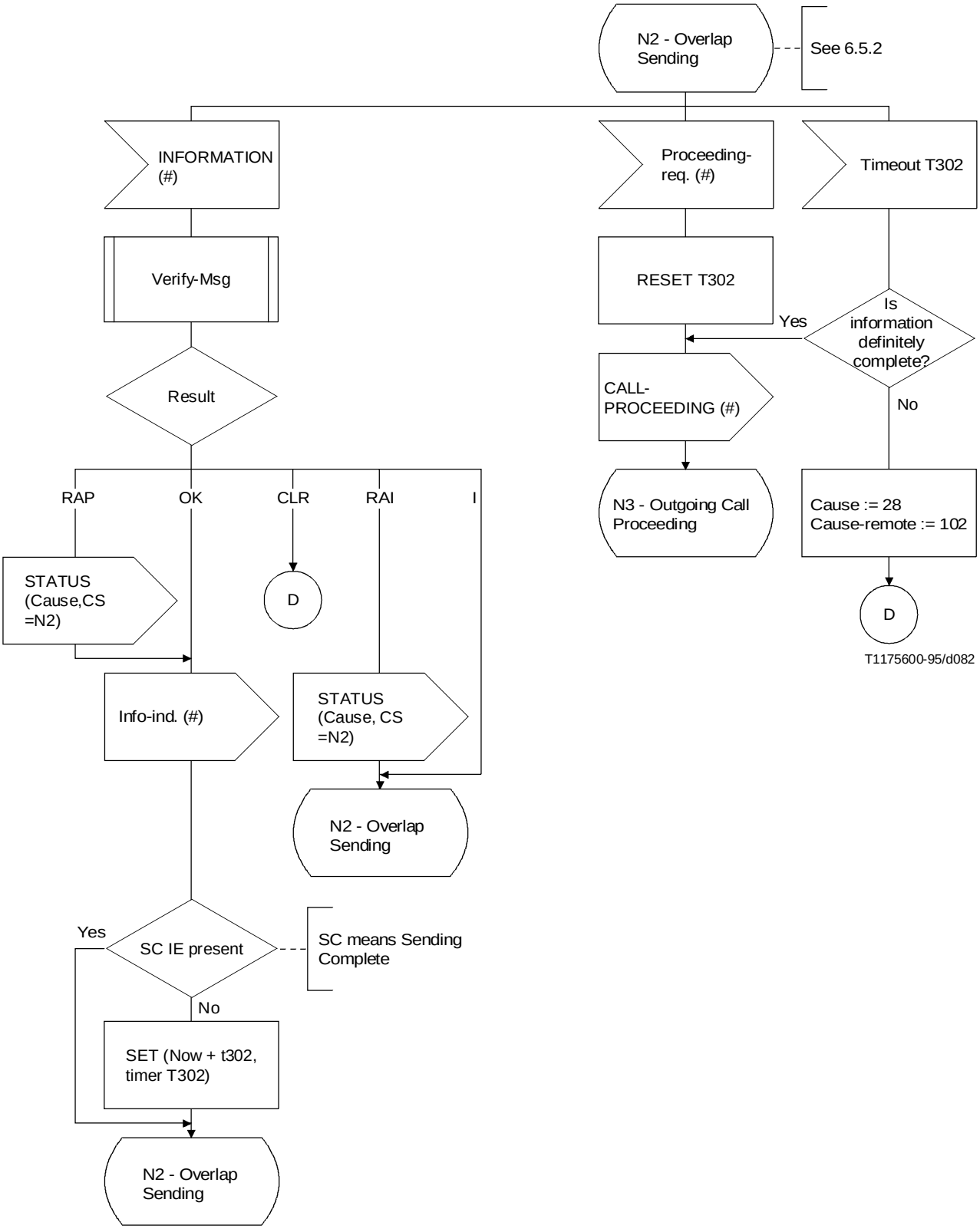

See 5.6.12
*
except N0, N11, N12
STATUS
(Cause, CS)
Verify message
Result
RAP
OK
CLR
RAI
I
STATUS
(Cause, CS)
N0 - Null
STATUS
(Cause, CS)
Yes
CS = 0
No
Cause = 30
No
Yes
RESET T322
Release-conf.
(cause)
Verify State
No
Compatible
State
Yes
Recovery
option
No
Yes
–
Status-ind.
(Cause := 101)
Recovery
procedure
Implementation
specific
D
*
except N0
See 5.6.11
STATUS-
ENQUIRY
Verify message
Result
I
RAP
OK
CLR
RAI
CS := 'current state',
Cause := 30
STATUS
(Cause, CS)
–
T1175570-95/d077

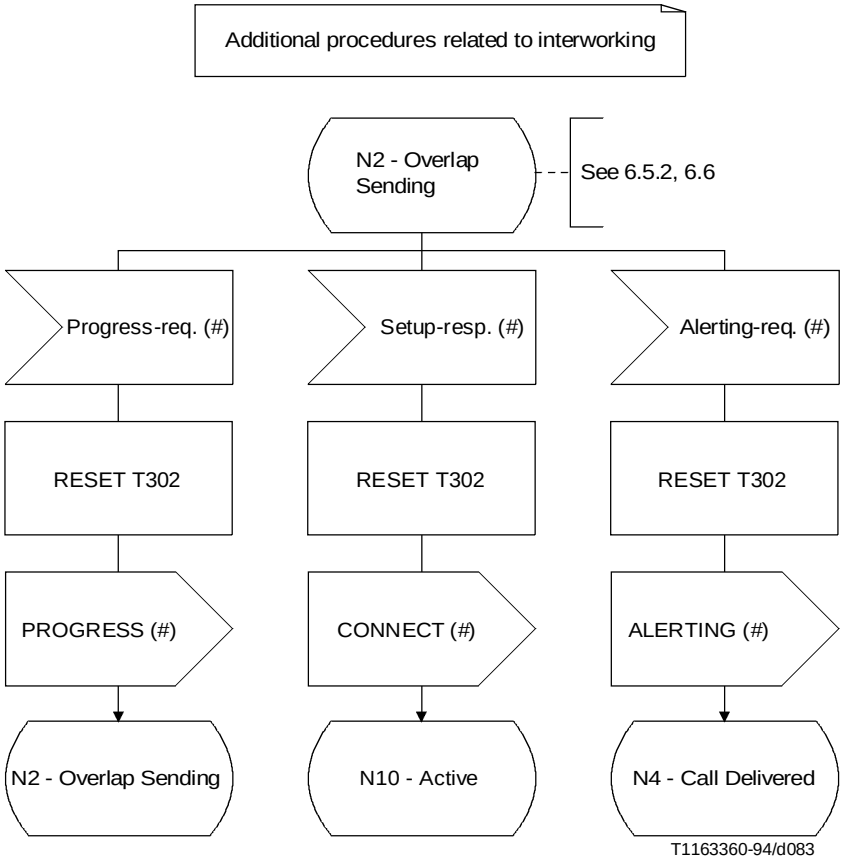

*
(except N0)
See 5.6.4, 5.6.11
Timeout T322
SE
*
/* any other message*/
Any recognized message other than those specifically shown in Q.2931N process
Timeout := Timeout + 1
Timeout := 0
Verify-Msg
ACTIVE T322
Yes
Result
Timeout = NT
No
No
Inst. Ind. flag = 0
RAI
Reserved Inst. Ind.
I
CLR
Yes
STATUS ENQUIRY (#)
STATUS Cause # 97/101
D
SET (Now + t322, timer T322)
State = Release request or Release indication?
NT = number of STATUS ENQUIRY transmissions; Implementation dependent value ≥ 1
–
–
No
D
unrecognized message
Verify-Msg
Result
Inst. ind. flag = 0
RAI
Reserved Inst. Ind.
I
CLR
STATUS Cause # 97/101
Yes
State = Release request or Release indication?
Notification can be sent on any state other than the null state
–
No
D
T1175580-95/d078

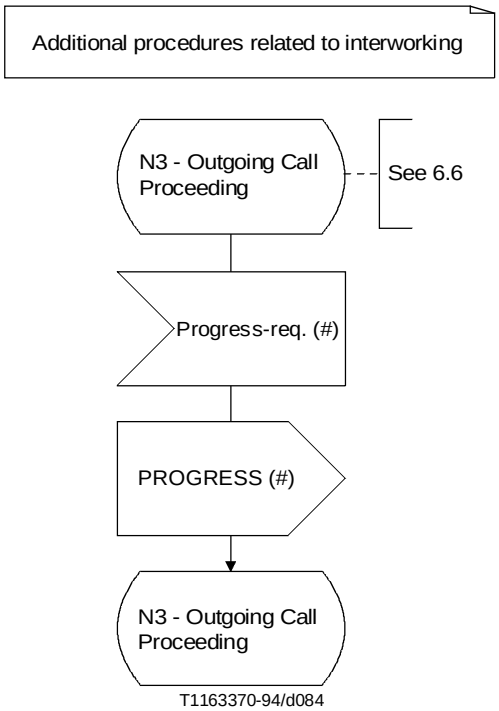

N11, N12
See 5.6.9 a), b)
Link Establish indication
–
N1, N3, N4, N6, N7, N8, N9
Link Establish indication
Status enquiry option supported?
No
Yes
–
SE
*
(except N10)
See 5.6.10
Link Release indication
Release-conf. (Cause := # 27)
T1165950-94/d079

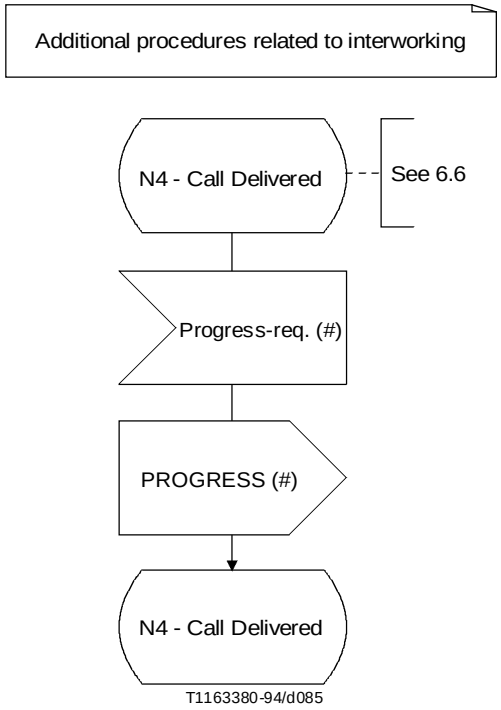

Extensions for symmetric call operation
N1 - Call Initiated
See 5.1.2.1, 5.1.3, 5.1.4, 5.1.5, 5.4.2, Annex H
Setup-resp. (#)
Alerting-req. (#)
CONNECT (#)
ALERTING (#)
N10 - Active
N4 - Call Delivered
T1163330-94/d080

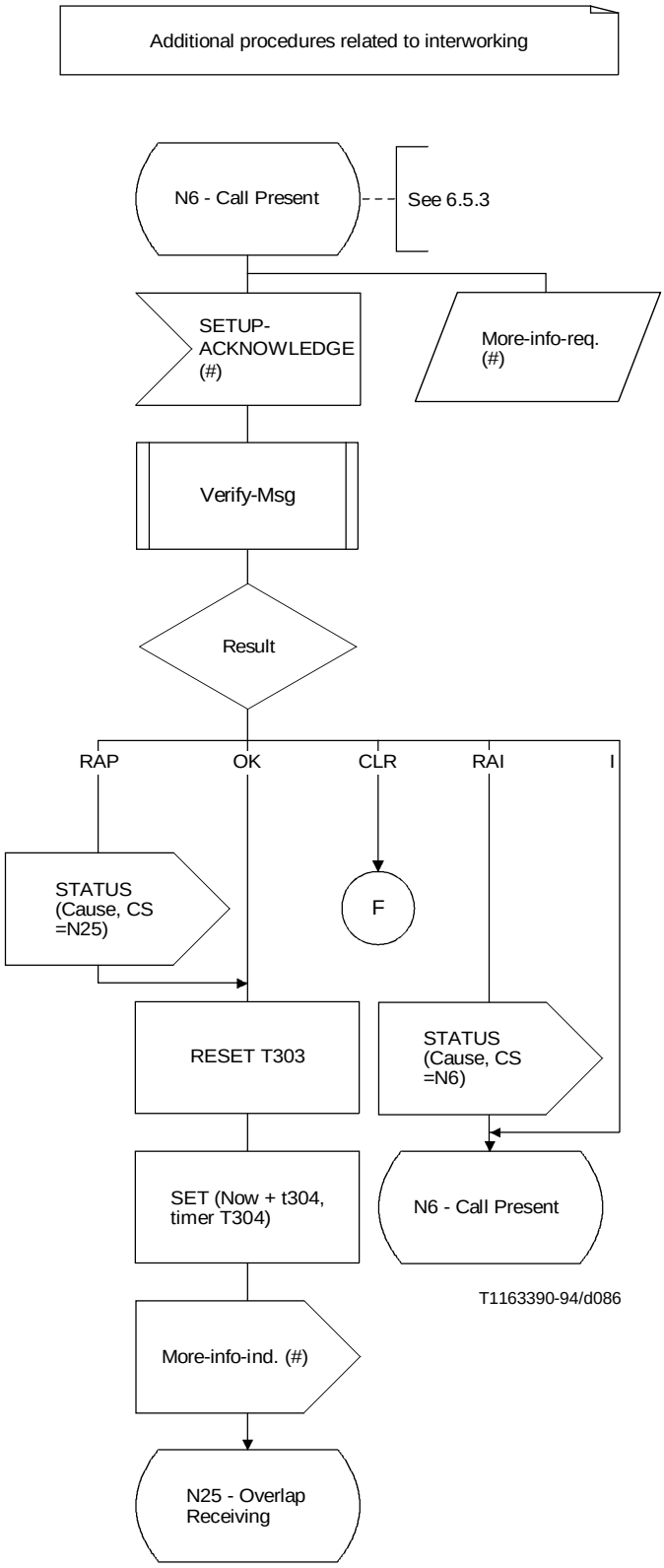

Additional procedures related to interworking
N1 - Call Initiated
See 6.5.2
More-info-req. (#)
SETUP ACKNOWLEDGE (#)
SET (Now + t302, timer T302)
N2 - Overlap Sending
T1163340-94/d081


N2 - Overlap Sending
See 6.5.2
INFORMATION (#)
Proceeding-req. (#)
Timeout T302
Verify-Msg
RESET T302
Yes
Is information definitely complete?
Result
CALL-PROCEEDING (#)
No
RAP
OK
CLR
RAI
I
N3 - Outgoing Call Proceeding
Cause := 28
Cause-remote := 102
STATUS (Cause,CS =N2)
D
D
T1175600-95/d082
Info-ind. (#)
STATUS (Cause, CS =N2)
N2 - Overlap Sending
Yes
SC IE present
SC means Sending Complete
No
SET (Now + t302, timer T302)
N2 - Overlap Sending

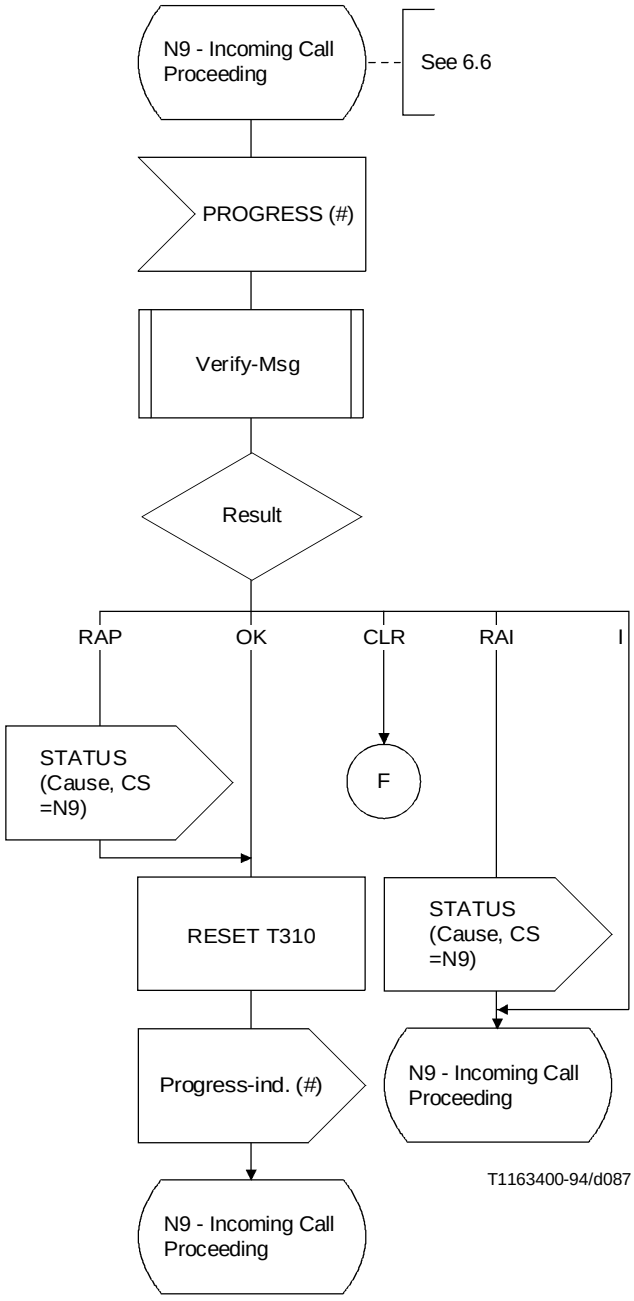

Additional procedures related to interworking
N2 - Overlap Sending
See 6.5.2, 6.6
Progress-req. (#)
Setup-resp. (#)
Alerting-req. (#)
RESET T302
RESET T302
RESET T302
PROGRESS (#)
CONNECT (#)
ALERTING (#)
N2 - Overlap Sending
N10 - Active
N4 - Call Delivered
T1163360-94/d083

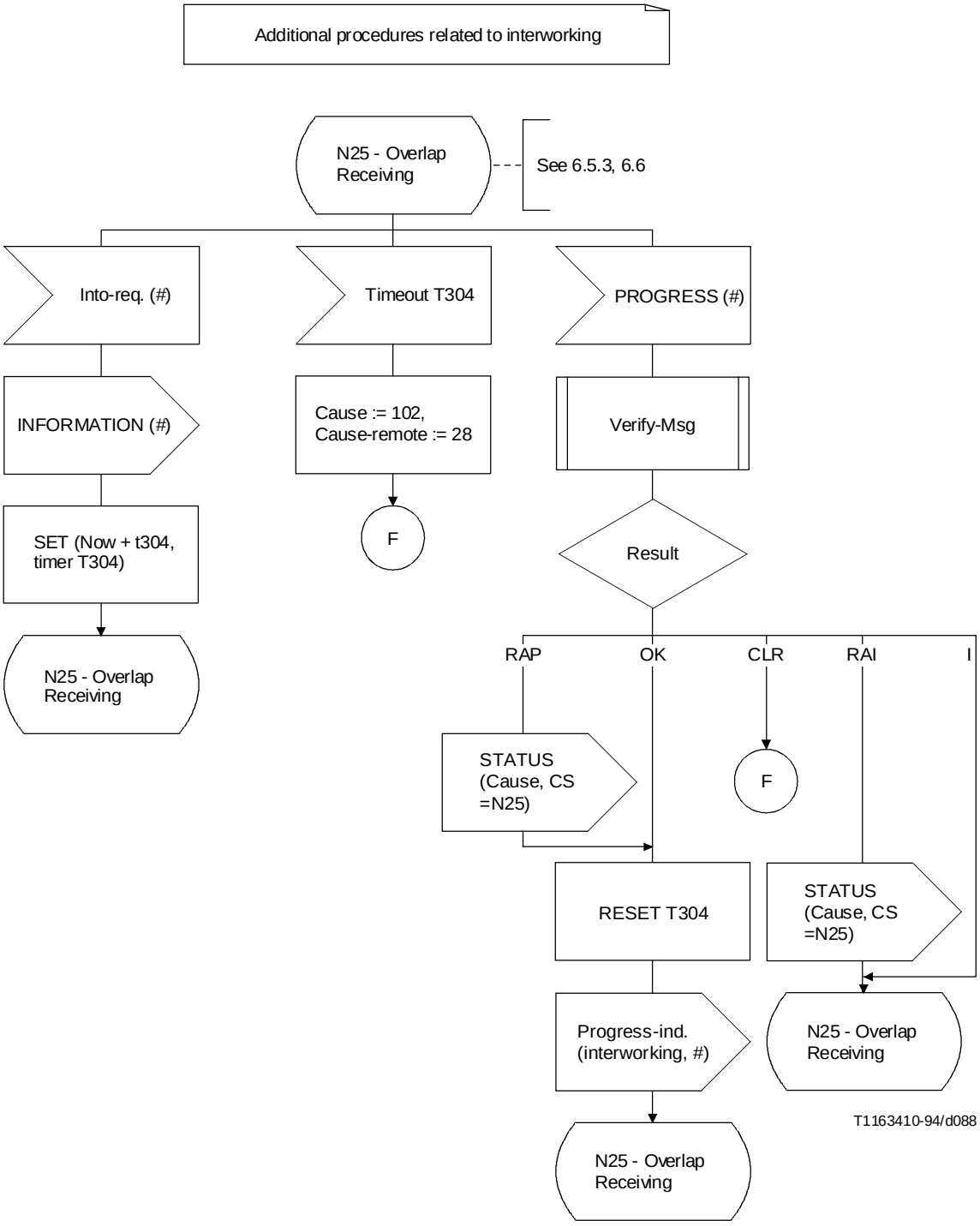

Additional procedures related to interworking
N3 - Outgoing Call Proceeding
See 6.6
Progress-req. (#)
PROGRESS (#)
N3 - Outgoing Call Proceeding
T1163370-94/d084

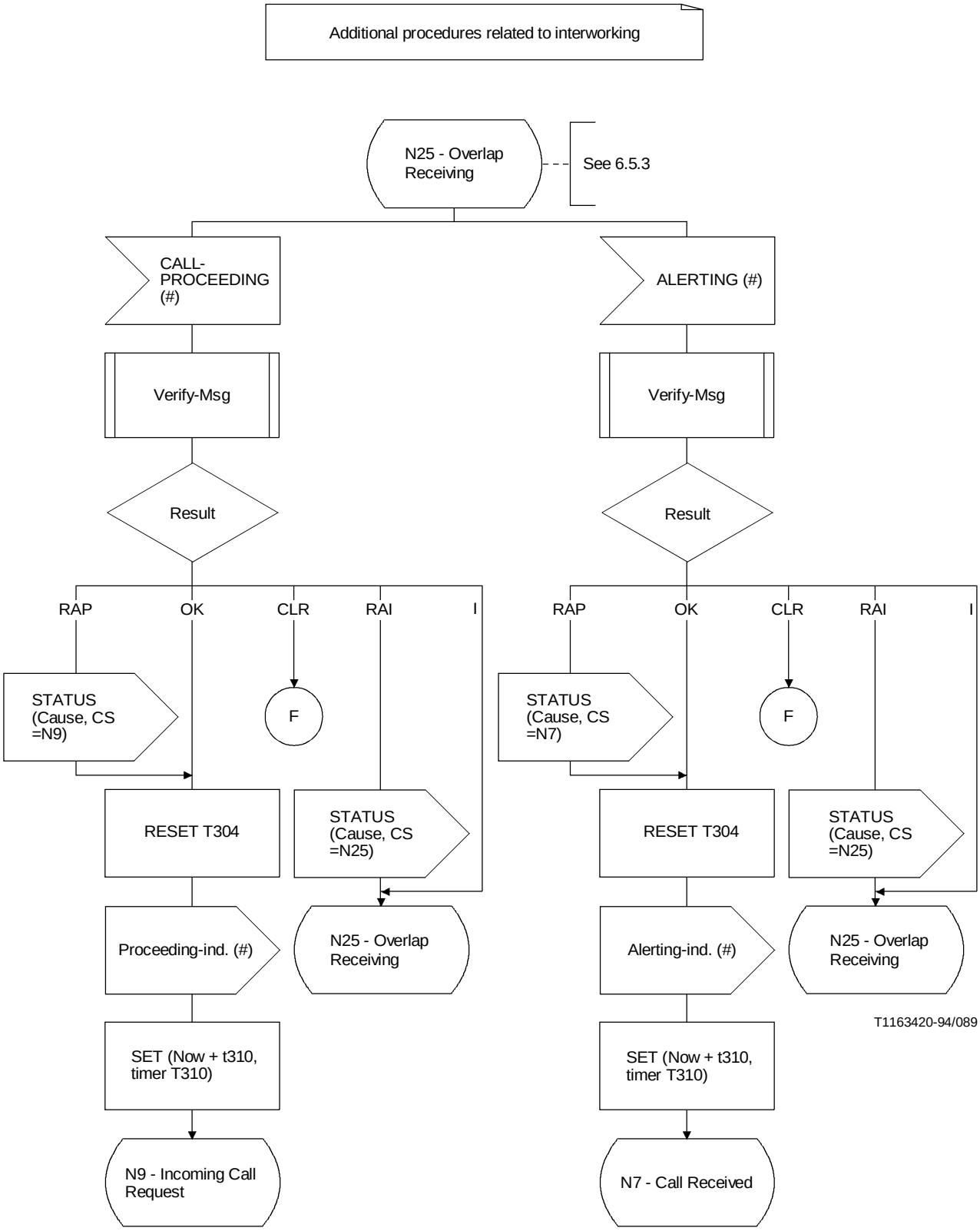

Additional procedures related to interworking
N4 - Call Delivered
See 6.6
Progress-req. (#)
PROGRESS (#)
N4 - Call Delivered
T1163380-94/d085

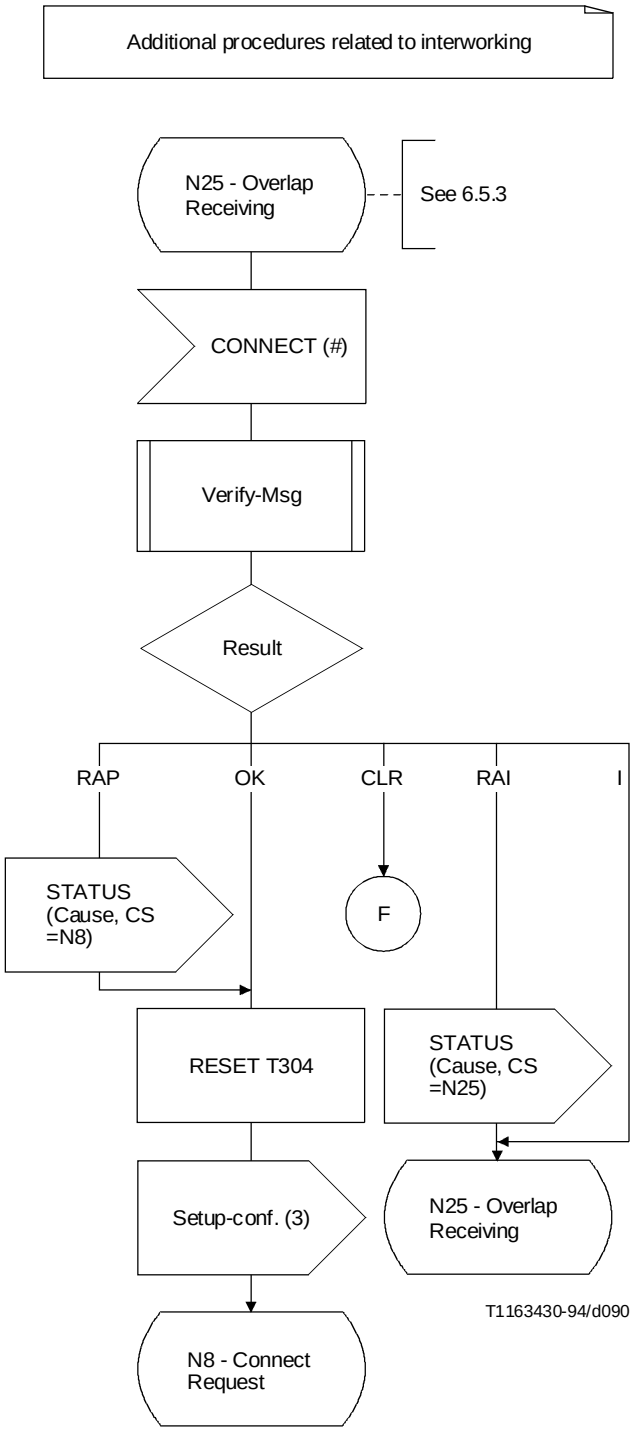

Additional procedures related to interworking
N6 - Call Present
See 6.5.3
SETUP-ACKNOWLEDGE (#)
More-info-req. (#)
Verify-Msg
Result
RAP
OK
CLR
RAI
I
STATUS (Cause, CS =N25)
F
RESET T303
STATUS (Cause, CS =N6)
SET (Now + t304, timer T304)
N6 - Call Present
T1163390-94/d086
More-info-ind. (#)
N25 - Overlap Receiving

Additional procedures related to interworking

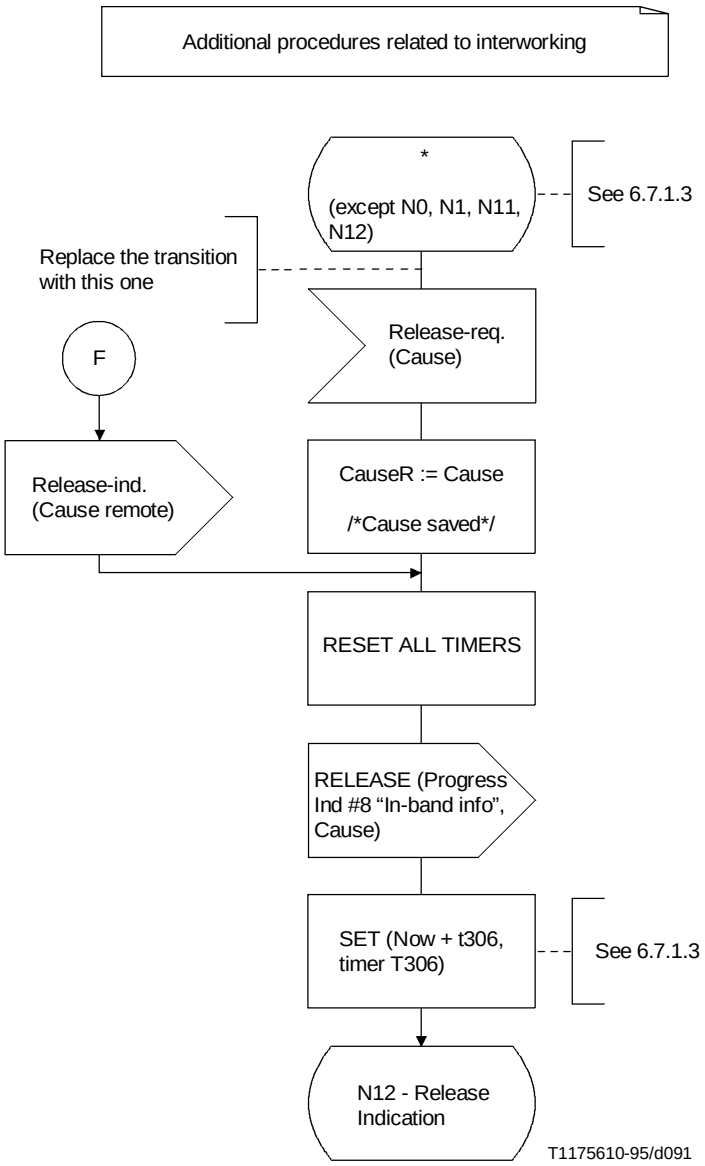


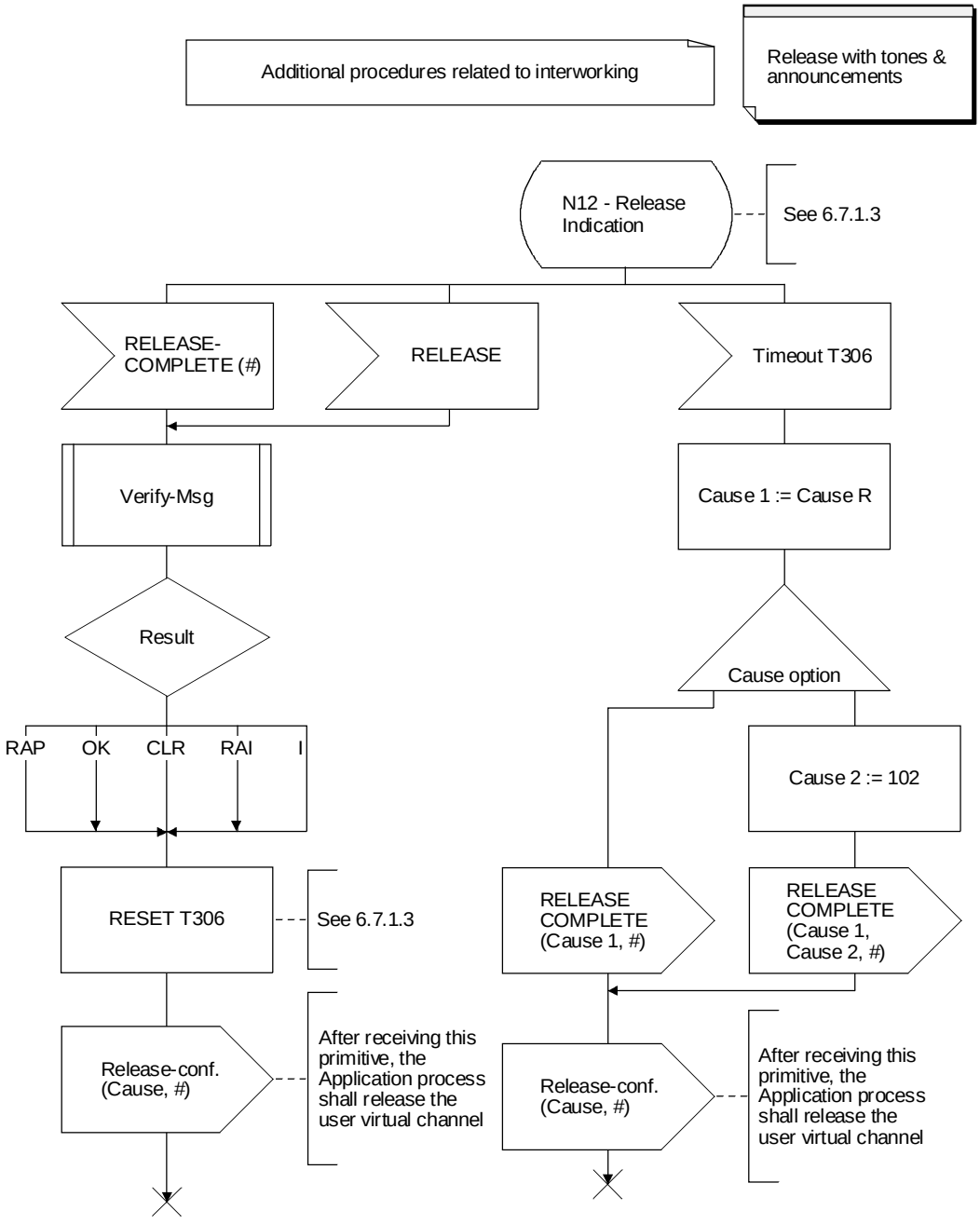

Additional procedures related to interworking
N25 - Overlap Receiving
See 6.5.3, 6.6
Into-req. (#)
Timeout T304
PROGRESS (#)
INFORMATION (#)
Cause := 102, Cause-remote := 28
Verify-Msg
SET (Now + t304, timer T304)
F
Result
N25 - Overlap Receiving
RAP
OK
CLR
RAI
I
STATUS (Cause, CS =N25)
F
RESET T304
STATUS (Cause, CS =N25)
Progress-ind. (interworking, #)
N25 - Overlap Receiving
T1163410-94/d088
N25 - Overlap Receiving


Additional procedures related to interworking
N25 - Overlap Receiving
See 6.5.3
CALL-PROCEEDING (#)
ALERTING (#)
Verify-Msg
Verify-Msg
Result
Result
RAP
OK
CLR
RAI
I
RAP
OK
CLR
RAI
I
STATUS (Cause, CS =N9)
F
STATUS (Cause, CS =N7)
F
RESET T304
STATUS (Cause, CS =N25)
RESET T304
STATUS (Cause, CS =N25)
Proceeding-ind. (#)
N25 - Overlap Receiving
Alerting-ind. (#)
N25 - Overlap Receiving
T1163420-94/089
SET (Now + t310, timer T310)
SET (Now + t310, timer T310)
N9 - Incoming Call Request
N7 - Call Received


Additional procedures related to interworking
N25 - Overlap Receiving
See 6.5.3
CONNECT (#)
Verify-Msg
Result
RAP
OK
CLR
RAI
I
STATUS (Cause, CS =N8)
F
RESET T304
STATUS (Cause, CS =N25)
Setup-conf. (3)
N25 - Overlap Receiving
T1163430-94/d090
N8 - Connect Request

PROCESS Q.2931-N;





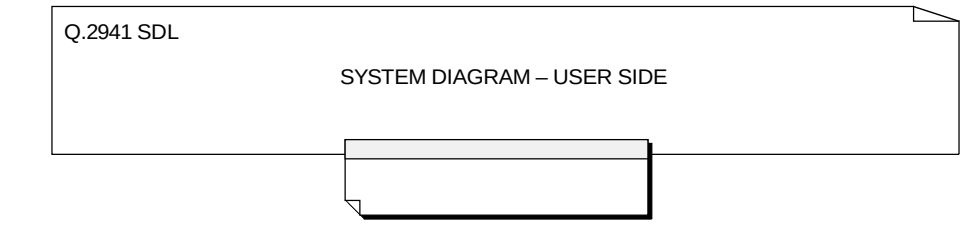
T1165980-94/d092

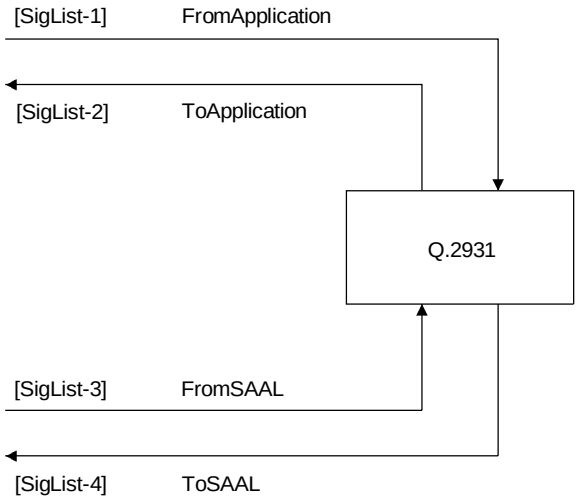
A.2 User side SDL diagrams

The User Side SDL diagrams are structured as follows:

Reference	Length (User Side)
System diagram	1 page
Block diagram	1 page
Co-ord-U process	10 pages
Reset-Start-U process	2 pages
Reset-Response-U process	2 pages
Q.2931-U process:	31 pages, comprises:
Procedures for B-ISDN calls (See clause 5)	pp. 1-17
Extensions for symmetric call operation (See Annex H)	pp. 18-20
Additional procedures related to interworking (See clause 6)	pp. 21-31

SYSTEM Q.2931 – User Side





SigList-1: From-AP

SigList-2: To-AP

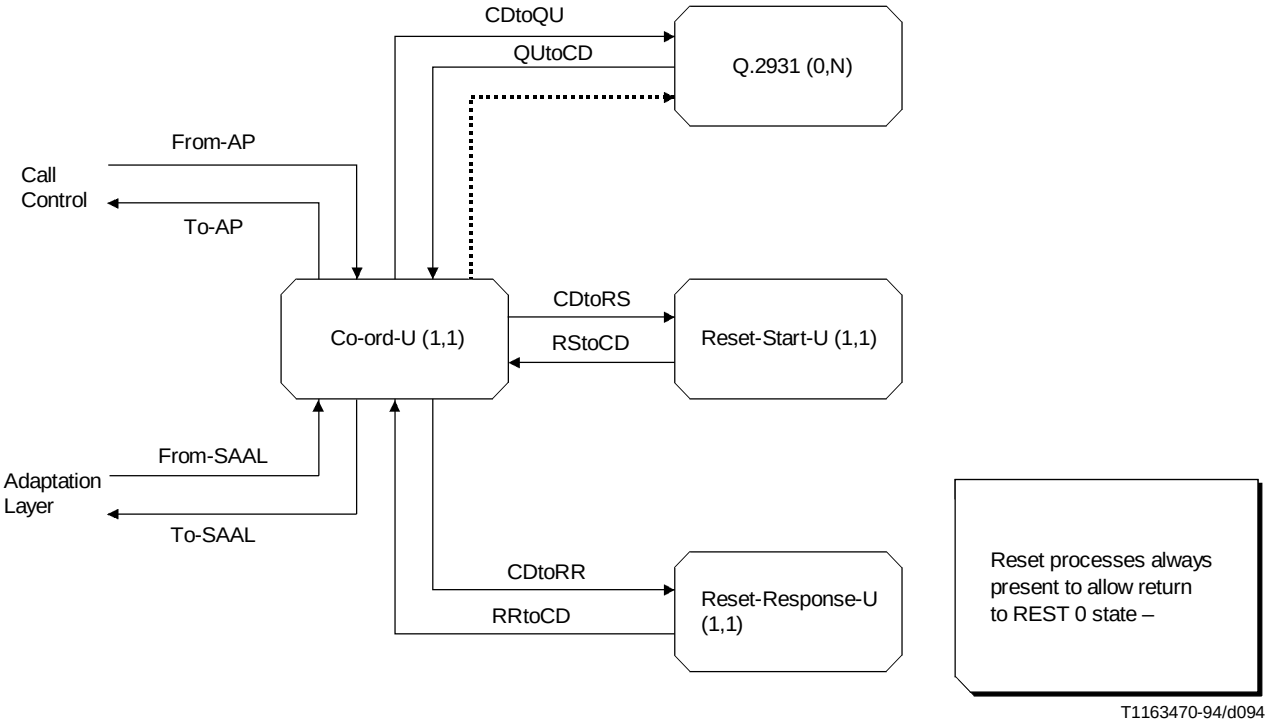
SigList-3: From-SAAL

SigList-4: To-SAAL

/*The signal lists are expanded in the Co-ord-U process diagram*/

T1165990-94/D093

BLOCK Q.2931 – User Side



Q.2931 SDL – User Side

Acronyms

Processes

Co-ord-U	=	Coordination function for all Q.2931 processes (ASEs) and performs "common" functions on the user side.
Q.2931-U	=	Process that performs the Call/Bearer specific signalling functions.
Reset-Start-U	=	Process that starts the RESTART procedure on the user side.
Reset-Respond-U	=	Process that responds to a RESTART message on the user side.

Others Entities

AP	=	Signalling Application Process
SAAL	=	Signalling ATM Adaptation Layer Process

Others

See x..x	=	Reference to relevant Section x.x of Q.2931
Cause	=	Cause field contents in Cause IE
CS	=	Call State value in Call State IE
#	=	Indicates all IEs in a primitive or message except those explicity identified (e.g. (Cause. #))
CLR	=	Release Call
CP	=	Coordination Process
I	=	Ignore
IE	=	Information Element
QU	=	Q.2931-U
RAI	=	Report and Ignore
RAP	=	Report and Proceed
RR	=	Reset-Respond-U
RS	=	Reset-Start-U
OK	=	Okay (proceed)
SC	=	Sending Complete

The List of IEs possible for each message and the contents of the IEs are defined in clauses 3 and 4.

T1166000-94/d095

Signal lists

Signals for B-ISDN Calls

Primitives to/from SAAL

From-SAAL	To-SAAL
AAL-Data-ind. – Includes Message from point-to-point signalling virtual channel connection	AAL-Data-req. – Message sent to specific point-to-point signalling virtual channel connection
AAL-ESTABLISH-ind. AAL-ESTABLISH-conf.	AAL-ESTABLISH-req. – SAAL link establishment
AAL-RELEASE-ind. AAL-RELEASE-conf.	AAL-RELEASE-req. – SAAL link reset or release

Primitives to/from Application Process

From-AP	To-AP
Setup-req.	Setup-ind.
Proceeding-req.	Proceeding-ind.
Alerting-req.	Alerting-ind.
Setup-resp.	Setup-conf.
	Setup-complete-ind.
Release-req.	Release-ind.
Release-resp.	Release-conf.
Reset-req.	Reset-ind.
Reset-resp.	Reset-conf.
Reset-error-response	Reset-error-indication
	Status-ind.
Notify-req.	Notify-ind.
Link Establish-request	Link Establish-conf.
Link Release-request	Link Release-conf.

Signal lists

Additional signals related to interworking

Primitives to/from Application Process

From-AP	To-AP
More-info-req.	More-info-ind.
Info-req.	Info-ind.
Progress-req.	Progress-ind.

Signal lists

Additional signals related to Supplementary Services

Primitives to/from Application Process

From-AP	To-AP

These primitives are listed in the relevant broadband supplementary service Recommendations (Q.295 x-Series).

T1163490-94/d096

Primitives to/from Q.2931-U

Signal lists

CDtoQU	QUtoCD
Setup-req.	Setup-ind.
Proceeding-req.	Proceeding-ind.
Alerting-req.	Alerting-ind.
Setup-resp.	Setup-conf.
	Setup-complete-ind.
Release-req.	Release-ind.
Release-resp.	Release-conf.
	Status-ind.
Notify-req.	Notify-ind.
Link Establish confirm	Link Establish request
Link Establish indication	
Link Release indication	
Link Establish error	

Primitives to/from Reset-Start-U

Signal lists

CDtoRS	RStoCD
Reset-req.	Reset-error-ind.
	Reset-conf.

Primitives to/from Reset-Respond-U

Signal lists

CDtoRR	RRtoCD
Reset resp.	Reset-ind.
Reset-error-resp.	Reset-error-ind.

Additional Primitives to/from Q.2931-U related to interworking

Signal lists

CDtoQU	QUtoCD
More-info-req.	More-info-ind.
	Timeout-ind.
Info-req.	Info-ind.
Progress-req.	Progress-ind.

Additional Primitives to/from Q.295x related to supplementary services

Signal lists

CDtoQU	QUtoCD
These primitives are listed in the relevant broadband supplementary service Recommendations (Q.295 x-Series).	

Messages to/from Q.2931-U for B-ISDN calls

Signal lists

CDtoQU	QUtoCD
SETUP	SETUP
CALL-PROCEEDING	CALL-PROCEEDING
ALERTING	ALERTING
CONNECT	CONNECT
CONNECT-ACK	CONNECT-ACK
RELEASE	RELEASE
RELEASE-COMPLETE	RELEASE-COMPLETE
STATUS	STATUS
STATUS-ENQUIRY	STATUS-ENQUIRY
NOTIFY	NOTIFY

Messages to/from Reset-Start-U

Signal lists

CDtoRS	RStoCD
RESTART-ACK	RESTART
	STATUS

Messages to/from Reset-Respond-U

Signal lists

CDtoRR	RRtoCD
RESTART	RESTART-ACK
	STATUS

Additional Messages to/from Q.2931-U related to interworking

Signal lists

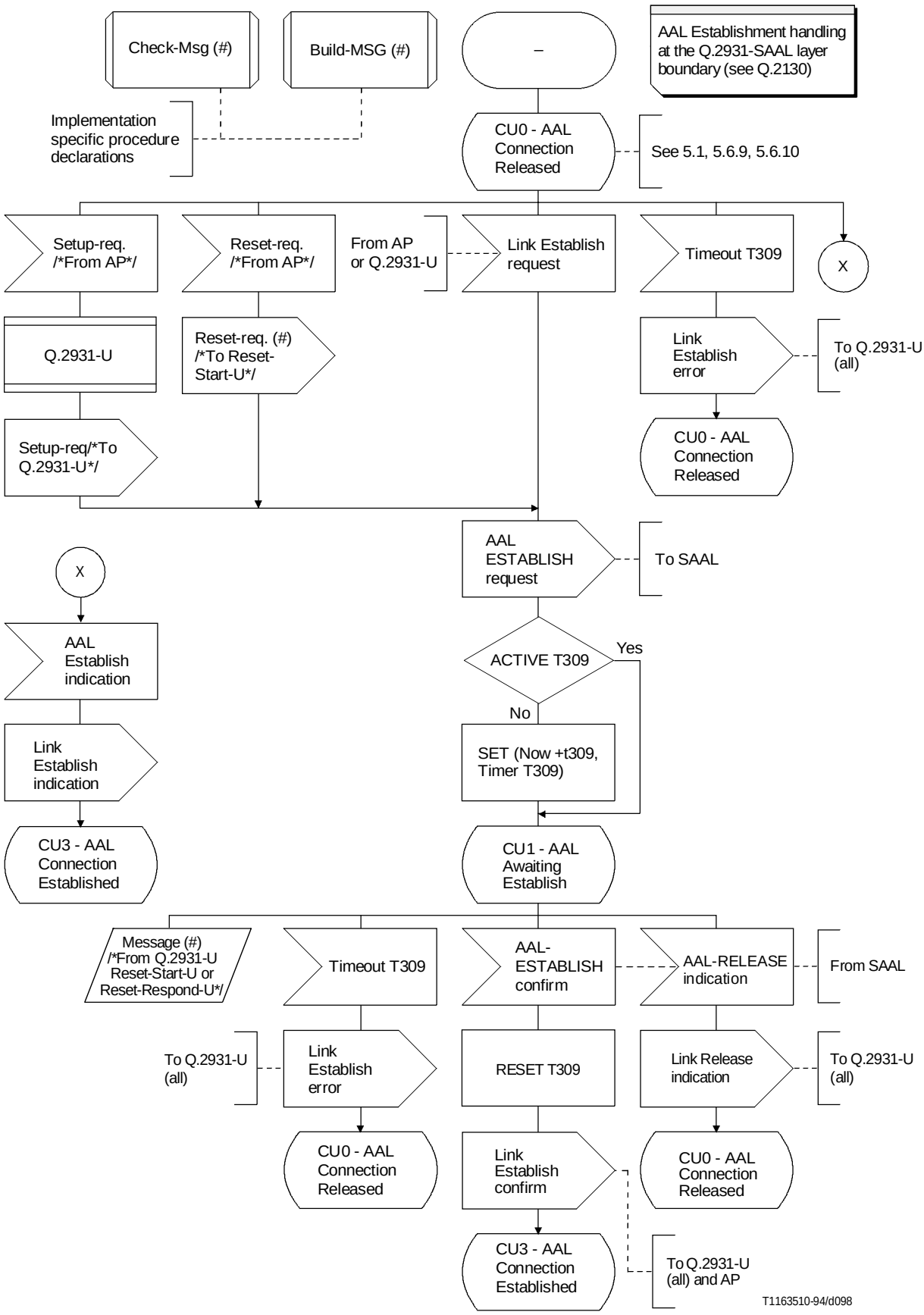
CDtoQU	QUtoCD
SETUP-ACKNOWLEDGE	SETUP-ACKNOWLEDGE
INFORMATION	INFORMATION
PROGRESS	PROGRESS

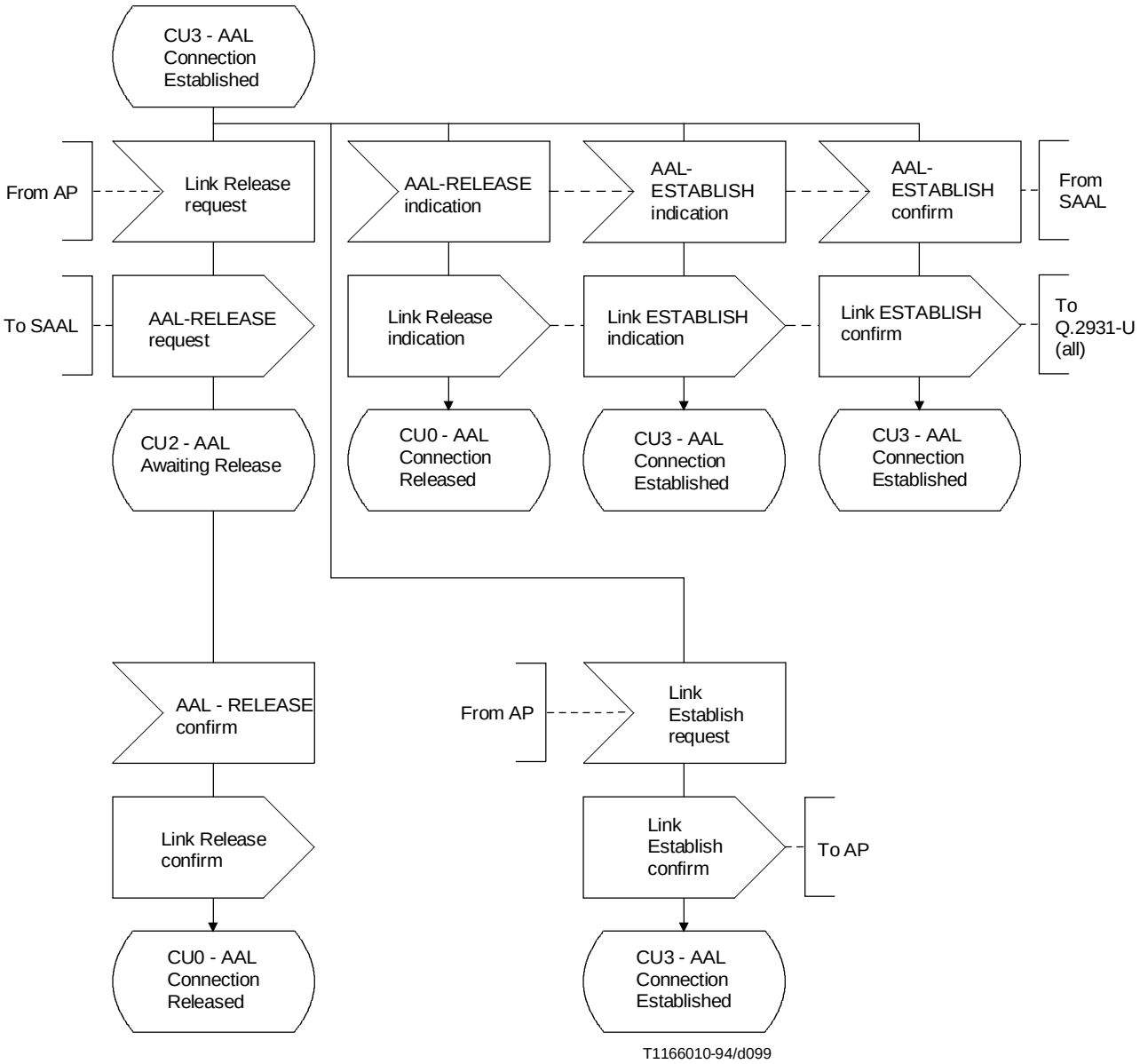
Additional Messages to/from Q.295x related to Supplementary Services

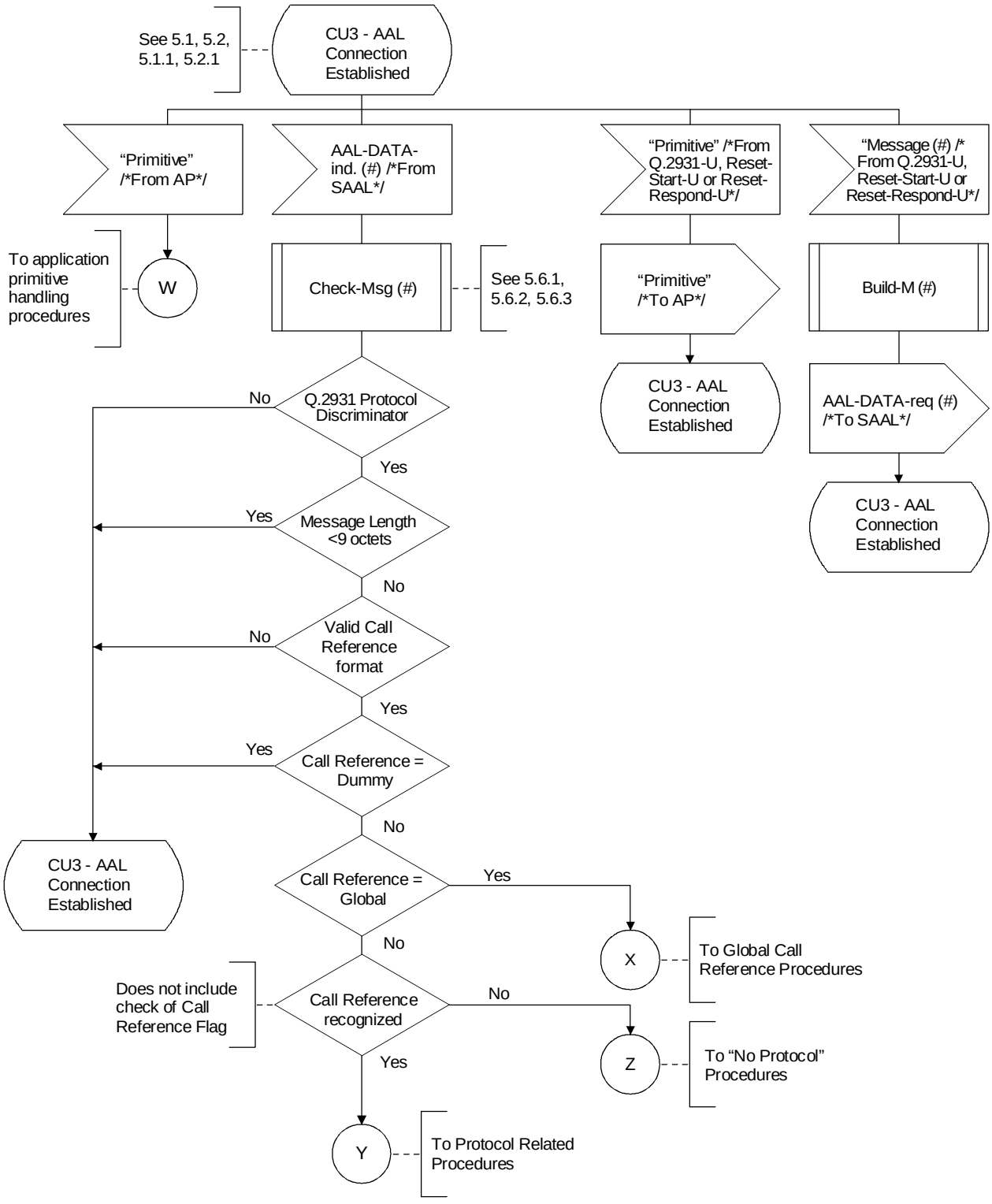
Signal lists

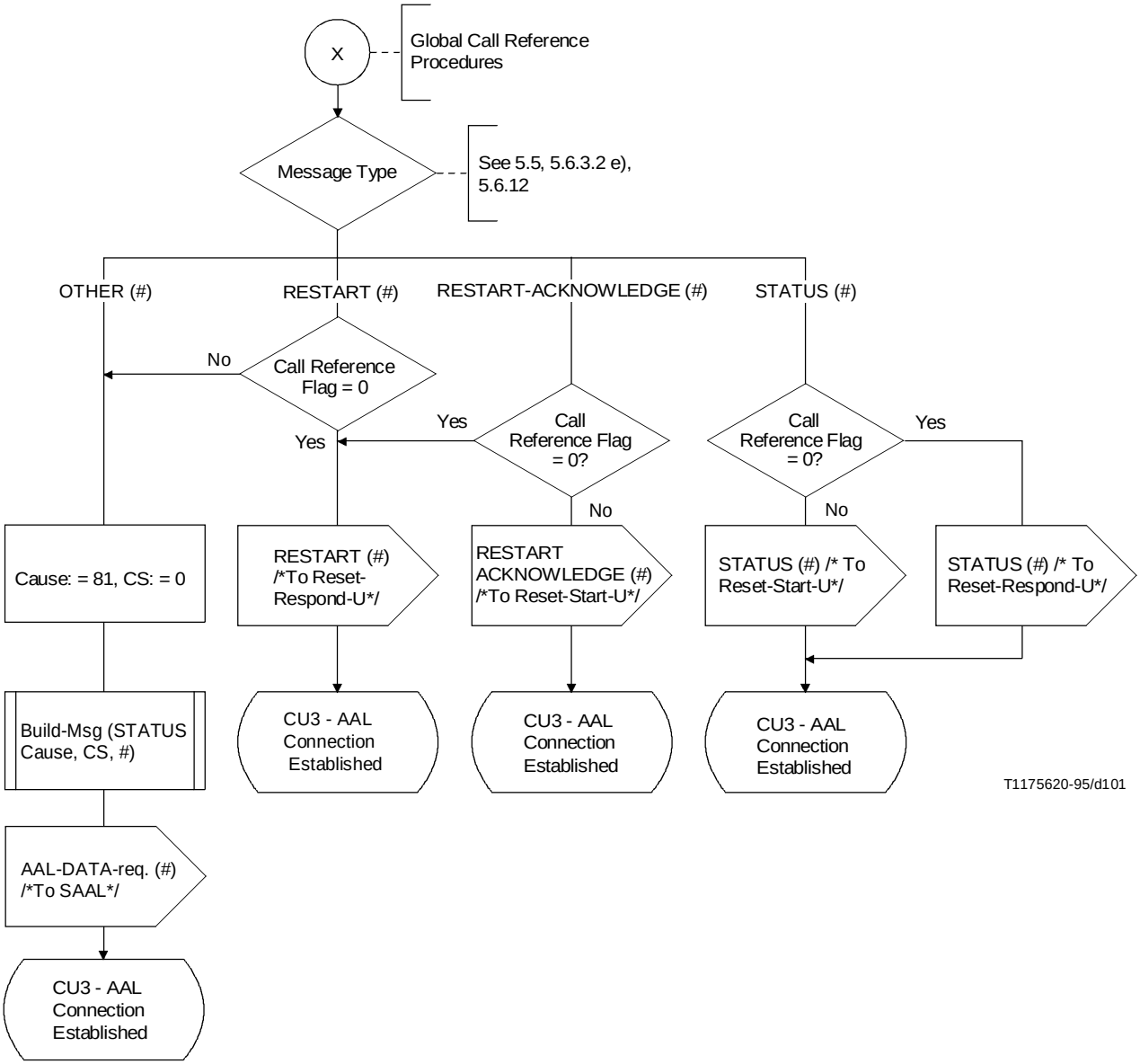
CDtoQU	QUtoCD
These primitives are listed in the relevant broadband supplementary service Recommendations (Q.295 x-Series).	

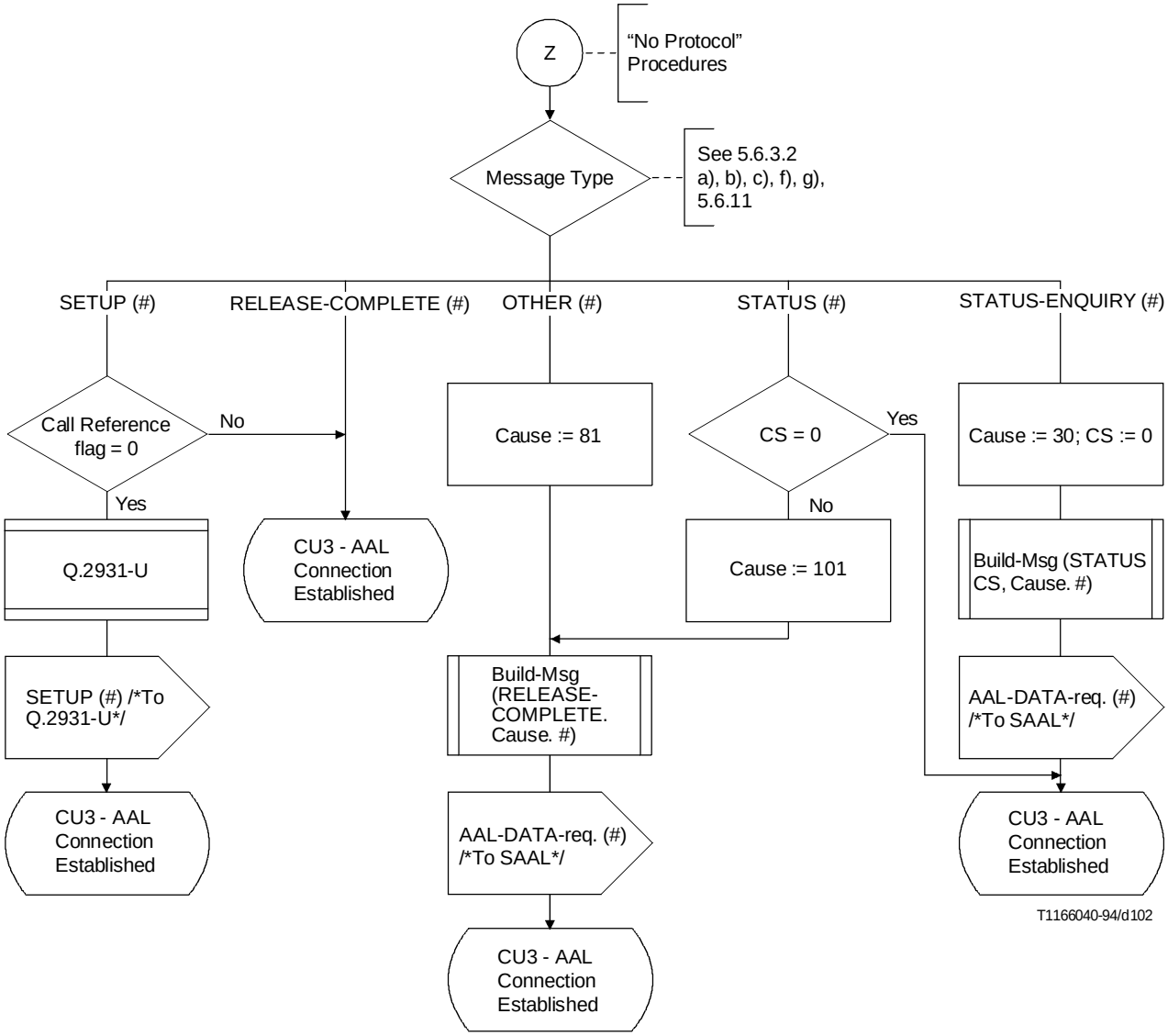
T1163500-94/d097


Check-Msg (#)
Build-MSG (#)
–
AAL Establishment handling at the Q.2931-SAAL layer boundary (see Q.2130)
Implementation specific procedure declarations
CU0 - AAL Connection Released
See 5.1, 5.6.9, 5.6.10
Setup-req. /*From AP*/
Reset-req. /*From AP*/
From AP or Q.2931-U
Link Establish request
Timeout T309
X
Q.2931-U
Reset-req. (#) /*To Reset-Start-U*/
Link Establish error
To Q.2931-U (all)
Setup-req/*To Q.2931-U*/
CU0 - AAL Connection Released
AAL ESTABLISH request
To SAAL
X
AAL Establish indication
ACTIVE T309
Yes
No
Link Establish indication
SET (Now +t309, Timer T309)
CU3 - AAL Connection Established
CU1 - AAL Awaiting Establish
Message (#) /*From Q.2931-U Reset-Start-U or Reset-Respond-U*/
Timeout T309
AAL-ESTABLISH confirm
AAL-RELEASE indication
From SAAL
To Q.2931-U (all)
Link Establish error
RESET T309
Link Release indication
To Q.2931-U (all)
CU0 - AAL Connection Released
Link Establish confirm
CU0 - AAL Connection Released
CU3 - AAL Connection Established
To Q.2931-U (all) and AP
T1163510-94/d098

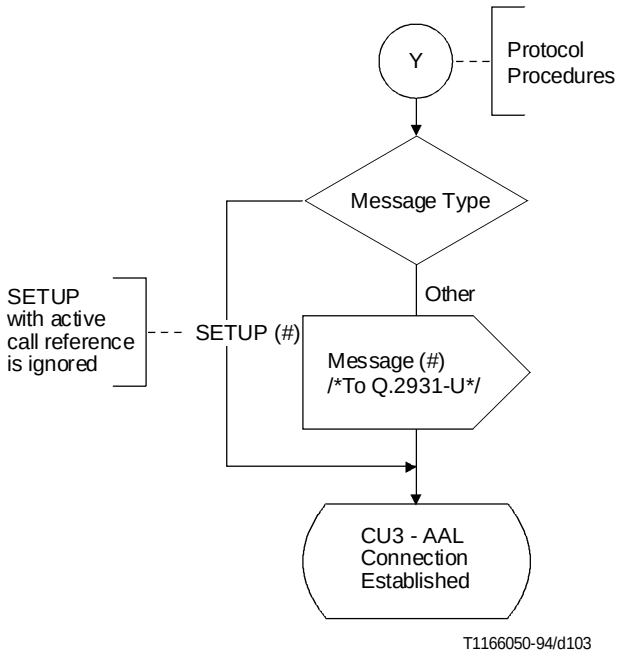

CU3 - AAL Connection Established
From AP
Link Release request
AAL-RELEASE indication
AAL-ESTABLISH indication
AAL-ESTABLISH confirm
From SAAL
To SAAL
AAL-RELEASE request
Link Release indication
Link ESTABLISH indication
Link ESTABLISH confirm
To Q.2931-U (all)
CU2 - AAL Awaiting Release
CU0 - AAL Connection Released
CU3 - AAL Connection Established
CU3 - AAL Connection Established
AAL - RELEASE confirm
From AP
Link Establish request
Link Release confirm
Link Establish confirm
To AP
CU0 - AAL Connection Released
CU3 - AAL Connection Established
T1166010-94/d099


See 5.1, 5.2, 5.1.1, 5.2.1
CU3 - AAL Connection Established
"Primitive" /*From AP*/
AAL-DATA-ind. (#) /*From SAAL*/
"Primitive" /*From Q.2931-U, Reset-Start-U or Reset-Respond-U*/
"Message (#) /* From Q.2931-U, Reset-Start-U or Reset-Respond-U*/
To application primitive handling procedures
W
Check-Msg (#)
See 5.6.1, 5.6.2, 5.6.3
"Primitive" /*To AP*/
Build-M (#)
CU3 - AAL Connection Established
AAL-DATA-req (#) /*To SAAL*/
CU3 - AAL Connection Established
Q.2931 Protocol Discriminator
No
Yes
Message Length <9 octets
Yes
No
Valid Call Reference format
No
Yes
Call Reference = Dummy
Yes
No
CU3 - AAL Connection Established
Call Reference = Global
Yes
No
X
To Global Call Reference Procedures
Does not include check of Call Reference Flag
Call Reference recognized
No
Yes
Z
To "No Protocol" Procedures
Y
To Protocol Related Procedures
T1166020-94/d100

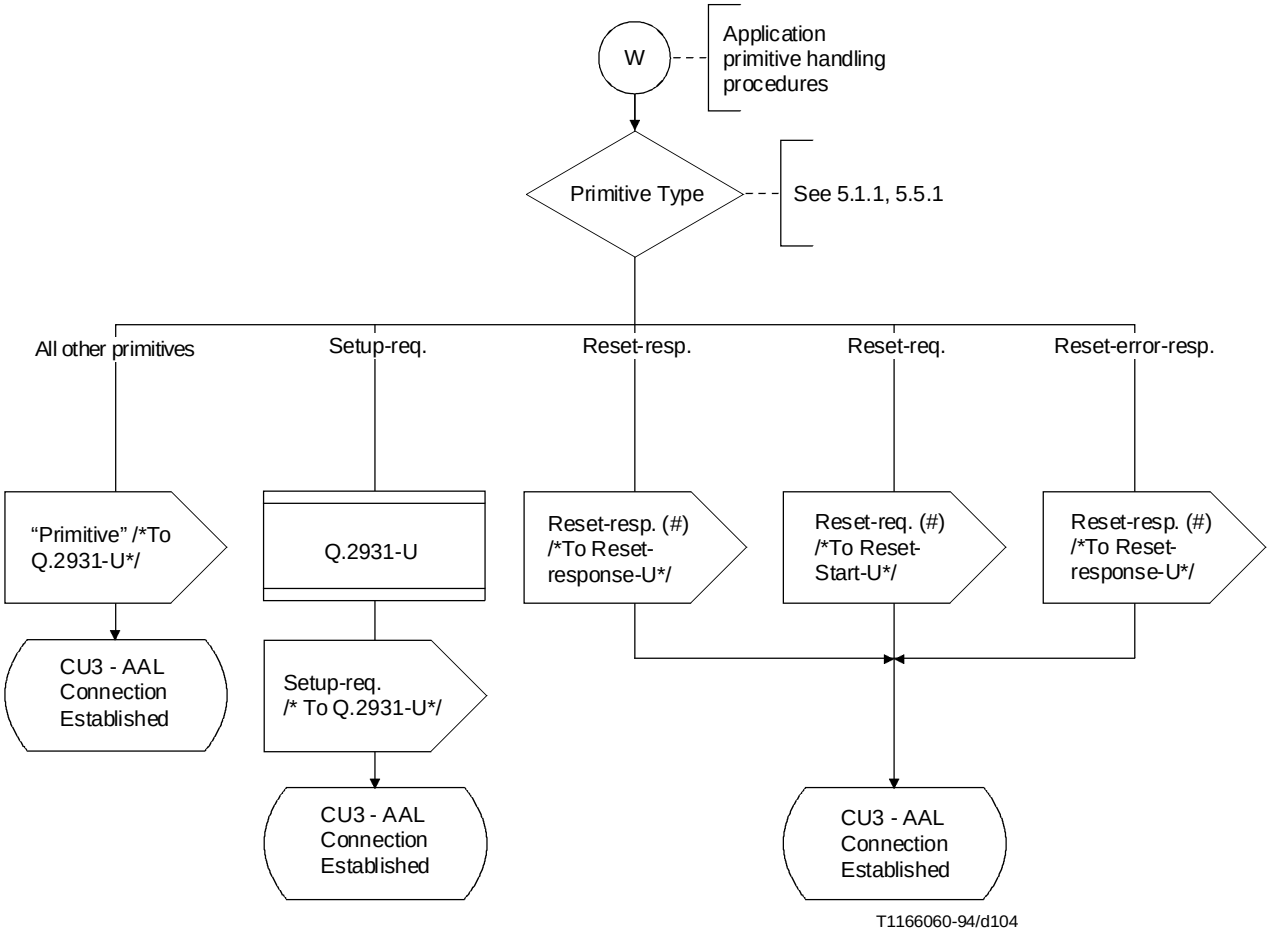

X
Global Call Reference Procedures
Message Type
See 5.5, 5.6.3.2 e), 5.6.12
OTHER (#)
RESTART (#)
RESTART-ACKNOWLEDGE (#)
STATUS (#)
No
Call Reference Flag = 0
Yes
Yes
Call Reference Flag = 0?
Yes
Call Reference Flag = 0?
No
No
Cause: = 81, CS: = 0
RESTART (#) /*To Reset-Respond-U*/
RESTART ACKNOWLEDGE (#) /*To Reset-Start-U*/
STATUS (#) /* To Reset-Start-U*/
STATUS (#) /* To Reset-Respond-U*/
Build-Msg (STATUS Cause, CS, #)
CU3 - AAL Connection Established
CU3 - AAL Connection Established
CU3 - AAL Connection Established
T1175620-95/d101
AAL-DATA-req. (#) /*To SAAL*/
CU3 - AAL Connection Established

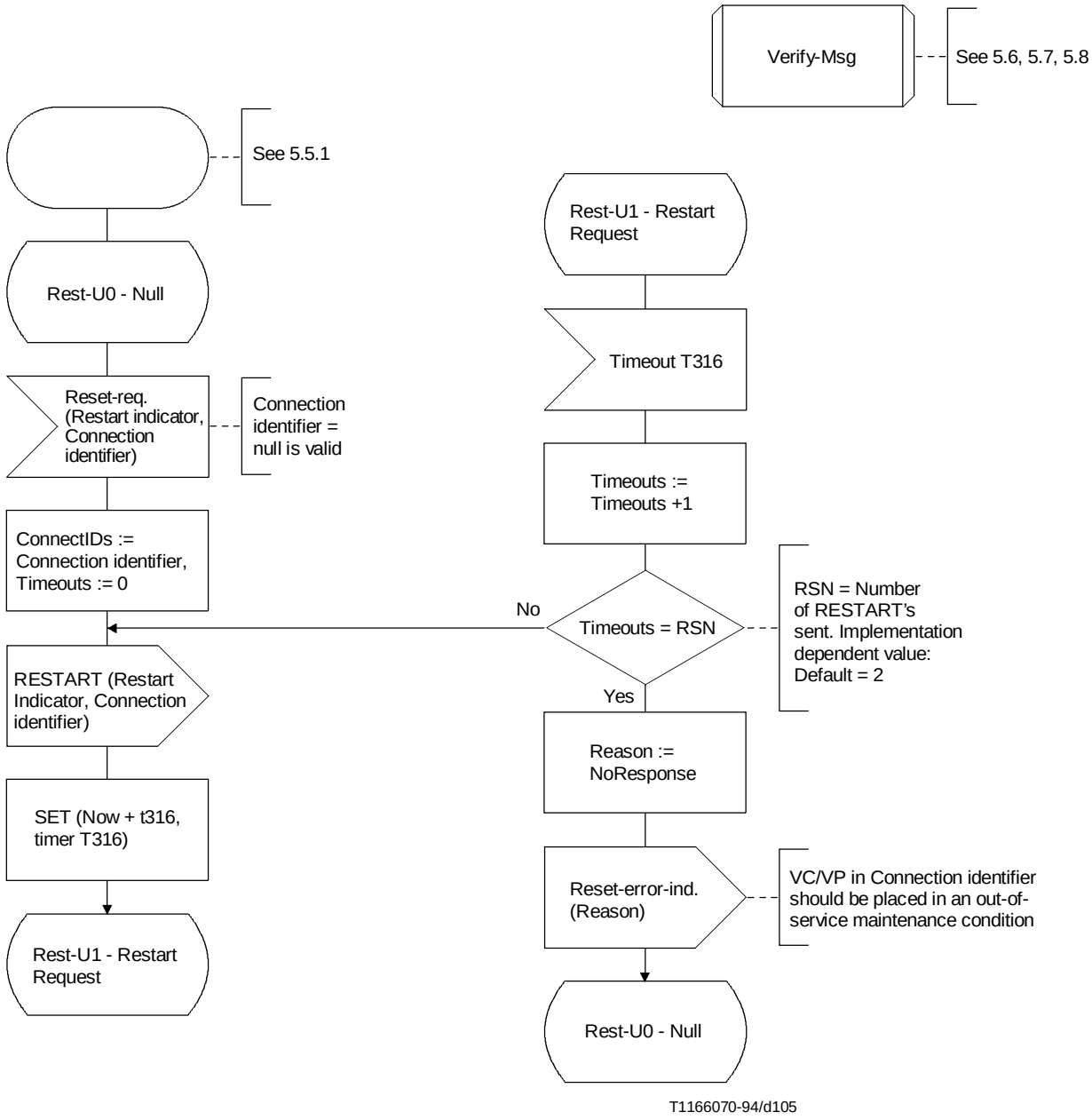

Z
"No Protocol" Procedures
Message Type
See 5.6.3.2 a), b), c), f), g), 5.6.11
SETUP (#)
RELEASE-COMPLETE (#)
OTHER (#)
STATUS (#)
STATUS-ENQUIRY (#)
Call Reference flag = 0
No
Yes
Q.2931-U
SETUP (#) /*To Q.2931-U*/
CU3 - AAL Connection Established
CU3 - AAL Connection Established
Cause := 81
Build-Msg (RELEASE-COMPLETE. Cause. #)
AAL-DATA-req. (#) /*To SAAL*/
CU3 - AAL Connection Established
CS = 0
Yes
No
Cause := 101
Cause := 30; CS := 0
Build-Msg (STATUS CS, Cause. #)
AAL-DATA-req. (#) /*To SAAL*/
CU3 - AAL Connection Established
T1166040-94/d102

PROCESS Co-ord-U; page 9 of (10)

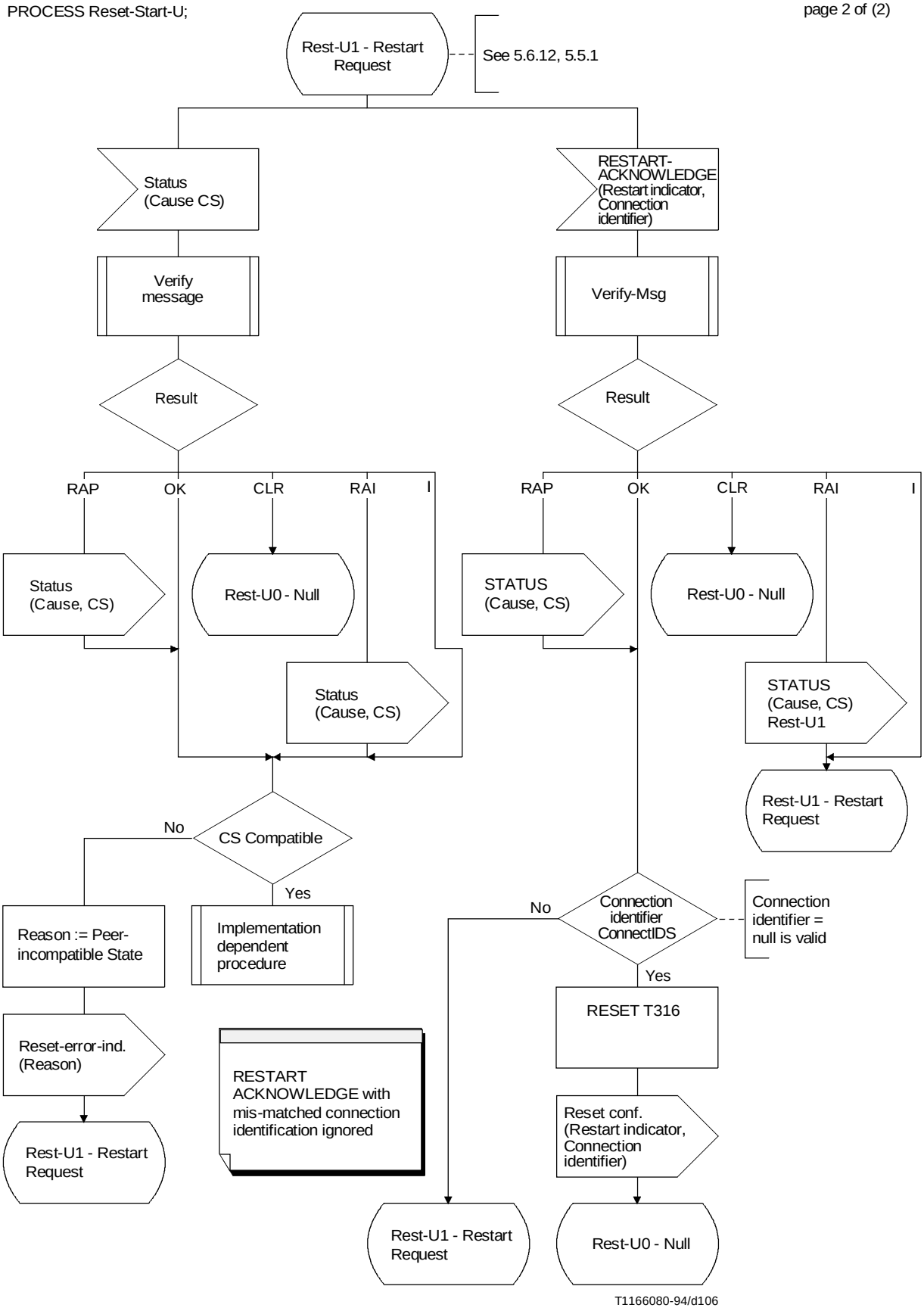


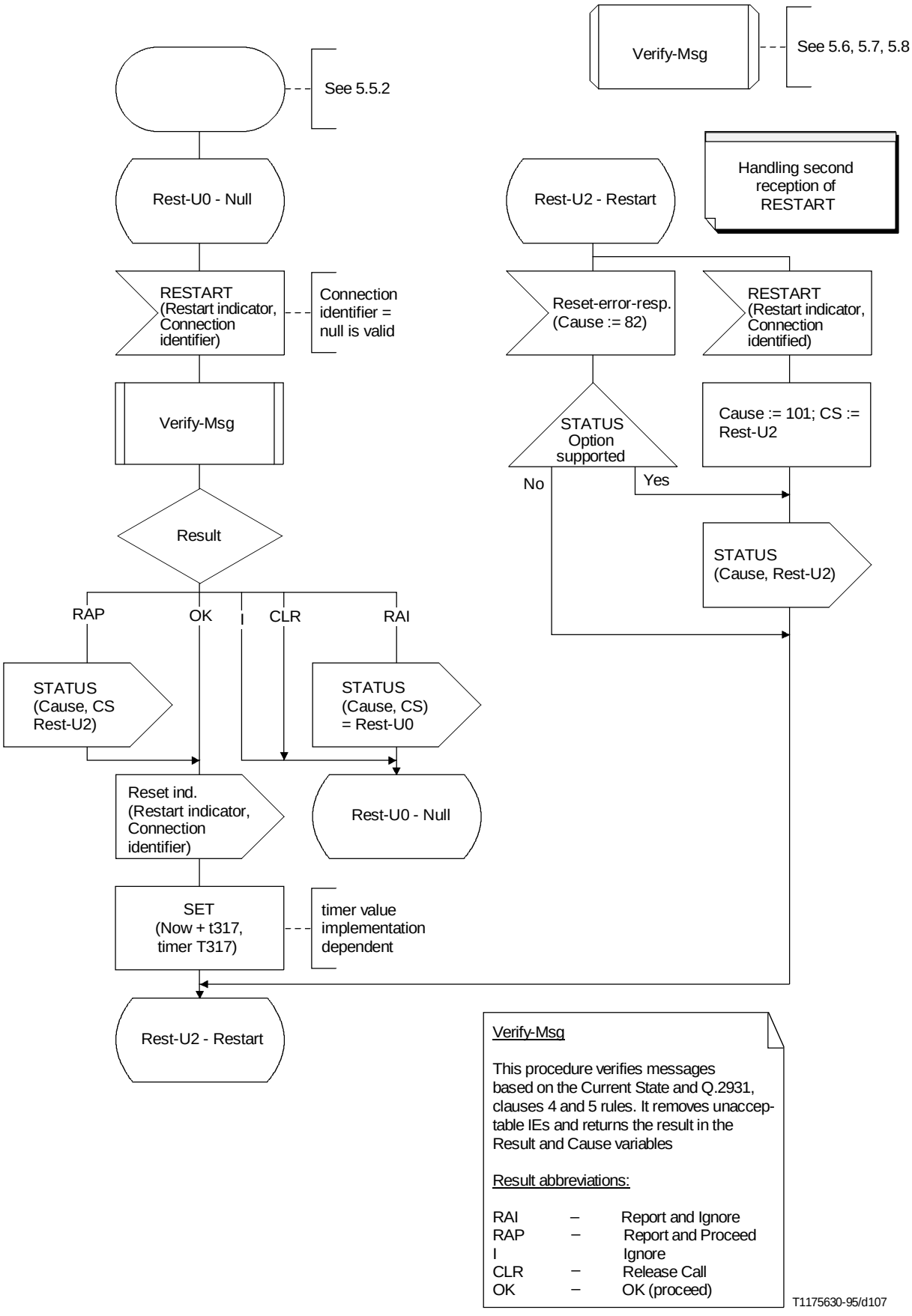
PROCESS Co-ord-U; page 10 of (10)

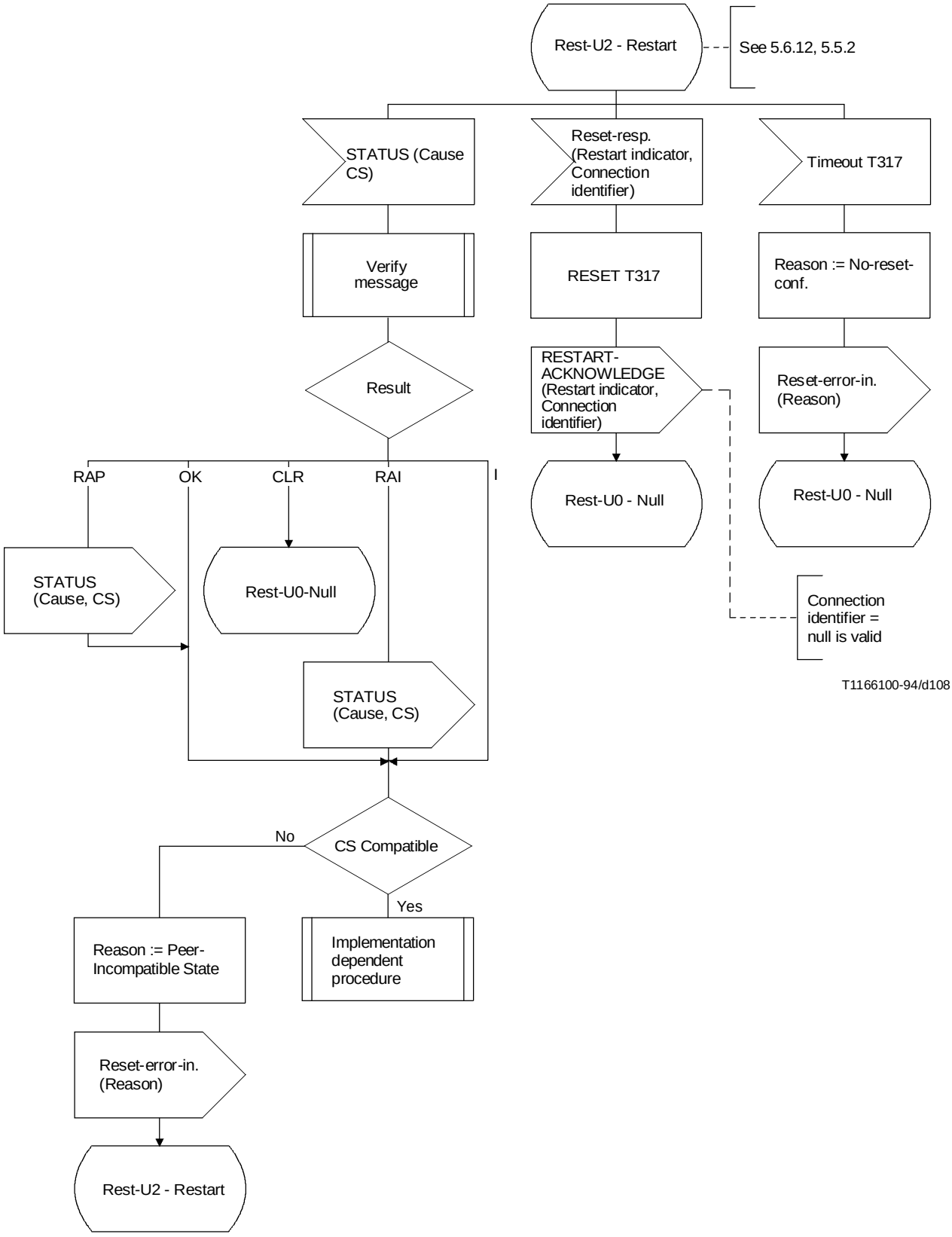


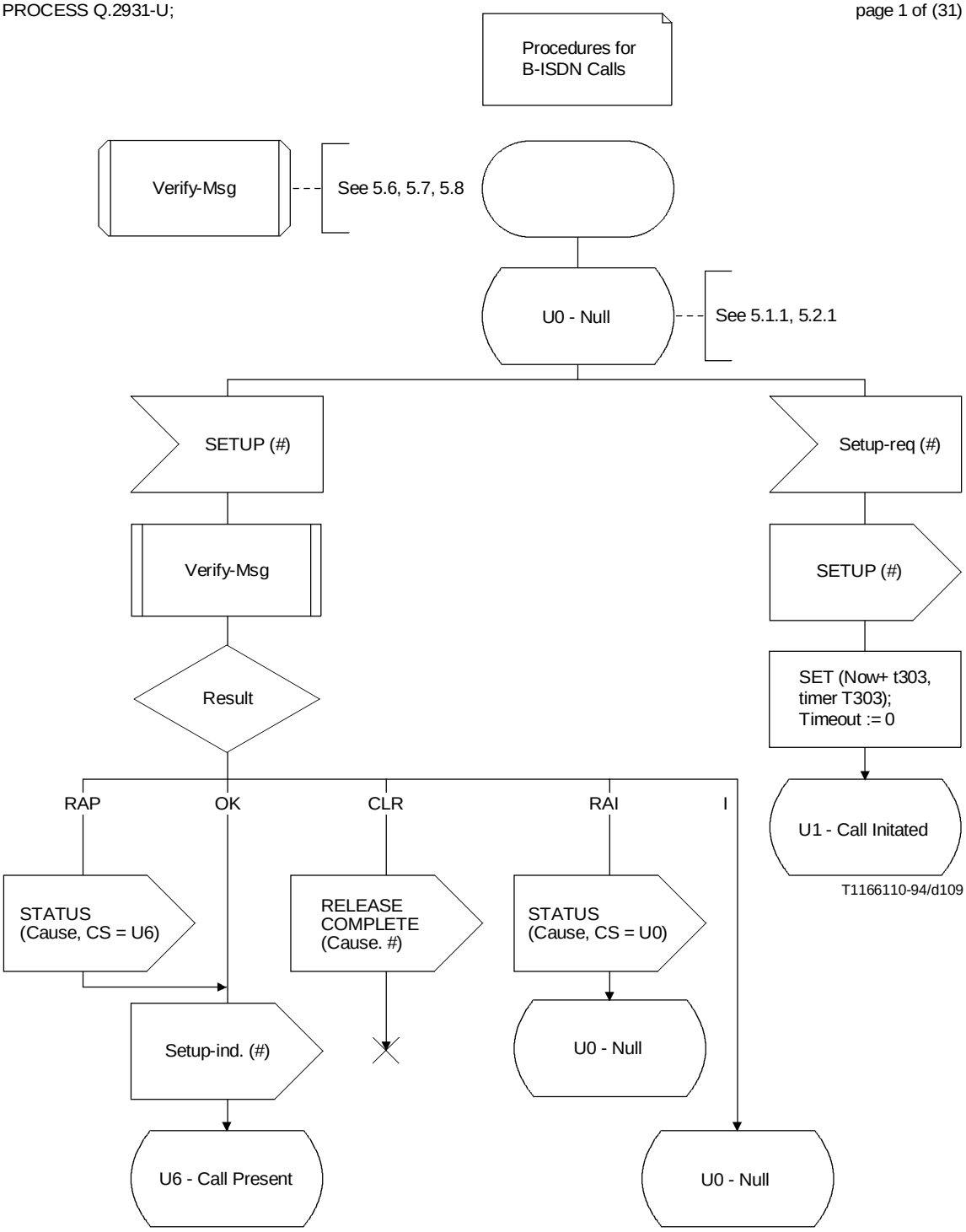


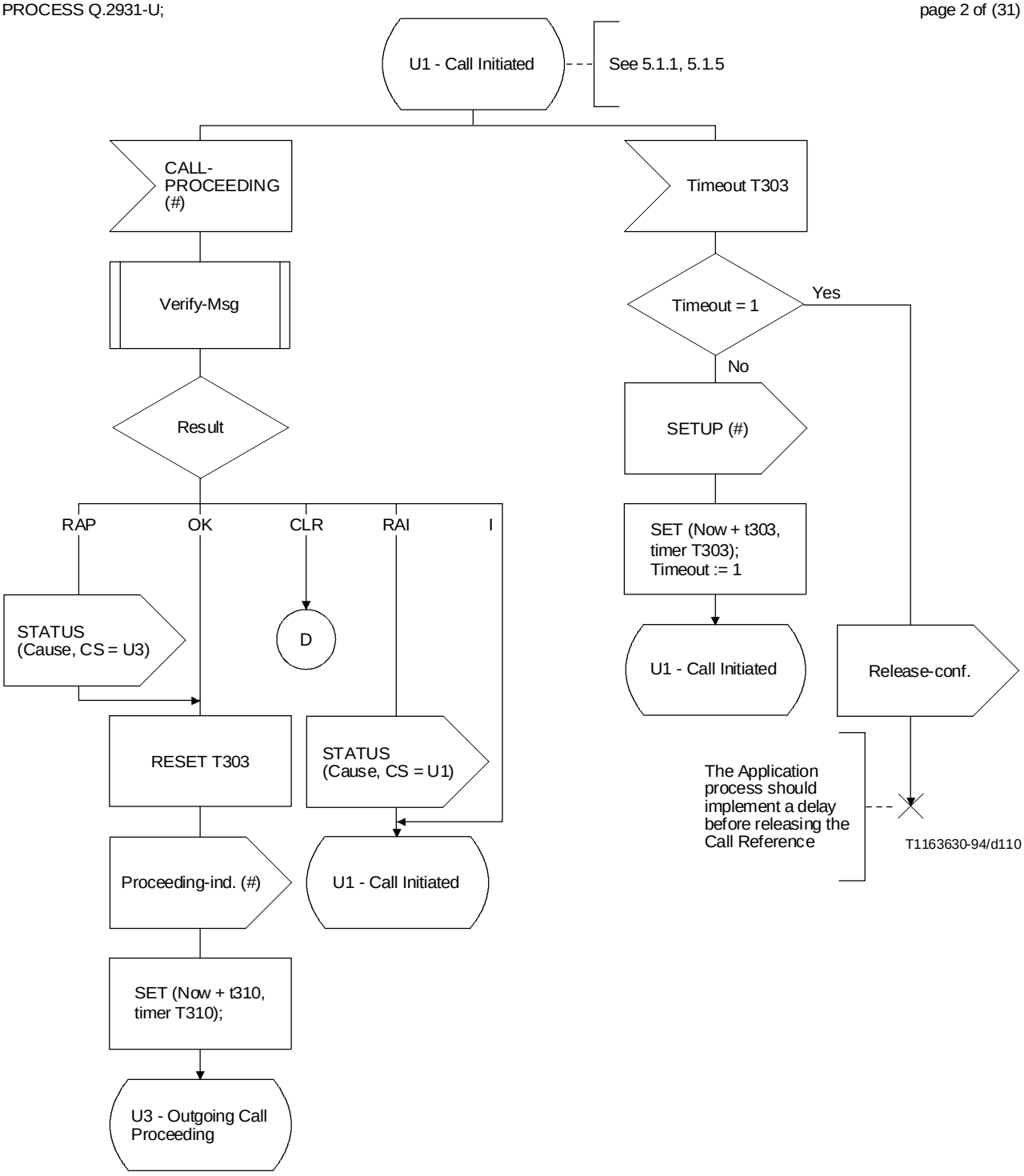
T1166070-94/d105

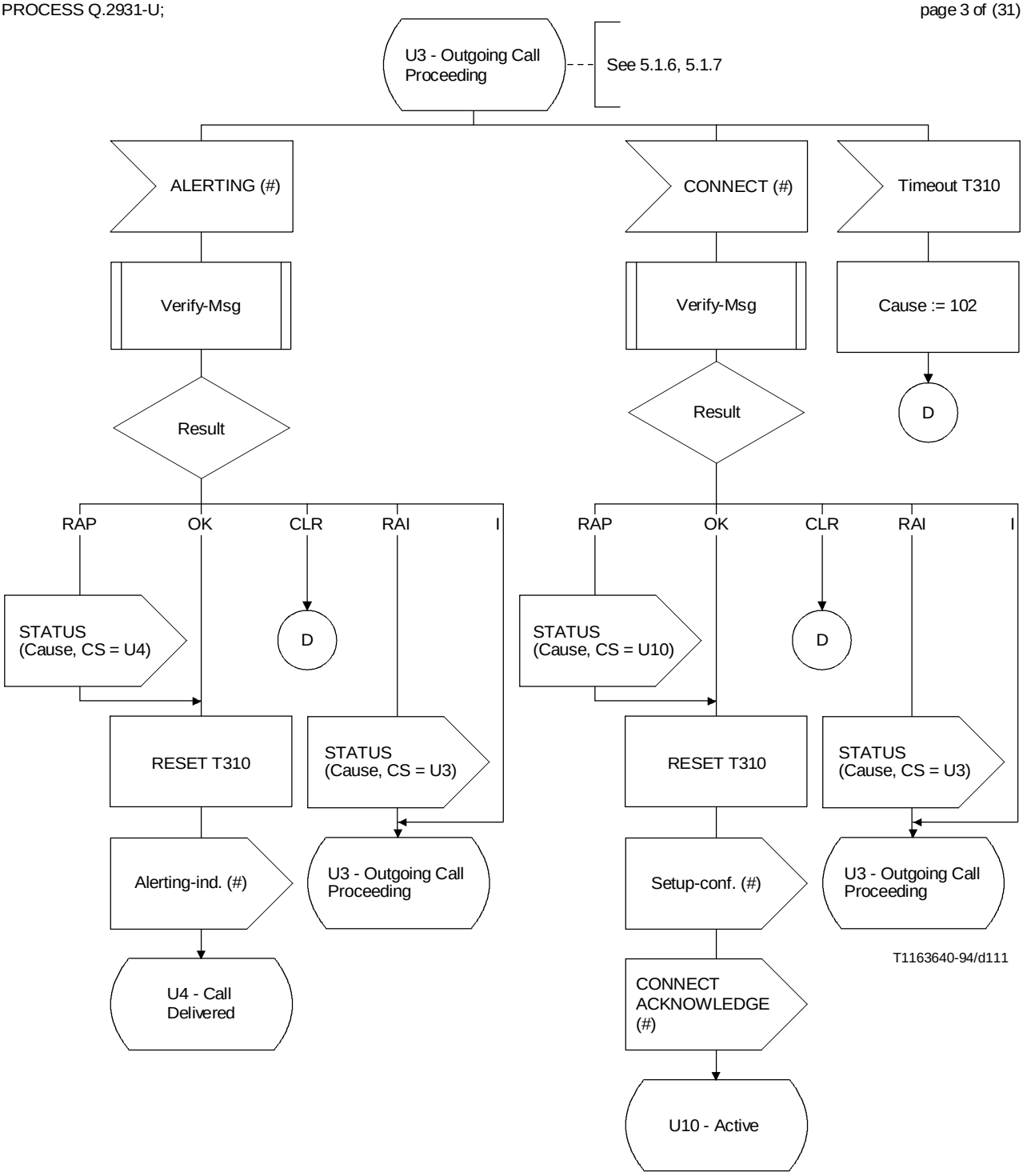

Rest-U1 - Restart Request
See 5.6.12, 5.5.1
Status (Cause CS)
RESTART-ACKNOWLEDGE (Restart indicator, Connection identifier)
Verify message
Verify-Msg
Result
Result
RAP
OK
CLR
RAI
I
RAP
OK
CLR
RAI
I
Status (Cause, CS)
Rest-U0 - Null
STATUS (Cause, CS)
Rest-U0 - Null
Status (Cause, CS)
STATUS (Cause, CS) Rest-U1
Rest-U1 - Restart Request
No
CS Compatible
Yes
Reason := Peer-incompatible State
Implementation dependent procedure
No
Connection identifier ConnectIDS
Connection identifier = null is valid
Yes
RESET T316
Reset-error-ind. (Reason)
RESTART ACKNOWLEDGE with mis-matched connection identification ignored
Reset conf. (Restart indicator, Connection identifier)
Rest-U1 - Restart Request
Rest-U1 - Restart Request
Rest-U0 - Null
T1166080-94/d106

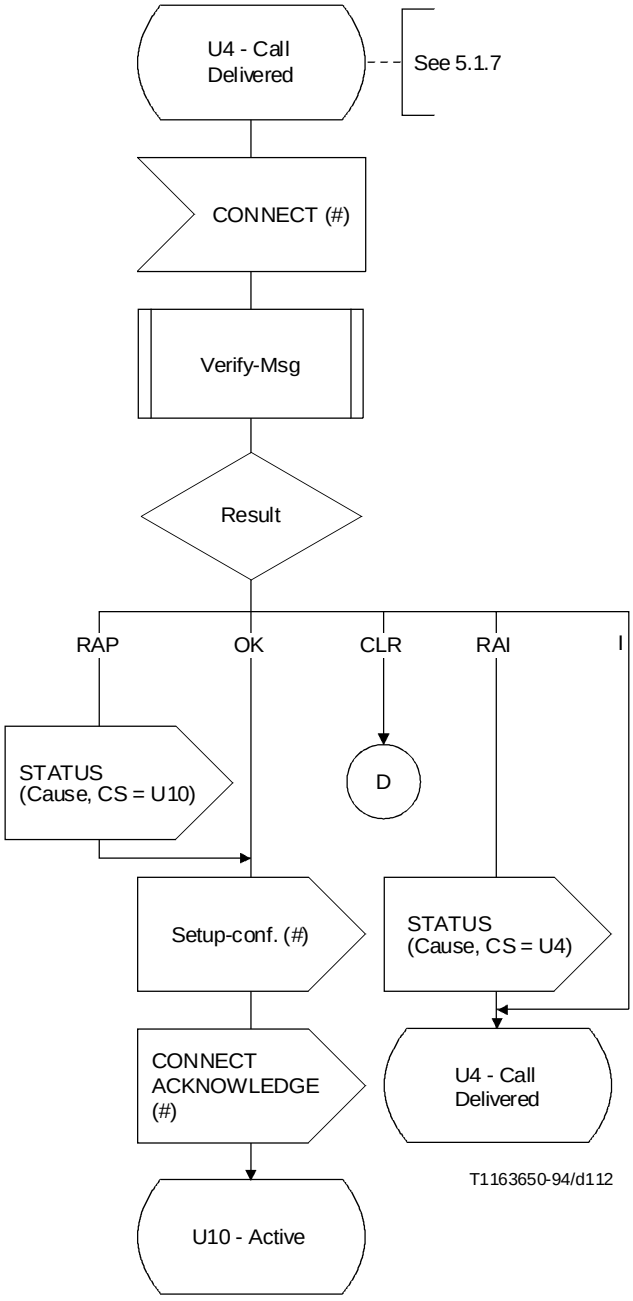

See 5.5.2
Rest-U0 - Null
RESTART (Restart indicator, Connection identifier)
Connection identifier = null is valid
Verify-Msg
Result
RAP
OK
I
CLR
RAI
STATUS (Cause, CS Rest-U2)
STATUS (Cause, CS) = Rest-U0
Reset ind. (Restart indicator, Connection identifier)
Rest-U0 - Null
SET (Now + t317, timer T317)
timer value implementation dependent
Rest-U2 - Restart
Verify-Msg
See 5.6, 5.7, 5.8
Rest-U2 - Restart
Handling second reception of RESTART
Reset-error-resp. (Cause := 82)
RESTART (Restart indicator, Connection identified)
STATUS Option supported
No
Yes
Cause := 101; CS := Rest-U2
STATUS (Cause, Rest-U2)
Verify-Msg
This procedure verifies messages based on the Current State and Q.2931, clauses 4 and 5 rules. It removes unacceptable IEs and returns the result in the Result and Cause variables
Result abbreviations:
RAI – Report and Ignore
RAP – Report and Proceed
I Ignore
CLR – Release Call
OK – OK (proceed)
T1175630-95/d107

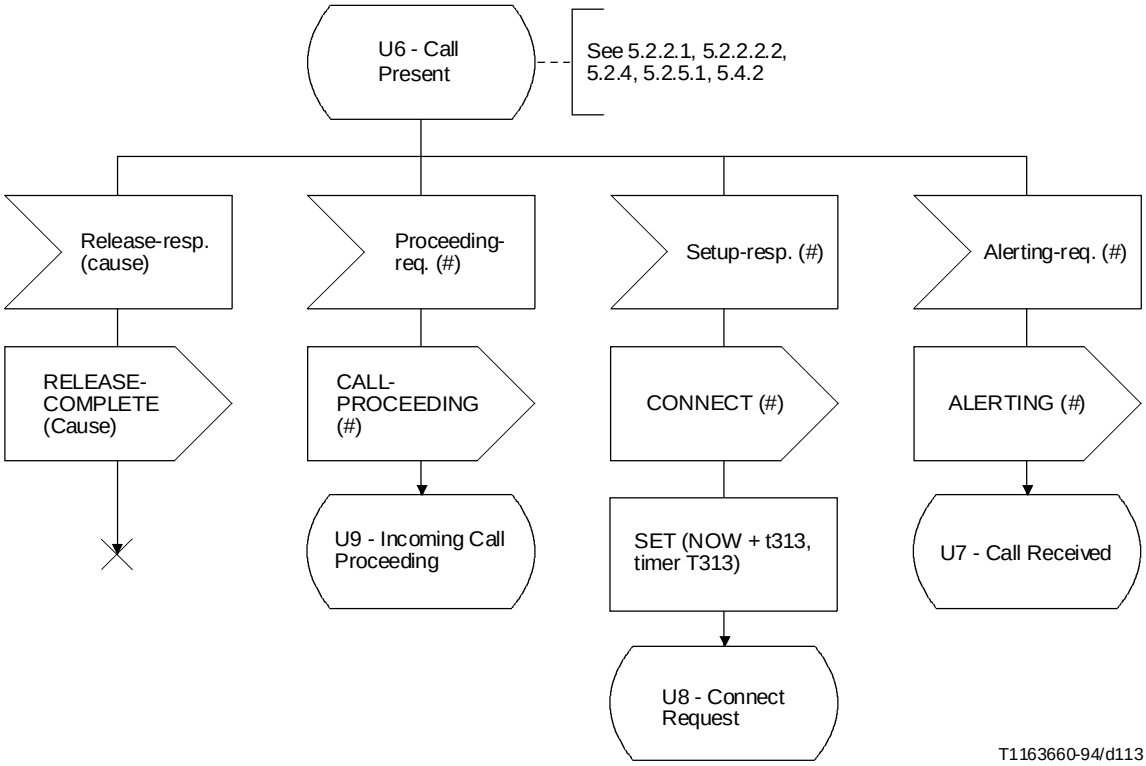

Rest-U2 - Restart
See 5.6.12, 5.5.2
STATUS (Cause CS)
Reset-resp. (Restart indicator, Connection identifier)
Timeout T317
Verify message
RESET T317
Reason := No-reset-conf.
Result
RESTART-ACKNOWLEDGE (Restart indicator, Connection identifier)
Reset-error-in. (Reason)
RAP
OK
CLR
RAI
Rest-U0 - Null
Rest-U0 - Null
STATUS (Cause, CS)
Rest-U0-Null
Connection identifier = null is valid
STATUS (Cause, CS)
T1166100-94/d108
No
CS Compatible
Yes
Reason := Peer-Incompatible State
Implementation dependent procedure
Reset-error-in. (Reason)
Rest-U2 - Restart

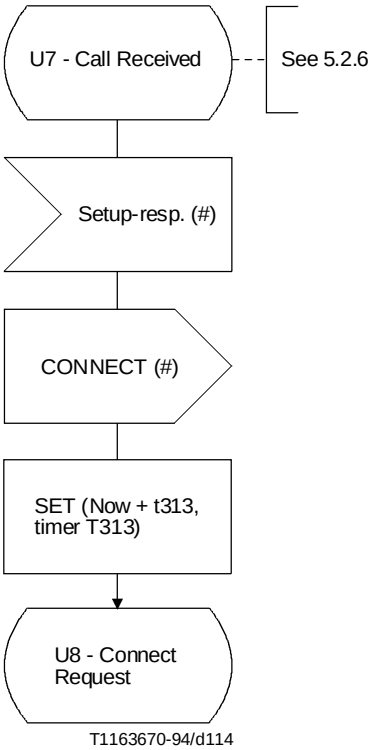

Procedures for
B-ISDN Calls
Verify-Msg
See 5.6, 5.7, 5.8
U0 - Null
See 5.1.1, 5.2.1
SETUP (#)
Setup-req (#)
Verify-Msg
SETUP (#)
Result
SET (Now+ t303,
timer T303);
Timeout := 0
RAP
OK
CLR
RAI
I
U1 - Call Initated
STATUS
(Cause, CS = U6)
RELEASE
COMPLETE
(Cause. #)
STATUS
(Cause, CS = U0)
Setup-ind. (#)
U0 - Null
U6 - Call Present
U0 - Null
T1166110-94/d109

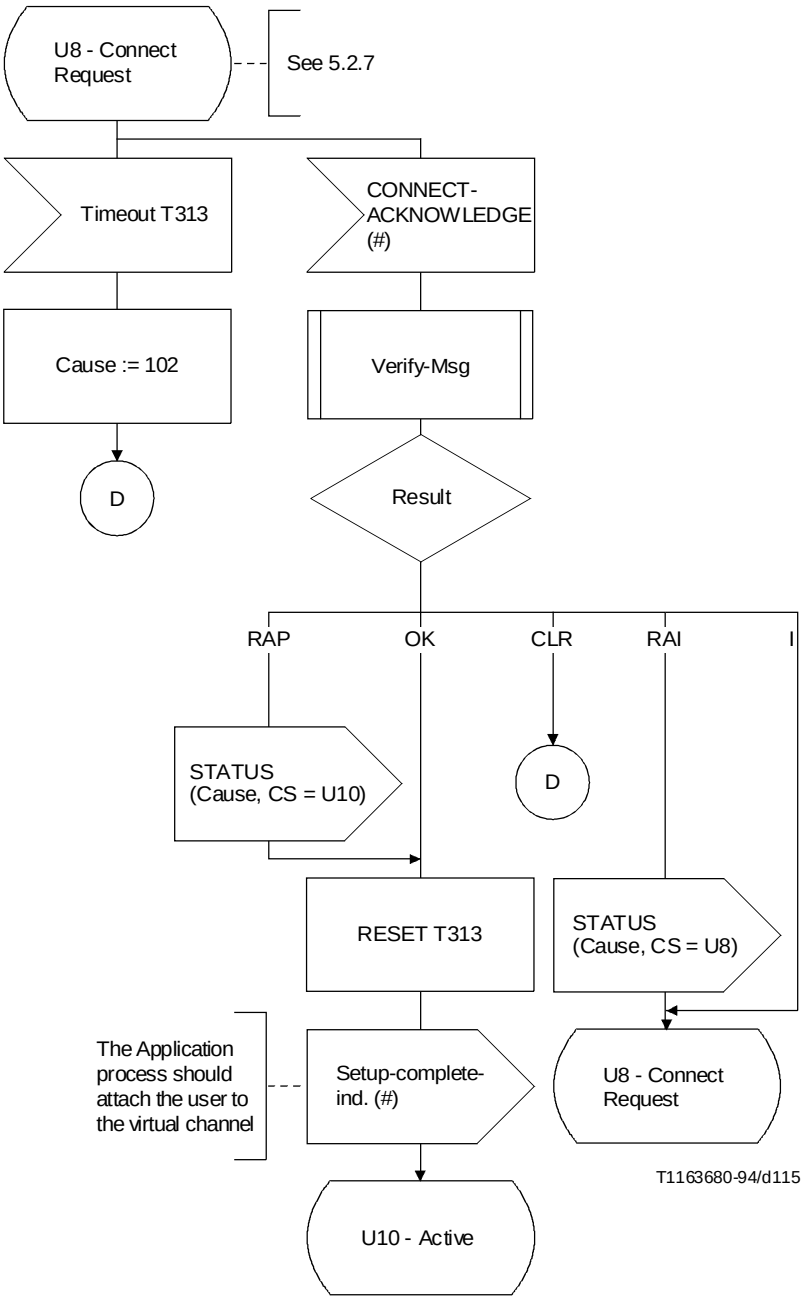

U1 - Call Initiated
See 5.1.1, 5.1.5
CALL-PROCEEDING (#)
Timeout T303
Verify-Msg
Timeout = 1
Yes
No
Result
SETUP (#)
RAP
OK
CLR
RAI
I
SET (Now + t303, timer T303); Timeout := 1
STATUS (Cause, CS = U3)
D
U1 - Call Initiated
Release-conf.
RESET T303
STATUS (Cause, CS = U1)
The Application process should implement a delay before releasing the Call Reference
T1163630-94/d110
Proceeding-ind. (#)
U1 - Call Initiated
SET (Now + t310, timer T310);
U3 - Outgoing Call Proceeding

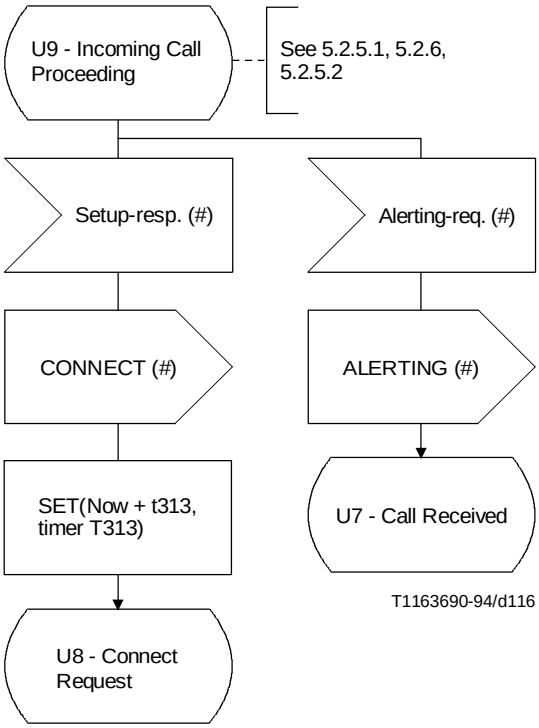

U3 - Outgoing Call Proceeding
See 5.1.6, 5.1.7
ALERTING (#)
CONNECT (#)
Timeout T310
Verify-Msg
Verify-Msg
Cause := 102
Result
Result
D
RAP
OK
CLR
RAI
I
RAP
OK
CLR
RAI
I
STATUS (Cause, CS = U4)
D
STATUS (Cause, CS = U10)
D
RESET T310
STATUS (Cause, CS = U3)
RESET T310
STATUS (Cause, CS = U3)
Alerting-ind. (#)
U3 - Outgoing Call Proceeding
Setup-conf. (#)
U3 - Outgoing Call Proceeding
T1163640-94/d111
U4 - Call Delivered
CONNECT ACKNOWLEDGE (#)
U10 - Active

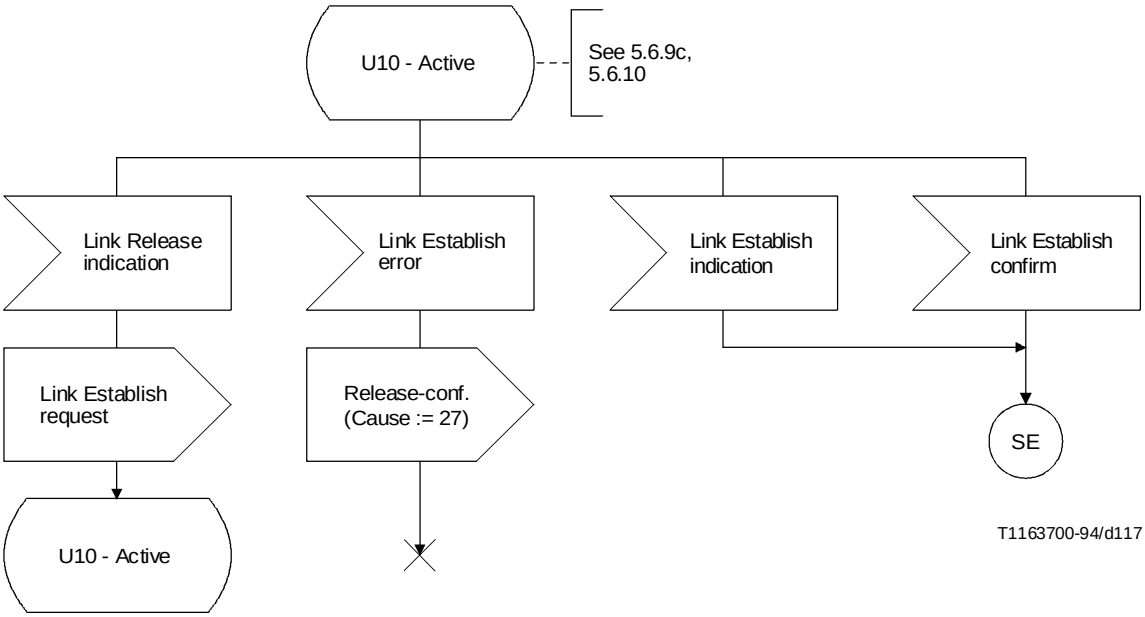

U4 - Call Delivered
See 5.1.7
CONNECT (#)
Verify-Msg
Result
RAP
OK
CLR
RAI
I
STATUS (Cause, CS = U10)
D
Setup-conf. (#)
STATUS (Cause, CS = U4)
CONNECT ACKNOWLEDGE (#)
U4 - Call Delivered
T1163650-94/d112
U10 - Active

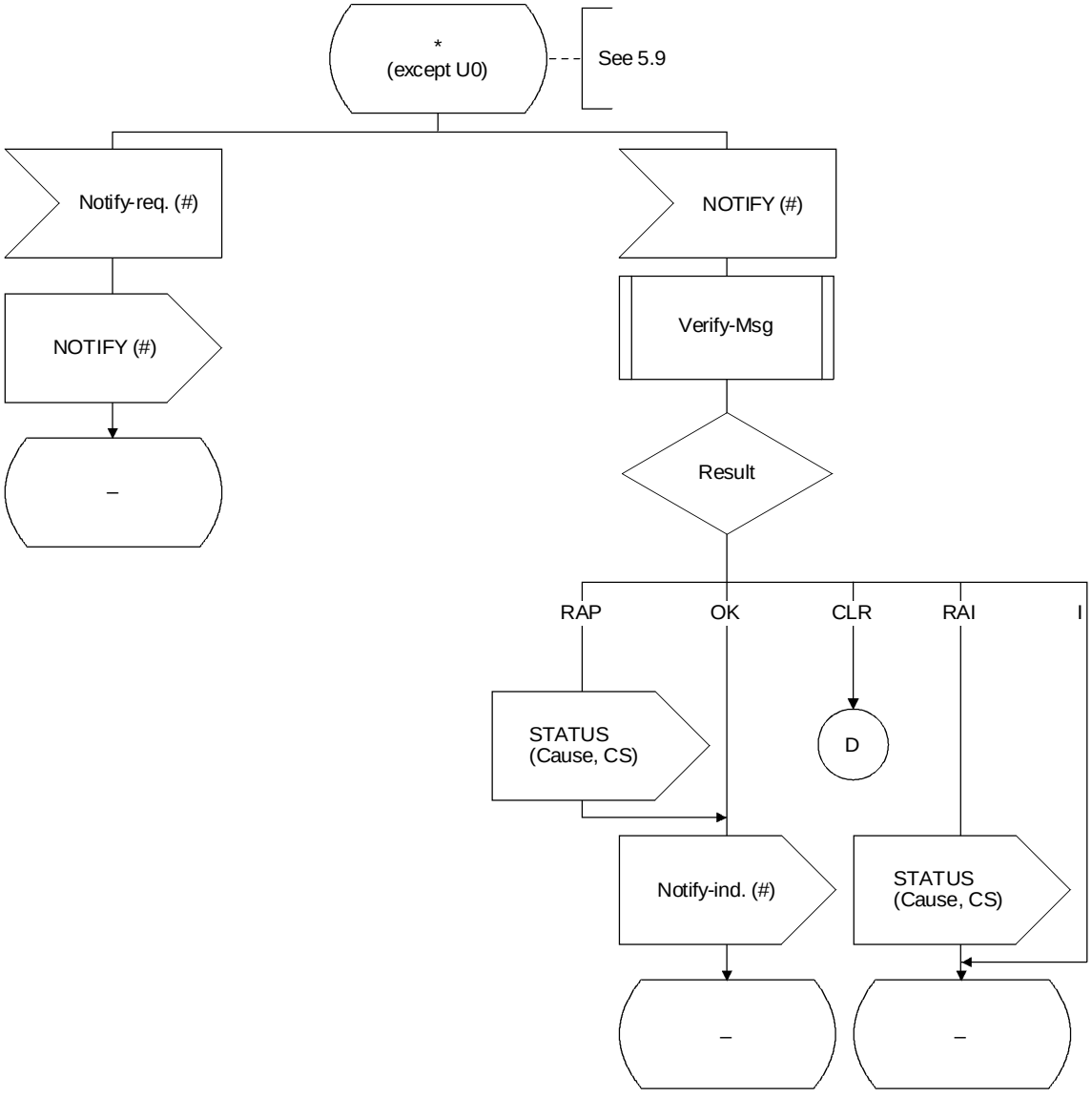

U6 - Call Present
See 5.2.2.1, 5.2.2.2.2, 5.2.4, 5.2.5.1, 5.4.2
Release-resp. (cause)
Proceeding-req. (#)
Setup-resp. (#)
Alerting-req. (#)
RELEASE-COMPLETE (Cause)
CALL-PROCEEDING (#)
CONNECT (#)
ALERTING (#)
U9 - Incoming Call Proceeding
SET (NOW + t313, timer T313)
U7 - Call Received
U8 - Connect Request
T1163660-94/d113


U7 - Call Received
See 5.2.6
Setup-resp. (#)
CONNECT (#)
SET (Now + t313, timer T313)
U8 - Connect Request
T1163670-94/d114

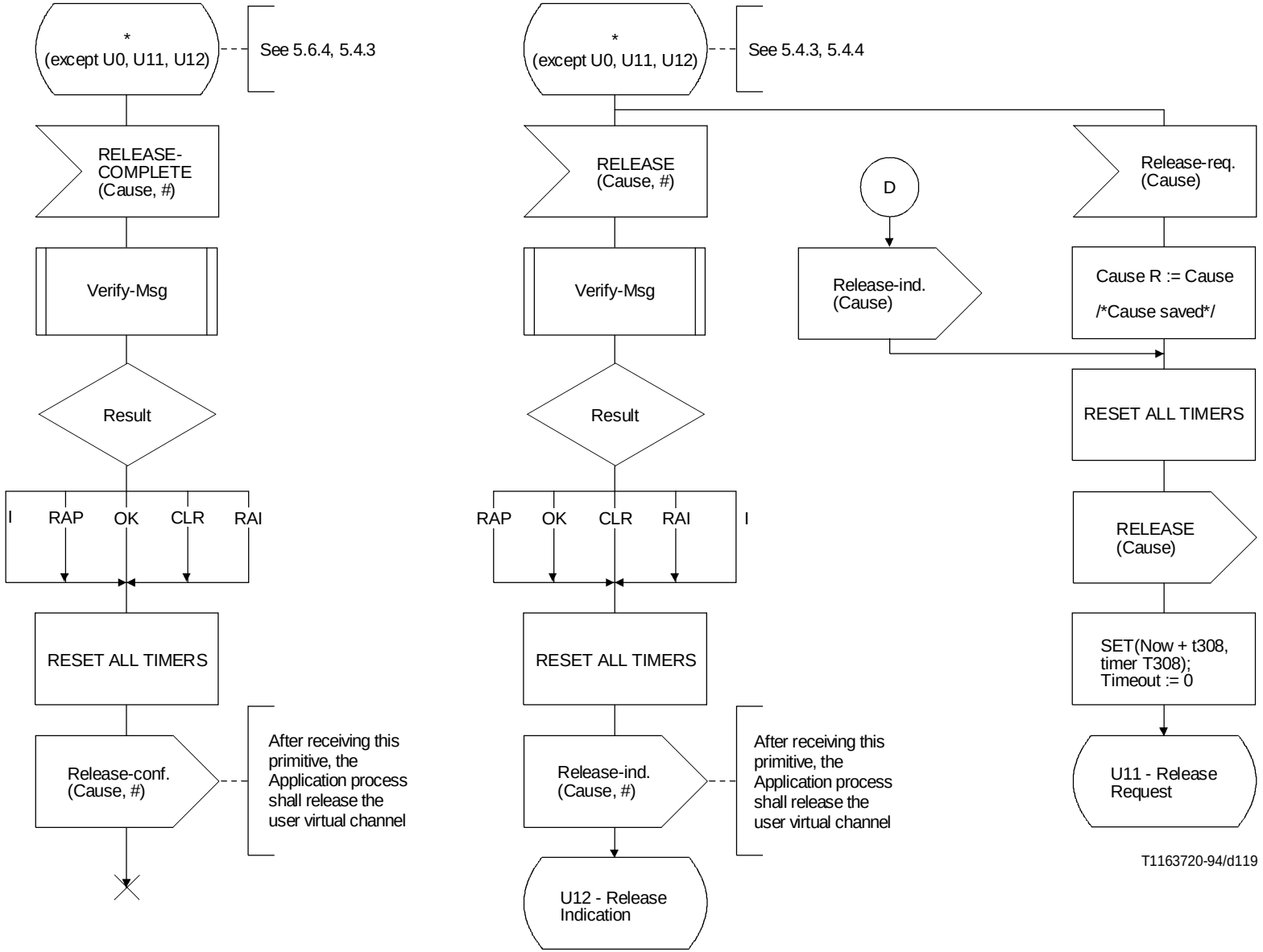

U8 - Connect Request
See 5.2.7
Timeout T313
CONNECT-ACKNOWLEDGE (#)
Cause := 102
Verify-Msg
D
Result
RAP
OK
CLR
RAI
I
STATUS (Cause, CS = U10)
D
RESET T313
STATUS (Cause, CS = U8)
The Application process should attach the user to the virtual channel
Setup-complete-ind. (#)
U8 - Connect Request
T1163680-94/d115
U10 - Active


U9 - Incoming Call Proceeding
See 5.2.5.1, 5.2.6, 5.2.5.2
Setup-resp. (#)
Alerting-req. (#)
CONNECT (#)
ALERTING (#)
SET(Now + t313, timer T313)
U7 - Call Received
T1163690-94/d116
U8 - Connect Request

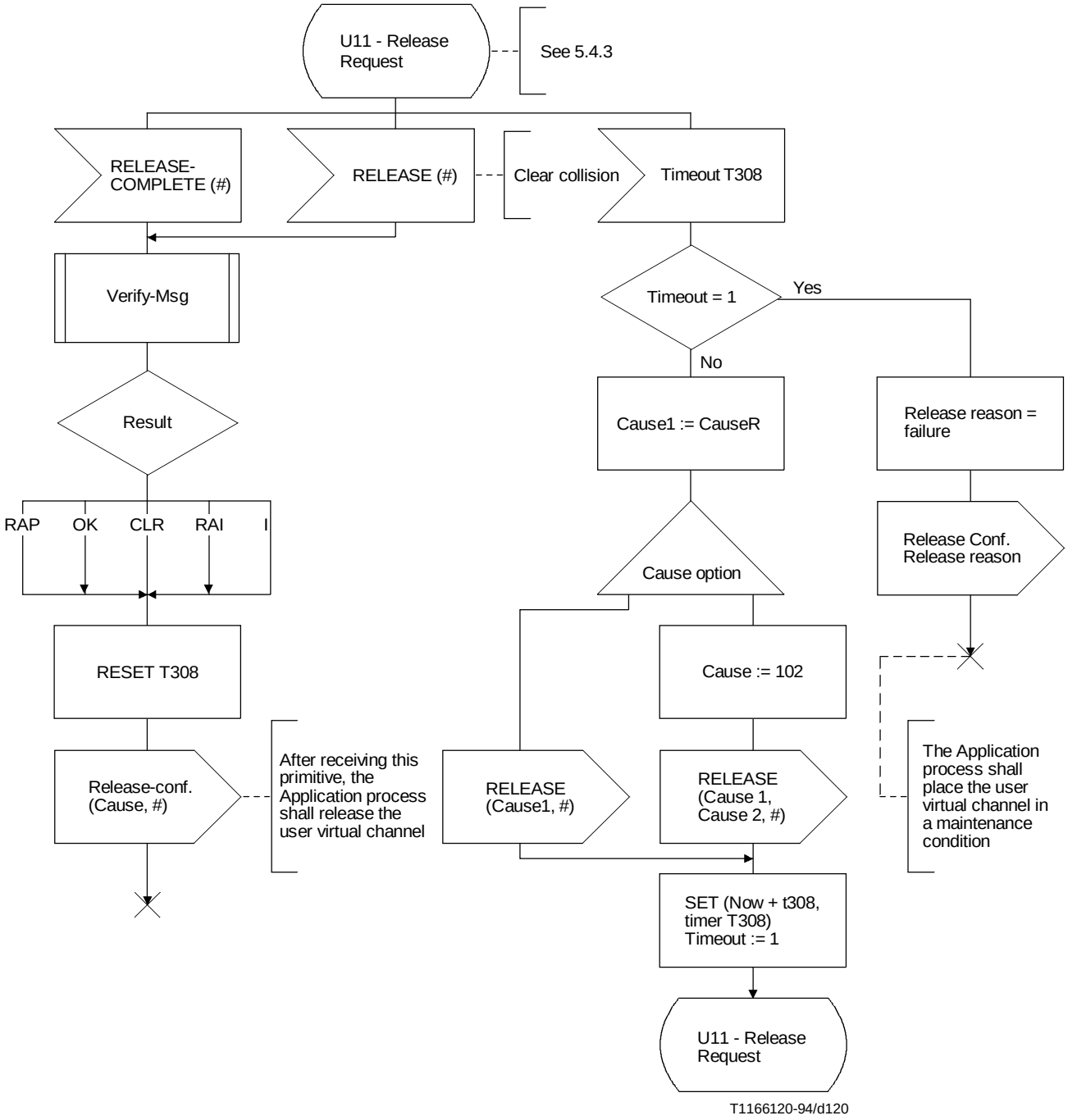

U10 - Active
See 5.6.9c, 5.6.10
Link Release indication
Link Establish error
Link Establish indication
Link Establish confirm
Link Establish request
Release-conf. (Cause := 27)
SE
T1163700-94/d117
U10 - Active

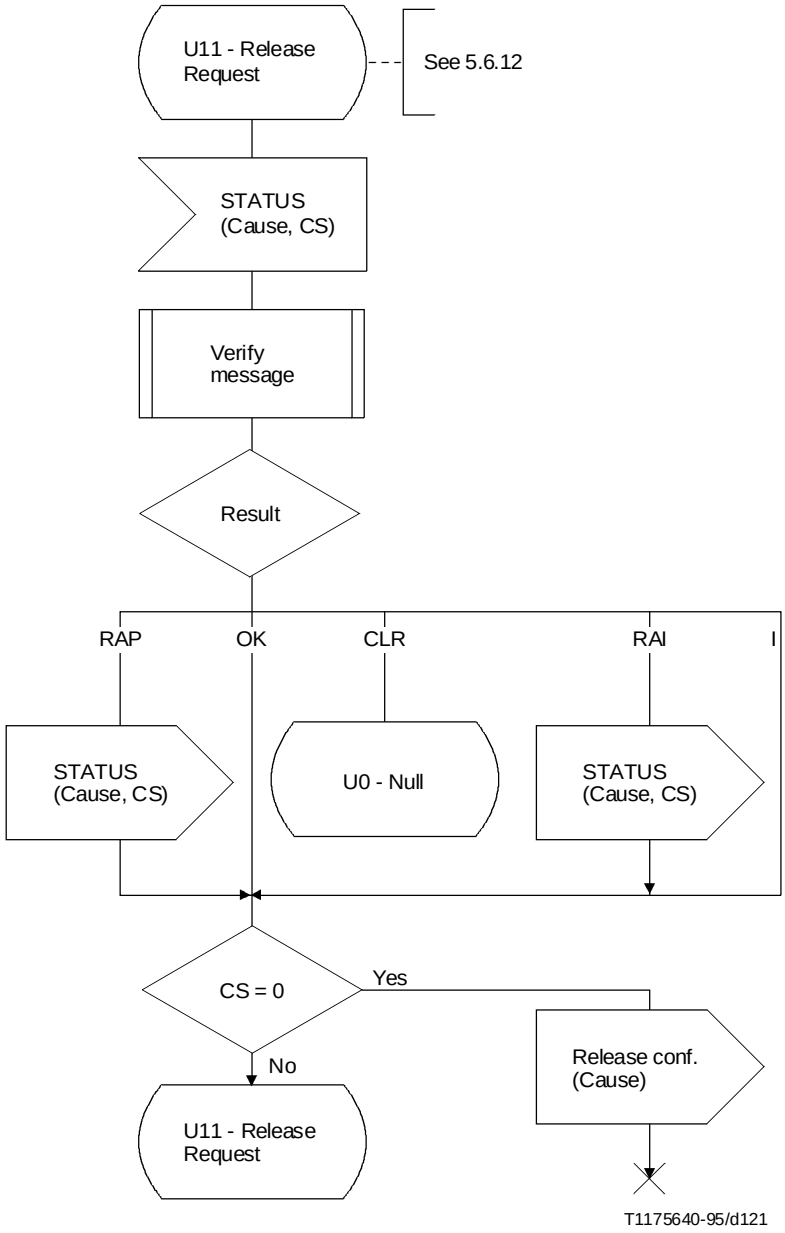


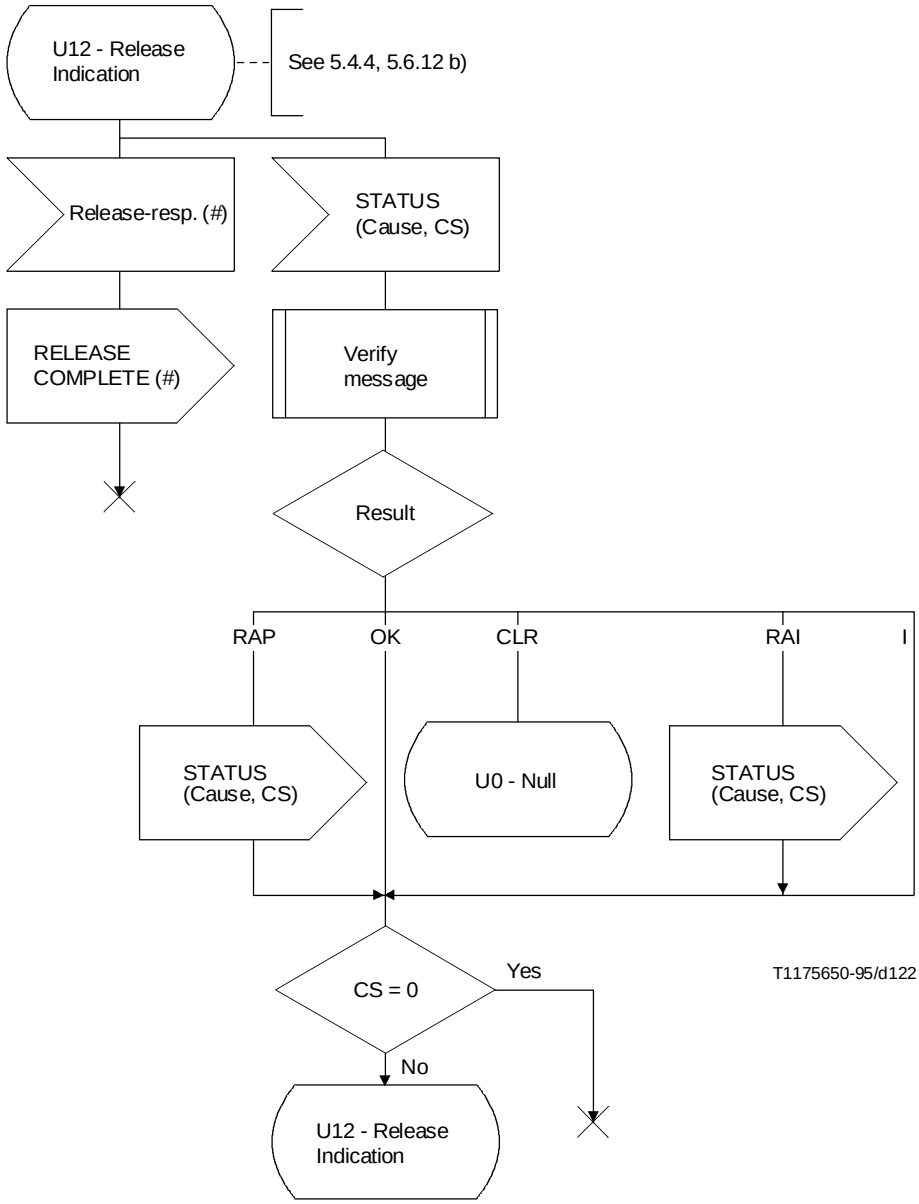
T1163710-94/d118

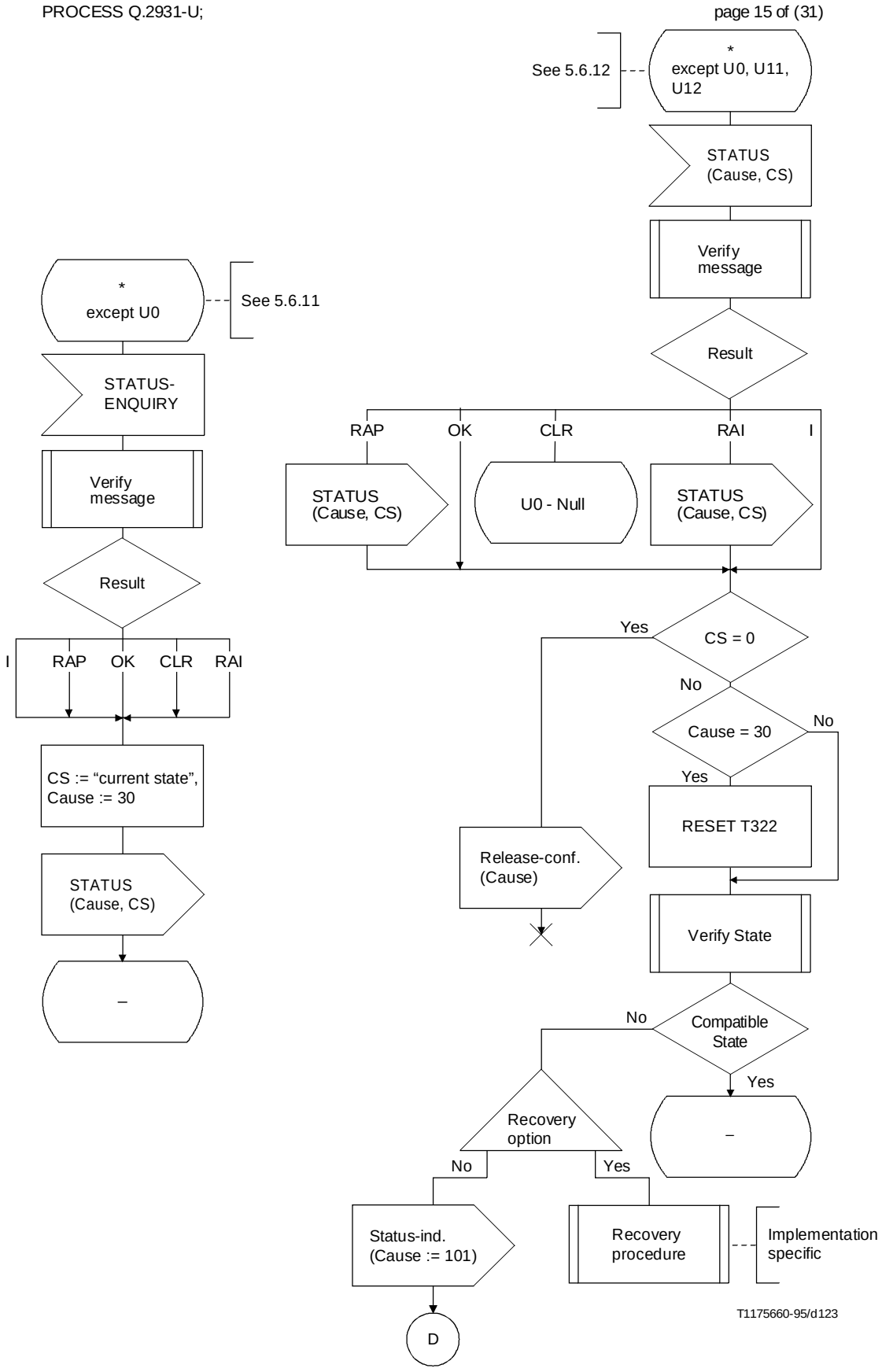


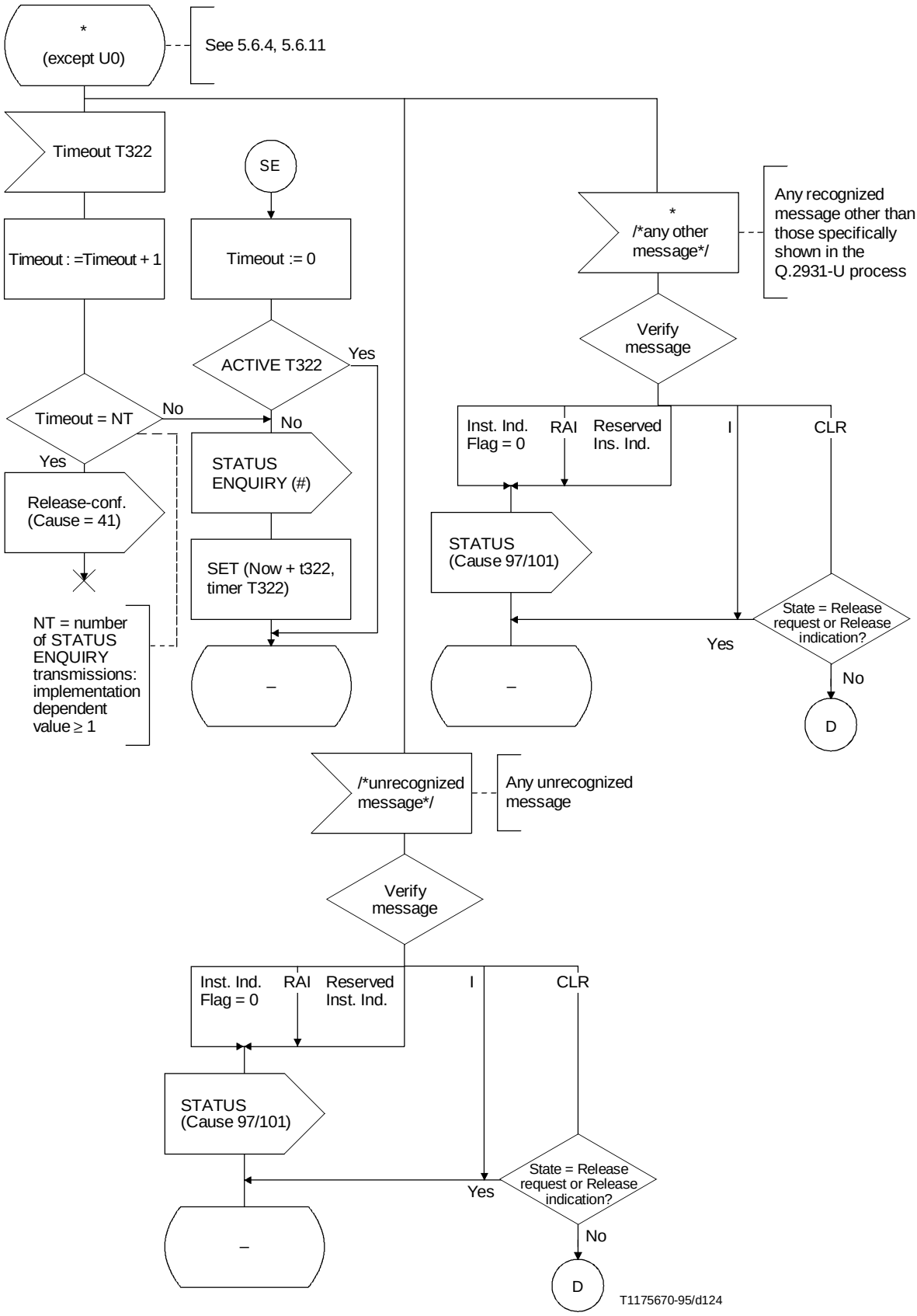
T1163720-94/d119

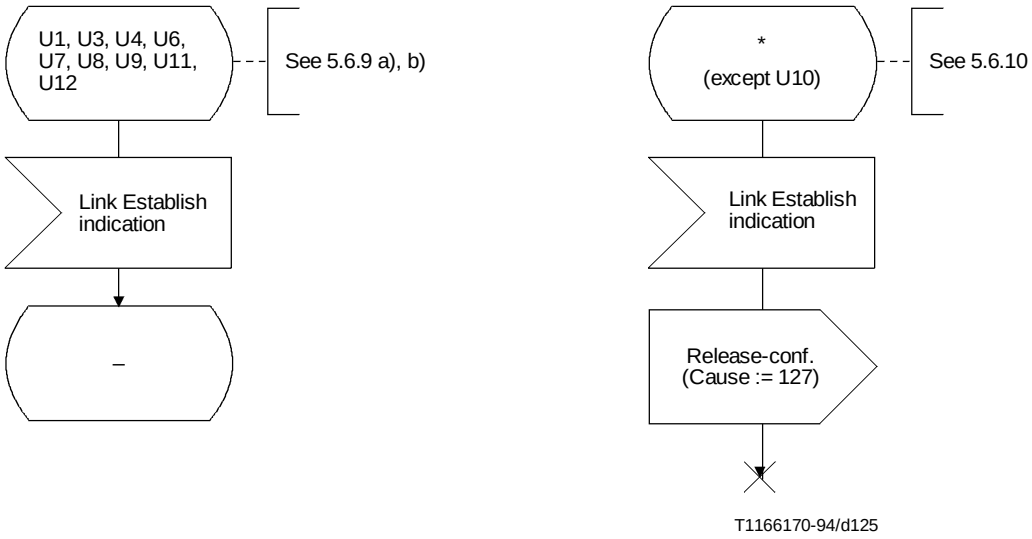

U11 - Release Request
See 5.4.3
RELEASE-COMPLETE (#)
RELEASE (#)
Clear collision
Timeout T308
Verify-Msg
Timeout = 1
Yes
No
Result
Cause1 := CauseR
Release reason = failure
RAP
OK
CLR
RAI
I
Cause option
Release Conf. Release reason
RESET T308
Cause := 102
Release-conf. (Cause, #)
After receiving this primitive, the Application process shall release the user virtual channel
RELEASE (Cause1, #)
RELEASE (Cause 1, Cause 2, #)
The Application process shall place the user virtual channel in a maintenance condition
SET (Now + t308, timer T308) Timeout := 1
U11 - Release Request
T1166120-94/d120

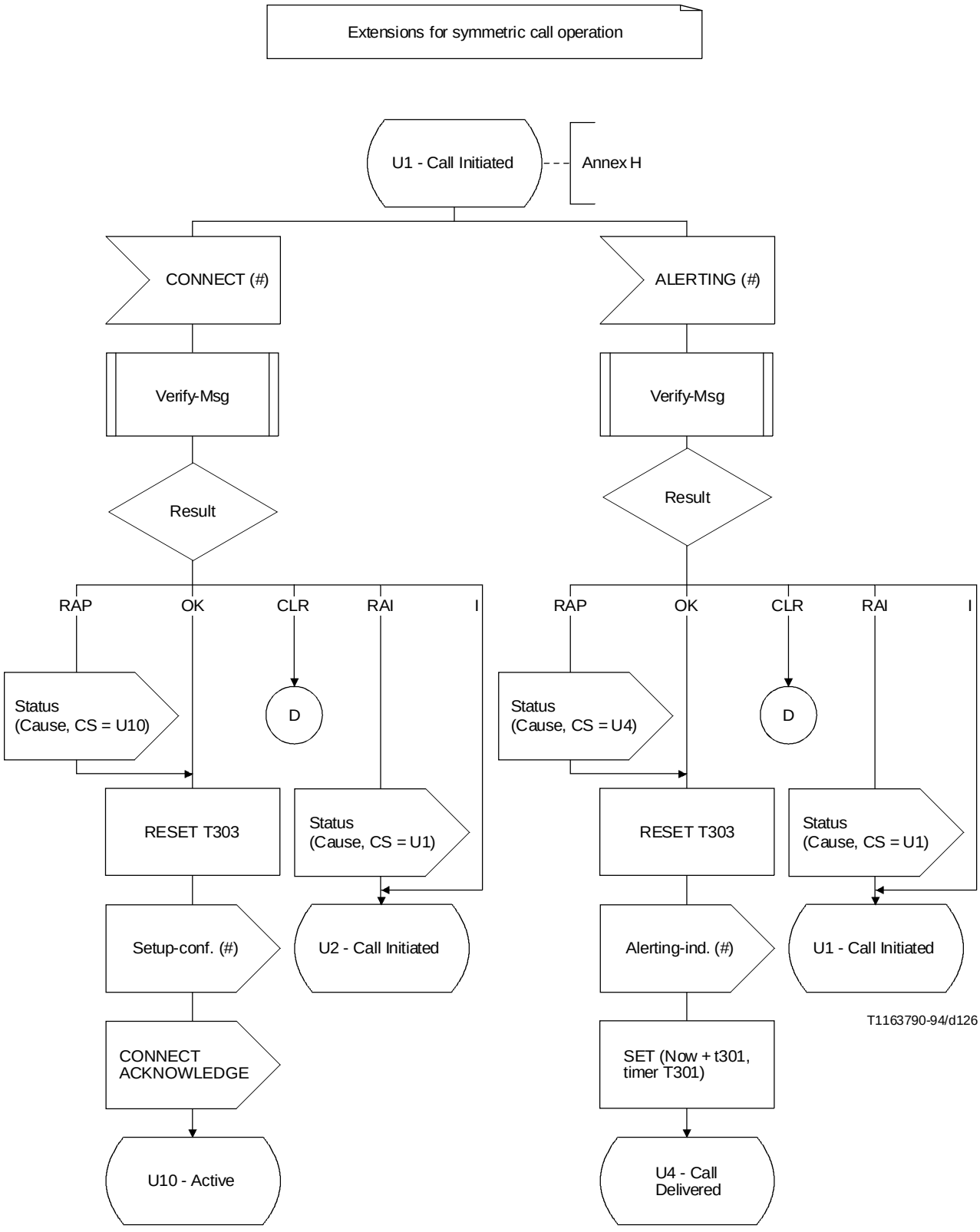

U11 - Release Request
See 5.6.12
STATUS (Cause, CS)
Verify message
Result
RAP
OK
CLR
RAI
I
STATUS (Cause, CS)
U0 - Null
STATUS (Cause, CS)
CS = 0
Yes
No
Release conf. (Cause)
U11 - Release Request
T1175640-95/d121

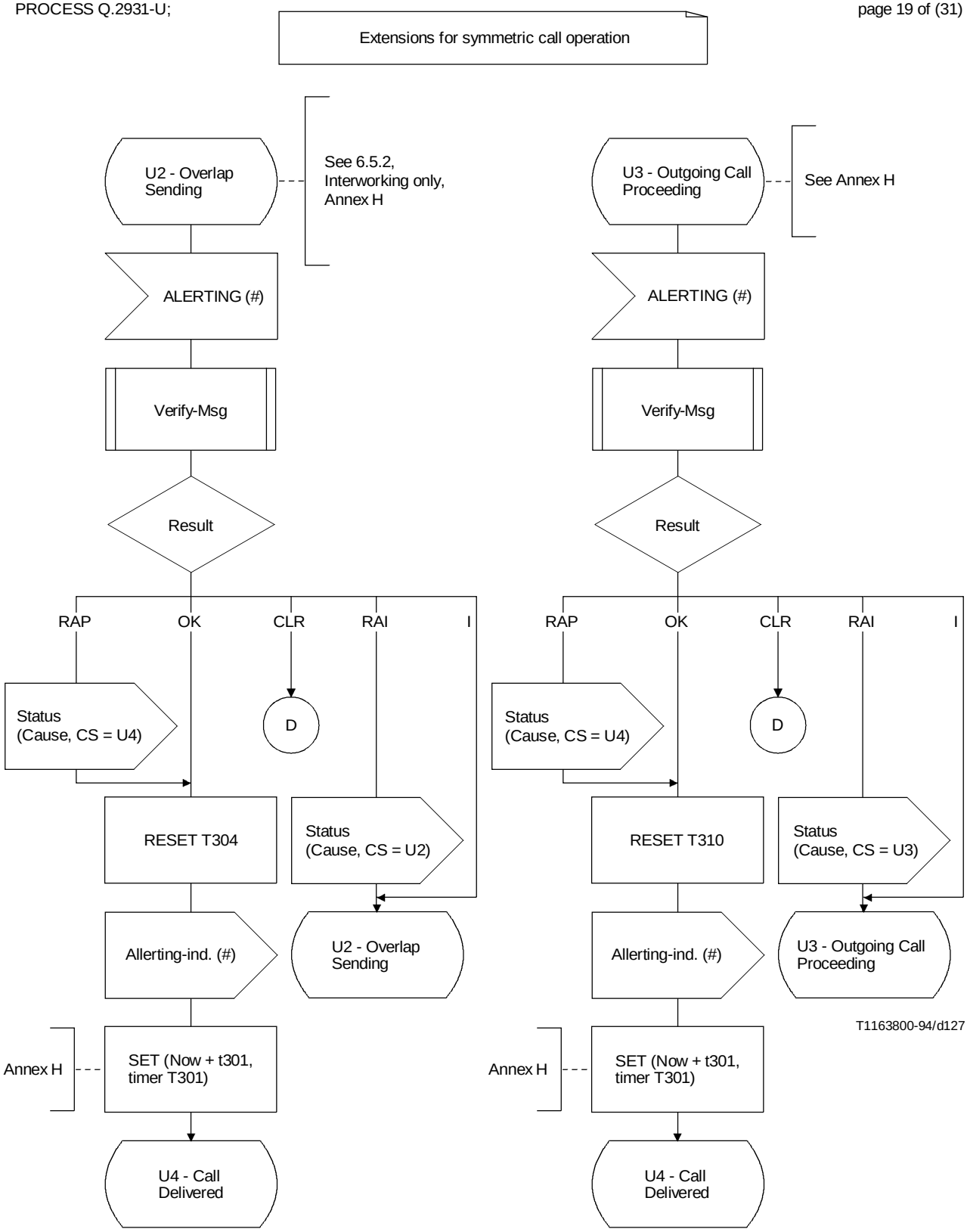

U12 - Release Indication
See 5.4.4, 5.6.12 b)
Release-resp. (#)
STATUS (Cause, CS)
RELEASE COMPLETE (#)
Verify message
Result
RAP
OK
CLR
RAI
I
STATUS (Cause, CS)
U0 - Null
STATUS (Cause, CS)
CS = 0
Yes
No
U12 - Release Indication
T1175650-95/d122

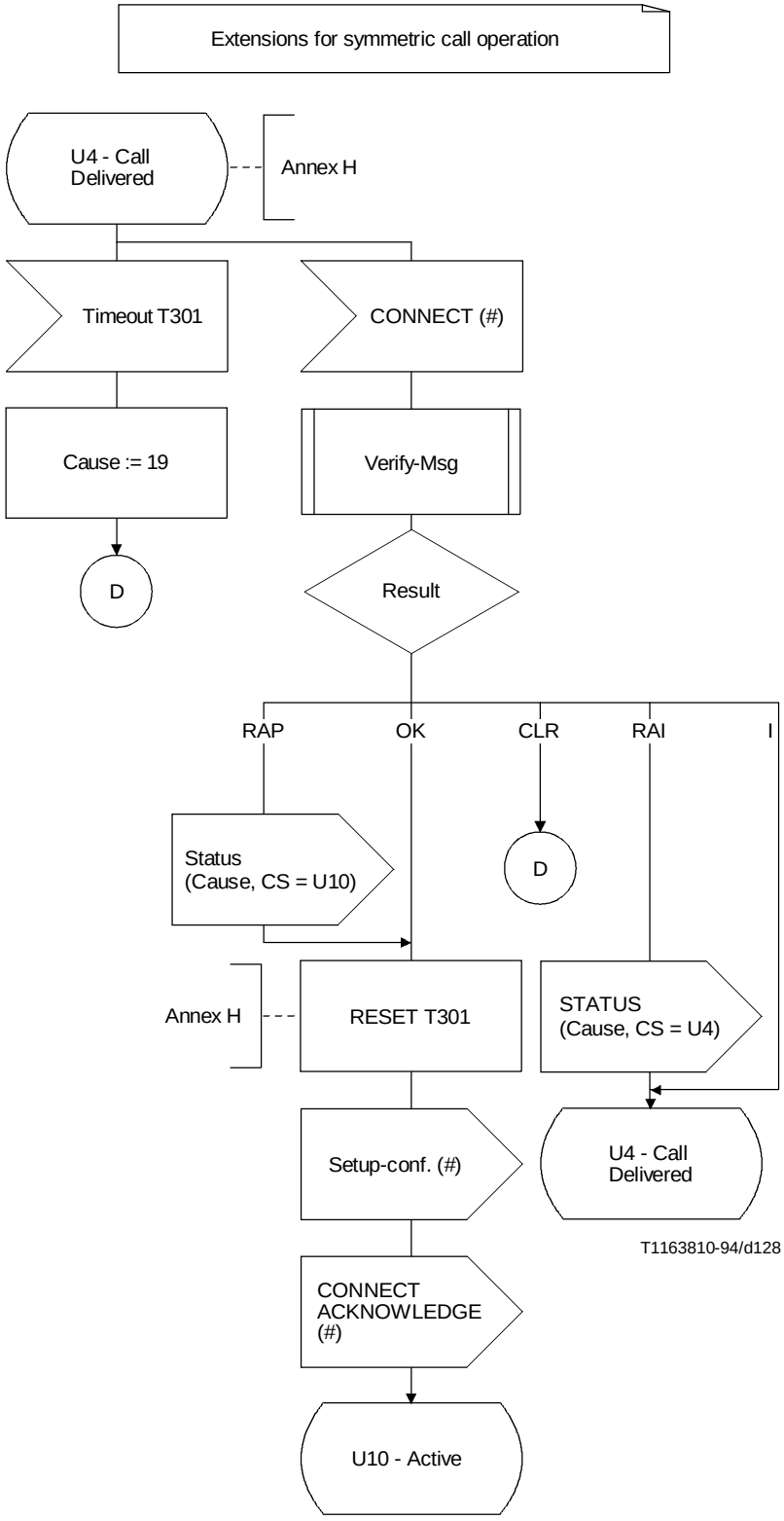

*
except U0, U11, U12
See 5.6.12
STATUS (Cause, CS)
Verify message
Result
RAP
OK
CLR
RAI
I
STATUS (Cause, CS)
U0 - Null
STATUS (Cause, CS)
CS = 0
Yes
No
Cause = 30
No
Yes
RESET T322
Release-conf. (Cause)
Verify State
Compatible State
No
Yes
Recovery option
No
Yes
–
Status-ind. (Cause := 101)
Recovery procedure
Implementation specific
D
*
except U0
See 5.6.11
STATUS-ENQUIRY
Verify message
Result
I
RAP
OK
CLR
RAI
CS := "current state", Cause := 30
STATUS (Cause, CS)
–
T1175660-95/d123

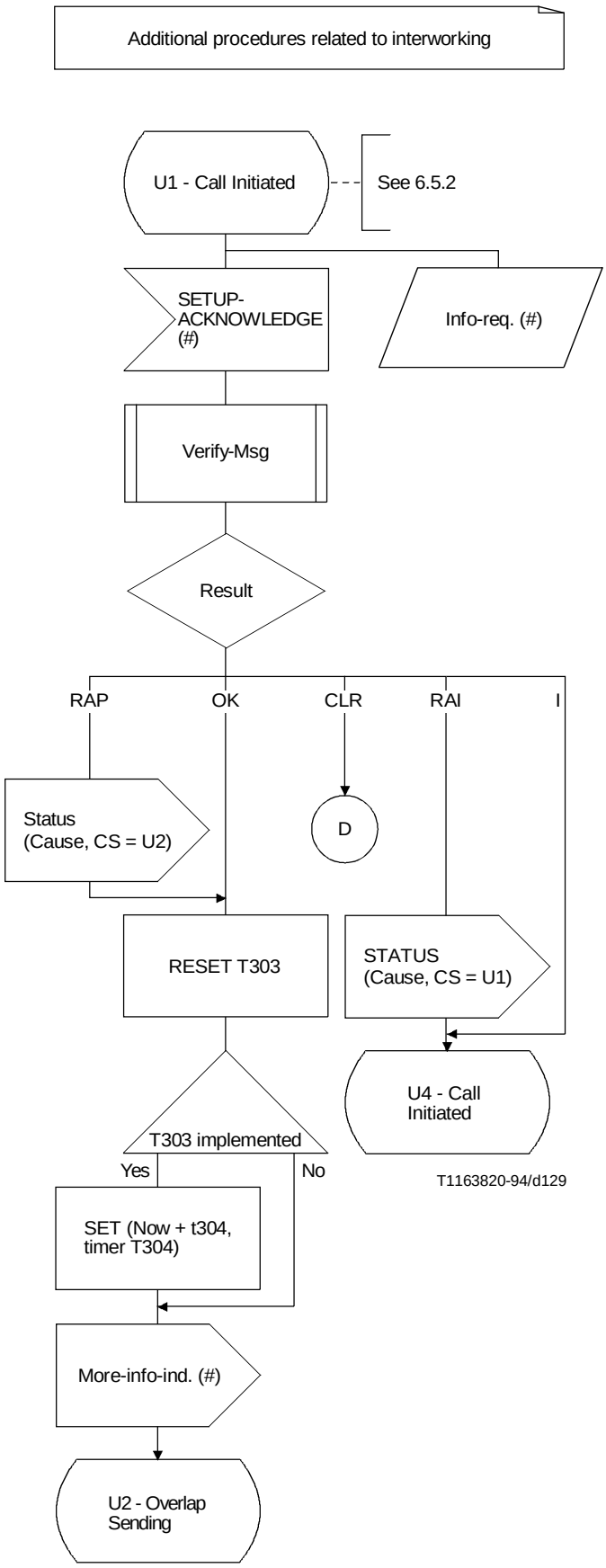

*
(except U0)
See 5.6.4, 5.6.11
Timeout T322
Timeout : =Timeout + 1
Timeout = NT
No
Yes
Release-conf.
(Cause = 41)
NT = number of STATUS ENQUIRY transmissions: implementation dependent value ≥ 1
SE
Timeout := 0
ACTIVE T322
Yes
No
STATUS ENQUIRY (#)
SET (Now + t322, timer T322)
–
*
/*any other message*/
Any recognized message other than those specifically shown in the Q.2931-U process
Verify message
Inst. Ind. Flag = 0
RAI
Reserved Ins. Ind.
I
CLR
STATUS (Cause 97/101)
–
State = Release request or Release indication?
Yes
No
D
/*unrecognized message*/
Any unrecognized message
Verify message
Inst. Ind. Flag = 0
RAI
Reserved Inst. Ind.
I
CLR
STATUS (Cause 97/101)
State = Release request or Release indication?
Yes
No
–
D
T1175670-95/d124

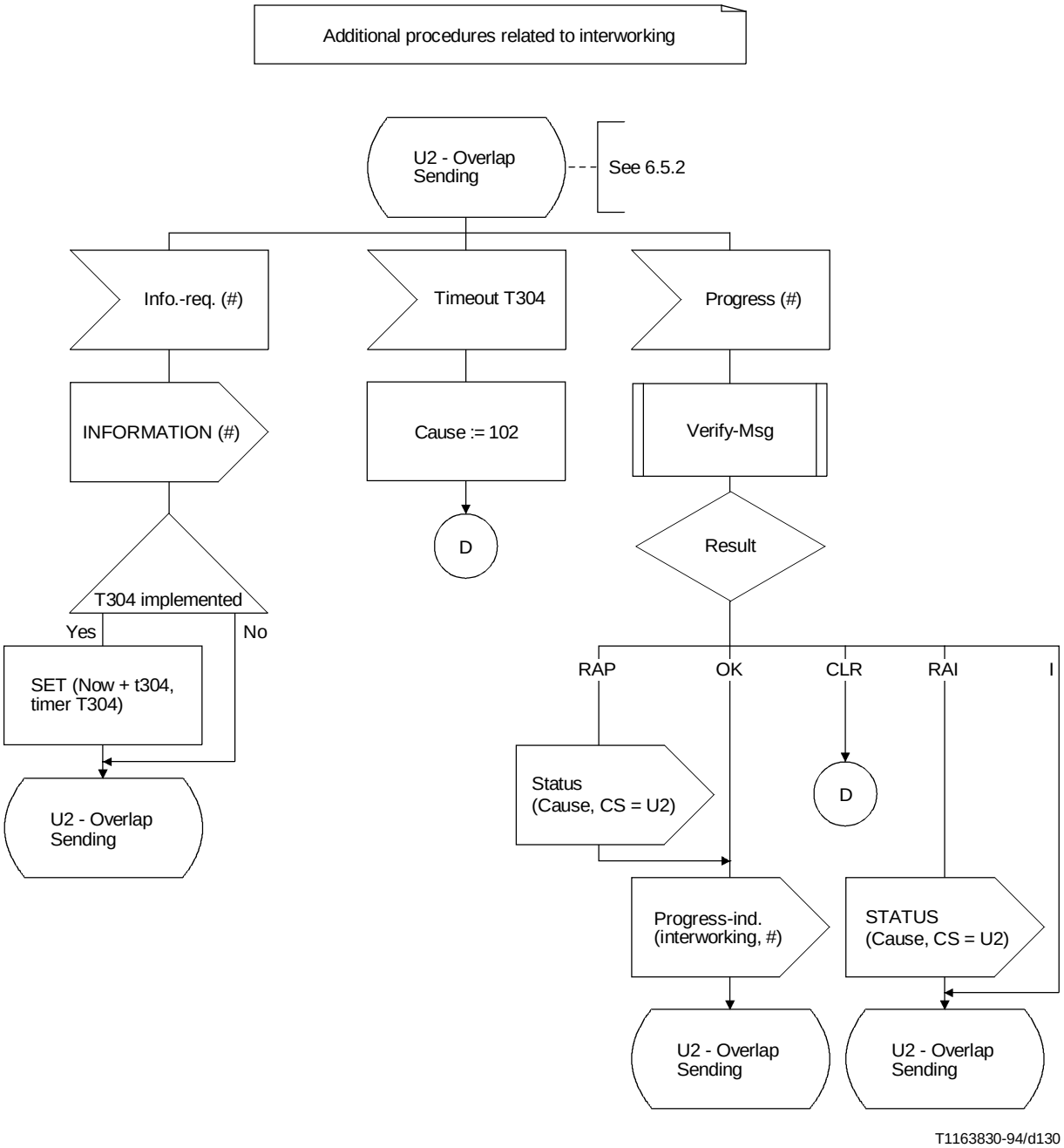

U1, U3, U4, U6, U7, U8, U9, U11, U12
See 5.6.9 a), b)
Link Establish indication
–
*
(except U10)
See 5.6.10
Link Establish indication
Release-conf.
(Cause := 127)
T1166170-94/d125


Extensions for symmetric call operation
U1 - Call Initiated
Annex H
CONNECT (#)
ALERTING (#)
Verify-Msg
Verify-Msg
Result
Result
RAP
OK
CLR
RAI
I
RAP
OK
CLR
RAI
I
Status (Cause, CS = U10)
D
Status (Cause, CS = U4)
D
RESET T303
Status (Cause, CS = U1)
RESET T303
Status (Cause, CS = U1)
Setup-conf. (#)
U2 - Call Initiated
Alerting-ind. (#)
U1 - Call Initiated
T1163790-94/d126
CONNECT ACKNOWLEDGE
SET (Now + t301, timer T301)
U10 - Active
U4 - Call Delivered

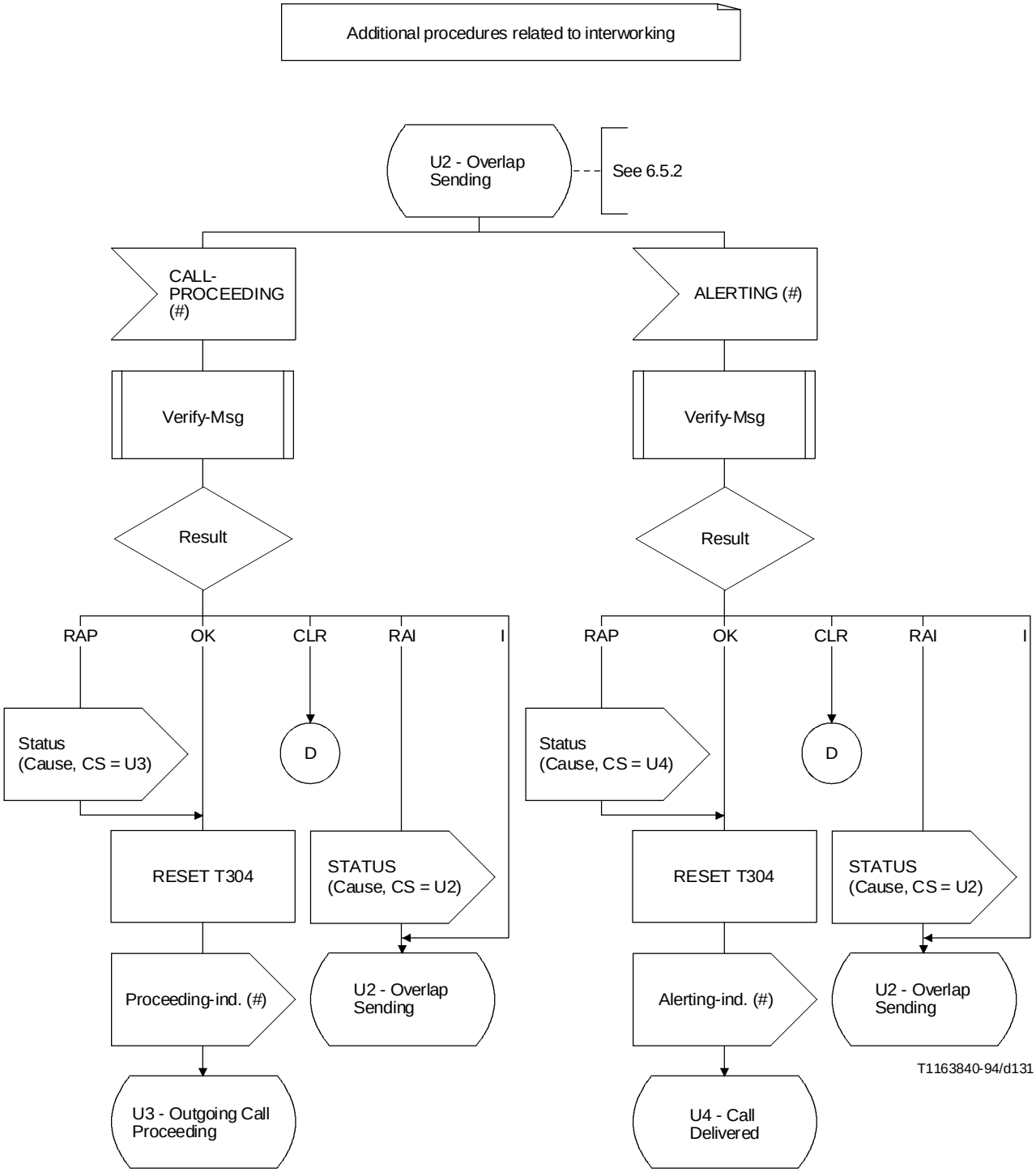

Extensions for symmetric call operation
U2 - Overlap Sending
See 6.5.2, Interworking only, Annex H
ALERTING (#)
Verify-Msg
Result
RAP
OK
CLR
RAI
I
Status (Cause, CS = U4)
D
RESET T304
Status (Cause, CS = U2)
Allerting-ind. (#)
U2 - Overlap Sending
Annex H
SET (Now + t301, timer T301)
U4 - Call Delivered
U3 - Outgoing Call Proceeding
See Annex H
ALERTING (#)
Verify-Msg
Result
RAP
OK
CLR
RAI
I
Status (Cause, CS = U4)
D
RESET T310
Status (Cause, CS = U3)
Allerting-ind. (#)
U3 - Outgoing Call Proceeding
Annex H
SET (Now + t301, timer T301)
U4 - Call Delivered
T1163800-94/d127

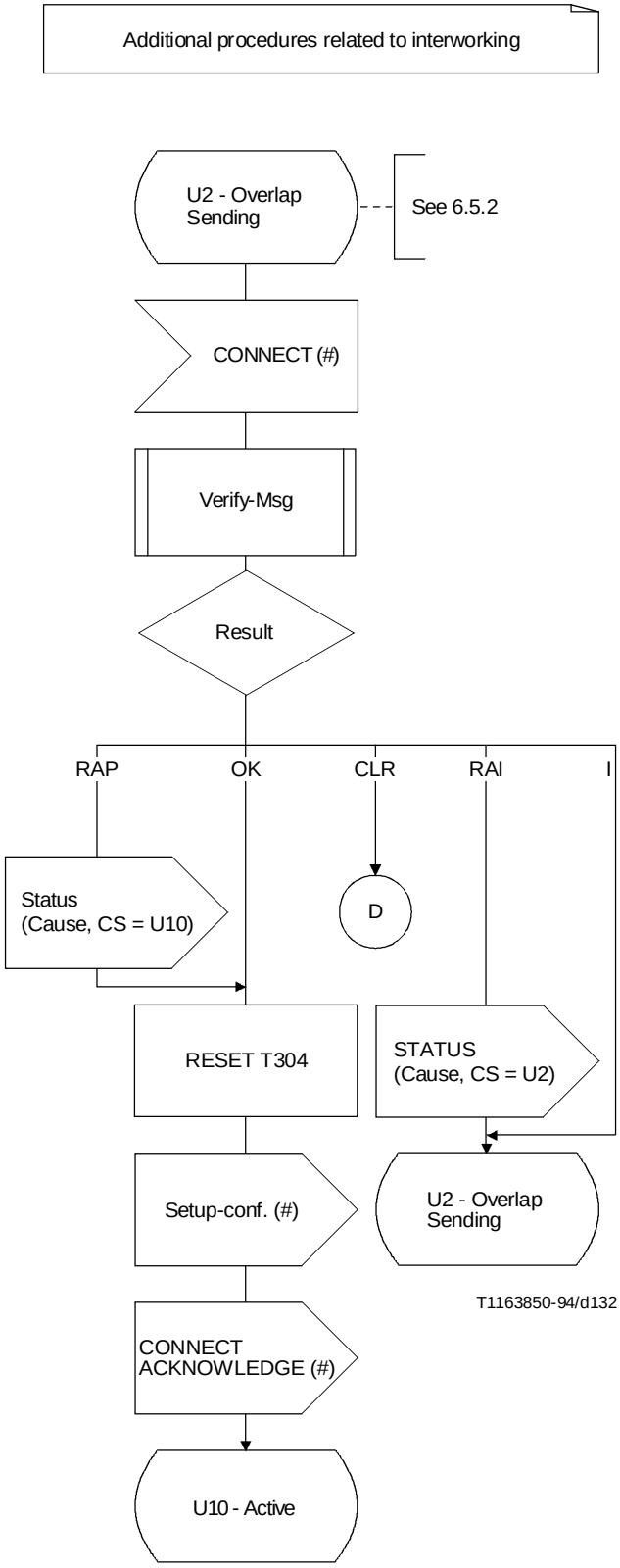

Extensions for symmetric call operation
U4 - Call Delivered
Annex H
Timeout T301
CONNECT (#)
Cause := 19
Verify-Msg
D
Result
RAP
OK
CLR
RAI
I
Status (Cause, CS = U10)
D
Annex H
RESET T301
STATUS (Cause, CS = U4)
Setup-conf. (#)
U4 - Call Delivered
T1163810-94/d128
CONNECT ACKNOWLEDGE (#)
U10 - Active

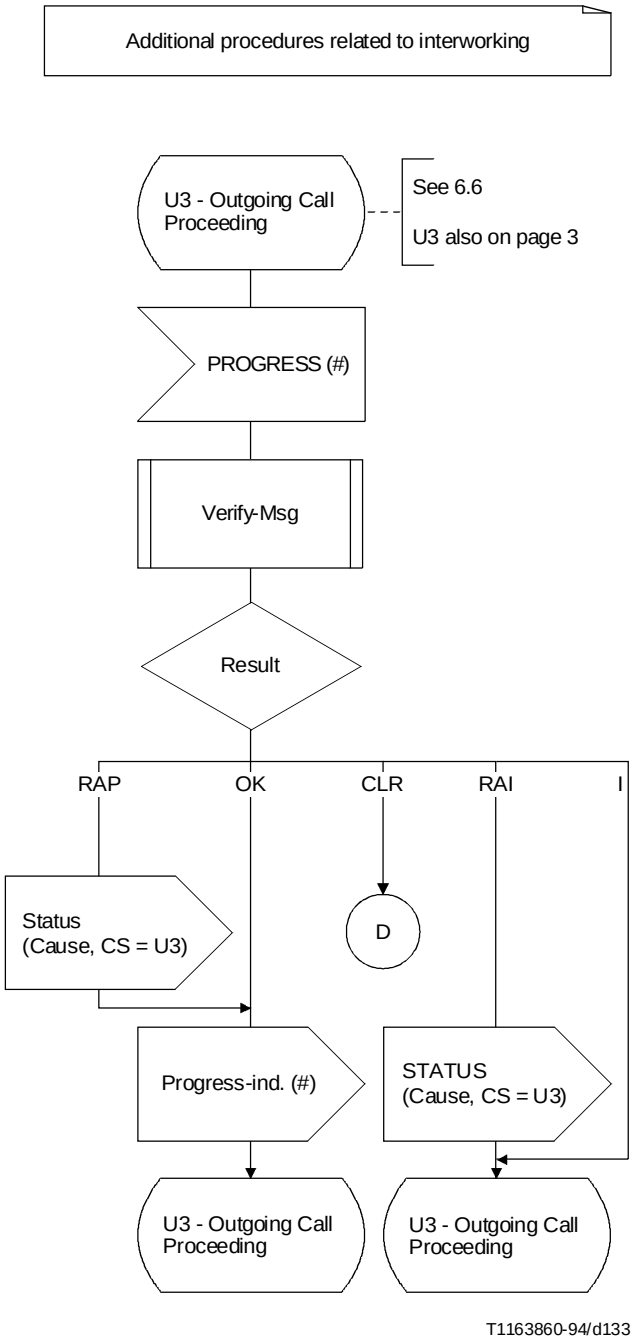

Additional procedures related to interworking
U1 - Call Initiated
See 6.5.2
SETUP-ACKNOWLEDGE (#)
Info-req. (#)
Verify-Msg
Result
RAP
OK
CLR
RAI
I
Status (Cause, CS = U2)
D
RESET T303
STATUS (Cause, CS = U1)
U4 - Call Initiated
T303 implemented
Yes
No
SET (Now + t304, timer T304)
More-info-ind. (#)
U2 - Overlap Sending
T1163820-94/d129

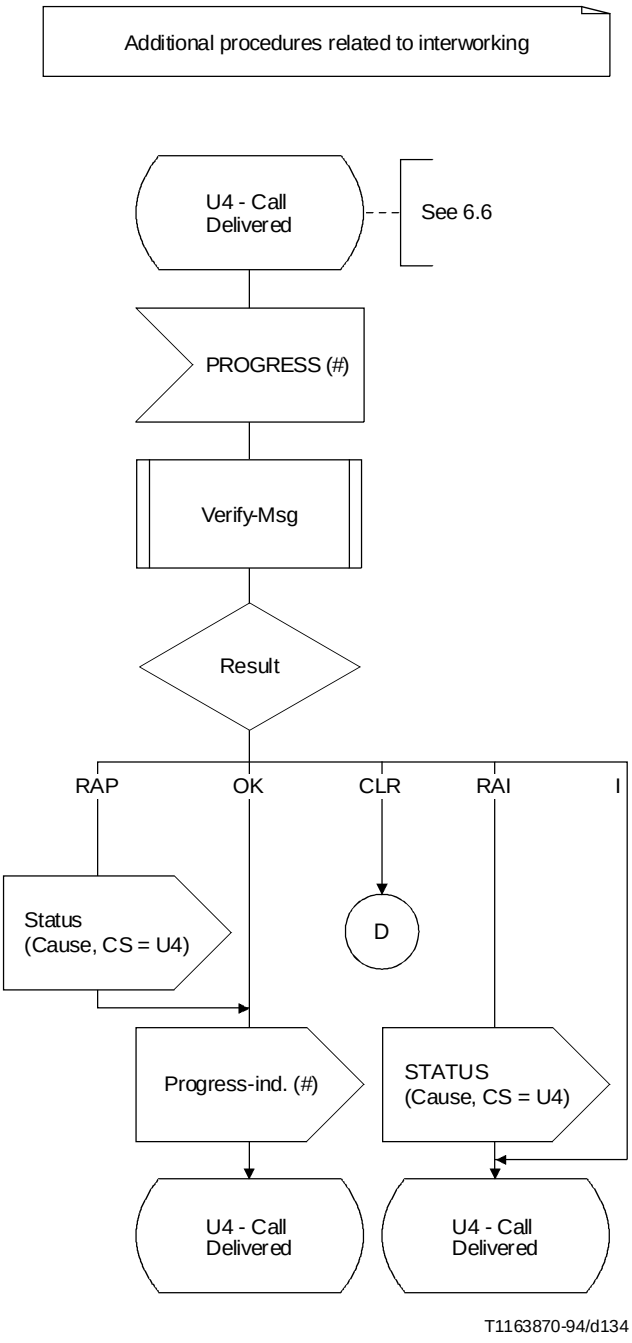


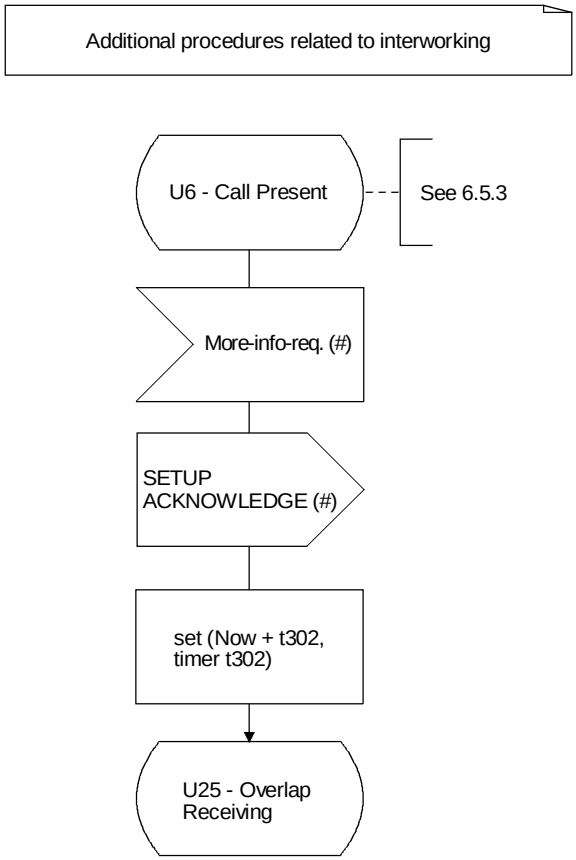
T1163830-94/d130

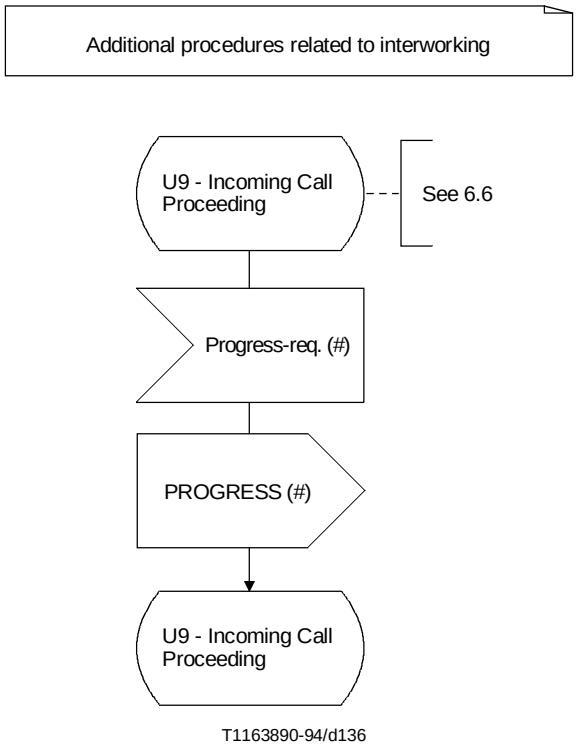

Additional procedures related to interworking
U2 - Overlap Sending
See 6.5.2
CALL-PROCEEDING (#)
ALERTING (#)
Verify-Msg
Verify-Msg
Result
Result
RAP
OK
CLR
RAI
I
RAP
OK
CLR
RAI
I
Status (Cause, CS = U3)
D
Status (Cause, CS = U4)
D
RESET T304
STATUS (Cause, CS = U2)
RESET T304
STATUS (Cause, CS = U2)
Proceeding-ind. (#)
U2 - Overlap Sending
Alerting-ind. (#)
U2 - Overlap Sending
T1163840-94/d131
U3 - Outgoing Call Proceeding
U4 - Call Delivered

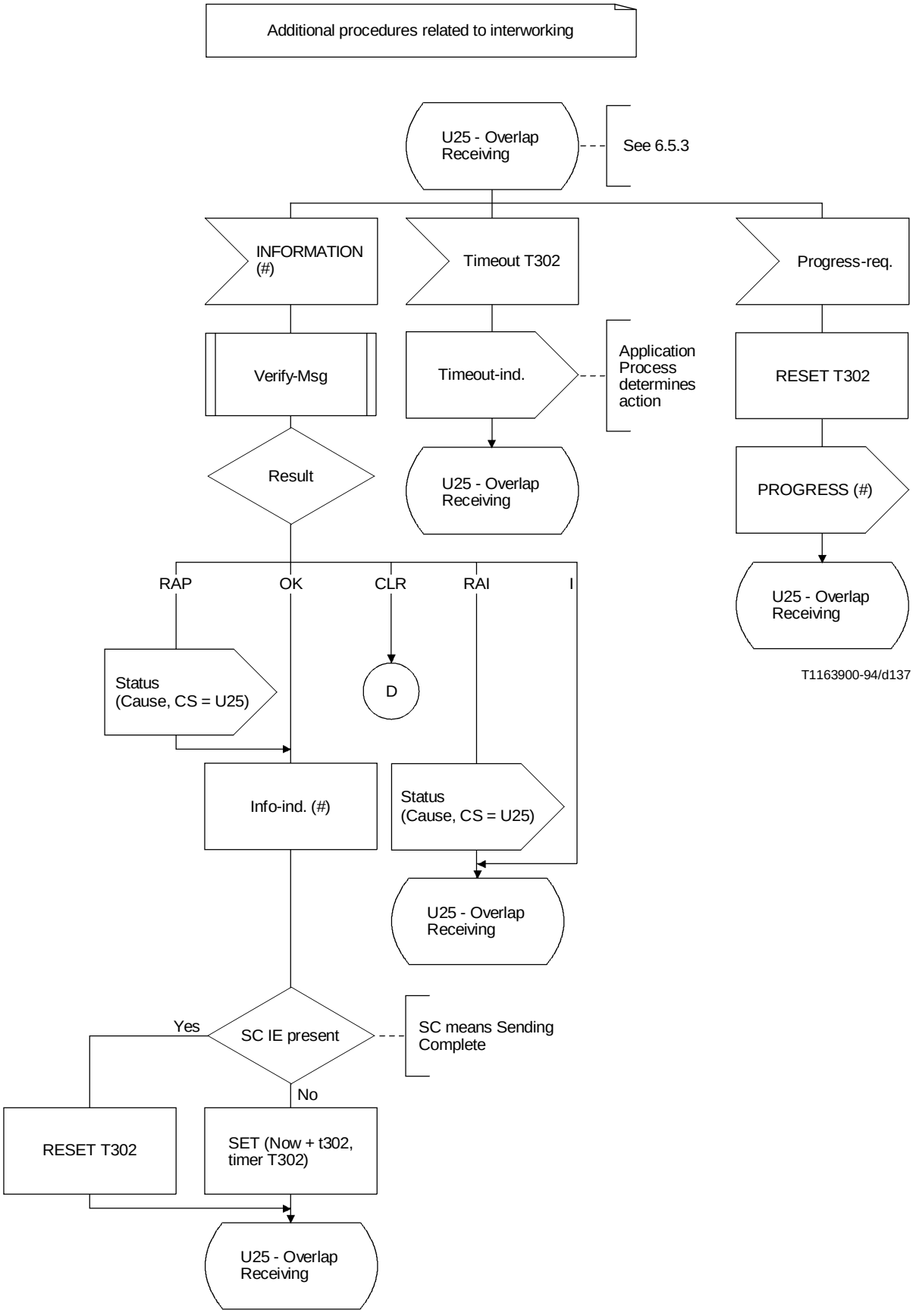

Additional procedures related to interworking
U2 - Overlap Sending
See 6.5.2
CONNECT (#)
Verify-Msg
Result
RAP
OK
CLR
RAI
I
Status (Cause, CS = U10)
D
RESET T304
STATUS (Cause, CS = U2)
Setup-conf. (#)
U2 - Overlap Sending
T1163850-94/d132
CONNECT ACKNOWLEDGE (#)
U10 - Active

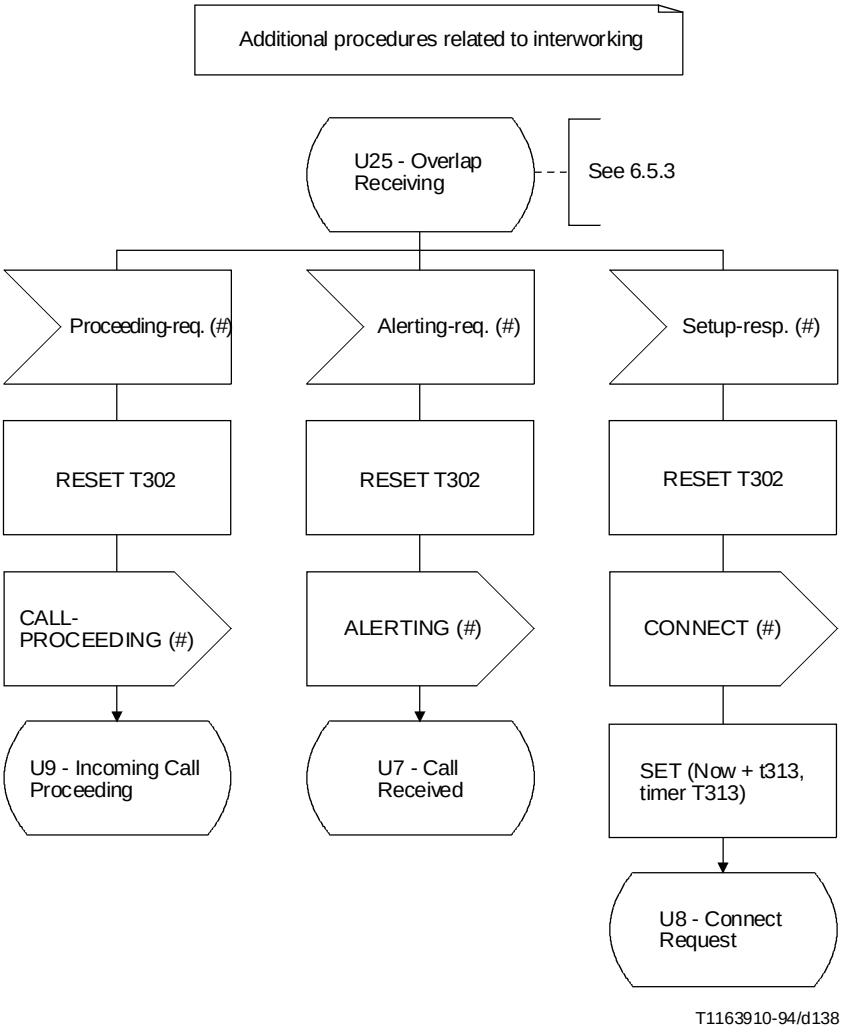

Additional procedures related to interworking
U3 - Outgoing Call Proceeding
See 6.6
U3 also on page 3
PROGRESS (#)
Verify-Msg
Result
RAP
OK
CLR
RAI
I
Status (Cause, CS = U3)
D
Progress-ind. (#)
STATUS (Cause, CS = U3)
U3 - Outgoing Call Proceeding
U3 - Outgoing Call Proceeding
T1163860-94/d133

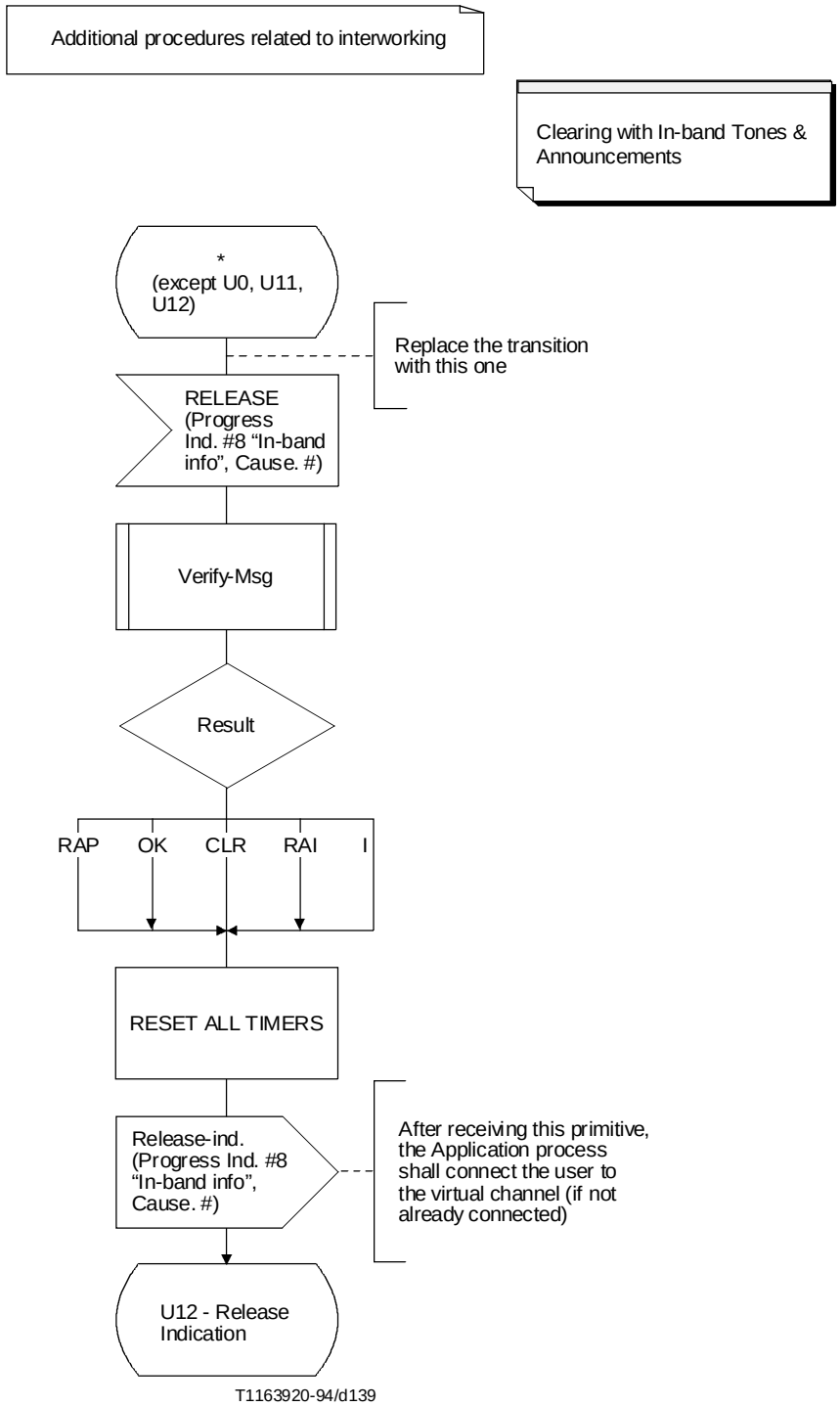

Additional procedures related to interworking
U4 - Call Delivered
See 6.6
PROGRESS (#)
Verify-Msg
Result
RAP
OK
CLR
RAI
I
Status (Cause, CS = U4)
D
Progress-ind. (#)
STATUS (Cause, CS = U4)
U4 - Call Delivered
U4 - Call Delivered
T1163870-94/d134


Additional procedures related to interworking
U6 - Call Present
See 6.5.3
More-info-req. (#)
SETUP ACKNOWLEDGE (#)
set (Now + t302, timer t302)
U25 - Overlap Receiving
T1163880-94/d135


Additional procedures related to interworking
U9 - Incoming Call Proceeding
See 6.6
Progress-req. (#)
PROGRESS (#)
U9 - Incoming Call Proceeding
T1163890-94/d136


Additional procedures related to interworking
U25 - Overlap Receiving
See 6.5.3
INFORMATION (#)
Timeout T302
Progress-req.
Verify-Msg
Timeout-ind.
Application Process determines action
RESET T302
Result
U25 - Overlap Receiving
PROGRESS (#)
RAP
OK
CLR
RAI
I
U25 - Overlap Receiving
Status (Cause, CS = U25)
D
T1163900-94/d137
Info-ind. (#)
Status (Cause, CS = U25)
U25 - Overlap Receiving
Yes
SC IE present
SC means Sending Complete
No
RESET T302
SET (Now + t302, timer T302)
U25 - Overlap Receiving


Additional procedures related to interworking
U25 - Overlap Receiving
See 6.5.3
Proceeding-req. (#)
Alerting-req. (#)
Setup-resp. (#)
RESET T302
RESET T302
RESET T302
CALL-PROCEEDING (#)
ALERTING (#)
CONNECT (#)
U9 - Incoming Call Proceeding
U7 - Call Received
SET (Now + t313, timer T313)
U8 - Connect Request
T1163910-94/d138


Additional procedures related to interworking
Clearing with In-band Tones & Announcements
*
(except U0, U11, U12)
Replace the transition with this one
RELEASE
(Progress Ind. #8 “In-band info”, Cause. #)
Verify-Msg
Result
RAP
OK
CLR
RAI
I
RESET ALL TIMERS
Release-ind.
(Progress Ind. #8 “In-band info”, Cause. #)
After receiving this primitive, the Application process shall connect the user to the virtual channel (if not already connected)
U12 - Release Indication
T1163920-94/d139

Annex B

Compatibility checking

(This annex forms an integral part of this Recommendation)

B.1 Introduction

This annex describes the various compatibility and address checks which should be carried out to ensure that the best match of user and network capabilities is achieved on a Broadband ISDN call.

For 64 kbit/s based circuit-mode ISDN services, the compatibility checking procedures of Annex B/Q.931 shall apply for the N-BC, N-HLC and N-LLC information elements.

Three different processes of checking shall be performed:

- At the user-to-network interface on the calling side (see B.2);
- At the network-to-user interface on the called side (see B.3.2); and
- User-to-user (see B.3.3).

NOTE – In this context and throughout this annex, the term "called user" is the endpoint entity which is explicitly addressed. This may be an Addressed Interworking Unit (IWU); see the I.500-Series of Recommendations.

B.2 Calling side compatibility checking

At the calling side, the network shall check that the bearer service requested by the calling user in the Broadband bearer related information elements match with the bearer services provided to that user by the network. If a mismatch is detected, then the network shall reject the call using one of the causes listed in 5.1.5.

Network services are described in Recommendations I.230 and I.240 as bearer services and teleservices, respectively.

B.3 Called side compatibility and address checking

In this subclause, the word "check" means that the user examines the contents of the specified information element.

B.3.1 Checking of addressing information

If an incoming SETUP message is offered with addressing information (i.e. subaddress or the appropriate part of the called party number), the following actions will occur:

- If a number or sub-address is assigned to a user, then the information in a Called party number or Called party sub-address information element of the incoming call shall be checked by the user against the corresponding part of the number assigned to the user or the user's sub-address. In case of a mismatch, the user shall reject the call. In the case of a match, the compatibility checking described in B.3.2 and B.3.3 will follow.
- If a user has no assigned number or sub-address, then the Called party number and Called party sub-address information elements shall be ignored. The compatibility checking described in B.3.2 and B.3.3 will follow.

NOTE – According to the user's requirements, compatibility checking can be performed in various ways from the viewpoint of execution order and information to be checked; e.g. first assigned number/sub-address and then compatibility or vice versa.

B.3.2 Network-to-user compatibility checking

When the network is providing a bearer service at the called side, the user shall check that the bearer service offered by the network in the Broadband bearer related information elements match the bearer services that the user is able to support. If a mismatch is detected in the Broadband bearer capability, then the user shall reject the offered call using cause No. 88, "incompatible destination". When the user is unable to provide the requested QOS, cause No. 49, "Quality of Service unavailable" should be returned. When the user is unable to support the indicated peak cell rate, cause No. 47, "resource unavailable" should be returned.

Upon receipt of a SETUP message, the user shall examine the following information elements:

- Broadband bearer capability;
- Quality of Service parameter;
- ATM traffic descriptor; and
- OAM traffic descriptor (if present).

The user may also examine the end-to-end transit delay information element (if present).

B.3.3 User-to-user compatibility checking

Next, the called side terminal equipment shall perform the following checks:

- Whether or not it can support the type of AAL requested and any associated parameters specified in the AAL parameters information element.
- Whether or not the Broadband Low Layer Information (B-LLI) information element is compatible with the functions it supports. The B-LLI information element (if available) shall be used to check compatibility of low layers (e.g. layer 2 and layer 3, if layered according to the OSI model).
- The called terminal equipment may check the Broadband High Layer Information (B-HLI) information element (if present) as part of user-to-user compatibility checking procedures.

If a mismatch is detected in checking any of the information elements above, then the terminal equipment shall either ignore or reject the offered call using cause No. 88, "incompatible destination".

With regard to the presence or absence of the B-HLI and B-LLI information elements, two cases arise:

- Compatibility assured with the available description of the call – Terminal equipment implements (i.e. understands the contents of) the AAL parameters, B-HLI and B-LLI information elements. Thus, based on the AAL parameters and B-LLI and B-HLI information element encoding, they are capable of accepting a call for which they have the requested functionality.
- Compatibility not assured with the available description of the call – The terminal equipment does not recognize (i.e. ignore) either the AAL parameters, B-HLI or B-LLI information elements. There is a danger that a terminal equipment which has incorrect functionality will accept the call.

Therefore, in order to assure compatibility with incoming calls, it is recommended that the terminal equipment check the B-LLI, B-HLI and AAL parameter information elements.

NOTE – Some terminal equipment, upon agreement with other users or in accordance with other standards (e.g. Recommendation X.213), may employ the user-to-user information element for additional compatibility checking. Such terminal equipment shall check the user-to-user information element in a manner identical to that described here for the Broadband high layer information information element assured case.

Annex C

Broadband low layer information negotiation

(This annex forms an integral part of this Recommendation)

This annex describes additional procedures for the use of the Broadband Low Layer Information (B-LLI) information element by the user.

C.1 General

The purpose of the B-LLI information element is to provide a means which should be used for compatibility checking by an addressed entity (e.g. a remote user or an interworking unit or high layer function network node addressed by the calling user). The B-LLI information element is transferred transparently by a B-ISDN between the call originating entity (e.g. the calling user) and the addressed entity.

The user information protocol fields of the B-LLI information element indicate the low layer protocols (i.e. layer 3 and layer 2 protocols above the AAL) used between endpoints (users). This information is not interpreted by the B-ISDN and therefore the bearer capability provided by the B-ISDN is not affected by this information. The addressed entity may modify the low layer attributes by the negotiation described below if that can be supported by the bearer capability actually provided by the B-ISDN.

The Broadband low layer information information element is coded according to 4.5.9.

C.2 Low layer compatibility notification to the called user

When the calling user wishes to notify the called user of its low layer protocols above the ATM adaptation layer (i.e. as identified in octets 6 and 7 of the B-LLI information element) to be used during the call, then the calling user shall include a B-LLI information element in the SETUP message; this element is conveyed by the network and delivered to the called user. However, if the network is unable to convey this information element, it shall act as described in 5.6.8.1 (unrecognized information element).

C.3 B-LLI negotiation between users

The B-LLI supports the indication of certain parameters of acknowledged mode HDLC elements of procedures. If they are included, parameter(s) may be negotiated. In this case, the called user accepting the call may include a B-LLI information element in the CONNECT message. This element will be conveyed transparently by the network and delivered to the calling user in the CONNECT message. If the calling user can not support the parameters in the CONNECT message, the calling user shall initiate call clearing procedures as described in 5.4.3.

NOTE – The lower layer protocol parameters which may be negotiated by this capability are: mode (octet 6a), window size (octet 6b), user-specified layer 2 information (octet 6a), default packet size (octet 7b), and packet window size (octet 7c).

If, for any reason, the network is unable to convey this information element, it shall act as described in 5.6.8.1 (unrecognized information element) except that the cause value No. 43, “access information discarded” shall be used in the STATUS message.

If the calling user rejects the B-LLI information element contents in the CONNECT message, the calling user shall initiate clearing with cause No. 100, “invalid information element contents”.

C.4 Alternate requested values

If the calling user wishes to indicate alternative values of B-LLI parameters (e.g. alternative protocol suites or protocol parameters), the B-LLI information element is repeated in the SETUP message. Up to three B-LLI information elements may be included in a SETUP message. The first B-LLI information element in the message is preceded by the Broadband repeat indicator information element specifying “priority list for selecting one possibility (descending order of priority)”. The order of appearance of the B-LLI information elements indicates the order of preference of end-to-end low layer parameters.

If the network or called user does not support repeating of the B-LLI information element, and therefore discards the Broadband repeat indicator information element and the subsequent B-LLI information elements, only the first B-LLI information element is used in the negotiation. In addition, if the network discards the B-LLI information element, it shall send a STATUS message with cause value No. 43, “access information discarded”.

The called user indicates a single choice from among the options offered in the SETUP message by including the B-LLI information element in the CONNECT message. Absence of a B-LLI information element in the CONNECT message indicates acceptance of the first B-LLI information element in the SETUP message.

If the calling user rejects the B-LLI information element contents in the CONNECT message, the calling user shall initiate clearing with cause No. 100, “invalid information element contents”.

Annex D

Transit network selection

(This annex forms an integral part of this Recommendation)

This annex describes the processing of the transit network selection information element.

D.1 Selection not supported

Some networks may not support transit network selection. In this case, when a Tansit network selection information element is received, that information element is processed according to the rules for unimplemented non-mandatory information elements (see 5.6.8.1).

D.2 Selection supported

When transit network selection is supported, the user identifies the selected transit network(s) in the SETUP message. One Transit network selection information element is used to convey a single network identification.

The user may specify more than one transit network. Each identification is placed in a separate information element. The call would then be routed through the specified transit networks in the order listed in the SETUP. For example, a user lists networks A and B, in that order, in two Transit network selection information elements within a SETUP message. The call is first routed to network A (either directly or indirectly), and then to network B (either directly or indirectly), before being delivered.

As the call is delivered to each selected network, the corresponding transit selection may be stripped from the call establishment signalling, in accordance with the relevant inter network signalling arrangement. The Tansit network selection information element(s) is/are not delivered to the called user.

No more than four Tansit network selection information elements may be used in a single SETUP message.

When a network cannot route the call due to insufficient bandwidth, the network shall initiate call clearing in accordance with 5.4, with cause No. 37, “user cell rate unavailable”.

If a network does not recognize the specified Transit network, the network shall initiate call clearing in accordance with 5.4, with cause No. 2, “no route to specified transit network”. The diagnostic field shall contain a copy of the contents of the Transit network selection information element identifying the unreachable network.

A network may screen all remaining Tansit network selection information elements to:

a) avoid routing loops; or

b) ensure an appropriate business relationship exists between selected networks; or

c) ensure compliance with national and local regulations.

If the transit network selection is of an incorrect format, or fails to meet criteria a), b) or c), the network shall initiate call clearing in accordance with 5.4, with cause No. 91, “invalid transit network selection”.

When a user includes the Transit network selection information element, pre-subscribed default transit network selection information (if any) is overridden.

Annex E

Mapping functions to support 64 kbit/s based circuit-mode ISDN services in B-ISDN and interworking between N-ISDN and B-ISDN (DSS 1/DSS 2)

(This annex forms an integral part of this Recommendation)

E.1 Introduction

This annex specifies the functions to be performed by an Interworking Function (IWF) installed between the B-ISDN and the N-ISDN. As regards the mapping function, only the interworking between the access protocols involved is covered. Interworking scenarios including the B-ISUP and the N-ISUP protocols are out of the scope of this annex.

The communication scenario is described in Annex A/I.580 [58], scenario B. It should be noted that the functions and the mapping described in this section also apply to a Terminal Adapter (TA) at the UNI connecting a N-ISDN terminal to a B-ISDN network.

Interworking functions between N-ISDN and B-ISDN are only provided for circuit-mode 64 kbit/s based N-ISDN services. Interworking functions to support packet and frame mode bearer services are not in the scope of this Recommendation.

For the interworking functions between N-ISDN and B-ISDN, the following principles shall apply:

A) *Interworking B-ISDN → N-ISDN*

1) If a B-ISDN specific service is requested at the DSS 2 side of the IWF, the call shall be rejected by the IWF.

2) If a N-ISDN service is requested at the DSS 2 side of the IWF but the bearer class in the B-BC information element does not indicate BCOB-A, then the call shall be rejected by the IWF. The same applies when the ATM traffic descriptor and/or the AAL parameters information elements do not specify values in accordance with E.4.

3) In the direction from DSS 2 to DSS 1, the IWF places the information elements to be transferred to the N-ISDN side into the ascending order required by Recommendation Q.931.

B) *Interworking N-ISDN → B-ISDN*

1) If the IWF receives a request for a N-ISDN service at its DSS 1 side, it will select an ATM user cell rate for the B-ISDN side which is able to carry the 64 kbit/s (or n x 64 kbit/s) bit rate of the N-ISDN service.

2) If the IWF receives a request for a N-ISDN service at its DSS 1 side, it will select Bearer Class A (CBR, CO, end-to-end timing required), and AAL type 1 or the AAL for voice as default values for the B-ISDN side. The value for the field “susceptibility to clipping” in the B-BC information element is set to “susceptible to clipping”.

E.2 Mapping functions for the direction DSS 2 → DSS 1

The mapping functions performed by the IWF for the direction from DSS 2 to DSS 1 are illustrated by the examples given below. These examples are not exhaustive. The same mapping principles also apply for other circuit-switched N-ISDN services.

The IWF will relay the content of the N-BC, N-LLC and N-HLC information elements transparently to the N-ISDN. No further processing is required, except for the changes needed to accommodate the different coding rules. The B-BC, ATM traffic descriptor, QOS parameter, end-to-end transit delay, OAM traffic descriptor and AAL parameters information elements are discarded.

E.2.1 A B-ISDN user requests the 3.1 kHz audio N-ISDN bearer service

See Table E.1.

TABLE E.1/Q.2931

Mapping performed by the IWF for the 3.1 kHz audio bearer service (direction DSS 2 → DSS 1)

DSS 2: Emulation of the N-ISDN bearer service 3.1 kHz audio	DSS 1: 3.1 kHz audio bearer service
N-BC: – 3.1 kHz audio – Circuit mode – 64 kbit/s – Rec. G.711, A- or μ-law	BC: – 3.1 kHz audio – Circuit mode – 64 kbit/s – Rec. G.711, A- or μ-law
N-HLC: Optional	HLC: Present, if provided
N-LLC: Optional	LLC: Present, if provided
B-BC: – BCOB-A – Susceptible to clipping	–
ATM traffic descriptor: Equal to 64 kbit/s	–
Quality of Service: Unspecified QOS class	–
AAL parameters: AAL for voice	–
End-to-end transit delay: See 4.5.17 (optional)	–
OAM traffic descriptor: See 4.5.24 (optional)	–

E.2.2 A B-ISDN user requests the N-ISDN unrestricted digital information bearer service

See Table E.2.

TABLE E.2/Q.2931

Mapping performed by the IWF for the unrestricted digital information bearer service (direction DSS 2 → DSS 1)

DSS 2: Emulation of the N-ISDN unrestricted digital information bearer service	DSS 1: Unrestricted digital information bearer service
N-BC: – Unrestricted digital information – Circuit mode – 64 kbit/s	BC: – Unrestricted digital information – Circuit mode – 64 kbit/s
N-HLC: Optional	HLC: Present, if provided
N-LLC: Optional	LLC: Present, if provided
B-BC: – BCOB-A – Susceptible to clipping	–
ATM traffic descriptor: Equal to 64 kbit/s	–
Quality of Service: Unspecified QOS class	–
AAL parameters: AAL type 1	–
End-to-end transit delay: See 4.5.17 (optional)	–
OAM traffic descriptor: See 4.5.24 (optional)	–

E.2.3 A B-ISDN user requests the N-ISDN telephony teleservice

See Table E.3.

TABLE E.3/Q.2931

Mapping performed by the IWF for the N-ISDN telephony teleservice (direction DSS 2 → DSS 1)

DSS 2: Emulation of the N-ISDN telephony teleservice	DSS 1: Telephony teleservice
N-BC: – Speech – Circuit mode – 64 kbit/s – Rec. G.711, A- or μ-law	BC: – Speech – Circuit mode – 64 kbit/s – Rec. G.711, A- or μ-law
N-HLC: Telephony	HLC: Telephony
N-LLC: Optional	LLC: Present, if provided
B-BC: – BCOB-A – Susceptible to clipping	–
ATM traffic descriptor: Equal to 64 kbit/s	–
Quality of Service: Unspecified QOS class	–
AAL parameters: AAL for voice	–
End-to-end transit delay: See 4.5.17 (optional)	–
OAM traffic descriptor: See 4.5.24 (optional)	–

E.2.4 A B-ISDN user requests the N-ISDN videotelephony teleservice based on the unrestricted digital information with tones/announcements bearer capability

See Table E.4.

TABLE E.4/Q.2931

Mapping performed by the IWF for the videotelephony teleservice (direction DSS 2 → DSS 1)

DSS 2: Emulation of the N-ISDN videotelephony teleservice	DSS 1: Videotelephony teleservice
N-BC: – Unrestricted digital information with tones/announcements – Circuit mode – 64 kbit/s – Recommendations H.221 and H.242	BC: – Unrestricted digital information with tones/announcements – Circuit mode – 64 kbit/s – Recommendations H.221 and H.242
N-HLC: Videotelephony (Recommendation F.721)	HLC: Videotelephony (Recommendation F.721)
N-LLC: Optional	LLC: Present, if provided
B-BC: – BCOB-A – Susceptible to clipping	–
ATM traffic descriptor: Equal to 64 kbit/s	–
Quality of Service: Unspecified QOS class	–
AAL parameters: See E.4	–
End-to-end transit delay: See 4.5.17 (optional)	–
OAM traffic descriptor: See 4.5.24 (optional)	–

E.3 Mapping functions for the direction DSS 1 → DSS 2

The mapping functions performed by the IWF for the direction from DSS 1 to DSS 2 are illustrated by the examples given below. These examples are not exhaustive. The same principles also apply to other circuit-switched ISDN services.

The IWF will relay the content of the BC, LLC and HLC information elements transparently to the B-ISDN. No further processing is required, except for the changes needed to accommodate the different coding rules. The B-BC, ATM traffic descriptor, QOS parameter, and AAL parameters information elements are generated by the IWF, using default values specified in E.4 and the information provided by the DSS 1 information elements.

The "susceptibility to clipping" field of the B-BC information element in DSS 2 is always set to "susceptible to clipping".

E.3.1 A N-ISDN user requests the 3.1 kHz audio bearer service

See Table E.5.

TABLE E.5/Q.2931

Mapping performed by the IWF for the 3.1 kHz audio bearer service (direction DSS 1 → DSS 2)

DSS 1: 3.1 kHz audio bearer service	DSS 2: Emulation of the N-ISDN 3.1 kHz audio bearer service
BC: – 3.1 kHz audio – Circuit mode – 64 kbit/s – Rec. G.711, A- or μ-law	N-BC: – 3.1 kHz audio – Circuit mode – 64 kbit/s – Rec. G.711, A- or μ-law
HLC: Optional	N-HLC: Present, if provided
LLC: Optional	N-LLC: Present, if provided
–	B-BC: See E.4
–	ATM traffic descriptor: See E.4
–	Quality of Service: See E.4
–	AAL parameters: See E.4

E.3.2 A N-ISDN user requests the unrestricted digital information bearer service

See Table E.6.

TABLE E.6/Q.2931

Mapping performed by the IWF for the unrestricted digital information bearer service (direction DSS 1 → DSS 2)

DSS 1: Unrestricted digital information bearer service	DSS 2: Emulation of the N-ISDN unrestricted digital information bearer service
BC: – Unrestricted digital information – Circuit mode – 64 kbit/s	N-BC: – Unrestricted digital information – Circuit mode – 64 kbit/s
HLC: Optional	N-HLC: Present, if provided
LLC: Optional	N-LLC: Present, if provided
–	B-BC: See E.4
–	ATM traffic descriptor: See E.4
–	Quality of Service: See E.4
–	AAL parameters: See E.4

E.3.3 A N-ISDN user requests the telephony teleservice

See Table E.7.

TABLE E.7/Q.2931

Mapping performed by the IWF for the telephony teleservice (direction DSS 1 → DSS 2)

DSS 1: Telephony teleservice	DSS 2: Emulation of the N-ISDN telephony teleservice
BC: – Speech – Circuit mode – 64 kbit/s – Rec. G.711, A- or μ-law	N-BC: – Speech – Circuit mode – 64 kbit/s – Rec. G.711, A- or μ-law
HLC: Telephony	N-HLC: Telephony
LLC: Optional	N-LLC: Present, if provided
–	B-BC: See E.4
–	ATM traffic descriptor: See E.4
–	Quality of Service: See E.4
–	AAL parameters: See E.4

E.3.4 A N-ISDN user requests the videotelephony teleservice based on the unrestricted digital information with tones/announcements bearer capability

See Table E.8.

TABLE E.8/Q.2931

Mapping performed by the IWF for the videotelephony teleservice (direction DSS 1 → DSS 2)

DSS 1: Videotelephony teleservice	DSS 2: Emulation of the N–ISDN videotelephony teleservice
BC: – Unrestricted digital information with tones/announcements – Circuit mode – 64 kbit/s – Recommendations H.221 and H.242	N-BC: – Unrestricted digital information with tones/announcements – Circuit mode – 64 kbit/s – Recommendations H.221 and H.242
HLC: Videotelephony (Recommendation F.721)	N-HLC: Videotelephony (Recommendation F.721)
LLC: Optional	N-LLC: Present, if provided
–	B-BC: See E.4
–	ATM traffic descriptor: See E.4
–	Quality of Service: See E.4
–	AAL parameters: See E.4

E.4 Codepoint values of information elements to support 64 kbit/s based circuit-mode ISDN services in B-ISDN

E.4.1 Introduction

This subclause provides the codepoint values of B-ISDN specific information elements to support 64 kbit/s based circuit-mode ISDN services in B-ISDN. The codepoints shall be used by terminal equipment connected to the B-ISDN if it requests a N-ISDN service and by an IWF for generation of the appropriate B-ISDN codepoints.

E.4.2 Codepoints of information elements used for emulated N-ISDN services

E.4.2.1 Broadband bearer capability

Octet	Information element field	Field value
5	Bearer class	BCOB-A
6	Susceptibility to clipping	Susceptible to clipping
	User plane connection configuration	Point-to-point

E.4.2.2 ATM traffic descriptor

E.4.2.2.1 ATM traffic descriptor for N-BC information transfer capabilities of unrestricted digital information and restricted digital information

Octet	Information element field	Field value if no OAM cells are used (Note 1)	Field value if 1 OAM cells/sec.is used (Note 2)	Field value with maximal OAM support (Note 3)
7.1 7.2 7.3	Forward peak cell rate (CLP = 0 + 1)	0000 0000 0000 0000 1010 1011 (171 cells/sec.)	0000 0000 0000 0000 1010 1100 (172 cells/sec.)	0000 0000 0000 0000 1010 1111 (175 cells/sec.)
8.1 8.2 8.3	Backward peak cell rate (CLP = 0 + 1)	0000 0000 0000 0000 1010 1011 (171 cells/sec.)	0000 0000 0000 0000 1010 1100 (172 cells/sec.)	0000 0000 0000 0000 1010 1111 (175 cells/sec.)

NOTES

1 These values are based on an AAL type 1 payload of 47 octets per cell (i.e. no partially filled cell) for user information and no cell rate allocation for OAM cells.

2 These values are based on an AAL type 1 payload of 47 octets per cell (i.e. no partially filled cell) for user information and on 1 cell/sec. allocation for OAM cells.

3 These values are based on an AAL type 1 payload of 47 octets per cell (i.e. no partially filled cell) for user information and the following cell rate allocation for OAM: two percent of the user cell rate and an additional 1 cell/sec.

E.4.2.2.2 ATM traffic descriptor for N-BC information transfer capabilities of speech and 3.1 kHz audio

The field values used for these information transfer capabilities are for further study (see Recommendation I.580 [58]).

E.4.2.3 QOS parameter

Octet	Information element field	Field value
5	QOS-class forward	Unspecified QOS class
6	QOS-class backward	Unspecified QOS class

E.4.2.4 AAL parameters

E.4.2.4.1 AAL parameters for N-BC information transfer capabilities of unrestricted digital information and restricted digital information

Octet	Information element field	Field value	
5	AAL-Type	0000 0001	(AAL Type 1)
6.1	Subtype	0000 0010	(circuit transport)
7.1	CBR Rate	0000 0001	(64 kbit/s)
9.1	Source Clock Frequency	0000 0000	(Null) (Note)
10.1	Error Correction method	0000 0000	(Null) (Note)
11.1/11.2	Structured data transfer block size	0000 0000 0000 0000	(block size of 1)
12.1	Partially filled cells method	0000 0000	(Null) (Note)
NOTE – These fields may also be absent which is equivalent to the null coding.			

E.4.2.4.2 AAL parameters for N-BC information transfer capabilities of speech and 3.1 kHz audio

Octet	Information element field	Field value	
5	AAL-Type	0000 0000	(AAL for voice)

E.4.2.4.3 AAL parameters for N-BC information transfer capabilities of unrestricted digital information with tones/announcements

The field values used for this information transfer capability are for further study.

Annex F

ATM adaptation layer parameters indication and negotiation

(This annex forms an integral part of this Recommendation)

This annex describes procedures for the use of the ATM adaptation layer parameters information element by endpoint equipment.

F.1 General

The purpose of the ATM adaptation layer parameters information element is to provide a means which may be used for conveying information related to the ATM adaptation layer between endpoints. The ATM adaptation layer parameters information element is transferred transparently between ATM endpoints by the network.

F.2 ATM adaptation layer parameter indication in the SETUP message

When the calling endpoint wishes to indicate to the called endpoint the AAL common part parameters and service specific part to be used during the call, the calling endpoint shall include an ATM adaptation layer parameters information element in the SETUP message. This information element is conveyed by the network and delivered to the called user.

The ATM adaptation layer parameters information element may include the following parameters for different AAL connection types:

a) *For AAL Connection type 1*

- Subtype;
- CBR Rate;
- Source Clock Frequency Recovery Method;
- Error Correction;
- Structured Data Transfer Blocksize;
- Partially Filled Cells Indicator.

b) *For AAL Connection type 3/4*

- Forward Maximum CPCS-SDU size;
- Backward Maximum CPCS-SDU size;
- MID range;
- SSCS Type.

c) *For AAL Connection type 5*

- Forward Maximum CPCS-SDU size;
- Backward Maximum CPCS-SDU size;
- SSCS Type.

NOTE – Forward maximum CPCS-SDU size and backward maximum CPCS-SDU size shall either both be present or both be absent in the ATM adaptation layer parameters information element. For unidirectional ATM virtual connections, the backward maximum CPCS-SDU size shall be set to "0".

If the called endpoint receives an ATM adaptation layer parameters information element in the SETUP message which contains the forward or backward maximum CPCS-SDU size but not both, the called endpoint should clear the call with cause No. 100, "invalid information element contents".

F.3 Maximum CPCS-SDU size negotiation

When the called user has received an ATM adaptation layer parameters information element in a SETUP message and the AAL type is either AAL 3/4 or AAL 5, the ATM adaptation layer parameters information element shall be included in the CONNECT message. The ATM adaptation layer parameters information element shall include the forward maximum CPCS-SDU size, indicating the size of the largest CPCS-SDU that the called user is able to receive, and the backward maximum CPCS-SDU size, indicating the size of the largest CPCS-SDU that it will transmit. The values for the forward and backward maximum CPCS-SDU size indicated in the CONNECT message shall not be greater than the values indicated by the calling user in the SETUP message. The ATM adaptation layer parameters information element will be conveyed to the calling user.

NOTE – For unidirectional ATM virtual connections, the backward maximum CPCS-SDU size shall be set to 0.

If the called user does not include the CPCS-SDU size in the CONNECT message, the calling user shall assume that the called user accepts the values of the forward and backward maximum CPCS-SDU size indicated by the calling user in the SETUP message.

If the calling party cannot use the forward or backward maximum CPCS-SDU size indicated in the CONNECT message (i.e. because the value negotiated by the called party is unacceptably small), then the call shall be cleared with cause No. 93, "AAL parameters can not be supported".

If the calling endpoint receives an ATM adaptation layer parameters information element in the CONNECT message which:

a) contains octet groups other than the forward and backward maximum CPCS-SDU size and/or MID range;

b) contains a maximum SDU size which is greater than the maximum SDU size which was sent in the SETUP message; or

c) is missing the forward or backward maximum CPCS-SDU size;

the calling endpoint should clear the call with cause No. 100, "invalid information element contents".

F.4 MID range negotiation

When the called user receives the ATM adaptation layer parameters information element in the SETUP message which indicates AAL type 3/4, the called user shall check the MID range value. If the called user cannot support the indicated MID range but it can support a smaller range, the called user includes an ATM adaptation layer parameters information element in the CONNECT message containing the MID range that it can support.

The calling user will either accept the MID range contained in the CONNECT message or will clear the call with cause No. 93, "AAL parameters can not be supported".

If the called user does not include the MID range in the CONNECT message, the calling user shall assume that the called user accepts the MID range indicated by the calling user in the SETUP message.

If the calling endpoint receives an ATM adaptation layer parameters information element in the CONNECT message which:

a) contains octet groups other than the forward and backward maximum CPCS-SDU size and/or MID range; or

b) contains a MID range which is greater than the MID range which was sent in the SETUP message;

the calling endpoint should clear the call with cause No. 100, "invalid information element contents".

F.5 Use of forward and backward maximum CPCS-SDU size by the AAL entity in the user plane

The values of forward and backward maximum CPCS-SDU size resulting from AAL parameters negotiation shall be used by the AAL entities in the user plane. The AAL entity in the calling user equipment shall not send a CPCS-SDU size larger than the indicated value specified in the forward maximum CPCS-SDU size parameter, and may allocate its internal resources based on the value indicated in the backward maximum CPCS-SDU size parameter. Similarly, the AAL entity in the called user equipment shall not send a CPCS-SDU size larger than the indicated value specified in the backward maximum CPCS-SDU size parameter, and may allocate its internal resources based on the value indicated in the forward maximum CPCS-SDU size parameter.

Annex G

This annex is reserved for future use.

Annex H

Extensions for symmetric call operation

(This annex forms an integral part of this Recommendation)

For support of symmetric call operation on a point-to-point access configuration, the additional optional procedures detailed below are required:

1) When call establishment information is received, a CALL PROCEEDING, an ALERTING or a CONNECT message, as appropriate, is transferred across the interface.

2) Upon receipt of a SETUP message, the equipment enters the Call Present state. Valid response to the SETUP message is a CALL PROCEEDING, an ALERTING, a CONNECT or a RELEASE COMPLETE message.

3) At the originating interface:

   - When the user receives the ALERTING message, the user may begin an internally generated alerting indication; stop T303 or T310 (if running) and shall enter the Call Delivered state.

   - On receipt of the CONNECT message, the calling user shall stop timer T303 or T310 (if running) in addition to procedures described in 5.1.7.

4) User endpoints implement the network side timer T301 along with the corresponding network side procedures for actions taken upon expiration of the timer.

Annex I

Handling of the OAM traffic descriptor

(This annex forms an integral part of this Recommendation)

The use of the Operation And Maintenance information flows, in particular of the end-to-end OAM F5 for fault management and for performance monitoring, is defined in Recommendation I.610.

I.1 Use of the OAM traffic descriptor information element

The OAM traffic descriptor information element is included by the calling user in the SETUP message to provide a specification of the end-to-end OAM flow as a fraction of the aggregate of the user and end-to-end OAM F5 flow.

The OAM traffic descriptor information element defined in 4.5.24 may, optionally, be included in the SETUP message by the calling user; however, its absence does not in itself mean that no OAM flow will be used within this call (see 3.1.7). The support of this information element is network dependent.

If the network or the user does not support this information element, it shall be treated as an unrecognized information element according to the procedures defined in 5.6.

I.2 Handling of the OAM traffic descriptor information element in the SETUP message

If supported, the network shall, as a minimum, transfer this information element and include it in the SETUP message delivered to the called user. Once the call and the connection are established and the CONNECT message has been received by the calling user, the calling user and the called user will negotiate the use of the end-to-end OAM F5 information flow according to the procedures defined by Recommendation I.610.

The use of an ATM traffic shaping is a network option, if no ATM traffic shaping is applied, the network shall transfer the Shaping indicator subfield of the OAM traffic descriptor information element transparently to the destination user.

The Shaping indicator subfield shall be interpreted by networks which apply ATM traffic shaping.

Networks which apply ATM traffic shaping but cannot support the user request to avoid aggregate ATM user information and end-to-end OAM F5 flow shaping shall clear the call and return cause No. 63, "service or option not available, unspecified", to the calling user.

In the case of separate shaping required by the user, the network may shape only the user data information flow on the basis of its specific Peak Emission Interval (or Peak Cell Rate), letting the OAM information flow by-pass the shaping function, provided that the network can accommodate the resulting traffic incurred by the OAM cell stream. If, as a network option, the network performs traffic shaping in conjunction with suitable Usage Parameter Control (UPC) function, the network may perform user data and OAM F5 aggregate shaping or separate shaping, according to the requirement specified by the user in the Shaping indicator field of the OAM traffic descriptor information element.

The handling of the ATM traffic descriptor information element in conjunction with the OAM traffic descriptor information element, when supported, for the purpose of Call Admission Control (CAC), Usage or Network Parameter Control (UPC and NPC) and traffic shaping shall be performed according to Recommendation I.371.

I.3 Procedure at the destination user-network interface

The called user shall, if it supports the OAM traffic descriptor information element and the specified OAM traffic descriptor, include the corresponding OAM traffic descriptor information element in the CONNECT message returned to the network. The network shall then transfer transparently this OAM traffic descriptor information element and deliver it to the calling user in the CONNECT message, to confirm the availability of the end-to-end OAM F5 flow.

If the OAM traffic descriptor is not included by the called user in the CONNECT message and if its Compliance indicator was set to "mandatory" in the SETUP message, the destination exchange shall initiate call clearing and send cause No. 63, "service or option not available, unspecified", to the called user and to the calling user. If the Compliance indicator was set to "optional" in the SETUP message, the call completion shall proceed. The calling user shall interpret the absence of the OAM traffic descriptor in the received CONNECT message as an indication that the end-to-end OAM F5 flow is not available.

NOTE – In the case of interworking with non-B-ISDN, the Interworking function may discard the OAM traffic descriptor information element and continue the establishment of the call. Therefore the calling user should interpret the absence of the OAM traffic descriptor information element in the received CONNECT message as an indication that the end-to-end OAM F5 flow is not available even if the Compliance indicator was set to "mandatory" in the SETUP message.

Annex J

Definitions, Abbreviations and References

(This annex forms an integral part of this Recommendation)

J.1 Definitions

For the purposes of this Recommendation, the following definition apply:

J.1.1 access: The set of equipment at a point of a network where a user connects to it. This includes the user equipment and the equipment in the network to which the user connects, i.e. the exchange termination, network termination and terminal equipment.

J.1.2 access information: Information contained in access information elements. These information elements are transported transparently through the network without being processed. They have only end-to-end relevance.

J.1.3 access information elements: A generic term for the following information elements:

- Narrow-band low layer compatibility;
- Narrow-band high layer compatibility;
- Broadband low layer information;
- Broadband high layer information;

– AAL parameters;

– Calling party sub-address;

– Called party sub-address.

Other Recommendations may also define additional information elements as access information elements.

J.1.4 alert: The action of attempting to make a user aware that a call is waiting to be answered at his terminal, for example by ringing the telephone bell.

J.1.5 answer (a call): The response of a user when he accepts a call to which he has been alerted, for example by lifting the telephone handset off the hook when it is ringing.

J.1.6 asynchronous transfer mode (ATM): A transfer mode in which the information is organized into cells; it is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic. It is a protocol within the OSI layer 1. An ATM cell consists of a 5 octet header followed by 48 octets of data. See also Recommendation I.361.

J.1.7 ATM adaptation layer (AAL): The AAL enhances the service provided by the ATM layer to support functions required by the next higher layer. It is an OSI layer 2 protocol. The AAL is different, depending on the needs of the next higher layer. This Recommendation uses an AAL called Signalling AAL. See also Recommendations I.362, I.363 and Q.2100.

J.1.8 ATM cell header: This contains a VPI, a VCI and other information necessary for functions such as routing the cell, cell delineation and maintenance. It has a different format depending on what part of the network it is being used in.

J.1.9 backward: The backward direction is defined as the direction from the called user to the calling user.

J.1.10 basic call/connection control: The set of functions used to process a basic call and associated connections (e.g. provide service features and establish, supervise, maintain and release connections). A basic call is a simple call between two parties without any supplementary services being active.

J.1.11 broadband connection oriented bearer service: A bearer service that establishes logical connections between users before transferring digital information. In general, information transfer is in real time, in sequence and bidirectional. The service attempts to deliver information unchanged from source to destination. Parameters such as transfer delay, bit rate in each direction and constant or variable bit rate can be specified by the user. See also Recommendation F.811.

J.1.12 broadband ISDN: An ISDN that provides transmission channels capable of supporting rates greater than 2 Mbits/s. It uses ATM as the transfer mode. See also Recommendation I.311.

J.1.13 called user: A user to which a call is made. Often called B-party.

J.1.14 calling user: A user which initiates a call. Often called A-party.

J.1.15 circuit mode: An information transfer mode in which transmission is achieved by allocation of constant bandwidth between transfer end points. It behaves as if a cable were placed between the end points. It is to be compared with packet mode.

J.1.16 clipping: An impairment in which the first fraction of a second of information to be transferred is lost. It occurs after a call is answered and before an associated connection is switched through.

J.1.17 connection: An association of transmission channels or circuits, switching and other functional units set up to provide a means of transfer of information between two or more points in a telecommunication network.

J.1.18 connection admission control: The procedure within the control part of network nodes used to decide whether or not a request for a connection can be accepted based on the requested usage parameters and already established connections.

J.1.19 connection oriented: An information transfer mode in which a connection is established between end users before information is transferred. Compare with connectionless.

J.1.20 connectionless: An information transfer mode in which blocks of data to be transferred are individually addressed and routed to their destination. Compare with connection oriented.

J.1.21 cross-connect: A network element which connects links and is directed by management plane functions and not by control plane functions. A VP cross-connect connects VP links; it translates VPI (not VCI) values. A VC cross-connect connects VC links; it terminates VPCs and translates VCI values. See also Recommendation I.311.

J.1.22 data link connection: An error free connection provided by the data link layer (OSI layer 2). For the purposes of this Recommendation, it connects the user to the network and is provided by the signalling AAL.

J.1.23 dual seizure: The condition when both the user and the network attempt to seize the same virtual channel at the same time for different connections.

J.1.24 *en bloc*: A method of signalling the address in which all the address digits are sent in a single message. In *en bloc* sending, the user must be aware of the last digit in order to initiate sending of the message. Compare with overlap.

J.1.25 end-to-end: Communication between terminals as opposed to communication between terminal and network or between network nodes.

J.1.26 field: A contiguous set of bits in an information element that represent information.

J.1.27 forward: The forward direction is defined as the direction from the calling user to the called user.

J.1.28 ignore: The information shall be treated as if it was not received.

J.1.29 information element: The components of a message are information elements. A particular information element type may be a component of more than one message type. An information element is composed of one or more octet groups.

J.1.30 integrated services digital network: A network that provides or supports a range of different telecommunication services using digital connections.

J.1.31 interface: The shared boundary between two entities across which they communicate.

J.1.32 interwork: The act of translating signals from a source signalling system to a destination signalling system that is different, such that the meaning of the translated signals is as close to that of the original as possible.

J.1.33 layer 2: The OSI data link layer. In this Recommendation, it refers to the SAAL.

J.1.34 layer 3: The OSI network layer.

J.1.35 layer management: Functions related to the management of the (N)-layer partly performed in the (N)-layer itself according to the (N)-protocol of the layer (activities such as activation and error control) and partly performed as a subset of systems-management. See also Recommendation X.200.

J.1.36 message: A block of information that is sent from a source entity to one or more destination entities. It is sent as a result of an event taking place in the source entity that requires an action in the destination entities. In addition to informing of the event, a message may contain additional information necessary or helpful to the destination entities in reacting to the event. A message is composed of information elements. Ideally, a message occupies zero time. In practice, a message occupies an interval of time. This interval is due only to limitations in the equipment processing the message and is as short as possible.

J.1.37 meta-signalling: A form of signalling used to establish a signalling relationship where none already exists. For the purposes of this Recommendation, the signalling relationship is a signalling virtual channel. See also Recommendation Q.2120.

J.1.38 narrow-band ISDN: ISDN before the advent of broadband ISDN. It is called narrow-band ISDN in order to distinguish it from broadband ISDN.

J.1.39 network connection: The part of a connection that is entirely within the network.

J.1.40 network termination: The functional group on the network side of a user-network interface. It is not necessarily co-located with the local exchange.

J.1.41 octet: A byte consisting of 8 bits. See clause 4.

J.1.42 octet group: The components of an information element. See 4.5.1.

J.1.43 originating access: The access used by the calling user.

J.1.44 overlap: A method of signalling the address in which all the address digits are not sent in a single message, typically one message for each digit. The network may begin routing before all digits are received. The network may determine when enough digits have been received. Compare with *en bloc*.

J.1.45 peak cell rate: The inverse of the minimum time interval between two requests to send an ATM-PDU. An ATM-PDU results in the transmission of a cell.

J.1.46 peer entities: Communicating entities in the same OSI layer but in different systems. The entities communicate using the underlying OSI layers. See also Recommendation X.200.

J.1.47 permanent data link connection: A data link connection that is established and released by subscription. It cannot be established, re-established or released by user equipment.

J.1.48 point-to-multipoint configuration (at the UNI): A configuration where more than one terminal equipment is supported by a single network termination at a user-network interface.

J.1.49 protocol data unit: A data unit that is transferred by a layer to its peer, i.e. across the lower boundary of the layer.

J.1.50 restart: To return the indicated virtual channel to the idle state. See 5.5.

J.1.51 semi-permanent connection: A connection that is established and released by subscription. It cannot be established, re-established or released by user equipment.

J.1.52 service access point: The point at which an OSI layer provides services to the next higher layer.

J.1.53 service data unit: A data unit that is transferred by a layer across a service access point, i.e. across the upper boundary of the layer.

J.1.54 signalling AAL: The AAL that is used for signalling. It is the next lower OSI layer from Q.2931. See also Recommendation Q.2100.

J.1.55 signalling channel: The bidirectional channel used for the transfer of Q.2931 messages.

J.1.56 signalling virtual channel: The virtual channel used for the transfer of Q.2931 messages.

J.1.57 teleservice: A type of telecommunication service that provides the complete capability, including terminal equipment functions, for communication between users according to protocols established by agreement between Administrations and/or ROAs.

J.1.58 terminal equipment: The functional group on the user side of a user-network interface.

J.1.59 terminating access: The access used by the called user.

J.1.60 user-network interface: The shared boundary between the network and user terminal equipment across which they communicate.

J.1.61 virtual channel (VC): A facility, provided by the ATM layer, for the transfer of digital data across an interface. The transfer is bidirectional, as near to real time as possible and in sequence. The data is sent in ATM cells. The VCI included in the cell header associates the data with the VC. The VCI is unique within the interface. See also Recommendation I.311.

J.1.62 virtual path (VP): A grouping of one or more VCs. The VPI included in the ATM cell header associates the VCs with the VP. The VPI is unique within the interface. See also Recommendation I.311.

J.1.63 virtual path connection (VPC): A concatenation of VP links that extends between the point where the VCI values are assigned and the point where those values are translated or removed. The VPI values of two concatenated VP links may be different. See also Recommendation I.311.

J.2 Abbreviations

For the purposes of this Recommendation, the following abbreviations are used:

AAL	ATM Adaptation Layer
AFI	Authority and Format Identifier
ATM	Asynchronous Transfer Mode
B-BC	Broadband Bearer Capability
B-HLI	Broadband High Layer Information
B-ISDN	Broadband ISDN
B-LLI	Broadband Low Layer Information
BC	Bearer Capability
BCD	Binary Coded Decimal
BCOB	Broadband Connection Oriented Bearer class
CBR	Constant Bit Rate
CLP	Cell Loss Priority
CN	Customer Network
CPCS-SDU	Common Part Convergence Sub-layer (of AAL) – Service Data Unit (see Recommendation Q.2130)
DCE	Data Circuit terminating Equipment
DSP	Domain Specific Part
DTE	Data Terminal Equipment
ET	Exchange Termination
HLC	High Layer Compatibility
HLI	High Layer Information
IDI	Initial Domain Identifier
IE	Information Element
IEC	International Electrotechnical Commission
ISDN	Integrated Services Digital Network
ISO	International Organisation for Standardization
IWF	Interworking Function
LLC	Low Layer Compatibility
LLI	Low Layer Information
MID	Multiplexing Identifier (see Recommendation I.363)
N-BC	Narrow-band Bearer Capability
N-HLC	Narrow-band High Layer Compatibility
N-ISDN	Narrow-band ISDN
N-LLC	Narrow-band Low Layer Compatibility
NPC	Network Parameter Control
NSAP	Network Service Access Point
OAM	Operations, Administration and Maintenance
PDU	Protocol Data Unit
QOS	Quality of Service
SAAL	Signalling AAL
SAP	Service Access Point

SDT	Structured Data Transfer
SPC	Semi-Permanent Connection
SSCOP	Service Specific Connection Oriented Protocol (of AAL) (see Recommendation Q.2110)
SSCS	Service Specific Convergence Sub-layer (of AAL) (see Recommendation Q.2130)
SVC	Signalling Virtual Channel
TE	Terminal Equipment
UNI	User-Network Interface
UPC	Usage Parameter Control
VBR	Variable Bit Rate
VC	Virtual Channel
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier
VP	Virtual Path
VPCI	Virtual Path Connection Identifier
VPI	Virtual Path Identifier

J.3 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-Recommendations is regularly published.

[1] Recommendation E.164, *Numbering plan for the ISDN era*.

[2] Recommendation F.811, *Broadband connection-oriented bearer service*.

[3] Recommendation G.711, *Pulse Code Modulation (PCM) of voice frequencies.*

[4] Recommendation G.721, *32 kbit/s Adaptive Differential Pulse Code Modulation (ADPCM)*.

[5] Recommendation G.722, *7 kHz audio-coding within 64 kbit/s*.

[6] Recommendation H.221, *Frame structure for a 64 to 1920 kbit/s channel in audiovisual teleservices*.

[7] Recommendation H.230, *Frame-synchronous control and indication signals for audiovisual systems*.

[8] Recommendation H.242, *System for establishing communication between audiovisual terminals using digital channels up to 2 Mbit/s*.

[9] Recommendation I.230, *Definition of bearer service categories*.

[10] Recommendation I.240, *Definition of teleservices*.

[11] Recommendation I.311, *B-ISDN general network aspects*.

[12] Recommendation I.327, *B-ISDN functional architecture*.

[13] Recommendation I.330, *ISDN numbering and addressing principles*.

[14] Recommendation I.334, *Principles relating ISDN numbers/sub-addresses to the OSI reference model network layer addresses*.

[15] Recommendation I.361, *B-ISDN ATM layer specification.*

[16] Recommendation I.362, *B-ISDN ATM Adaptation Layer (AAL) functional description*.

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

[18] Recommendation I.371, *Traffic control and congestion control in B-ISDN*.

[19] Recommendation I.413, *B-ISDN user-network interface*.

[20] Recommendation I.460, *Multiplexing, rate adaption and support of existing interfaces*.

[21] Recommendation I.500, *General structure of the ISDN interworking Recommendations*.

[22] Recommendation I.610, *Organization and maintenance principles of the B-ISDN access*.

[23] ISO 1745, *Information processing basic mode control procedures for data communication systems*.

[24] ISO 4335, *Information technology – Telecommunications and information exchange between systems – High-level Data Link Control (HDLC) procedures – Elements of procedures*.

[25] ISO 7776, *Information processing systems – Data communications – High-level data link control procedures – Description of the X.25 LAPB compatible DTE data link procedures*.

[26] ISO/IEC 8208, *Information technology – Data communications – X.25 Packet Layer Protocol For Data Terminal Equipment*.

[27] ISO 8473, *Information processing systems – Data communications – Protocol for providing the connectionless-mode network service*.

[28] ISO 8802/2, *Information processing systems – Local area networks – Part 2: Logical link control*.

[29] ISO/IEC TR 9577, *Information technology – Telecommunications and information exchange between systems – Protocol identification in the network layer*.

[30] Recommendation Q.850, *Use of cause and location in the digital Subscriber Signalling System No. 1 and the Signalling System No. 7 ISDN user part*.

[31] Recommendation Q.921, *ISDN user-network interface – Data link layer specification*.

[32] Recommendation Q.922, *ISDN data link layer specification for frame mode bearer services*.

[33] Recommendation Q.931, *ISDN user-network interface layer 3 specification for basic call control*.

[34] Recommendation Q.933, *ISDN Digital Subscriber Signalling System No. 1 (DSS 1) – Signalling specification for frame mode bearer service*.

[35] Recommendation Q.2010, *Broadband integrated services digital network overview signalling capability set 1, relase 1*.

[36] Recommendation Q.2120, *B-ISDN meta-signalling protocol*.

[37] Recommendation Q.2650, *Broadband-ISDN, – Interworking between Signalling System No. 7 broadband ISDN user part (B-ISUP) and Digital Subscriber Signalling System No. 2 (DSS 2)*.

[38] Recommendation Q.2100, *B-ISDN Signalling ATM Adaptation Layer (SAAL) overview description*.

[39] Recommendation T.50/ISO 646, *International Alphabet No. 5*.

[40] Recommendation T.70, *Network-independent basic transport service for the telematic services*.

[41] Recommendation T.71, *Link Access Protocol Balanced (LAPB) extended for half-duplex physical level facility*.

[42] Recommendation T.90, *Characteristics and protocols for terminals for telematic services in ISDN*.

[43] Recommendation V.110/X.30, *Support of Data Terminal Equipments (DTEs) with V-Series type interfaces by an integrated services digital network.*

[44] Recommendation V.120, *Support by an ISDN of data terminal equipment with V-Series type interfaces with provision for statistical multiplexing*.

[45] Recommendation X.25, *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit.*

[46] Recommendation X.31, *Support of packet mode terminal equipment by an ISDN*.

[47] Recommendation X.75, *Packet-switched signalling system between public networks providing data transmission services.*

[48] Recommendation X.121, *International number plan for public data networks*.

[49] Recommendation X.200, *Reference model of Open Systems Interconnection for CCITT applications*.

[50] Recommendation X.213/ISO 8348, *Network service definition for Open Systems Interconnection for CCITT applications.*

[51] Recommendation X.223/ISO 8878, *Use of X.25 to provide the OSI connection-mode network service for CCITT applications.*

[52] Recommendation Q.2110, *B-ISDN ATM adaptation layer – Service Specific Connection Oriented Protocol (SSCOP).*

[53] Recommendation Q.2130, *B-ISDN signalling ATM adaptation layer – Service specific coordination function for support of signalling at the user-to-network interface (SSCF at UNI)*.

[54] Recommendation Q.2761, *Broadband Integrated Services Digital Network (B-ISDN) – Functional description of the B-ISDN user part (B-ISUP) of Signalling System No. 7*.

[55] Recommendation Q.2762, *Broadband Integrated Services Digital Network (B-ISDN) – General functions of messages and signals of the B-ISDN user part B-ISUP of Signalling System No. 7*.

[56] Recommendation Q.2763, *Broadband Integrated Services Digital Network (B-ISDN) – Signalling System No. 7 B-ISDN user part (B-ISUP) – Formats and codes*.

[57] Recommendation Q.2764, *Broadband Integrated Services Digital Network (B-ISDN) – Signalling System No. 7 B-ISDN user part (B-ISUP) – Basic call procedures*.

[58] Recommendation I.580, *General arrangements for interworking between B-ISDN and 64 kbit/s based ISDN*.

Annex K

Handling of the End-to-end transit delay information element

(This annex forms an integral part of this Recommendation)

K.1 General

This annex describes the use of the End-to-end transit delay information element.

The support of the End-to-end transit delay information element and the procedures described in this annex is mandatory for the network and optional for the user.

The purpose of the End-to-end transit delay information element is to indicate the maximum end-to-end transit delay acceptable for a call, and to indicate the cumulative transit delay to be expected for a virtual channel connection.

The calling user may indicate a maximum end-to-end transit delay value to specify end-to-end transit delay requirements for a given call or indicate that any end-to-end transit delay is acceptable.

The cumulative transit delay expected for the transmission of user data from the calling terminal equipment to the network boundary may be indicated by the calling user.

NOTE 1 – The handling of this information within the network is described in the B-ISUP Recommendations [54], [55], [56], [57]. These Recommendations state that the cumulative transit delay value is updated sequentially along the route of the call to determine the end-to-end transit delay to be expected for the call. The B-ISUP clears the call if the maximum end-to-end transit delay requirement cannot be met.

The network shall include an End-to-end transit delay information element in the SETUP message which is sent to the called user if the calling user included an End-to-end transit delay information element in the SETUP message.

It is recommended that the called user updates the cumulative transit delay value received from the network.

NOTE 2 – This is particularly important if the transmission line between the network boundary and the called terminal equipment causes substantial further delay (e.g. a satellite link).

If a maximum end-to-end transit delay value is specified, it is recommended that the called user takes appropriate action (e.g. call rejection) when the cumulative transit delay value exceeds the specified maximum end-to-end transit delay value.

If the called user accepts the call, it is recommended that the called user includes an End-to-end transit delay information element in the CONNECT message specifying the final cumulative transit delay value for the call.

NOTE 3 – The B-ISUP Recommendations state that the cumulative transit delay value which the network receives in the CONNECT message will be passed transparently to the calling user.

Further details about the handling of the End-to-end transit delay information element are given below.

K.2 Handling of the End-to-end transit delay information element in the SETUP message at the originating UNI

The inclusion of the End-to-end transit delay information element in the SETUP message by the calling user is optional.

If the calling user includes an End-to-end transit delay information element in the SETUP message, both the cumulative transit delay subfield and the maximum end-to-end transit delay subfield shall be present. The user may set the maximum end-to-end transit delay subfield to any end-to-end transit delay value acceptable, deliver cumulative end-to-end transit delay value to the called user if any end-to-end transit delay is acceptable.

If the networks receives an End-to-end transit delay information element which contains only the maximum end-to-end transit delay subfield or only the cumulative transit delay subfield, the network shall handle the End-to-end transit delay information element as a non-mandatory information element with content error.

K.3 Handling of the End-to-end transit delay information element in the SETUP message at the destination UNI

The network shall include an End-to-end transit delay information element if the calling user included an End-to-end transit delay information element in the SETUP message. Both the cumulative transit delay subfield and the maximum end-to-end transit delay subfield shall be present.

K.4 Handling of the End-to-end transit delay information element by the called user

It is recommended that the called user updates the cumulative transit delay value received from the network. If the cumulative transit delay value exceeds the maximum end-to-end transit delay value specified by the calling user, it is also recommended that the called user rejects the call with cause No. 49, “Quality of Service not available”.

K.5 Handling of the End-to-end transit delay information element in the CONNECT message at the destination UNI

If the SETUP message sent to the called user included an End-to-end transit delay information element, the called user may include an End-to-end transit delay information element in the CONNECT message specifying the final cumulative transit delay value for the call. No maximum end-to-end transit delay subfield shall be included. If the network receives an End-to-end transit delay information element in the CONNECT message containing a maximum end-to-end transit delay subfield, this field shall be discarded.

The network does not check the correctness of the cumulative transit delay value provided.

K.6 Handling of the End-to-end transit delay information element in the CONNECT message at the originating UNI

The network shall include an End-to-end transit delay information element in the CONNECT message sent to the calling user if the called user included an End-to-end transit delay information element in the CONNECT message. No maximum end-to-end transit delay subfield shall be included.

Annex L

Examples for Message Structure and Information Element Format

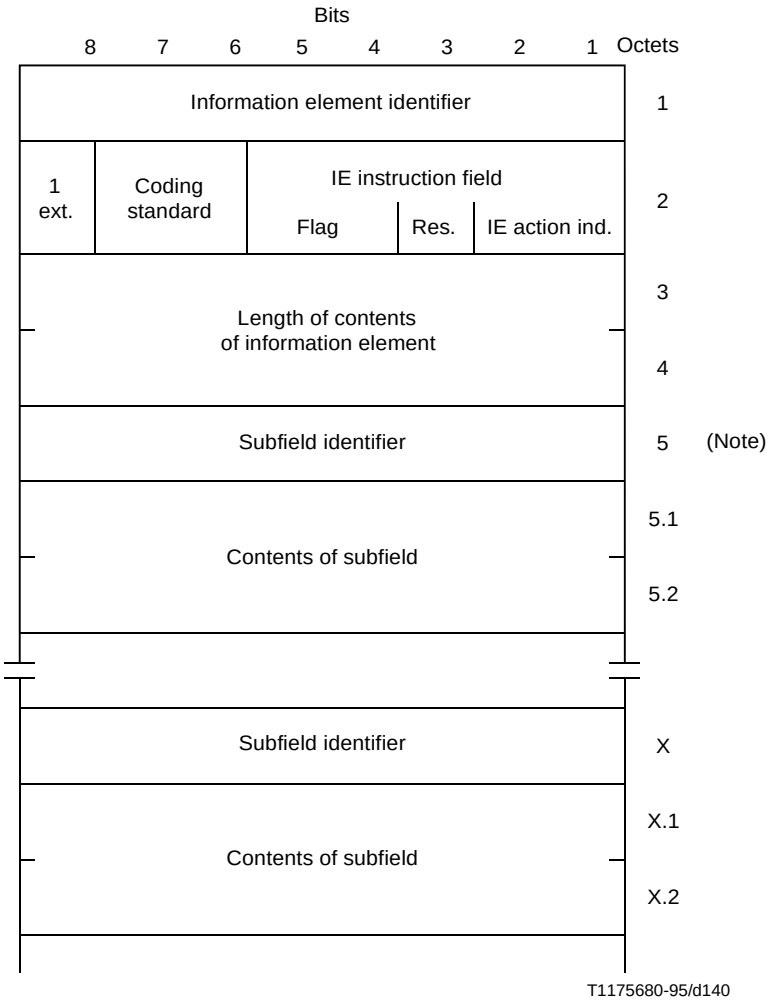
(This annex forms an integral part of this Recommendation)

L.1 Introduction

This annex shows an example of the structure of a Q.2931 information element.

L.2 Structure using of an information subfield identifiers

An example of the structure of a Q.2931 information element using subfield identifiers is shown in Figure L.1.



NOTE – Some information elements are structured using subfield identifiers, e.g. ATM traffic descriptor.

FIGURE L.1/Q.2931

Structure of a Q.2931 information element using subfield identifiers

L.3 The ordering of information elements

An example of the structure of a Q.2931 message clarifying the ordering of information elements is shown in Figure L.2.

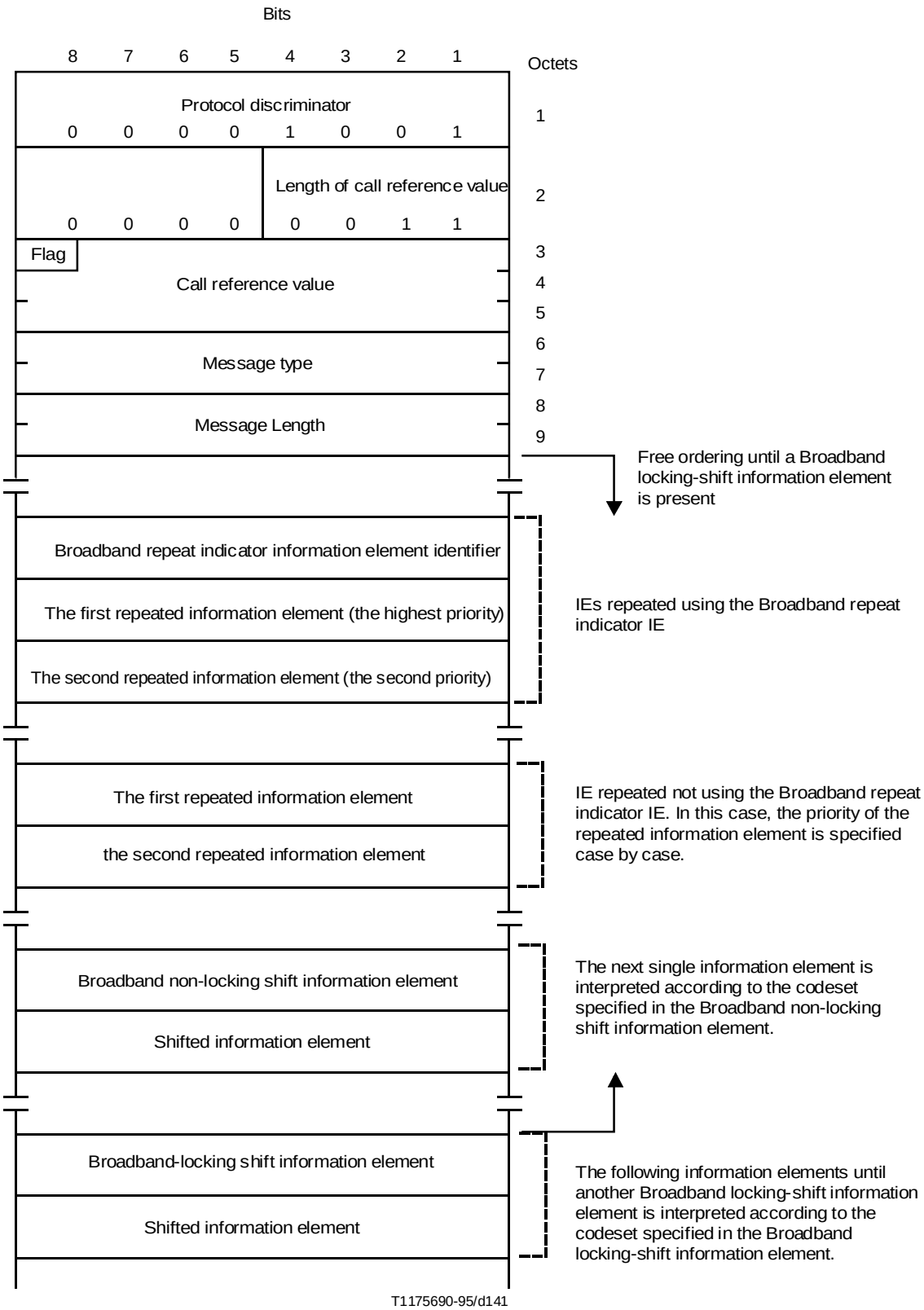


FIGURE L.2/Q.2931

Examples of the structure of a Q.2931 message clarifying the ordering of information elements

Appendix I

Guidelines for the use of Instruction indicators

(This appendix does not form an integral part of this Recommendation)

For the current Q.2931 messages and information elements related to B-ISDN basic call/connection control, interworking, and for the global call reference related procedures, the Instruction indicator flag needs not to be set to "Follow explicit instructions". Recommendations for Instruction indicator codings are shown in Tables I.1 and I.2.

For the Q.2931 messages and information elements related to Release 1 supplementary services, the Instruction indicator value to be used will be specified in the respective specification.

For DSS 2 messages and information elements which are defined in other Recommendations, the Instruction indicator flag may be set as "Follow explicit instructions". The coding of the Instruction field is defined according to the forward/backward compatibility requirements.

For information elements containing codepoints, which are not defined in this Recommendation, the Instruction indicator flag may also be set as "Follow explicit instructions".

The following abbreviations have been used in the tables:

Used	Follow explicit instructions
Not used	Instruction field not significant
N	Network
U	User

TABLE I.1/Q.2931

Typical use of Instruction indicators for the Q.2931 messages which are related to the basic call control

Message	Flag	Origin	Action indicator
ALERTING	Not used	N&U	Not significant
CALL PROCEEDING	Not used	N&U	Not significant
CONNECT	Not used	N&U	Not significant
CONNECT ACKNOWLEDGE	Not used	N&U	Not significant
INFORMATION	Not used	N&U	Not significant
NOTIFY	Not used	N&U	Not significant
PROGRESS	Not used	N&U	Not significant
SETUP	Not used	N&U	Not significant
SETUP ACKNOWLEDGE	Not used	N&U	Not significant
STATUS	Not used	N&U	Not significant
STATUS ENQUIRY	Not used	N&U	Not significant
RELEASE	Not used	N&U	Not significant
RELEASE COMPLETE	Not used	N&U	Not significant
RESTART	Not used	N&U	Not significant
RESTART ACKNOWLEDGE	Not used	N&U	Not significant

TABLE I.2/Q.2931

Typical use of Instruction indicators for the Q.2931 information elements which are related to the basic call control

Information elements	Flag	Origin	Action indicator
Broadband-locking shift	Not used	N&U	Not significant
Broadband-non-locking shift	Not used	N&U	Not significant
ATM adaptation layer parameter	Not used	N&U	Not significant
ATM traffic descriptor	Not used	N&U	Not significant
Broadband bearer capability	Not used	N&U	Not significant
Broadband high layer information	Not used	N&U	Not significant
Broadband low layer information	Not used	N&U	Not significant
Call state	Not used	N&U	Not significant
Called party number	Not used	N&U	Not significant
Called party sub-address	Not used	N&U	Not significant
Calling party number	Not used	N&U	Not significant
Calling party sub-address	Not used	N&U	Not significant
Cause	Not used	N&U	Not significant
Connection identifier	Not used	N&U	Not significant
End-to-end transit delay	Not used	N&U	Not significant
Quality of Service parameter	Not used	N&U	Not significant
Broadband repeat indicator	Not used	N&U	Not significant
Restart indicator	Not used	N&U	Not significant
Broadband sending complete	Not used	N&U	Not significant
Transit network selection	Not used	N&U	Not significant
Notification indicator	Not used	N&U	Not significant
OAM traffic descriptor	Not used	N&U	Not significant
Narrow-band bearer capability	Not used	N&U	Not significant
Narrow-band high layer compatibility	Not used	N&U	Not significant
Narrow-band low layer compatibility	Not used	N&U	Not significant
Progress indicator	Not used	N&U	Not significant

Appendix II

Information items for connection establishment in B-ISDN

(This appendix does not form an integral part of this Recommendation)

II.1 Scope

This appendix clarifies information items for connection establishment in B-ISDN.

II.2 Information items specified by the calling terminal

II.2.1 Information items used for B-ISDN specific services

1) B-BC (Broadband bearer capability):
   - Bearer Class;
   - Traffic type (CBR or VBR) ← only for bearer class X;
   - Timing requirement (required or not required) ← only for bearer class X;
   - Susceptibility to clipping;
   - User plane connection configuration.
2) ATM traffic descriptor.
3) Quality of Service parameter.
4) AAL parameters.
5) End-to-end transit delay.
6) B-LLI (Broadband low layer information).
7) B-HLI (Broadband high layer information).
8) OAM traffic descriptor.

II.2.2 Emulation of N-ISDN bearer services and interworking with N-ISDN

The calling terminal generally cannot identify the type of called terminal (ATM terminal or N-ISDN terminal) at call-setup. Therefore, the same procedure shall apply for both emulation of N-ISDN bearer services between ATM terminals and interworking with N-ISDN (Figure II.1).

The following summarizes the main information items required for emulation of N-ISDN bearer services between ATM terminals and for interworking with N-ISDN.

1) N-BC (Narrow-band bearer capability):
   - Information transfer capability (speech, unrestricted digital information, restricted digital information, 3.1 kHz audio, unrestricted digital information with tone/announcement, video).
   - Transfer mode (circuit, packet, frame).
   - Information transfer rate (bit/s).
   - User information layer 1 protocol (A-law, ...).
2) B-BC (Broadband bearer capability):
   - Bearer Class (BCOB-A).
   - Susceptibility to clipping (susceptible to clipping).
   - User plane connection configuration (point-to-point).

3) ATM traffic descriptor:

The two types of cell rate defined by Recommendation I.371 are included as follows:

a) Peak cell rate for CLP = 0:

– Forward cell rate;

– Backward cell rate.

b) Peak cell rate for CLP = 0 + 1:

– Forward cell rate;

– Backward cell rate.

4) Quality of Service parameter.

5) AAL parameters.

6) End-to-end transit delay.

7) N-LLC (Narrow-band low layer compatibility).

8) N-HLC (Narrow-band high layer compatibility).

9) OAM traffic descriptor.

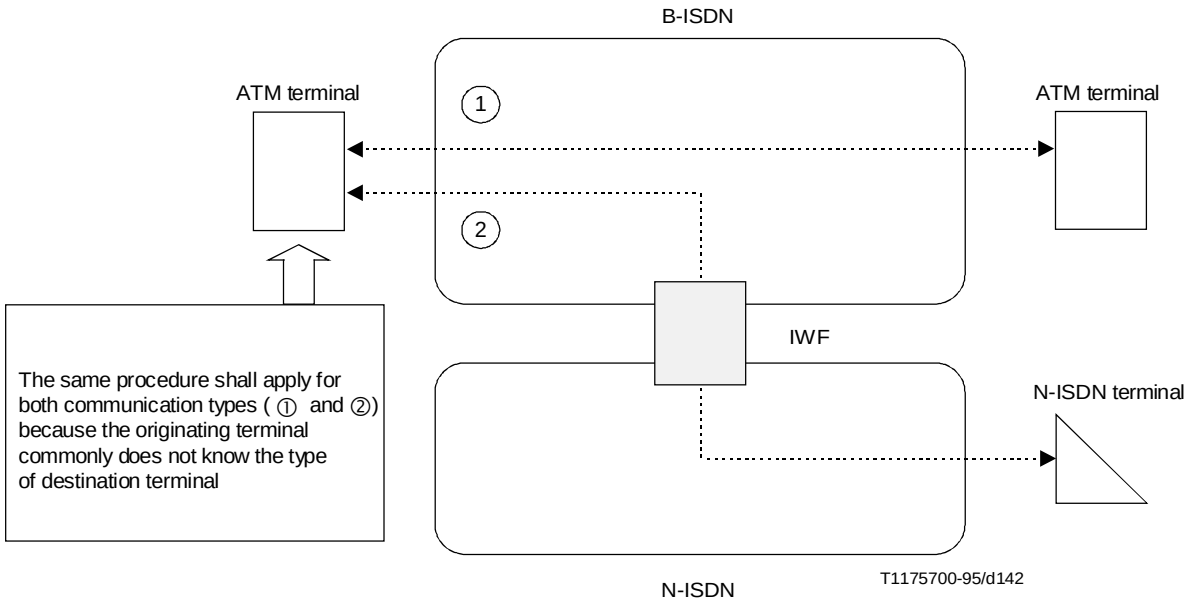


FIGURE II.1/Q.2931

Two communication types for emulation of N-ISDN bearer services in B-ISDN

Appendix III

Status monitoring procedures for Semi-Permanent Virtual Channel Connections

(This appendix does not form an integral part of this Recommendation)

The support of the procedures of this appendix is optional for both the user and the network provider. When supported, their provision requires bilateral agreement between the subscribers and the network provider. However, it should be taken into consideration that studies are currently being undertaken in parallel in other bodies addressing the complete area of management of SPC and PVC to support network operations. Therefore, the status monitoring mechanism for SPC as contained in this appendix may in the future be provided by alternative mechanisms contained in more comprehensive Recommendations other than B-ISDN signalling Recommendations; the progress and introduction of which should not be prejudiced by this appendix. This appendix will not be further enhanced to introduce new functionality or expand existing functionality. If such functionality is required, it will be the subject of Recommendations other than B-ISDN signalling Recommendations.

If implemented, these procedures are supported to co-exist with 1.610 procedures; the functionality provided by the procedures of this appendix is supported to complement the 1.610 functions.

The procedures of this appendix are intended to be used for real time operational purposes. In the following, they are specified in terms of protocol elements (messages, information elements and procedures) for the monitoring of the status of Semi-Permanent Virtual Channel Connections (SPCs).

These procedures include:

- Real time notification of the:
  - SPC initial configuration;
  - SPC activation;
  - SPC addition (indication: “new” SPC);
  - SPC deactivation;
  - SPC deletion (indication: “delete” SPC).
- Interrogation of the bulk status of the availability (i.e. SPC in activated state) or unavailability (i.e. SPC in deactivated state) of configured SPCs.

The procedures for status monitoring of SPCs may be initiated by management entities in the equipment on either side of the user-network interface that supports SPCs and the un-assured data transfer procedures specified in Annex B/Q.2130 (SSCF at UNI for SPC control).

The procedures comprise of a real time bidirectional query/response transaction between management entities in user equipment and in the network, regarding the operational status of SPCs previously configured.

The high level sequence diagram is shown in Figure III.4.

Although these procedures perform a real time SPC status monitoring function, they are based on a small subset of the Q.2931 protocol and the messages use the protocol discriminator of Q.2931 messages. As such, they constitute higher layer management procedures for monitoring SPCs and provide information that complements the information provided by other management procedures such as OAM F5 flows, etc. They are meant to enable the management entities on the user side and on the side of the service provider to take necessary action.

The status monitoring procedures require that the management entity at the network side of the user-network interface is always aware of the status of the SPCs. The means by which this can be guaranteed (e.g. OAM F5 flow) is outside the scope of this appendix. Furthermore, the establishment and the release of SPCs is outside the scope of this appendix.

III.1 Messages used for SPC status

All messages for SPC monitoring use the SPC call reference. These messages are SPC UPDATE STATUS, SPC UPDATE STATUS ACK, SPC STATUS ENQUIRY and SPC STATUS REPORT. The messages are sent on the virtual channel for SPC control (VCI = 31).

They are sent across the UNI using the un-assured data transfer procedures of Annex B/Q.2130 (definition of SSCF at UNI for SPC control). See Table III.1.

TABLE III.1/Q.2931

Messages used for SPC status

Message	Reference
SPC STATUS REPORT	III.1.1
SPC UPDATE STATUS ACK	III.1.2
SPC STATUS ENQUIRY	III.1.3
SPC UPDATE STATUS	III.1.4

III.1.1 SPC STATUS REPORT message

This message is sent in response to an SPC STATUS ENQUIRY message to indicate the status of one or more SPCs. This message is used only for reporting the availability of the requested existing SPCs. See Table III.2.

TABLE III.2/Q.2931

SPC STATUS REPORT

Message type: SPC STATUS REPORT
Direction: Both
Significance: Local

Information element	Reference	Direction	Type	Length (octets)
Protocol discriminator	4.2	Both	M	1
Call reference (Note 1)	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Transaction number	III.3.1	Both	M	5
SPC report type	III.3.2	Both	M	5
SPC status	III.3.3	Both	O (Note 2)	9-10

NOTES

1 Only the SPC call reference is used.

2 If the SPC report type indicates SPC list, it contains one SPC status information element for each SPC request. If the SPC report type indicates SPC range, it contains SPC status information elements up to 256 for the configured SPCs. In the case of SPC range, the SPC status information elements are arranged in the ascending order of the connection identifier (VPCI/VCI).

III.1.2 SPC UPDATE STATUS ACK message

The SPC UPDATE STATUS ACK message is sent in response to an SPC UPDATE STATUS message to acknowledge the SPC UPDATE STATUS message. See Table III.3.

TABLE III.3/Q.2931

SPC UPDATE STATUS ACK

Message type: SPC UPDATE STATUS ACK
Direction: Both
Significance: Local

Information element	Reference	Direction	Type	Length (octets)
Protocol discriminator	4.2	Both	M	1
Call reference (Note 1)	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Transaction number	III.3.1	Both	M	5
SPC status	III.3.3	Both	O (Note 2)	9-10

NOTES
1 Only the SPC call reference is used.
2 Only included if the status of particular SPC is different from the status report in the SPC UPDATE STATUS message.

III.1.3 SPC STATUS ENQUIRY message

The SPC STATUS ENQUIRY message is sent to request the status of one or more SPCs. Sending an SPC STATUS REPORT message in response to an SPC STATUS ENQUIRY is mandatory. See Table III.4.

III.1.4 SPC UPDATE STATUS message

The SPC UPDATE STATUS message is sent to indicate a change in the status of one or more SPCs. The change of status includes notification of SPC addition or deletion and notification of SPC availability (active) or unavailability (inactive). See Table III.5.

III.2 General information elements

III.2.1 Protocol discriminator

See 4.2.

III.2.2 Call reference

The SPC call reference shall be used. The value of the SPC call reference is all 1. See 4.3.

III.2.3 Message type

See 4.4.

III.2.4 Message length

See 4.4.

III.2.5 Connection identifier

See 4.5.

TABLE III.4/Q.2931

SPC STATUS ENQUIRY

Message type: SPC STATUS ENQUIRY

Direction: Both

Significance: Local

Information element	Reference	Direction	Type	Length (octets)
Protocol discriminator	4.2	Both	M	1
Call reference (Note 1)	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Transaction number	III.3.1	Both	M	5
SPC report type	III.3.2	Both	M	5
Connection identifier	4.5	Both	O	9 (Note 2)

NOTES

1 Only the SPC call reference is used.

2 If the SPC report type indicates SPC list, the connection identifier information element may be repeated to request the status of more than one SPC. If the SPC report type indicates SPC range, the connection identifier information element will indicate the start of the SPC range.

TABLE III.5/Q.2931

SPC UPDATE STATUS

Message type: SPC UPDATE STATUS

Direction: Both

Significance: Local

Information element	Reference	Direction	Type	Length (octets)
Protocol discriminator	4.2	Both	M	1
Call reference (Note 1)	4.3	Both	M	4
Message type	4.4	Both	M	2
Message length	4.4	Both	M	2
Transaction number	III.3.1	Both	M	5
SPC status	III.3.3	Both	M	9-10 (Note 2)

NOTES

1 Only the SPC call reference is used.

2 The SPC STATUS REPORT message contains one or more SPC information elements each of which is 9 or 10 octets long. The SPC UPDATE STATUS message contains one SPC status information element for each SPC that has experienced a status change.

III.3 Other information elements

The following other information element identifiers are used:

– *Information element identifiers*

Bits

8 7 6 5 4 3 2 1

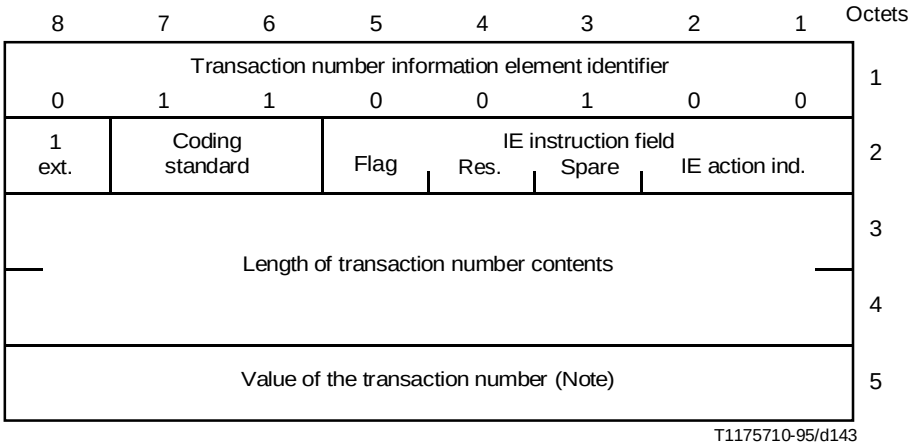
0 1 1 0 0 1 0 0 Transaction Number

0 1 1 0 0 1 0 1 SPC Status

0 1 1 0 0 1 1 0 SPC Report Type

III.3.1 Transaction number

The purpose of the transaction number is to associate a response with a request. Each new SPC STATUS ENQUIRY message or SPC UPDATE STATUS message will have a new transaction number. See Figure III.1.



NOTE – It is suggested that implementations avoid immediate re-use of the transaction number after the transaction is completed. The transaction number is binary encoded.

FIGURE III.1/Q.2931

Transaction number information element

III.3.2 SPC report type

The purpose of the SPC report type information element is to indicate the type of report requested when included in an SPC STATUS ENQUIRY message or to indicate the contents of the SPC STATUS REPORT message. The length of this information element is 5 octets. See Figure III.2.

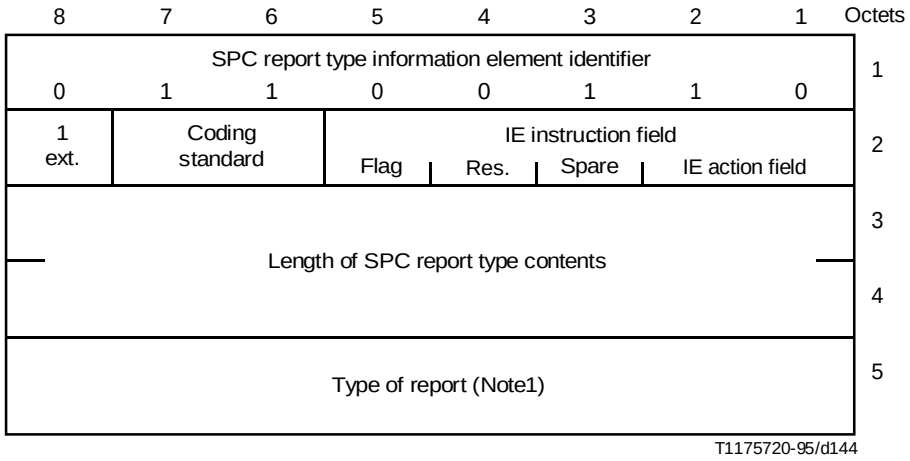
III.3.3 SPC status

The purpose of the SPC status information element is to indicate the status of configured SPCs. This information element can be repeated, as necessary, in a message to indicate the status of two or more SPCs. The maximum length of this information element is 10 octets. See Figure III.3.

A new SPC is one that has been recently configured but for which a status report has not yet been sent across the UNI. A new SPC is indicated by setting the new (N) bit to "1".

An SPC is active if it is operational and it is inactive if it is configured but not available for use. The active (A) bit is set to "1" for an active SPC and set to "0" for an inactive SPC.

An SPC is deleted if it is not configured. The deleted (D) bit is set to indicate the SPC is not configured when it is necessary to explicitly do so as described in III.4.



NOTES

1 Type of report (octet 5):

Bits
8 7 6 5 4 3 2 1
0 0 0 0 0 1 0 0 SPC list
0 0 0 0 0 1 0 1 SPC range (Note 2).

2 In the case of the SPC report type is SPC range, the SPC STATUS REPORT message may contain an order list of the provision SPCs up to a maximum number of 256.

FIGURE III.2/Q.2931

SPC report type information element

III.4 Procedures across the UNI

III.4.1 SAAL procedures

The un-assured mode of the SAAL is used to provide the transport for these signalling procedures. All message used in these procedures are sent in the order they were generated and with the same priority using AAL-UNIT-DATA primitive.

III.4.2 Initial UNI status

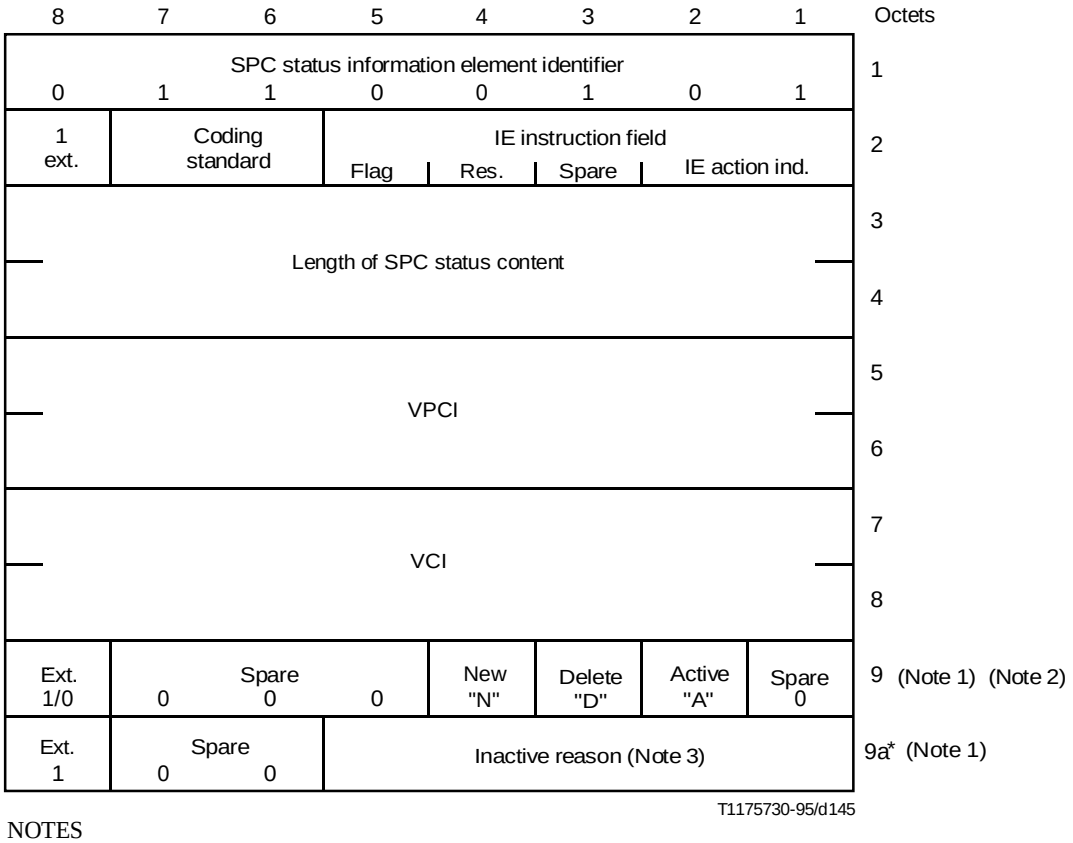
At the time of SAAL initialization, both the user equipment and the network may report the status of all configured SPCs through one or more SPC UPDATE STATUS messages.

While a SAAL is released, no SPC UPDATE STATUS message can be delivered. Therefore, the reporting entity will be unable to clear the “new” status of a newly configured SPC. When the SAAL is restored, the new bit will be set for that SPC in the SPC UPDATE STATUS message that is sent as a result of SAAL restoration. Subclause III.4.5 describes these procedures.

III.4.3 Requesting SPC status

The status of one or more SPCs can be requested at any time. When the SPC report type indicates “SPC list”, a connection identifier information element shall be included for each requested SPC. When the SPC report type indicates “SPC range”, a connection identifier information element shall be included which indicates the start of the range.

The SPC STATUS ENQUIRY message includes a transaction number, which is used to verify that the SPC STATUS ENQUIRY message is acknowledged with a subsequent SPC STATUS REPORT message. When the SPC STATUS ENQUIRY message is sent, timer T393 is started, and retry counter N394 is set to “1”. When an SPC STATUS REPORT message is received, the transaction number is verified. If the transaction number matches the transaction number of the last transmitted SPC STATUS ENQUIRY message, timer T393 is stopped, and the status of each reported SPC may be updated. If the transaction number does not match the transaction number of the last transmitted SPC STATUS ENQUIRY message, the SPC STATUS REPORT message is discarded.



NOTES

1 If the active bit is set to "0", then octet 9a will be included.

– *VPCI (octets 5 and 6)* See 4.5.

– *VCI (octets 7 and 8)* See 4.5.

– *New "N" (octet9*)

Bit
4
0 SPC is already present.
1 SPC is new.

– *Delete "D" (octet 9)*

Bit
3
0 SPC is configured.
1 SPC is deleted.

2 When this bits is set to "1", the new and active bits have no significance and should be set to "0". The delete bit is set to "0" when the new or active bits have significance and are set to "1".

– *Active "A" (octet 9)*

Bit
2
0 SPC is inactive.
1 SPC is active.

3 The reporting entity sets this bit to "0" when it determines that the SPC is not operational.

– *Inactive reason (octet 9a)*

The inactive reason field is used to indicate why an SPC has become inactive. Coding for this field is as follows:

Bits
5 4 3 2 1
0 0 0 0 0 SPC inactive in adjacent network.
0 0 1 0 0 SPC deleted in adjacent network.
0 1 0 0 1 Interface inactive to adjacent network or user.
0 1 0 1 0 SPC non-operational in the network.
0 1 0 1 1 SPC inactive at UNI.
0 1 1 0 0 SPC deleted in this network.
All other values are reserved.

FIGURE III.3/Q.2931

SPC status information element

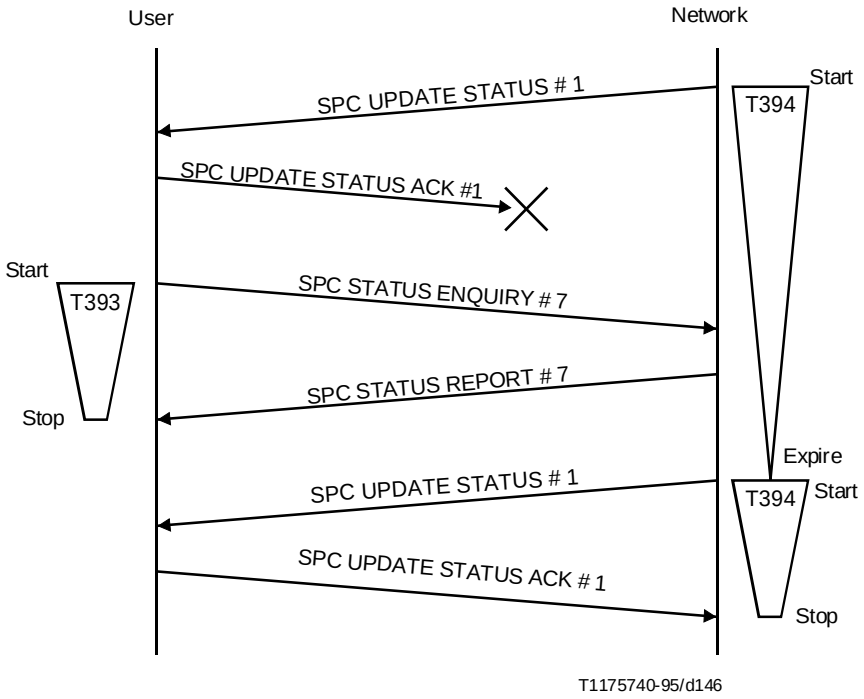


FIGURE III.4/Q.2931

Independent processing of SPC UPDATE STATUS versus SPC STATUS REPORT messages

If timer T393 expires before the receipt of an SPC STATUS REPORT message with the correct transaction number, and the maximum retry count has not been exceeded, then the same SPC STATUS ENQUIRY message with the same transaction number may be retransmitted. If the message is retransmitted, timer T393 is restarted, and retry counter N394 is incremented.

If the maximum retry count has been exceeded (check before retransmission), SAAL (the link) shall be considered to be inactive.

These procedures assume that only one SPC STATUS ENQUIRY message may be outstanding at any time.

III.4.4 Reporting SPC status

When an SPC STATUS ENQUIRY message is received, an SPC STATUS REPORT message is sent which reports the current status of the requested SPCs. The SPC report type and transaction number contained in the SPC STATUS ENQUIRY message will be included.

If the SPC report type indicates “SPC range”, the SPC STATUS REPORT message contains an order list of the provision SPCs up to maximum number of 256.

One SPC status information element is included for each requested SPCs. An SPC STATUS REPORT message shall not contain more than one SPC status information element for a given SPC. The receiving entity is not required to check for duplicate SPC status information elements.

If the SPC STATUS ENQUIRY message requests the status of an SPC that is not configured within the SPC list (SPC report type equal to SPC list), the receiving entity shall respond with an SPC STATUS REPORT message that contains a corresponding SPC status information element with the D bit set to “1”.

Use of the above reporting procedures will not clear a status of ‘new’ for any SPC.

III.4.5 Reporting asynchronous status

When the status of one or more SPC has changed (i.e. active, inactive, or deleted), or when an SPC is initially configured, an SPC UPDATE STATUS message is sent. Also, the reporting of all configured SPCs is necessary during SAAL initialization.

SPC status information elements shall be ordered in the sequence in which the events they report were detected. The grouping of SPC status information elements into SPC UPDATE STATUS message is implementation option to send the single or group (up to 256) of SPC status information element in SPC UPDATE STATUS message. Therefore, it is possible for two or more SPC status information elements in an SPC UPDATE STATUS message to specify the same SPC. The support of receiving SPC UPDATE STATUS message with a single or multiple SPC status information element is mandatory.

An SPC UPDATE STATUS message shall not include SPC status information elements for SPCs whose status has not changed.

The SPC UPDATE STATUS message includes a transaction number, which is used to verify that the SPC UPDATE message is acknowledged with a subsequent SPC UPDATE STATUS ACK message. When the SPC UPDATE STATUS message is sent, timer T394 is started and retry counter N395 is set to "1". When an SPC UPDATE STATUS ACK message is received, the transaction number is verified. If the transaction number matches the transaction number of the last transmitted SPC UPDATE STATUS message, timer T394 is stopped, and the status of each reported SPC shall be updated. If the transaction number does not match the transaction number of the last transmitted SPC UPDATE STATUS message, the SPC UPDATE STATUS ACK message is discarded.

If timer T394 expires before the receipt of an SPC UPDATE STATUS ACK message with the correct transaction number, and the maximum retry count has not been exceeded, the same SPC UPDATE STATUS message with the same transaction number shall be retransmitted. If the message is retransmitted, timer T394 is started, and retry counter N395 is incremented.

If the maximum retry count has been exceeded (check before transmission), SAAL (the link) shall be considered to be inactive.

III.4.5.1 Reporting new SPCs

One of the functions of the SPC UPDATE STATUS message is to notify the receiving entity of the newly configured SPCs. An SPC must be deleted by the SPC management entity before another SPC is added with the same VPCI/VCI. The procedures are as follows:

- When a new SPC has been added, the reporting entity sends an SPC UPDATE STATUS message with the 'new' (N) bit in the status information element set to "1".
- When a SPC is newly configured, its initial status may be inactive or active. This is indicated in the initial status report.

The 'new' status of an SPC will not be cleared until the SPC UPDATE STATUS message reporting the 'new' status has been acknowledged.

III.4.5.2 Reporting the availability of SPCs

One of the functions of the SPC UPDATE STATUS message is to indicate the changes in status of configured SPCs. The SPC UPDATE STATUS message is sent whenever the status of an SPC changes. The changed status, inactive or active, is indicated by setting the 'active' (A) bit to "0" or "1" respectively.

Since there is a delay between the time an SPC becomes active and the time the SPC's change in status is received by the other entity, a receiving entity may receive cells for an inactive SPC. The action of the user equipment at the UNI is implementation dependent. The action the network takes is also implementation dependent and may include discarding of received cells.

If the network receives an SPC UPDATE STATUS message for an SPC which is not configured, there are two cases. If the 'delete' (D) bit is 0, then the network sends an SPC UPDATE STATUS message with the 'delete' (D) bit set to "1". Otherwise, no action concerning the status is required.

III.4.5.3 Reporting deleted SPCs

To indicate that a SPC has been deleted, an SPC UPDATE STATUS message is sent with the 'delete' (D) bit set to "1" for the affected SPC. The 'deleted' status in one direction is independent of the 'deleted' status in the other direction.

When an entity receives an SPC UPDATE STATUS message with 'delete' (D) bit set to "1", and the corresponding SPC is present, an inactive status may be propagated toward the remote user. Otherwise, no action concerning the status is required.

III.4.6 Acknowledgement of SPC UPDATE STATUS message

When an SPC UPDATE STATUS message is received, an SPC UPDATE STATUS ACK message shall be sent with the same transaction number that was indicated in the received SPC UPDATE STATUS message.

III.4.7 ATM OAM flow 5 procedures

On the ATM connection used for these SPC status procedures, the OAM F5 fault and performance monitoring management procedures (see Recommendation I.610) can be used. The F5 fault management procedures provide detection and verification of the availability of the ATM connection.

III.5 Error conditions

III.5.1 UNI procedures for operational errors

The reporting entity at the UNI shall report an SPC as inactive if it detects a service affecting condition.

III.5.2 Signalling protocol errors

Layer 3 status signalling protocol errors are handled according to procedures defined in 5.6 and 5.7 (i.e. protocol discriminator, message type, message length, call reference and mandatory information element errors).

III.5.3 UNI failure

When the network detects that the UNI is inoperative, it notifies users of the SPCs that the SPCs are inactive.

III.5.4 Network response to SPC status change

When the network determines that the status of a SPC has changed, either because of a network failure or repair or because it has received a SPC UPDATE STATUS message from the user specifying a status change for the SPC, the SPC status change may be propagated toward the remote user.

If the network element at the UNI receives an indication from the remote interface that a SPC's status has changed, it reports this across the UNI to the user.

III.6 System timers

See Table III.6.

III.7 System parameters

See Table III.7.

TABLE III.6/Q.2931

System timers

Timer	Description	Range (seconds)	Default (seconds)	Cause for started	Cause for normal stop	Action at the expire	Implemen-tation	Reference
T393	SPC STATUS ENQUIRY timer	5-30	10	SPC STATUS ENQUIRY sent	SPC STATUS REPORT received	The same SPC STATUS ENQUIRY is retransmitted and N394 is incremented	Mandatory	III.4.3
T394	SPC UPDATE STATUS timer	5-30	10	SPC UPDATE STATUS sent	SPC UPDATE STATUS ACK received	The same SPC UPDATE STATUS is retransmitted and N395 is incremented	Mandatory	III.4.5

TABLE III.7/Q.2931

System parameters

Parameter	Description	Default value	Action at the expire	Implementation	Reference
N394	Maximum value of retry counter N394 for SPC STATUS ENQUIRY/REPORT procedures	3	Considered to be inactive	Mandatory	III.4.3
N395	Maximum value of retry counter N395 for SPC UPDATE STATUS/ACK procedures	3	Considered to be inactive	Mandatory	III.4.5