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SERIES Q: SWITCHING AND SIGNALLING

Broadband ISDN – B-ISDN application protocols for access signalling

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Digital Subscriber Signalling System No. 2 – Generic functional protocol:

Core functions

ITU-T Recommendation Q.2932.1

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION Q.2932.1

DIGITAL SUBSCRIBER SIGNALLING SYSTEM NO. 2 – GENERIC FUNCTIONAL PROTOCOL: CORE FUNCTIONS

Summary

This Recommendation defines the operation of the Digital Subscriber Signalling System Number 2 (DSS 2) for Generic Functional Protocol core functions at the T_B or at the coincident S_B and T_B reference point of the User to Network Interface of the Broadband-Integrated Services Digital Network (B-ISDN). The Generic Functional Protocol core functions defined in this Recommendation provide a means of exchanging ROSE components on behalf of signalling application in peer entities. These signalling applications may either be for the support of supplementary services or provide protocol support for the other features (such as Look Ahead, Status request, Local/remote interrogation), in association with existing calls and bearers (bearer related signalling), or independently of existing bearers (connection-oriented or connectionless bearer independent signalling).

Source

ITU-T Recommendation Q.2932.1 was prepared by ITU-T Study Group 11 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 9th of July 1996.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

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).

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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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Recommendation Q.2932.1

DIGITAL SUBSCRIBER SIGNALLING SYSTEM No. 2 – GENERIC FUNCTIONAL PROTOCOL: CORE FUNCTIONS

(Geneva, 1996)

1 Scope

This Recommendation specifies the functional protocol for the Broadband Integrated Services Digital Network (B-ISDN), using local information exchange, for the application to a range of additional basic call capabilities and supplementary services at the T_B reference point or coincident S_B and T_B reference point (as defined in Recommendation I.413 [1] by means of the Digital Subscriber Signalling System No. 2 (DSS 2) protocol.

The functional protocol is based on the use of the Facility information element.

To be functional, this protocol requires knowledge of the additional basic call capabilities and supplementary services supported by the user equipment. This facilitates user equipment operation without human intervention by defining the semantics for the protocol elements which user equipment can process on its own.

The procedures specified in this Recommendation can be used for:

– activation and deactivation;

– invocation and operation;

– interrogation;

– status request; and

– status notification;

of additional basic call capabilities and supplementary services in association with existing calls or outside any existing call.

The application of this Recommendation to individual additional basic call capabilities and supplementary services is outside the scope of this Recommendation and is defined in those Recommendations which specify the individual capabilities.

Further parts of this Recommendation cover the capabilities for non-local addressing within the generic functional protocol.

All conformance to this Recommendation is based on the external behaviour at the interface at the T_B or coincident S_B and T_B reference point, i.e. on the generation of the correct message structure and in the proper sequence as specified in this Recommendation.

Further part(s) of this Recommendation specify the method of testing required to identify conformance to this Recommendation.

This Recommendation is applicable to equipment, supporting additional basic call capabilities and supplementary services using the functional protocol, to be attached at either side of a T_B reference point or coincident S_B and T_B reference point when used as an access to the public ISDN.

2 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 addition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1] ITU-T Recommendation I.413 (1993), *B-ISDN user-network interface.*

[2] CCITT Recommendation X.229 (1988), *Remote operations: Protocol specification.*

[3] CCITT Recommendation X.219 (1988), *Remote operations: Model, notation and service definition*.

[4] CCITT Recommendation Q.9 (1988), *Vocabulary of switching and signalling terms*.

[5] ITU-T Recommendation I.112 (1993), *Vocabulary of terms for ISDNs*.

[6] CCITT Recommendation X.208 (1988), *Specification of Abstract Syntax Notation One (ASN.1).*

[7] CCITT Recommendation X.209 (1988), *Specification of basic encoding rules for Abstract Syntax Notation One (ASN.1).*

[8] ITU-T Recommendation X.680 (1994), *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation.*

[9] ITU-T Recommendation X.690 (1994), *Information technology – ASN.1 encoding rules; Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER).*

[10] CCITT Recommendation I.210 (1988), *Principles of telecommunication services supported by an ISDN and the means to describe them.*

[11] ITU-T Recommendation Q.2951.2 (1995*); Stage 3 description for number identification supplementary services using B-ISDN Digital Subscriber Signalling System No. 2 (DSS 2) – Basic call: Multiple Subscriber Number (MSN).*

[12] ITU-T Recommendation Q.2951.8 (1995), *Stage 3 description for number identification supplementary services using B-ISDN; Digital Subscriber Signalling System No. 2 (DSS 2) – Basic call: Sub-addressing (SUB).*

[13] ITU-T Recommendation Q.2931 (1995), *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.*

[14] ITU-T Recommendation Q.2971 (1995), *Broadband Integrated Services Digital Network (B-ISDN) – Digital Subscriber Signalling System No. 2 (DSS 2) – User-network interface layer 3 specification for point-to-multipoint call/connection control*.

[15] ITU-T Recommendation Q.2130 (1994), *B-ISDN ATM Adaptation layer-Service Specific Coordination Function (SSCF) for support of signalling at the User Network Interface (SSCF at UNI).*

[16] ITU-T Recommendation Z.100 (1993), *CCITT Specification and Description Language (SDL).*

[17] ITU-T Recommendation X.880 (1994), *Information technology – Remote operations: Concepts, model and notation*.

3 Definitions

This Recommendation makes use of the following terms defined in Recommendation X.219 [3]:

– remote operation;

– operation;

– operation classes (class 1 to class 5);

– association (initiator; responder);

– invoking (application entity; invoker).

For the purposes of this Recommendation, the following definitions apply:

3.1 application protocol data unit (APDU); component: Data structure as defined in A.1. The term component that appears in Recommendations defining DSS 1 has an identical meaning.

3.2 bearer-independent control message: A message as defined in 8.1.3, which on sending or receipt causes a change of the call/connection state at either the network or the user.

3.3 bearer-related transport mechanism: A procedure tied to the procedures for basic call control and tied to a connection in progress, active or in the clearing phase. The call reference used by the basic call control procedure is adopted by the bearer-related service invocations to correlate with the appropriate basic call control transaction.

3.4 bearer-independent transport mechanism: A procedure independent of the procedures for basic call control and not correlated to a connection.

3.5 call/connection control message: A message as defined in 3.1/Q.2931 [13], which on sending or receipt causes a change of the call/connection state at either the network or the user. For a call that interworks with the Narrow-band ISDN (N-ISDN), a message as defined in 3.1/Q.2931 or 3.2/Q.2931 [13] which on sending or receipt causes a change of the call/connection state at either the network or the user. In this case, call/connection control messages also include the INFORMATION message and PROGRESS message.

3.6 call reference: (Excluding dummy call reference) an identifier of a signalling transaction. The signalling transaction may either be bearer related, in which case the signalling transaction can be used to control that bearer, or bearer independent, in which case there is no bearer associated with that signalling transaction. Where there is only one bearer required for a call, then the call reference of the associated bearer-related signalling transaction may be used to identify the call.

3.7 call/connection state: A state as defined in 2.1/Q.2931 [13] for either the user or the network as appropriate. For a call that interworks with the N-ISDN, a state as defined in 2.1/Q.2931 or 2.2/Q.2931 [13] for either the user or the network as appropriate. A call/connection state may exist for each call reference value [and for each additional responding Connection Endpoint Identifier (CEI) in the incoming call/connection states].

3.8 call: See 2.2/Q.9 [4], definition 2201.

3.9 connection: See clause 0/Q.9 [4] definition 0011. In this Recommendation, the use of this term is taken to include a bearer and its associated control signalling.

3.10 connection-oriented transport mechanism: A mechanism requiring the establishment of a signalling AAL connection and a transport association between the service requesting entity and the

service provider. It provides a facility to access remote operations where success and/or failure reporting is required. It provides a call reference within the transport association as a means to associate uniquely among the related transport messages.

3.11 connectionless transport mechanism: A mechanism where no transport association exists but a single transport message transfer is provided using the dummy call reference.

3.12 dummy call reference: A null value indicating that the message is not applicable to an identified signalling transaction. Other rules specify the association of DSS 2 protocol entities.

3.13 functional protocol: A functional protocol consists of a sequence of functional information elements. A functional information element requires a degree of intelligent processing by a terminal in either generation or analysis.

3.14 incoming network: An incoming transport entity that is also a network, i.e. DSS 2 protocol entity at the network side of the interface. For bearer-related transport, the incoming network is also the destination network.

3.15 incoming transport entity: An entity that responds to a peer entity initiating a transport mechanism.

3.16 incoming user: An incoming transport entity that is also a user, i.e. DSS 2 protocol entity at the user side of the interface. For bearer-related transport, the incoming user is also the destination user.

3.17 initiator: An entity (user or network) requesting establishment of a signalling connection between an initiator and the responder.

3.18 integrated Services Digital Network (ISDN): See 2.3/I.112 [5], definition 308.

3.19 invoke APDU: See 9.4.2.1. Where reference is made to an "xxxx" invoke APDU, an invoke APDU is meant with its operation value set to the value of the operation "xxxx".

3.20 local information exchange: The exchange of generic functional data between ROSE or other ASEs which are located in the DSS 2 entities at either side of the access.

3.21 network: The DSS 2 protocol entity at the network side of the user-network interface.

3.22 non-local information exchange: The exchange of generic functional data between ROSE or other ASEs for which one, or other, or both, are not located in the DSS 2 entities at either side of the access.

3.23 outgoing network: An outgoing transport entity that is also a network, i.e. DSS 2 protocol entity at the network side of the interface. For bearer-related transport, the outgoing network is also the originating network.

3.24 outgoing transport entity: An entity that initiates a transport mechanism.

3.25 outgoing user: An outgoing transport entity that is also a user, i.e. DSS 2 protocol entity at the user side of the interface. For bearer-related transport, the outgoing user is also the originating user.

3.26 party control message: A message as defined in 8.1.2/Q.2971 [14], which on sending or receipt causes a change in party state at either the network or the user.

3.27 party state: States for each party in the call (see 7.2.1/Q.2971 [14]) which are known at the interface.

3.28 responder: The entity (user or network) responding to a request from an initiator on establishing a signalling connection.

3.29 return result APDU: See 9.4.2.2. Where reference is made to an "xxxx" return result APDU, a return result APDU is meant which is related to an "xxxx" invoke APDU.

3.30 return error APDU: See 9.4.2.3. Where reference is made to an "xxxx" return error APDU, a return error APDU is meant which is related to an "xxxx" invoke APDU.

3.31 reject APDU: See 9.4.2.4.

3.32 signalling AAL connection endpoint identifier; connection endpoint identifier (CEI): Identifier used by a layer 3 protocol entity to address its peer entity.

3.33 signalling connection: An association of DSS 2 protocol entities using the bearer-independent procedure with the connection-oriented transport mechanism.

3.34 supplementary service: See 2.4/I.210 [10].

3.35 user: The DSS 2 protocol entity at the user side of the user-network interface.

4 Abbreviations

For the purposes of this Recommendation, the following abbreviations are used:

APDU	Application Protocol Data Unit
AS-Control	Application Service Control
ATM	Asynchronous Transfer Mode
BER	Basic Encoding Rules
B-ISDN	Broadband Integrated Services Digital Network
BR	Bearer Related
CL-BI	Connectionless Bearer Independent
CO-BI	Connection-Oriented Bearer Independent
DSS 1	Digital Subscriber Signalling System No. 1
DSS 2	Digital Subscriber Signalling System No. 2
GFT-Control	Generic Functional Transport Control
N-ISDN	Narrow-band Integrated Services Digital Network
NNI	Network Node Interface
ROSE	Remote Operations Service Element
SAAL	Signalling ATM Adaptation Layer
UNI	User-Network Interface

5 Description

5.1 Overview

The generic functional protocol provides a means of exchanging ROSE APDU on behalf of signalling applications in peer entities. These signalling applications may either be for the support of supplementary services, or provide protocol for the support of other functionality (e.g. look ahead). This exchange may take place either in association with a bearer established using DSS 2 procedures, or may be carried independently of any bearer.

The exchange of ROSE APDU between signalling applications may be local or non-local to the user-network interface.

5.1.1 Local information exchange

If the exchange of information is local (i.e. one signalling application exists at the network and the peer signalling application exists at the user), no addressing information is required, unless there is a need to select from multiple signalling entities at the user side of the interface, e.g. as in the multiple subscriber number supplementary service.

The exchange of information may be using any of:

a) bearer-related transport;

b) connectionless bearer-independent transport;

c) connection-oriented bearer-independent transport.

This does not preclude a local exchange of information being used for the support of a signalling application on a more global basis; usage in this form is dependent on the specification of the individual signalling application itself. The exchange is local between a signalling application in the local network and a signalling application in the local user. As a result of receiving these APDUs, the signalling application in the local network may establish a signalling association with other signalling applications eventually incorporating the remote user.

Non-local information exchange is outside the scope of this part of this Recommendation. Requirements for non-local information exchange will be covered in other parts of this Recommendation.

5.1.2 Non-local information exchange

If the exchange of information is non-local, then addressing information is required. This addressing information may be provided by using a value associated with a particular abstract functionality, or by explicitly using an ISDN number to identify the signalling endpoint. This non-local exchange could be entirely within the DSS 2 protocol (i.e. across a single exchange between two user-network interfaces). A more common occurrence will be to map this mechanism in DSS 2 into equivalent functionality within either broadband private network signalling protocols, or into TCAP protocol associated with the broadband NNI protocol.

5.2 Protocol architecture

Figure 1 shows the conceptual model for the generic functional protocol and its relation to the basic call model defined in Recommendation Q.2931 [13].

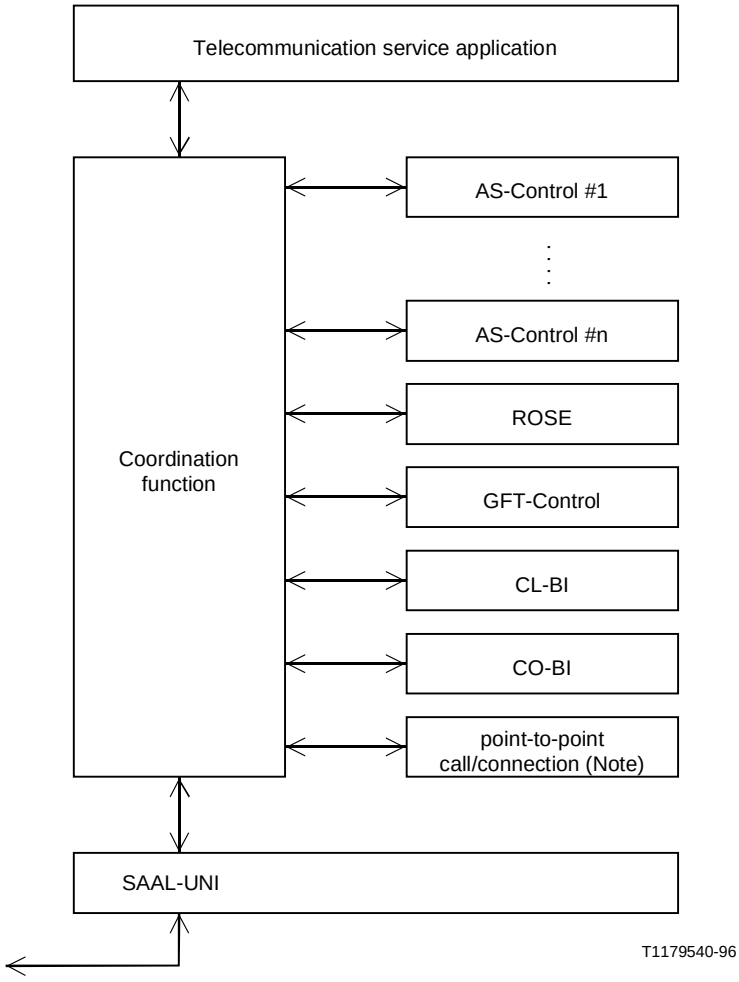
At the top layer (the signalling application layer) the actual supplementary service protocol, or other signalling application protocol, operates between peer Application Service Control (AS-Control)

entities which are service specific. The operation of specific AS-Control entities is beyond the scope of this Recommendation.

AS-Control entities use the services of the Remote Operations Service Element (ROSE) via the coordination function. These entities use the services of the Generic Functional Transport Control (GFT-Control) via the coordination function.

The coordination function provides coordination between GFT-Control (and the individual transport functions controlled by GFT-Control), the various AS-Control entities and ROSE, in addition to the functions performed for basic call.

The provision and application of this model is for the purpose of description within this Recommendation, and is expected only to constrain implementations in terms of provision of the protocol on the access. Implementations are free to use any internal architecture providing the requirements of the protocol are met.



NOTE – Call/connection control is included for the transport of bearer-related information. Although only the point-to-point call/connection control described in Recommendation Q.2931 [13] is shown, the point-to-multipoint call/connection control described in Recommendation Q.2971 [14] is also applicable.

FIGURE 1/Q.2932.1

DSS 2 protocol model, including additions for generic functional protocol

5.3 Application of the protocol model to local information exchange

Figure 1 shows an example of the flow of information in the protocol model for the case where the signalling applications to be associated in communication are in adjacent nodes, e.g. between a DSS 2 user and a DSS 2 network using the CO-BI transport mechanism. Other transport mechanisms could be used as described in 5.1.1.

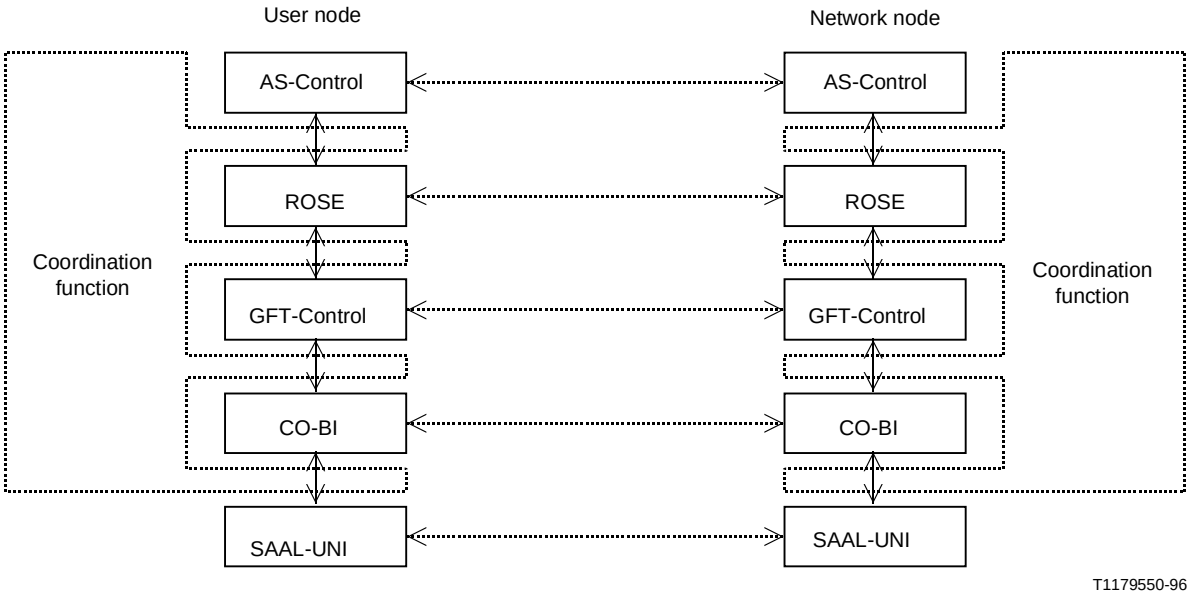


FIGURE 2/Q.2932.1

Application of the protocol mode to local information exchange

5.4 Services provided by individual protocol entities

5.4.1 Services provided by ROSE

ROSE provides a set of services to AS-Control to support the ROSE protocol. These services are specified in Recommendation X.219 [3].

5.4.2 Services provided by GFT-control

This entity provides the following services to AS-Control and ROSE via the coordination function:

a) *Bearer-related service*

- GFT-Setup: request for the transfer of data in the bearer establishment phase. This service is a confirmed service;
- GFT-Release: request for the transfer of data in the bearer release phase. This service is a confirmed service;
- GFT-Reject: rejection of the ability to use a transport mechanism. This service is an unconfirmed service;
- GFT-Data: request for the transfer of data in active phase of a bearer. This service is an unconfirmed service.

b) *Connectionless bearer-independent service*

– GFT-Unit Data: request for the transfer of data. This service is an unconfirmed service.

c) *Connection-oriented bearer-independent service*

– GFT-Setup: request for the establishment of a bearer-independent signalling association (with data transfer if required). This service is a confirmed service;

– GFT-Release: request for the release of a bearer-independent signalling association (with data transfer if required). This service is a confirmed service;

– GFT-Reject: rejection of the ability to use a transport mechanism. This service is an unconfirmed service;

– GFT-Data: request for the transfer of data in active phase of a bearer-independent signalling association. This service is an unconfirmed service.

5.4.3 Services provided by bearer-related transport

Any of the bearer-related procedures specified in Recommendations Q.2931 [13] and Q.2971 [14] can be used for bearer-related protocol control. As multiconnection protocol provides the bearer control using the procedures of Recommendation Q.2931 [13], no extra services are required for transport in relation to multiconnection calls. The services provided by these entities are specified in those. In addition, these services provide one additional service:

– BR-Data: this service is an unconfirmed service.

A notification service is already provided within Recommendations Q.2931 [13] and Q.2971 [14].

5.4.4 Services provided by connectionless bearer-independent transport

Connectionless bearer-independent transport provides the following services to GFT-Control via the coordination function:

– CL-BI-Unit Data: This service is an unconfirmed service.

5.4.5 Services provided by connection-oriented bearer-independent transport

Connection-oriented bearer-independent transport provides the following services to GFT-Control via the coordination function:

– CO-BI-Setup: this service is a confirmed service;

– CO-BI-Release: this service is a confirmed service;

– CO-BI-Reject: this service is an unconfirmed service;

– CO-BI-Data: this service is an unconfirmed service.

In addition, connection-oriented bearer-independent transport also supports a notification data transfer service as follows:

– CO-BI-Notification: this service is an unconfirmed service.

6 Operational requirements

6.1 Provision and withdrawal

There are no direct requirements for provision and withdrawal of capabilities within this Recommendation. Provision and withdrawal of applications using this Recommendation are specified in the Recommendations describing those applications.

Support of options within this Recommendation is conditioned by Recommendations defining the use of this Recommendation. However, in particular:

– support of each individual transport mechanism is optional, although at least one transport mechanism shall be supported;
– support of the requirements as presented by GFT-Control and as described in 9.3 is mandatory, although support of procedures associated with individual protocol profile values within the Facility information element is optional, and at least one value of protocol profile shall be supported;
– if the value of protocol profile "ROSE" is supported, then the procedures relating to ROSE shall also be supported;
– support of the use of the Called party number information element within the bearer-independent transport mechanisms is dependent on the support of the multiple subscriber number supplementary service;
– support of the use of the Called party subaddress information element within the bearer-independent transport mechanisms is dependent on the support of the subaddressing supplementary service;
– support of the use of the Calling party number information element within the bearer-independent transport mechanisms is dependent on the support of the multiple subscriber number supplementary service.

6.2 Requirements on the originating network side

The requirements for provision of capabilities of this Recommendation are dependent on applications using this Recommendation. Capabilities in this Recommendation are therefore network and user options, but may become mandatory according to the requirements of other Recommendations.

6.3 Requirements on the destination network side

The requirements for provision of capabilities of this Recommendation are dependent on applications using this Recommendation. Capabilities in this Recommendation are therefore network and user options, but may become mandatory according to the requirements of other Recommendations.

7 Primitive definitions and state definitions

7.1 Primitive definitions

The following primitives are used as defined in 8.2/Q.2931 [13] subclause 8.2:

– AAL_ESTABLISH.request;
– AAL_ESTABLISH.indication;
– AAL_ESTABLISH.confirm;
– AAL_RELEASE.request;
– AAL_RELEASE.indication;
– AAL_RELEASE.confirm;
– AAL_DATA.request;
– AAL_DATA.indication.

All primitives use the AAL connection endpoint identifier to identify a particular signalling AAL connection.

The following additional primitives are described for internal use within this Recommendation, in particular in order to describe the relationship between entities within the SDL specification:

a) between AS-Control and the coordination function:

NOTE 1 – These primitives are dependent entirely on those defined in other Recommendations for the supplementary services or additional capabilities, but will reflect the requirements of ROSE and the need for notification from the transport mechanisms.

b) between ROSE and the coordination function:

NOTE 2 – These primitives are defined in Recommendations X.219 [3] and X.880 [17].

c) between GFT-Control and the coordination function:

– signalroute CD_to_GF:

GF_Data.request;

BR_Data.indication;

CO_BI_Data.indication;

CL_BI_Unit_Data.indication;

NOTE 3 – In addition, the following primitives are dealt with by GFT-Control in order to manage the CO-BI transport mechanism but not explicitly described in the SDL: CO_BI_Setup.indication; CO_BI Proceeding.indication; CO_BI_Setup.confirm; CO_BI_Release.indication; CO_BI_Release.confirm.

– signalroute GF_to_CD:

GF_Data.indication;

BR_Data.request;

CO_BI_Data.request;

CL_BI_Unit_Data.request;

NOTE 4 – In addition, the following primitives are dealt with by GFT-Control in order to manage the CO-BI transport mechanism but not explicitly described in the SDL: CO_BI_Setup.request; CO_BI_Proceeding.request; CO_BI_Setup.response; CO_BI_Release.request.

d) between the connection-oriented bearer-independent transport mechanism (CO-bearer_independent) and the coordination function:

– signalroute CO_to_CD:

CO_BI_Setup.indication;

CO_BI_Proceeding.request;

CO_BI_Setup.confirm;

CO_BI_Data indication;

CO_BI_Notify.indication;

CO_BI_Release.indication;

CO_BI_Release.confirm;

Link_Release.indication;

Link_Establish.error;

Link_Establish.indication;

Link_Establish.confirm;

– signalroute CD_to_CO:

CO_BI_Setup.request;

CO_BI_Proceeding.indication;

CO_BI_Setup.response;

CO_BI_Data.request;

CO_BI_Notify.request;

CO_BI_Release.request;

Link_Establish.request;

e) between the connectionless bearer-independent transport mechanism (CL-bearer_independent) and the coordination function:

– signalroute CD_to_CL:

CL_BI_Unit_Data.request;

– signalroute CL_to_CD:

CL_BI_Unit_Data.indication;

f) between the bearer-related transport mechanism (Q.2931_U) and the coordination function (in addition to those defined in Recommendations Q.2931 [13] and Q.2971 [14]):

– signalroute CD_to_QU:

BR_Data.request;

– signalroute QU_to_CD:

BR_Data.indication;

g) between the bearer-related transport mechanism (Q.2931_N) and the coordination function (in addition to those defined in Recommendations Q.2931 [13] and Q.2971 [14]):

– signalroute CD_to_QN:

BR_Data.request;

– signalroute QN_to_CD:

BR_Data.indication.

7.2 State definitions

7.2.1 APDU transport mechanisms

7.2.1.1 Bearer-related transport mechanism

There are no additional call/connection states over and above those defined in Recommendation Q.2931 [13] or Recommendation Q.2971 [14].

7.2.1.2 Connectionless bearer-independent transport mechanism

This subclause defines the connectionless bearer-independent states for the B-ISDN generic functional protocol. The states are identical for the network and the user.

7.2.1.2.1 Null (0) (U0) (N0)

A request for service has been received from GFT-Control, or a transport request has been received from the peer entity, but this request has not yet been acted upon.

This state is defined for the purpose of the SDL defined in clause 13 and does not have any direct coding impact in the protocol.

7.2.1.3 Connection-oriented bearer-independent transport mechanism

This subclause defines the connection-oriented bearer-independent states for the B-ISDN generic functional protocol. The states are identical for the network and the user.

7.2.1.3.1 Null (0) (U0) (N0)

An establishment request for service has been received from GFT-Control, or an establishment request has been received from the peer-entity, but this request has not yet been acted upon.

NOTE – This state will also be used by the coordination process in the absence of the CO-BI process indicated by the call reference.

7.2.1.3.2 Call Initiated (1) (U1) (N1)

This state exists for an outgoing transport establishment request when GFT-Control requests transport establishment from the peer entity.

7.2.1.3.3 Outgoing call proceeding (3) (U3) (N3)

This state exists for an outgoing transport establishment request when the transport entity has received acknowledgement that the peer entity has received all information necessary to effect transport establishment.

7.2.1.3.4 Call Present (6) (U6) (N6)

This state exists for an incoming transport establishment request where the transport entity has not yet sent acknowledgement that GFT-Control has received all the information necessary to effect transport establishment.

7.2.1.3.5 Incoming call proceeding (9) (U9) (N9)

This state exists for an incoming transport establishment request when the transport entity has sent acknowledgement that GFT-Control has received all information necessary to effect transport establishment.

7.2.1.3.6 Active (10) (U10) (N10)

This state exists for an incoming transport establishment request when the transport entity has sent an acknowledgement to the peer entity that the information transfer has been awarded. This state exists for an outgoing transport establishment request when the transport entity has received an indication that the remote entity has agreed to the information transfer.

7.2.1.3.7 Release Request (11) (U11) (N11)

This state exists when the transport entity has requested the peer entity to clear the transport and is waiting for a response.

7.2.2 GFT-Control

The following state is defined for the purposes of the Specification and Description Language (SDL) defined in clause 13, and does not have any direct coding impact on the protocol:

– Pending: GFT-Control has been activated and is in a state ready to process APDUs.

8 Coding requirements

8.1 Message functional definitions and content

This subclause shall be read in conjunction with clause 3/Q.2931 [13]. All messages are additional to those defined in that clause and the following tables should be interpreted according to the introductory material of clause 3/Q.2931 [13].

In the following subclauses the key as described below applies to the "Reference" column.

Key: Q.2931/nn: reference to subclause nn in Recommendation Q.2931 [13];

Q.2932.1/nn: reference to subclause nn in this Recommendation.

To determine if an information element specified in this Recommendation is allowed to be included in the following messages, see 8.2.

Information elements not defined in 8.2 are only allowed to be included in the following messages when explicitly indicated in the message structure.

8.1.1 Additional messages for bearer-related transactions

In addition to the message structures defined below, the Facility information element may also be included in any call/connection control message or party control message, as defined in 8.2.2.2.

8.1.1.1 FACILITY

This message may be sent by the network or the user to control a supplementary service or additional basic call capability. The supplementary service or additional basic call capability to be invoked, and its associated parameters, are specified in the Facility information element. The structure of the FACILITY message is shown in Table 1.

TABLE 1/Q.2932.1

FACILITY message content

Message type: FACILITY
Significance: local (Note 1)
Direction: both

Information element	Reference	Direction	Type	Length
Protocol discriminator	Q.2931/4.2	Both	M	1
Call reference (Note 2)	Q.2931/4.3	Both	M	4
Message type	Q.2932.1/8.2.1	Both	M	2
Message length	Q.2931/4.4	Both	M	2
Facility	Q.2932.1/8.2.2.2	Both	M (Note 4)	10-*
Notification indicator	Q.2931/4.5.23	Both	O (Note 3)	4-*

NOTES

1 – This message has local significance; however it may carry information of global significance.

2 – For bearer-related transport, the value of the call reference used is the call reference of the call/connection to which the transported APDU is related.

3 – This indicator may be present whenever notification is delivered. The Notification indicator information element may be repeated in this message. The maximum length and the number of repetitions allowed is a network option.

4 – This information element may be repeated any number of times.

8.1.2 Messages for connectionless bearer-independent transport

8.1.2.1 FACILITY

This message may be sent by the network or the user to control a supplementary service or additional basic call capability. The supplementary service or additional basic call capability to be invoked, and its associated parameters, are specified in the Facility information element. The structure of the FACILITY message is shown in Table 2.

TABLE 2

FACILITY message content

Message type: FACILITY
Significance: local (Note 1)
Direction: both

Information element	Reference	Direction	Type	Length
Protocol discriminator	Q.2931/4.2	Both	M	1
Call reference (Note 2)	Q.2931/4.3	Both	M	4
Message type	Q.2932.1/8.2.1	Both	M	2
Message length	Q.2931/4.4	Both	M	2
Facility	Q.2932.1/8.2.2.2	Both	M (Note 7)	10-*
Called party number	Q.2931/4.5.11	n -> u	O (Note 3)	4-*
Called party subaddress	Q.2931/4.5.12	n -> u	O (Note 4)	4-25
Calling party number	Q.2931/4.5.13	u -> n	O (Note 6)	4-*
Notification indicator	Q.2931/4.5.23	Both	O (Note 5)	4-*

NOTES

1 – This message has local significance; however it may carry information of global significance.

2 – The dummy call reference is used.

3 – Included when the transport mechanism user-entity wishes to address a particular entity at the user using Called party number information. Usage is dependent on provision of the multiple subscriber number supplementary service. It is only applicable at the coincident S_B and T_B reference point.

4 – Included when the transport mechanism user-entity wishes to address a particular entity at the user using called party subaddress information. Usage is dependent on the provision of the subaddressing supplementary service. It is only applicable at the coincident S_B and T_B reference point.

5 – This indicator may be present whenever notification is delivered. The notification indicator information element may be repeated in this message. The maximum length and the number of repetitions allowed is a network option.

6 – Included when an entity at the user wishes to identify itself to the transport mechanism user-entity. Usage is dependent on provision of the multiple subscriber number supplementary service. It is only applicable at the coincident S_B and T_B reference point.

7 – This information element may be repeated any number of times.

8.1.3 Messages for connection-oriented bearer-independent transport

8.1.3.1 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 transport establishment has been initiated and that no more establishment information will be accepted. The structure of the CALL PROCEEDING message is shown in Table 3.

TABLE 3/Q.2932.1

CALL PROCEEDING message content

Message type: CALL PROCEEDING Significance: local Direction: both				
Information element	Reference	Direction	Type	Length
Protocol discriminator	Q.2931/4.2	Both	M	1
Call reference	Q.2931/4.3	Both	M	4
Message type	Q.2931/4.4	Both	M	2
Message length	Q.2931/4.4	Both	M	2

8.1.3.2 CO-BI SETUP

This message is sent by the calling user to the network, and by the network to the called user, to initiate transport establishment. The structure of the CO-BI SETUP message is shown in Table 4.

TABLE 1-4/Q.2932.1

CO-BI SETUP message content

Message type: CO-BI SETUP Significance: local (Note 1) Direction: both				
Information element	Reference	Direction	Type	Length
Protocol discriminator	Q.2931/4.2	Both	M	1
Call reference	Q.2931/4.3	Both	M	4
Message type	Q.2932.1/8.2.1	Both	M	2
Message length	Q.2931/4.4	Both	M	2
Facility	Q.2932.1/8.2.2.2	Both	O (Note 2)	4-*
Called party number	Q.2931/4.5.11	n -> u	O (Note 3)	4-*
Called party subaddress	Q.2931/4.5.12	n -> u	O (Note 4)	4-25
Calling party number	Q.2931/4.5.13	u -> n	O (Note 5)	4-*
Notification indicator	Q.2931/4.5.23	Both	O (Note 6)	4-*

NOTES

1 – This message has local significance; however it may carry information of global significance.

2 – Included if the requesting GFT-Control wishes to include APDUs in the setup request. This information element may be repeated any number of times.

3 – Included in the network-to-user direction if a transport mechanism user-entity wishes to address a particular entity at the user using Called party number information, and it is a coincident S_B and T_B reference point, and the multiple subscriber number supplementary service is provided.

4 – Included in the network-to-user direction if a transport mechanism user-entity wishes to address a particular entity at the user using called party subaddress information, and it is a coincident S_B and T_B reference point, and the subaddressing supplementary service is provided.

5 – Included in the user-to-network direction if a user wishes to identify itself to a transport mechanism user-entity using Calling party number information, and it is a coincident S_B and T_B reference point, and the multiple subscriber number supplementary service is provided.

6 – This indicator may be present whenever notification is delivered. The Notification indicator information element may be repeated in this message. The maximum length and the number of repetitions allowed is a network option.

8.1.3.3 CONNECT

This message is sent by the called user to the network, and by the network to the calling user to indicate acceptance of a transport establishment request by the called entity. The structure of the CONNECT message is shown in Table 5.

TABLE 5/Q.2932.1

CONNECT message content

Message type: CONNECT Significance: local (Note 1) Direction: both				
Information element	Reference	Direction	Type	Length
Protocol discriminator	Q.2931/4.2	Both	M	1
Call reference	Q.2931/4.3	Both	M	4
Message type	Q.2931/4.4	Both	M	2
Message length	Q.2931/4.4	Both	M	2
Facility	Q.2932.1/8.2.2.2	Both	O (Note 2)	4-*
Notification indicator	Q.2931/4.5.23	Both	O (Note 3)	4-*
NOTES 1 – This message has local significance; however it may carry information of global significance. 2 – Included if the responding GFT-Control wishes to include APDUs in the call setup response. This information element may be repeated any number of times. 3 – This indicator may be present whenever notification is delivered. The Notification indicator information element may be repeated in this message. The maximum length and the number of repetitions allowed is a network option.				

8.1.3.4 FACILITY

This message may be sent by the network or the user to control a supplementary service or additional basic call capability. The supplementary service or additional basic call capability to be invoked, and its associated parameters, are specified in the Facility information element. The structure of the FACILITY message is the same as that shown in 8.1.1.1 (see Table 1).

8.1.3.5 NOTIFY

This information is sent by the user or the network to indicate information pertaining to a call. The structure of the NOTIFY message is the same as that shown in 3.1.10/Q.2931 [13] (see Table 3-11/Q.2931).

8.1.3.6 RELEASE

This message is sent by the transport entity to request clearing of the part of the end-to-end transport connection controlled by the peer transport entity and to prepare to release its call reference value after sending RELEASE COMPLETE. The structure of the RELEASE message is shown in Table 6.

TABLE 6/Q.2932.1

RELEASE message content

Message type: RELEASE Significance: local (Note 1) Direction: both				
Information element	Reference	Direction	Type	Length
Protocol discriminator	Q.2931/4.2	Both	M	1
Call reference	Q.2931/4.3	Both	M	4
Message type	Q.2931/4.4	Both	M	2
Message length	Q.2931/4.4	Both	M	2
Cause	Q.2931/4.5.15	Both	M (Note 2)	6-34
Facility	Q.2932/8.2.2.2	Both	O (Note 3)	4-*
Notification indicator	Q.2931/4.5.23	Both	O (Note 4)	4-*

NOTES

1 – This message has local significance; however it may carry information of global significance.

2 – This information element may appear twice in a message.

3 – Included if the releasing GFT-Control wishes to include APDUs in the Release Request. This information element may be repeated any number of times.

4 – This indicator may be present whenever notification is delivered. The Notification indicator information element may be repeated in this message. The maximum length and the number of repetitions allowed is a network option.

8.1.3.7 RELEASE COMPLETE

This message is sent by the user or the network to indicate that the transport entity sending the message has released its call reference value. The receiving equipment shall release its call reference value. The structure of the RELEASE COMPLETE message is the same as that shown in 3.16/Q.2931 [13] (see Table 3-7/Q.2931).

8.1.3.8 STATUS

This message is sent from the user or the network in response to a STATUS ENQUIRY message or at any point in time to report certain error conditions. The structure of the STATUS message is the same as that shown in 3.1.8/Q.2931 [13] (see Table 3-9/Q.2931).

8.1.3.9 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. The structure of the STATUS ENQUIRY message is as shown in 3.1.9/Q.2931 [13] (see Table 3-10/Q.2931).

8.2 General message format and information element coding

Clause 4/Q.2931 shall be used with the following additions.

8.2.1 Message type

The additional message type codings for the purpose of this Recommendation are defined in Table 7.

TABLE 7/Q.2932.1

Message types

Bits	
8 7 6 5 4 3 2 1	
0 0 0 - - - - -	Q.2931 [13] call establishment message group
1 0 1 0 1	CO-BI SETUP
0 1 1 - - - - -	Q.2931 [13] miscellaneous message group
0 0 0 1 0	FACILITY

8.2.2 Other information elements

Table 8 shows the additional information elements defined for the generic functional protocol and those information elements of Recommendation Q.2931 [13] which are extended for this purpose.

TABLE 8/Q.2932.1

Information elements specific to the generic functional protocol

Bits 8 7 6 5 4 3 2 1	Subclause reference	Maximum length (octets)
0 0 0 1 1 1 0 0 Facility	8.2.2.2	(Note)
All other values are reserved		
NOTE – The maximum length of the Facility information elements is application dependent consistent with the maximum length of the message.		

8.2.2.1 Call state

The call state information element is defined as in subclause 4.5.10/Q.2931 [13]. However the state value assignments defined in Table 9 exist for the connection-oriented bearer-independent transport mechanism.

TABLE 9/Q.2932.1

Call state information element

– Call state value (octet 5)							
Bits							
6	5	4	3	2	1	state	
0	0	0	0	0	0	0	Null
0	0	0	0	0	1	1	Call Initiated
0	0	0	0	1	1	3	Outgoing Call Proceeding
0	0	0	1	1	0	6	Call Present
0	0	1	0	0	1	9	Incoming Call Proceeding
0	0	1	0	1	0	10	Active
0	0	1	0	1	1	11	Release Request

8.2.2.2 Facility

The purpose of the Facility information element is to carry APDUs.

The Facility information element can be included in all call/connection control messages, all party control messages, and all messages defined in this Recommendation except for the NOTIFY, STATUS, and STATUS ENQUIRY messages.

Figure 3 shows the structure of the Facility information element. Table 10 shows the value of the protocol profile field applicable for supplementary services or additional basic call capabilities.

8	7	6	5	4	3	2	1	Octets
Facility								
0	0	0	1	1	1	0	0	1
Information element identifier								
1	Coding standard		Information element instruction field					2
ext			Flag	Res.	Information element action indicator			
Length of facility contents								3
								4
1	0	0						5
ext.	Spare		Protocol profile					
APDU(s) (Note)								6

NOTE – One or more APDUs may be included depending on specific service requirements. Multiple APDUs may be sent in one Facility information element or in more than one (individual) Facility information elements. It is a sender's choice to use either one or several Facility information elements taking into account the maximum length of the Facility information element.

FIGURE 3/Q.2932.1

Facility information element

TABLE 10/Q.2932.1

Facility information element protocol profile

Bits 5 4 3 2 1	
1 0 0 0 1	Remote operations protocol (Note)
All other values are reserved and their usage is the subject of other Recommendations.	
NOTE – Use of this codepoint indicates that the only APDUs appearing in octet 4 will be those defined for use in ROSE. All local values will be those specified for the DSS 1 and DSS 2 protocols.	

The APDU structures are defined in Table A.1 using ASN.1 as specified in Recommendation X.208 [6]. A representation using ASN.1 as specified in Recommendation X.680 is defined in Table B.1.

When specified according to Recommendation X.208 [6], all data structures in the Facility information element (octet 6, etc.) shall be encoded according to the Basic Encoding Rules (BERs) as specified in Recommendation X.209 [7].

When specified according to Recommendation X.680 [8], all data structures in the Facility information element (octet 6, etc.) shall be encoded according to the BER as specified in Recommendation X.690 [9].

NOTE – The following guidelines apply for the application of the different length encodings:

– the short form definitive length encoding should be used to indicate the length of a data value with a length less than 128 octets;

– when the long form definitive length encoding is used, the minimum number of octets should be used;

– OCTET STRING and BIT STRING values should be encoded in a primitive form.

Receiving entities shall be able to interpret all length forms of the basic encoding rules.

8.2.2.2.1 Treatment of existing Q.2931 information elements as parameters

Supplementary service or additional basic call capability protocol specifications are expected to require new parameters to be defined and to require existing Q.2931 [13] information elements.

New parameters shall be defined using X.209 [7] coding, or Recommendation X.690 [9] as appropriate, if they do not appear elsewhere in Q.2931 [13] messages.

Supplementary service or additional basic call capability protocol specifiers may elect to encapsulate one or more existing Q.2931 [13] information elements within an X.209 [7] data element, or X.690 [9] data element, as appropriate, thereby retaining the Q.2931 [13] coding for these information elements. When this option is chosen, all the Q.2931 [13] information elements should be grouped together as the content following the Q.2931 [13] information elements tag. This data element may appear by itself or as a member of a sequence or set.

Encapsulation of the Facility information element within Facility information elements shall not be used.

A formal definition of this mechanism using ASN.1, as specified in Recommendation X.208 [6], is given in A.2. A formal definition of this mechanism using ASN.1, as specified in Recommendation X.680 [8], is given in Table B.2.

9 Signalling procedures at the coincident S_B and T_B reference point

9.1 APDU transport mechanisms

The transport function for operations is performed by the exchange of APDUs via DSS 2 messages.

A supplementary service or additional basic call capability functional protocol (using the Facility information element) may use an existing bearer-related call reference if it is to be coupled to the connection, or it may use a bearer-independent call reference.

9.1.1 Bearer-related transport

NOTE – The definition of "Bearer-related transport mechanism" is given in 3.3.

The procedures for connection control are described in clause 5/Q.2931 [13]. These procedures are not influenced by the APDUs carried. Bearer-related transport procedures and operations shall operate independently of each other.

9.1.1.1 Normal operation

For bearer-related transport any call/connection control message, any party control message, and the messages defined in 8.1.1, may be used to carry the APDUs in a Facility information element. These messages shall use the call reference of the bearer connection.

The FACILITY message shall not be sent in the following call/connection states:

– Null (0) (U0) (N0);
– Call Initiated (1) (U1) (N1);
– Call Present (6) (U6) (N6);
– Release Request (11) (U11) (N11);
– Release Indication (12) (U12) (N12).

The call reference provides the means to correlate messages belonging to the same connection. When a supplementary service or additional basic call capability affects more than one connection, different call references are used to identify each connection individually. This implies the use of different messages in order to manage each connection separately.

When the call/connection associated with the AS-Control functionality is cleared due to AS-Control actions, the Cause information element in the clearing message shall be set to #16 "normal clearing".

NOTE – Any additional reason for clearing is included in the APDUs generated by AS-Control, and therefore transferred in the Facility information element.

When indicated by GFT-Control, generic functional data shall be included in a Facility information element and transferred in a call control message or party control message if such a message is being sent for other reasons, or else in a FACILITY message.

The transport mechanism shall pass all valid received generic functional data and protocol profile values in the Facility information element to GFT-Control and the procedures specified in GFT-Control (see 9.3) shall also apply.

9.1.1.2 Exceptional procedures

If the network or user recognizes a supplementary service or additional basic call capability request in a received SETUP message but is not able to process the request, then the following options shall apply:

– the network or user may clear the call request and reject the supplementary service or additional basic call capability invocation by means of an appropriate call-clearing message which contains the Cause information element and a return error APDU with the appropriate parameters in the Facility information element;
– the network or user may continue to process the call request according to the call control procedures of Recommendation Q.2931 [13], and reject the supplementary service or additional basic call capability invocation by including a return error APDU with the appropriate parameters in the Facility information element by means of a FACILITY message or in an appropriate call/connection control message or party control message.

The option to be used depends on the individual supplementary service or additional basic call capability procedures which are the subject of other Recommendations.

In addition, when the network or user identifies an error in the received APDU, the network or user may continue to process the call request according to the call control procedures of Recommendation Q.2931 [13], and ignore the supplementary service or additional basic call capability invocation, in which case a reject component shall be generated.

No response message shall be sent after the call reference value has been released.

The procedures of 9.1.1 are an extension to the procedures of Recommendations Q.2931 [13] and Q.2971 [14]. As such the general error handling procedures as defined in 5.6/Q.2931 [13] and 9.5/Q.2971 apply. However, the handling of errors in octet 5 of the Facility information element is specified in 9.3.2. The handling of errors in APDUs is specified in Appendix III. If the connection is being cleared, the treatment of outstanding supplementary service or additional basic call capability requests is subject to the Recommendations for the individual supplementary services or additional basic call capabilities.

9.1.2 Bearer-independent transport mechanisms

This subclause and 9.1.3 and 9.1.4 define the transport of APDUs independently of a connection. This Recommendation utilizes the signalling AAL connection services as described in Recommendation Q.2130 [15]. The messages used for transport (i.e. CO-BI SETUP, CONNECT, FACILITY and RELEASE) may carry the Facility information elements containing the application-oriented operation APDUs.

The correlation among the various transport messages is provided by means of the call reference value of each message.

The bearer-independent transport functions are divided into the following two categories:

– connection-oriented (Note);

– connectionless (Note).

NOTE – A definition of the terms "connection-oriented" and "connectionless" is given in clause 3.

Within this subclause, signalling AAL service primitives are used to illustrate the communication between protocol layers and are not intended to specify or constrain implementations.

9.1.3 Connection-oriented bearer-independent transport mechanism

The procedures in this subclause describe a connection-oriented service which provides APDU transfer between signalling entities outside the context of a bearer.

The description of the protocol control requirements for connection-oriented bearer-independent transport uses a set of states defined in 7.2.1.3.

9.1.3.1 Actions in the Null state

When asked to initiate a Bearer-independent signalling connection by GFT-Control, the outgoing transport entity shall:

a) ensure that a reliable SAAL connection exists. If a reliable SAAL connection does not exist, the transport entity shall establish a reliable SAAL connection according to the procedures described in Recommendation Q.2130 [15];

b) send a CO-BI SETUP message on the appropriate SAAL connection which shall contain only:

   – a call reference, selected according to 4.3/Q.2931 [13];

   – if indicated by GFT-Control, one or more Facility information elements;

– if indicated by any AS-Control entity, one or more Notification indicator information elements.

NOTE – In addition, the CO-BI SETUP message may also be extended with the Called party number information element, the Calling party number information element, and the Called party subaddress information element as described in 9.2.

c) start timer T303; and

d) enter the Call Initiated state.

On receipt of a CO-BI SETUP message relating to establishment of a bearer-independent signalling connection, the incoming transport entity shall:

i) if the request is valid and can be processed, indicate the connection request to GFT-Control and enter the Call Present state; or

ii) if the request is invalid or cannot be accepted by the GFT-control, return a RELEASE COMPLETE message to the outgoing transport entity, release the call reference and remain in the Null state.

9.1.3.2 Actions in the Call Present state

If indicated by GFT-Control, the incoming transport entity shall return a CALL PROCEEDING message to the outgoing transport entity, and shall enter the Incoming Call Proceeding state.

If indicated by GFT-Control, the incoming transport entity shall return a CONNECT message to the outgoing transport entity, and shall enter the Active state.

9.1.3.3 Actions in the Call Initiated state

On receipt of a CALL PROCEEDING message from the incoming transport entity, the outgoing transport entity shall stop timer T303, and enter the Outgoing Call Proceeding state.

If no response is received before timer T303 expires, the outgoing transport entity shall inform GFT-Control of the failure of the signalling connection request and enter the Null state.

NOTE 1 – A clearing cause value of #102 "recovery on timer expiry" shall be indicated for use in any protocol signalling to a preceding entity.

NOTE 2 – If the connection-oriented procedures are not supported by a GFT-Control which receives a CO-BI SETUP message, and the instruction indicators in the Message type information element do not indicate a different course of action, it will respond with a RELEASE COMPLETE message indicating, cause #81 "invalid call reference value". This will initiate connection release in accordance with 9.1.3.8.

9.1.3.4 Actions in the Incoming Call Proceeding state

When receiving an indication that the bearer-independent signalling connection is established from GFT-Control, the incoming transport entity shall: send a CONNECT message to the outgoing transport entity and enter the Active state.

The CONNECT message shall contain:

– if indicated by GFT-Control, one or more Facility information elements;

– if indicated by any AS-Control entity, one or more Notification indicator information elements.

9.1.3.5 Actions in the Outgoing Call Proceeding state

On receipt of a CONNECT message from the incoming transport entity, the outgoing transport entity shall: inform GFT-Control that the signalling connection is established and enter the Active state.

9.1.3.6 Actions in the Active state

In the Active state a FACILITY message can be sent or received.

9.1.3.7 Connection release

When a transport entity is requested by GFT-Control to release a bearer-independent signalling connection, the transport entity shall:

– if in the Release Request state, ignore the request from GFT-Control; or

– if in any other transport entity state, send a RELEASE message with an appropriate cause value, start timer T308 and enter the Release Request state.

When Transport entity makes a local decision to release a bearer-independent signalling connection (e.g. due to a protocol error), it shall, if not in the Release Request state: inform GFT-Control that the signalling connection has been released, send a RELEASE message, start timer T308 and enter the Release Request state.

The RELEASE message shall contain:

– an appropriate cause value;

– if indicated by GFT-Control, one or more Facility information elements;

– if indicated by any AS-Control entity, one or more Notification indicator information elements.

On receipt of a RELEASE message in any state other than the Release Request state, the transport entity shall indicate to GFT-Control that the signalling connection has been released, stop all timers, send a RELEASE COMPLETE message, release the call reference and enter the Null state.

On receipt of a RELEASE COMPLETE message in any state other than the Release Request state, the transport entity shall indicate to GFT-Control that the signalling connection has been released, stop all timers, release the call reference and enter the Null state.

9.1.3.8 Actions in the Release Request state

On receipt of a RELEASE or a RELEASE COMPLETE message, the transport entity shall: stop timer T308, release the call reference and enter the Null state.

If timer T308 expires for the first time, the RELEASE message shall be retransmitted and timer T308 shall be restarted. If timer T308 expires a second time, the transport entity shall release the call reference and enter the Null state.

9.1.3.9 Transport of APDUs associated with a connection-oriented bearer-independent signalling connection

When indicated by GFT-Control, generic functional data shall be included in a Facility information element and transferred in a bearer-independent control message if such a message is being sent to establish or clear the signalling transaction, or, whilst in the Active state, in a FACILITY message.

The transport mechanism shall pass all valid received generic functional data and protocol profile values in the Facility information element to GFT-control and the procedures specified in GFT-Control (see 9.3) shall also apply.

9.1.3.10 Transport of notifications

The delivery of bearer-independent notifications shall use an active call reference of the connection-oriented transport mechanism. In this context, a call reference shall be active from the initiation of

establishment (i.e. the CO-BI SETUP message) to the initiation of clearing (i.e. the RELEASE message).

If the delivery of the notification coincides with establishment or clearing, the notification information can be carried in a bearer-independent control message. 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 DSS 2 entity only after the first response to a CO-BI SETUP message has been sent or received and before the 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 state change shall occur at either side of the interface following sending or receipt of a NOTIFY message.

If a receiving CO-BI transport entity has no related AS-Control entity – i.e. a relationship between AS-Control entities does not yet exist, will not be created as a result of the received message, or has ceased to exist – then the received notification shall be discarded.

9.1.3.11 Protocol error handling

Subclause 5.6/Q.2931 [13] shall apply with the following modifications:

– actions regarding the handling of VCIs and VPCIs are not applicable;

– if a SETUP ACKNOWLEDGE, ALERTING or PROGRESS message (defined in ITU-T Recommendation Q.2931 [13]) is received in any state (except the Null state, where invalid call reference error procedures apply) it shall be treated as an unexpected or unrecognized message in accordance with 5.6.4/Q.2931 [13];

These general error handling procedures only apply for octet 1 through 4 of the Facility information element. The handling of errors in octet 5 is specified in 9.3.2.

Subclause 5.6.11/Q.2931 [13] shall apply for the generation and request of bearer-independent connection state information.

9.1.4 Connectionless bearer-independent transport mechanism

9.1.4.1 Normal operation

The connectionless transport mechanism is based on FACILITY messages. However, the connectionless transport mechanism shall only use the dummy call reference value as specified in 4.3/Q.2931 [13].

Before data can be sent the transport entity shall first ensure establishment, if not already available, of a reliable signalling AAL connection using the signalling AAL_ESTABLISH.request service primitive as described in Recommendation Q.2130 [15]. Completion of establishment of this connection is indicated by a signalling AAL_ESTABLISH.confirm primitive.

The FACILITY message is used to carry the "user" information, i.e. the APDU structures in the Facility information element.

NOTE – In addition, the FACILITY message may also be extended with the Called party number information element, the Calling party number information element, the Called party subaddress information elements described in 9.2.

When indicated by GFT-Control, the transport entity shall include generic functional data in one or more Facility information elements and shall transfer this information in a FACILITY message.

The transport entity shall pass all valid received generic functional data and protocol profile values in the Facility information element to GFT-Control and the procedures specified in GFT-Control (see 9.3) shall also apply.

9.1.4.2 Exceptional procedure

If the message action indictor is to be applied to a received FACILITY message as a result of error handling, the receiver shall treat the "clear call" and "discard and report status" values as if "discard and ignore" had been received.

If the instruction indicator is to be applied for a received information element, the receiver shall treat the "clear call" and discard "message and report status" values as if "discard message and ignore" had been received.

If a FACILITY message is received and it does not contain the Facility information element, the receiving entity shall discard the FACILITY message.

If a FACILITY message is received that contains a Facility information element with invalid content in octets 1 to 4, then that Facility information element and the FACILITY message shall be ignored and no action taken on the contents of the FACILITY message.

If a FACILITY message is received that contains an unexpected information element, an unrecognized information element, or an optional information element with content error, and explicit actions are not applied, then that information element shall be ignored, and action taken on the message and those information elements that are recognized and have valid content.

If either transport entity receives an indication that the signalling AAL connection has been released via the signalling AAL_RELEASE.indication primitive, or that the signalling AAL connection has spontaneously been reset via the signalling AAL_ESTABLISH.indication primitive, then the procedures as they affect the supplementary service or additional basic call capability are outside the scope of this Recommendation.

NOTE – The handling of layer 2 errors is dependent on the supplementary service or additional basic call capability and are therefore specified in the individual Recommendation referencing this subclause.

9.2 Addressing of APDUs

9.2.1 Local addressing

Within this part of this Recommendation communication is entirely local, i.e. an association exists between an AS-Control entity in the user and an AS-Control entity in the network. However, there exists the possibility that multiple AS-Control entities may exist in the user, and identification/addressing of these is performed by either the multiple subscriber number supplementary service or the subaddressing supplementary service. Figure 4 shows the associated architecture for multiple terminal applications as described above.

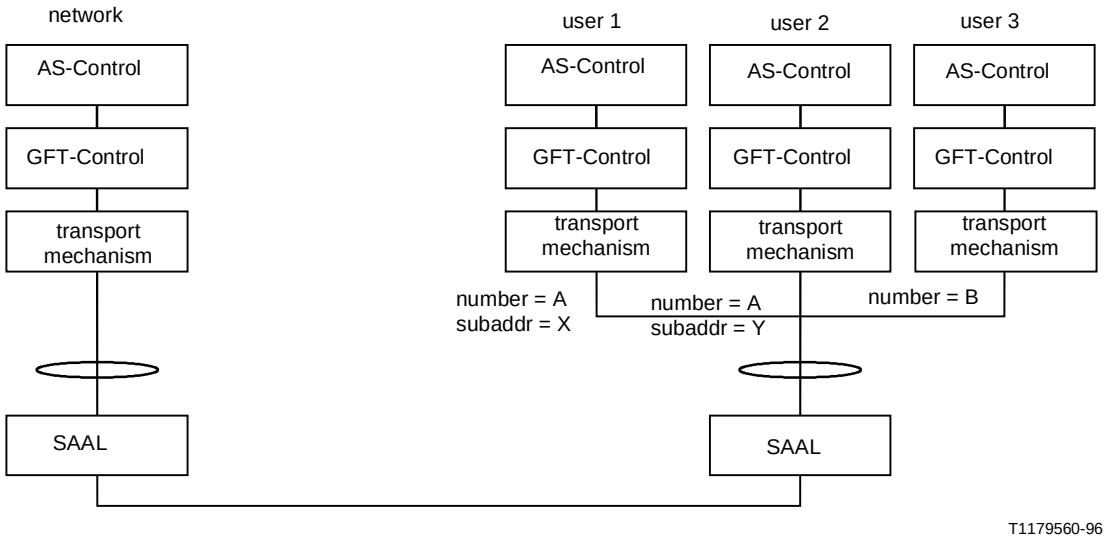


FIGURE 4/Q.2932.1

Protocol architecture associated with the use of multiple subscriber number and subaddressing supplementary services

Any local address required is supplied by GFT-Control and thus to the appropriate transport entity.

9.2.2 Additional transport procedures where the multiple subscriber number supplementary service applies

9.2.2.1 Bearer-related transport mechanism

The multiple subscriber number supplementary service applies only to the bearer as described in Recommendation Q.2951.2 [11].

9.2.2.2 Connection-oriented bearer-independent transport mechanism

The outgoing user may include in the CO-BI SETUP message a Calling party number information element. The coding of the Calling party number information element shall follow the same requirements as specified for the SETUP message in 1.9.1.1/Q.2951.2 [11].

On receipt of a Calling party number information element in a CO-BI SETUP message by the outgoing network, the network shall apply the same procedures to the Calling party number information element as are specified in 1.9.1.1/Q.2951.2 [11] for basic call.

The incoming network may include in the CO-BI SETUP message a Called party number information element. The coding of the Called party number information element shall follow the same requirements as specified for the SETUP message in 1.9.2.1/Q.2951.2 [11].

On receipt of a Called party number information element in a CO-BI SETUP message by the incoming user, the network shall apply the same procedures to the Called party number information element as are specified in 1.9.1.2/ Q.2951.2 [11] for basic call.

9.2.2.3 Connectionless bearer-independent transport mechanism

The outgoing user may include in the FACILITY message a Calling party number information element. The coding of the Calling party number information element shall follow the same requirements as specified for the SETUP message in 1.9.1.1/Q.2951.2 [11].

On receipt of a Calling party number information element in a FACILITY message by the incoming network, the network shall apply the same procedures to the Calling party number information element as are specified in 1.9.1.1/Q.2951.2 [11] for basic call.

The incoming network may include in the FACILITY message a Called party number information element. The coding of the Called party number information element shall follow the same requirements as specified for the SETUP message in 1.9.2.1/Q.2951.2 [11]. An exception is that no protocol is returned.

On receipt of a Called party number information element in a FACILITY message by the incoming user, the user shall apply the same procedures to the Called party number information element as are specified in 1.9.1.2/Q.2951.2 [11] subclause for basic call.

9.2.3 Additional transport procedures where the subaddressing supplementary service applies

9.2.3.1 Bearer-related transport mechanism

The subaddressing supplementary service applies only to the bearer as described in Recommendation Q.2951.8 [12].

9.2.3.2 Connection-oriented bearer-independent transport mechanism

The incoming network may include in the CO-BI SETUP message a Called party subaddress information element. The coding of the Called party subaddress information element shall follow the same requirements as specified for the SETUP message in 1.9.2.1/Q.2951.8 [12].

On receipt of a Called party subaddress information element in a CO-BI SETUP message by the incoming user, the user shall apply the same procedures to the Called party subaddress information element as are specified in 1.9.2.2/Q.2951.8 [12] for basic call.

9.2.3.3 Connectionless bearer-independent transport mechanism

The incoming network may include in the FACILITY message a Called party subaddress information element. The coding of the Called party subaddress information element shall follow the same requirements as specified for the SETUP message in 1.9.2.1/Q.2951.8 [12]. An exception is that no protocol is returned.

On receipt of a Called party subaddress information element in a FACILITY message by the incoming user, the user shall apply the same procedures to the Called party subaddress information element as are specified in 1.9.1.2/Q.2951.8 [12] for basic call.

9.3 GFT-Control

This subclause provides the limited procedures for GFT-Control when local addressing only is supported.

9.3.1 Transmission of generic functional data

When ROSE or any other ASE requires to transmit generic functional data, this is indicated to GFT-Control. GFT-Control shall:

– determine from the information supplied by ROSE or any other ASE the transport mechanism required;

– ensure that the required transport mechanism is in a state to transmit generic functional data;

– where it is required to establish a new connection-oriented bearer-independent transport mechanism, then on receipt of an indication from the transport mechanism that a CALL PROCEEDING message has been received, GFT-Control shall start timer T310. On receipt of an indication from GFT-Control that a CONNECT message has been received, GFT-Control shall stop timer T310. If T310 expires, then the appropriate AS-Control shall be informed of the failure to send generic functional data;

  NOTE 1 – A clearing cause value of #102 "recovery on timer expiry" shall be indicated for use in any protocol signalling to a preceding entity.

– supply to the appropriate transport mechanism the generic functional data and protocol profile based on the type of ASE requesting transport of generic functional data. In particular, for the support of ROSE for local addressing within the constraints of this part of this Recommendation, the protocol profile shall be set to "ROSE";

– indicate the instruction indicator for use in the Facility information element;

  NOTE 2 – The prime function of the instruction indicator in the Facility information element is to provide corrective action when the generic functional protocol is not supported.

– indicate any required address for the multiple subscriber number or subaddressing supplementary service.

If GFT-Control is unable to provide the transfer of generic functional data, it shall indicate this to ROSE or any other appropriate ASE.

9.3.2 Receipt of generic functional data

When a transport mechanism receives a Facility information element, this is indicated to GFT-Control.

GFT-Control shall check the protocol profile, and if it is valid it shall indicate this data to the appropriate ASE. In particular, if the protocol profile is set to "ROSE", this shall be indicated to the ROSE ASE. If the protocol profile is set to a reserved value, or to a value of protocol profile that is not supported, the generic functional data shall be discarded, and the procedures for unrecognized information element content specified in 5.6.8.2/Q.2931 or 5.7.2/Q.2931 [13], as appropriate, shall be followed on the appropriate transport mechanism. The error handling rules in subclauses 5.6.8.2/Q.2931 and 5.7.2/Q.2931 [13] shall apply only for errors in the octets 1 through 5 of the Facility information element. Errors in subsequent octets shall be handled according to the appropriate ROSE procedures.

9.4 Remote operations procedures

9.4.1 Introduction

The generic functional protocol provides a means of exchanging generic functional data and is specified as a realization of ROSE (see Recommendations X.219 [3] and X.880 [17]).

9.4.2 Procedures for operations

The specification of procedures for operations of this subclause is according to the definition of elements of procedure of Recommendations X.229 [2] or X.880 [17], but uses only those elements which are specified for application within the Facility information element of this Recommendation. In addition, this subclause includes some extensions to ROSE concerning the error procedures. Recommendations X.229 [2] and Recommendation X.880 [17] provide consistent specifications of the remote operation procedures and the application of one or the other depends on the version of the abstract syntax used for the specification of the remote operations by the AS-Control entities.

The procedures for operations are defined in terms of the interactions between peer-to-peer protocol machines through the use of a transport mechanism of the DSS 2 protocol. The operation protocol comprises of the following procedures:

– invocation;

– return result;

– return error; and

– reject.

The structure, contents and encoding of the appropriate APDUs are defined in 8.2. Dependent on the specific operation, return result and return error APDUs can be applicable. This is specified in the Recommendation of the individual applications.

In the following subclauses a summary of the procedures of each of these APDUs is given as far as applicable to this Recommendation.

9.4.2.1 Invocation

An application entity (invoker) shall use the invocation procedure to initiate an operation to be performed by the other application entity (performer). The invocation procedures shall use the invoke APDU as described in Table A.1. The invoke APDU shall be delivered towards the remote peer entity within a Facility information element sent within an appropriate transport message (e.g. call/connection control messages, party control messages, bearer-independent control messages, or FACILITY messages).

The operation value shall be used to identify the operation to be invoked, e.g. a specific supplementary service, a part of a specific supplementary service or a generic function.

The invoke identifier shall be used to identify the request of a ROSE-invoke service (10.1/X.219 [3]) and to correlate this request with the corresponding replies. The value is assigned by the invoker.

The invoke identifier shall be significant within a certain call reference value. The value (invoke identifier, call reference, signalling AAL connection endpoint identifier) shall uniquely identify an instance of an operation. In this respect the dummy call reference shall be regarded as a call reference as well.

An invoke identifier value shall not be reused as long as a response is expected pertaining to the invocation identified by this invoke identifier.

The linked identifier shall be used within a ROSE-invoke service (10.1/X.219 [3]), when the invoked operation is a child operation and this parameter identifies the linked parent operation.

9.4.2.2 Return result

An AS-Control entity (performer) shall use the return result procedure to request the transfer of the result of a successfully performed operation to the other AS-Control entity (invoker). The return result procedure shall use the return result APDU as described in Table A.1.

The return result APDU shall be delivered towards the remote peer entity in a Facility information element within an appropriate transport message.

9.4.2.3 Return error

An AS-Control entity (performer) shall use the return error procedure to request the transfer of the error information in the case of an unsuccessfully performed operation to the other AS-Control entity (invoker). The return error procedure shall use the return error APDU as described in Table A.1. Error values shall be defined specifically for each individual operation.

The return error APDU shall be delivered towards the remote peer entity in a Facility information element within an appropriate transport message.

9.4.2.4 Reject

An AS-Control entity shall use the reject procedure to reject the request (invocation) or reply (result or error) of the other AS-Control entity. The reject procedure shall be used by the receiver when the received request or reply cannot be processed because of errors in the received APDU (e.g. mistyped APDU or unrecognized operation). The receipt of a reject APDU shall not result in the start of a reject procedure.

In addition, a reject component may also be generated by ROSE for the same reasons as apply in the application.

The reject procedure shall use the reject APDU as described in Table A.1 and shall use the definition of problems as specified in Table 11. The reject APDU shall be delivered towards the remote peer entity in a Facility information element within an appropriate transport message.

TABLE 11/Q.2932.1

Problem code definitions

General-problem	
– unrecognized-APDU	signifies that the type of the APDU, as evidenced by its type identifier, is not one of the four defined in A.1
– mistyped-APDU	signifies that the structure of the APDU does not conform to A.1
– badly-structured-APDU	signifies that the structure of the APDUs does not conform to the standard notation and encoding, defined in Recommendations X.208 [6] and X.209 [7], or Recommendations X.680 [8] and X.690 [9] as appropriate
Invoke-problem	
– duplicate-invocation	signifies that the invoke-identifier parameter violates the assignment rules of Recommendation X.219 [3]
– unrecognized-operation	signifies that the operation is not one of those agreed between the user and the network
– mistyped-argument	signifies that the type of the operation argument supplied is not that agreed between the user and the network (Note 1)
– resource-limitation	the performing user or network is not able to perform the invoked operation due to resource limitation
– initiator-releasing	the application is not willing to perform the invoked operation because it is about to attempt to release the connection-oriented transport mechanism
– unrecognized-linked-identifier	signifies that there is no operation in progress with an invoke-identifier equal to the specified linked-identifier
– linked-response-unexpected	signifies that the invoked operation referred to by linked-identifier is not a parent-operation
– unexpected-child-operation	signifies that the invoked child-operation is not one that the invoked parent-operation referred to by the linked-identifier allows
Return-result-problem	
– unrecognized-invocation	signifies that no operation with the specified invoke-identifier is in progress
– result-response-unexpected	signifies that the invoke operation does not report a result
– mistyped-result	signifies that the type of the result parameter supplied is not that agreed between the user and the network (Note 1)
Return-error-problem	
– unrecognized-invocation	signifies that no operation with the specified invoke-identifier is in progress
– error-response-unexpected	signifies that the invoked operation does not report failure
– unrecognized-error	signifies that the reported error is not one of those agreed between the user and the network
– unexpected-error	signifies that the reported error is not one that the invoked operation may report
– mistyped-parameter	signifies that the type of the error parameters supplied is not that agreed between the user and the network (Note 1)

NOTES

1 – This problem shall not be used if all values (data elements) which are neither optional nor have default values assigned are correctly received (see 8.2.2.2).

2 – The above definitions are adapted from 7.4.4.2/X.229 and 7.5.4.2/X.229 [2].

9.4.2.5 Formal definition of data types

The formal definition of the OPERATION and ERROR macro shall be as given in Figure 4/X.219 [3] and is described in ASN.1 using the ASN.1 macro concept. These macros shall be used in the Recommendations of the individual supplementary services to define the required operations and errors.

NOTE – These definitions are reproduced in Appendix III.

10 Procedures for interworking with private ISDNs

10.1 APDU transport mechanisms

The transport function for operations is performed by the exchange of APDUs via DSS 2 messages as specified in Recommendation Q.2931 [13].

A supplementary service or additional basic call capability functional protocol (using the Facility information element) may use an existing bearer-related call reference if it is to be coupled to the connection, or it may use a bearer-independent call reference.

10.1.1 Bearer-related transport

The procedures shall be as specified in 9.1.1.

10.1.2 Bearer-independent transport mechanisms

The two transport mechanisms specified in 9.1.2 shall apply, i.e. the connection-oriented bearer independent transport mechanism and the connectionless bearer-independent transport mechanism.

NOTE – It is recommended that the connection-oriented transport mechanism is used for procedures that are specific for interworking with private ISDNs. This is however application-dependent and specified in Recommendations using the procedures of this Recommendation.

10.1.3 Connection-oriented bearer-independent transport mechanism

The procedures of 9.1.3 shall apply.

10.1.4 Connectionless bearer-independent transport mechanism

The procedures of 9.1.4 shall apply.

10.2 Addressing of APDUs

The procedures of 9.2.1 shall apply. The procedures for the multiple subscriber number or subaddressing supplementary services are not applicable at the T_B reference point for interworking with private ISDNs.

10.3 GFT-Control

This subclause provides the limited procedures for GFT-Control when local addressing only is supported.

The procedures of 9.3 shall apply.

10.4 Generic functional protocol

The procedures of subclause 9.4 shall apply.

11 Interactions with other networks

This clause provides procedures for interworking between DSS 2 and other access protocols (e.g. DSS 1), through an interworking unit. It also therefore indicates possible appropriate mappings where more complex functionality intervenes.

11.1 Interworking with N-ISDNs

Two means exist for interworking with the N-ISDN. In the first the generic functional protocol is fully terminated. In the second, a generic interworking function is provided.

An interworking function shall either provide the procedures in 11.1.1 or those in 11.1.2. The alternative procedures cannot be used on a case-by-case basis.

NOTE – While 11.1.2 provides the simpler functionality, it is only possible to use this functionality when all supplementary services or additional basic call functionality using the generic functional protocol that it is desired to interwork across the interworking function has equivalent procedural requirements and equivalent abstract and concrete syntax definitions in both the DSS 1 and DSS 2 protocols. Where these conditions do not apply, then 11.1.1 should be used.

11.1.1 Full termination of generic functional protocol

Figure 5 shows the protocol architecture of this interworking mechanism.

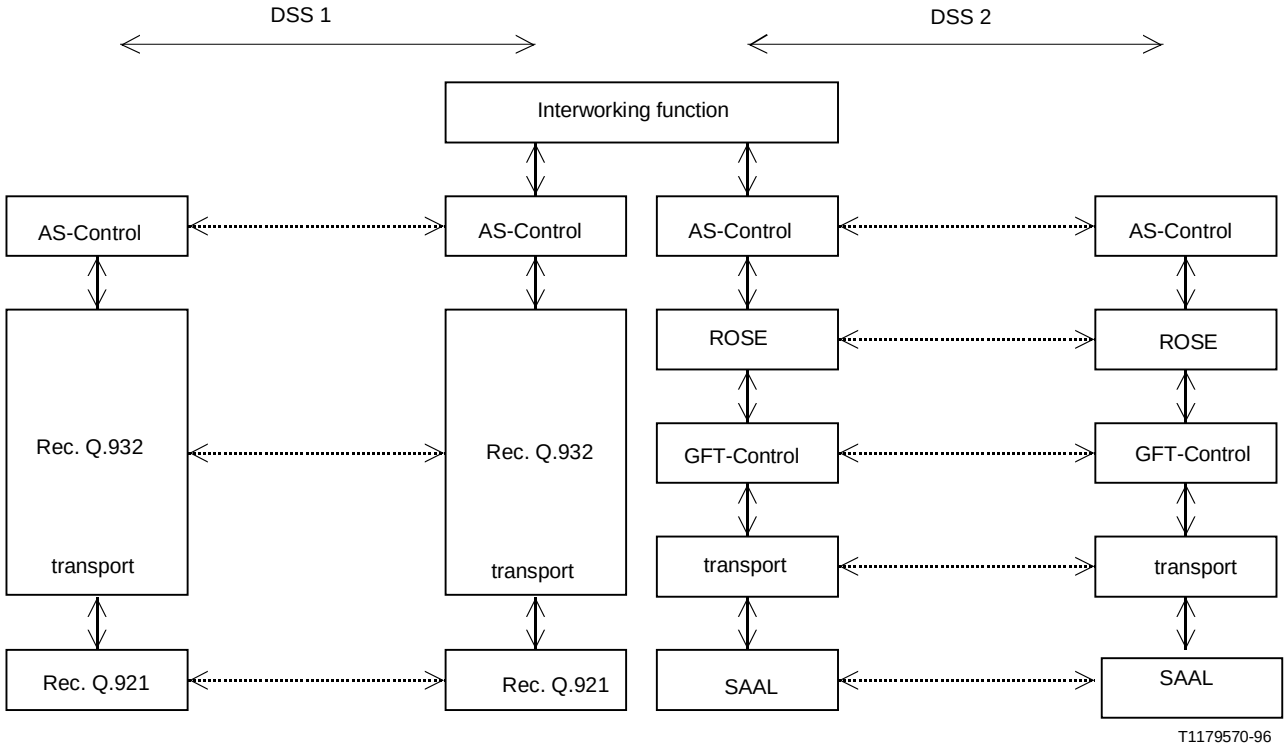


FIGURE 5/Q.2932.1

Fully terminated interworking

In this situation the generic functional protocol is fully terminated in the interworking unit, and interworking requirements are therefore specified by the ITU-T Recommendation specification giving the AS-Control entity requirements. These procedures are therefore outside the scope of this Recommendation. Within the interworking function the procedures of clauses 9 or 10 shall apply at the DSS 2 side as appropriate.

11.1.2 Generic interworking function

11.1.2.1 Architecture

Figure 6 shows the protocol architecture of this interworking mechanism.

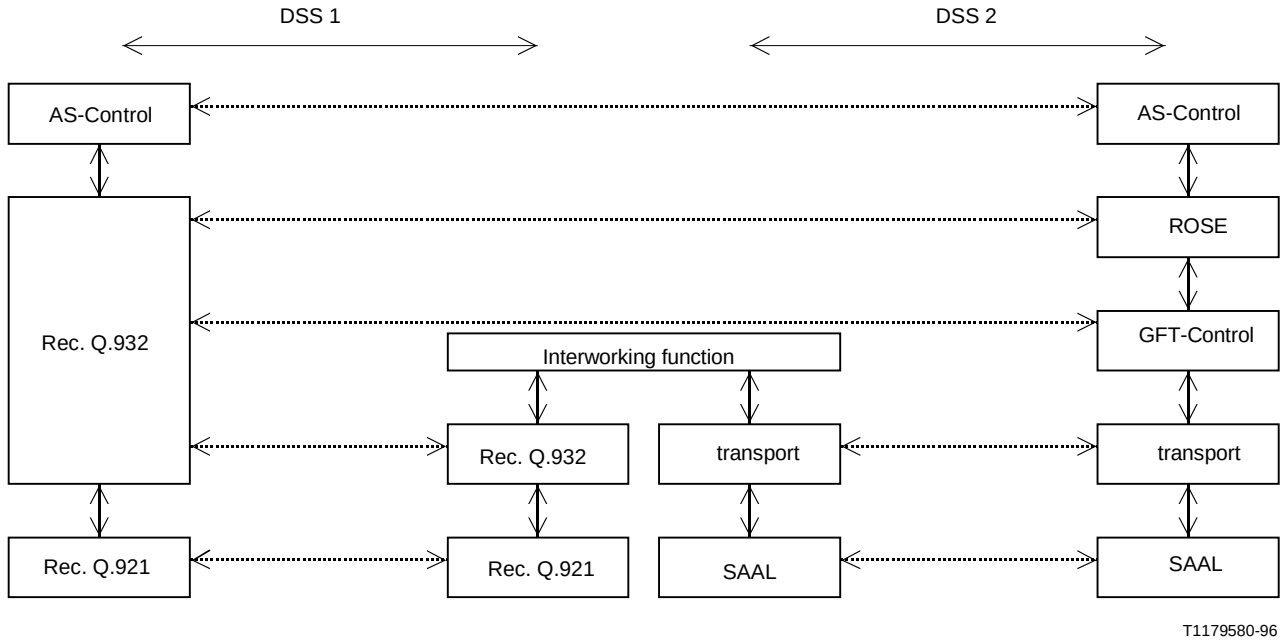


FIGURE 6/Q.2932.1

Generic interworking

For this form of interworking to take place, the supplementary service procedures or other functionality for both DSS 1 and DSS 2 are identical with the exception of the transport mechanism. The same operation and error values shall be used in both protocols for the same supplementary service or other functionality.

The procedures for interworking the various transport mechanisms are given in the following subclauses.

11.1.2.2 Bearer-related transport mechanism

All mapping is performed as specified in 6/Q.2931 [13], with the addition that the Facility information element is included in all mapped messages.

In addition, for mapping DSS 2 to DSS 1 the mappings shown in Table 12 shall apply.

TABLE 12/Q.2932.1

DSS 2 to DSS 1 mapping

DSS 2 message		DSS 1 message
FACILITY	→	FACILITY

In addition, for mapping DSS 1 to DSS 2, the mappings shown in Table 13 shall apply.

TABLE 13/Q.2932.1

DSS 1 to DSS 2 mapping

DSS 1 message		DSS 2 message
FACILITY	→	FACILITY

The DSS 2 Facility information element is mapped to the DSS 1 Facility information element by removing its second octet and adjusting the length indication without causing other changes to the contents.

The DSS 1 Facility information element is mapped to the DSS 2 Facility information element by inserting the second octet and changing length indication field from one to two octets, adjusting the length accordingly, without causing other changes to the contents. The flag bit in the second octet is set to "0", i.e. the normal error handling procedures as defined in 5.6/Q.2931 apply.

11.1.2.3 Connection-oriented bearer independent mechanism

The mapping below only applies for the local transport of generic functional data. For mapping DSS 2 to DSS 1, the mappings shown in Table 14 shall apply.

TABLE 14/Q.2932.1

DSS 2 to DSS 1 mapping

DSS 2 message		DSS 1 message
CO-BI SETUP (Note 1)	→	REGISTER
CALL PROCEEDING		not mapped
CONNECT	→	FACILITY (Note 3)
FACILITY	→	FACILITY
RELEASE (Note 2)	→	RELEASE COMPLETE
RELEASE COMPLETE	→	RELEASE COMPLETE (Note 4)
NOTIFY (Note 5)		not mapped
NOTES 1 – A CALL PROCEEDING message and a CONNECT message are also returned to the DSS 2 entity by the interworking function. 2 – A RELEASE COMPLETE message is also returned to the DSS 2 entity by the interworking function. 3 – Mapping is only performed if the CONNECT message contains a Facility information element. 4 – This mapping only occurs if the DSS 2 RELEASE COMPLETE message is the first clearing message. 5 – It is not expected that this message would occur in a DSS 2 to DSS 1 interworking scenario.		

For mapping DSS 1 to DSS 2, the mappings shown in Table 15 shall apply.

TABLE 15/Q.2932.1

DSS 1 to DSS 2 mapping

DSS 1 message		DSS 2 message
REGISTER	→	CO-BI SETUP
FACILITY	→	FACILITY
RELEASE COMPLETE	→	RELEASE

For the mappings shown in Tables 14 and 15, the following information elements are mapped in either direction:

– facility information element;

– called party number information element;

– called party subaddress information element;

– notification indicator information element.

The contents of the following information elements contained in the DSS 2 protocol are discarded:

– calling party number information element.

The DSS 2 Facility information element is mapped to the DSS 1 Facility information element by removing its second octet and adjusting the length indication without causing other changes to the contents.

The DSS 1 Facility information element is mapped to the DSS 2 Facility information element by inserting the second octet and changing length indication field from one to two octets, adjusting the length accordingly, without causing other changes to the contents. The flag bit in the second octet is set to "0", i.e. the normal error handling procedures as defined in 5.6/Q.2931 apply.

Other information elements are mapped as defined in 6/Q.2931.

11.1.2.4 Connectionless bearer independent mechanism

For mapping DSS 2 to DSS 1, the mappings shown in Table 16 shall apply.

TABLE 16/Q.2932.1

DSS 2 to DSS 1 mapping

DSS 2 message		DSS 1 message
FACILITY	→	FACILITY

For mapping DSS 1 to DSS 2, the mappings shown in Table 17 shall apply.

TABLE 17/Q.2932.1

DSS 1 to DSS 2 mapping

DSS 1 message		DSS 2 message
FACILITY	→	FACILITY

The contents of the following information elements are mapped in either direction:

– facility information element;

– called party number information element;

– called party subaddress information element;

– notification indicator information element.

The contents of the following information elements contained in the DSS 2 protocol are discarded:

– calling party number information element.

The DSS 2 Facility information element is mapped to the DSS 1 Facility information element by removing its second octet and adjusting the length indication without causing other changes to the contents.

The DSS 1 Facility information element is mapped to the DSS 2 Facility information element by inserting the second octet and changing length indication field from one to two octets, adjusting the length accordingly, without causing other changes to the contents. The flag bit in the second octet is set to "0", i.e. the normal error handling procedures as defined in 5.6/Q.2931 apply.

Other information elements are mapped as defined in 6/Q.2931.

11.2 Interworking with non-ISDNs

Interworking of the generic functional protocol with non-ISDNs is not possible.

All information received within the DSS 2 protocol relating to the generic functional protocol is discarded at the interworking function.

11.3 Interworking with frame-relay

Interworking of the generic functional protocol with frame-relay is not possible.

All information received within the DSS 2 protocol relating to the generic functional protocol is discarded at the interworking function.

11.4 Interworking with PSPDNs

Interworking of the generic functional protocol with PSPDNs is not possible.

All information received within the DSS 2 protocol relating to the generic functional protocol is discarded at the interworking function.

12 Parameter values

12.1 Connection-oriented bearer-independent transport

Table 18 defines the values and attributes of the protocol timers required for the connection-oriented bearer-independent transport entity.

In Table 18, the following conventions are used to indicate the applicability of the protocol timers to an incoming transport entity or outgoing transport entity:

M: The support of the timer is Mandatory.

O: The support of the timer is Optional.

M(I): The support of the timer is Mandatory if the associated (optional) procedures are implemented.

All timer values given in Table 18 shall have a tolerance of 10%. Where minimum and maximum values are given, the choice of value is an implementation matter, within the range specified, with a tolerance of 10% below the minimum value and 10% above the maximum value.

TABLE 18/Q.2932.1

Transport entity timer values

Timer number	Timer value	Call state	Cause for start	Normally terminated	Action to be taken when timer expires	Incoming transport entity	Outgoing transport entity
T303	Minimum 4 s, Maximum 6 s	Call initiated	On Sending CO-BI SETUP	On receipt of CALL PROCEEDING, CONNECT or RELEASE COMPLETE	Release the connection as specified in 9.1.3.8		M
T308	Minimum 4 s, Maximum 6 s	Release Request	On Sending RELEASE	On Receiving RELEASE or RELEASE COMPLETE	Retransmit RELEASE, restart T308	M	M
Second T308	Minimum 4 s, Maximum 6 s	Release Request	On expiry of T308	On receiving RELEASE or RELEASE COMPLETE	Release Call Reference	M	M
T309	10 s	Any state	SAAL disconnection. Connections in Stable states are not lost	On SAAL reconnected	Release connection and call reference	M	M
T322	Minimum 4 s, Maximum 6 s	Any connection state except Null	STATUS ENQUIRY sent	STATUS, RELEASE or RELEASE COMPLETE received	STATUS ENQUIRY may be transmitted several times - implementation dependent.	M (I)	M (I)

TABLE 19/Q.2932.1

GFT-Control timer values

Timer number	Timer value	State	Cause for start	Normally terminated	Action to be taken when timer expires	Incoming entity	Outgoing entity
T310	30 s	Idle	On receipt of CO-BI-proceeding.indication	On receipt of CO-BI-Setup.confirm or CO-BI-release.indication	Release the connection as specified in 9.1.3.8		M

13 Dynamic description (SDLs)

The Specification and Description Language (SDL) diagrams are provided according to ITU-T Recommendation Z.100 [16].

13.1 Block overview diagram

The block overview diagram for a DSS 2 protocol with the minimum required for the generic functional protocol is shown in Figure 7.

13.2 Coordination function

The additional SDL diagrams for the coordination function of Recommendation Q.2931 [13] Coord-N and Coord-U are shown in Figures 8 and 9, respectively.

13.3 Component transport mechanisms

13.3.1 Bearer-related transport mechanism

The additional SDL diagrams for the bearer-related transport mechanism for the network (Q.2931_N) and for the user (Q.2931_U) are shown in Figures 10 and 11, respectively.

13.3.2 Connection-oriented bearer-independent transport mechanism

The SDL diagram for the connection-oriented bearer-independent transport mechanism is shown in Figure 12.

13.3.3 Connectionless bearer-independent transport mechanism

The SDL diagram for the connectionless bearer-independent transport mechanism is shown in Figure 13.

13.4 Generic functional transport control (GFT-Control)

The SDL diagram for GFT-Control is shown in Figure 14.

The procedure for determine destination is shown in Figure 15.

The procedures for the MSN supplementary service are shown in Figures 16 and 18.

The procedures for the SUB supplementary service are shown in Figures 17 and 19.

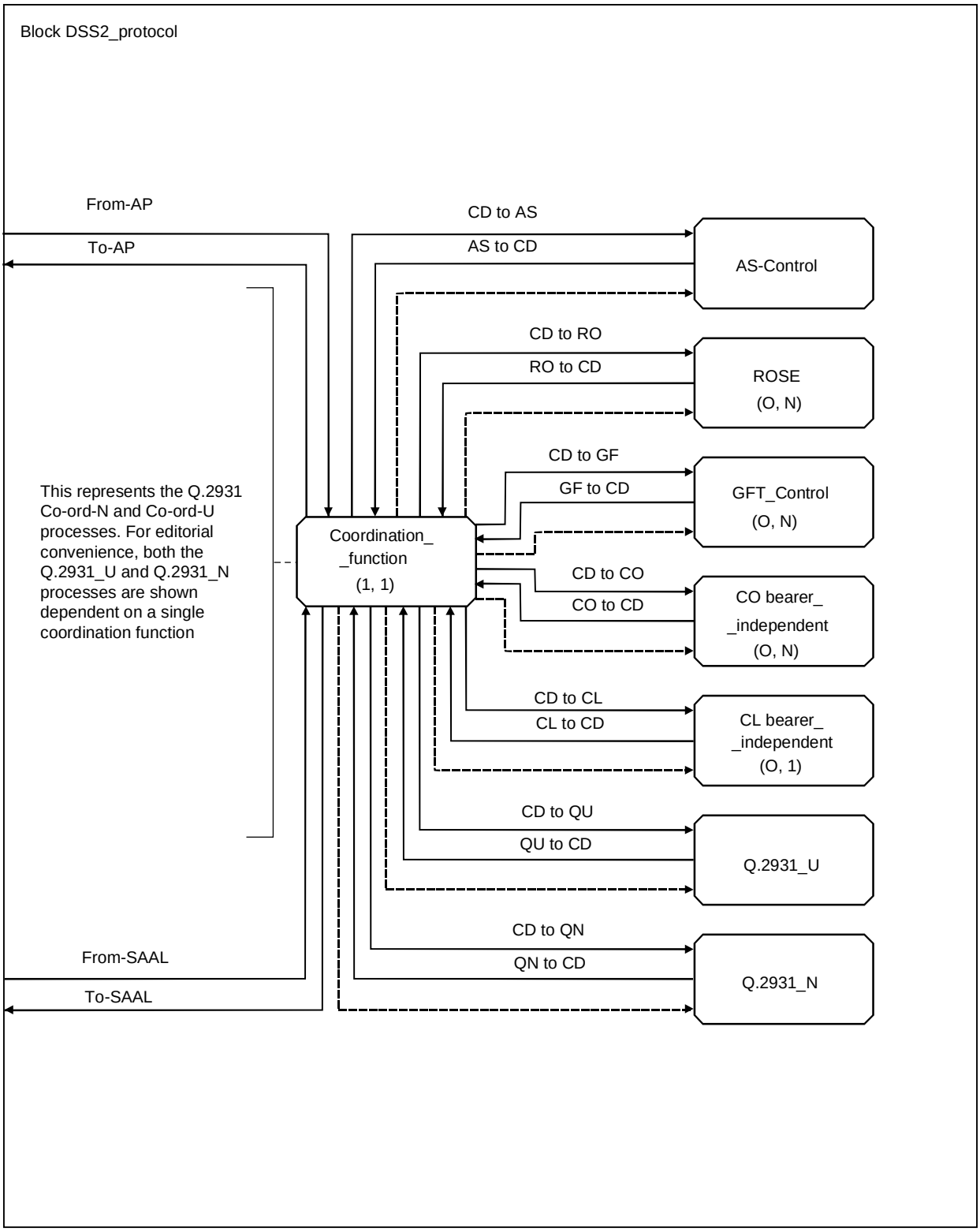


FIGURE 7/Q.2932.1

Block overview diagram

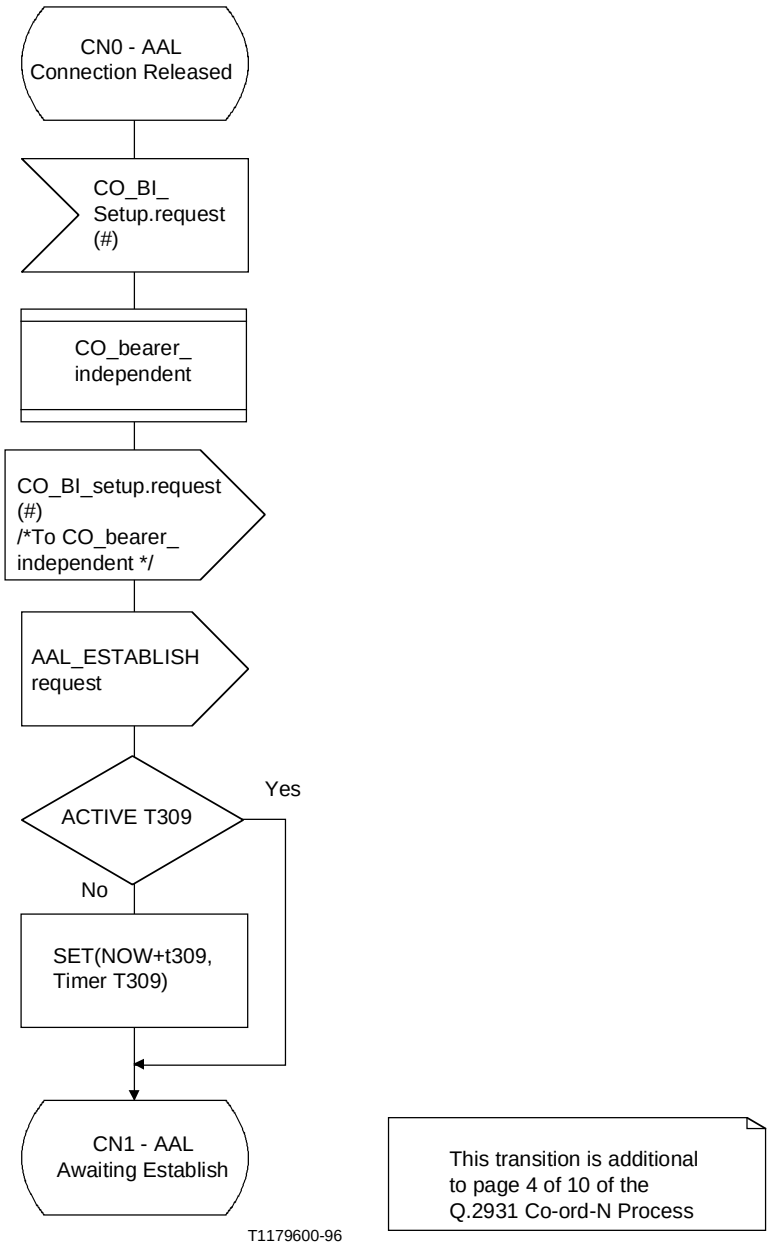


FIGURE 8/Q.2932.1 (sheet 1 of 7)

PROCESS Co-ord-N

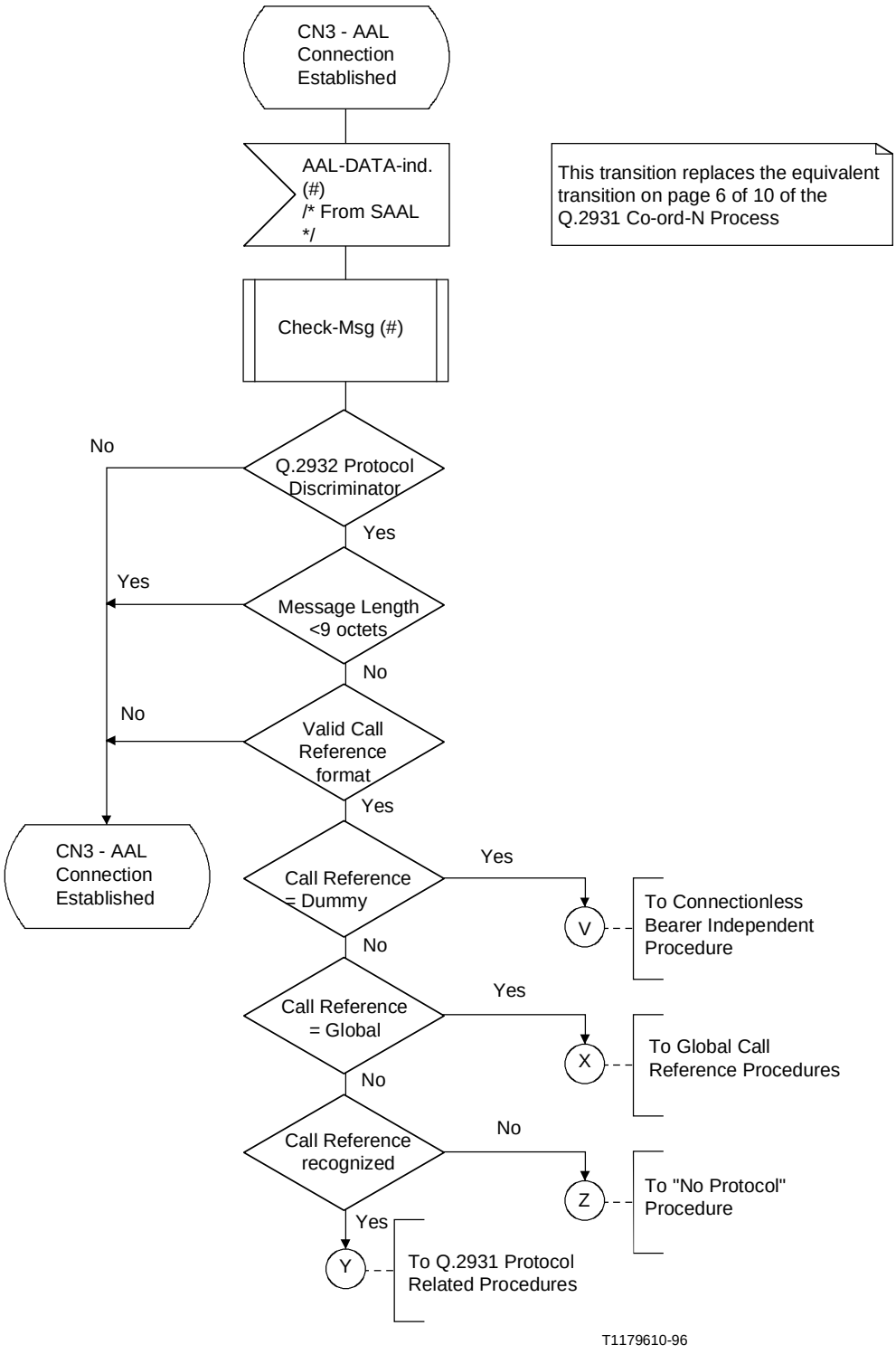


FIGURE 8/Q.2932.1 (sheet 2 of 7)

PROCESS Co-ord-N

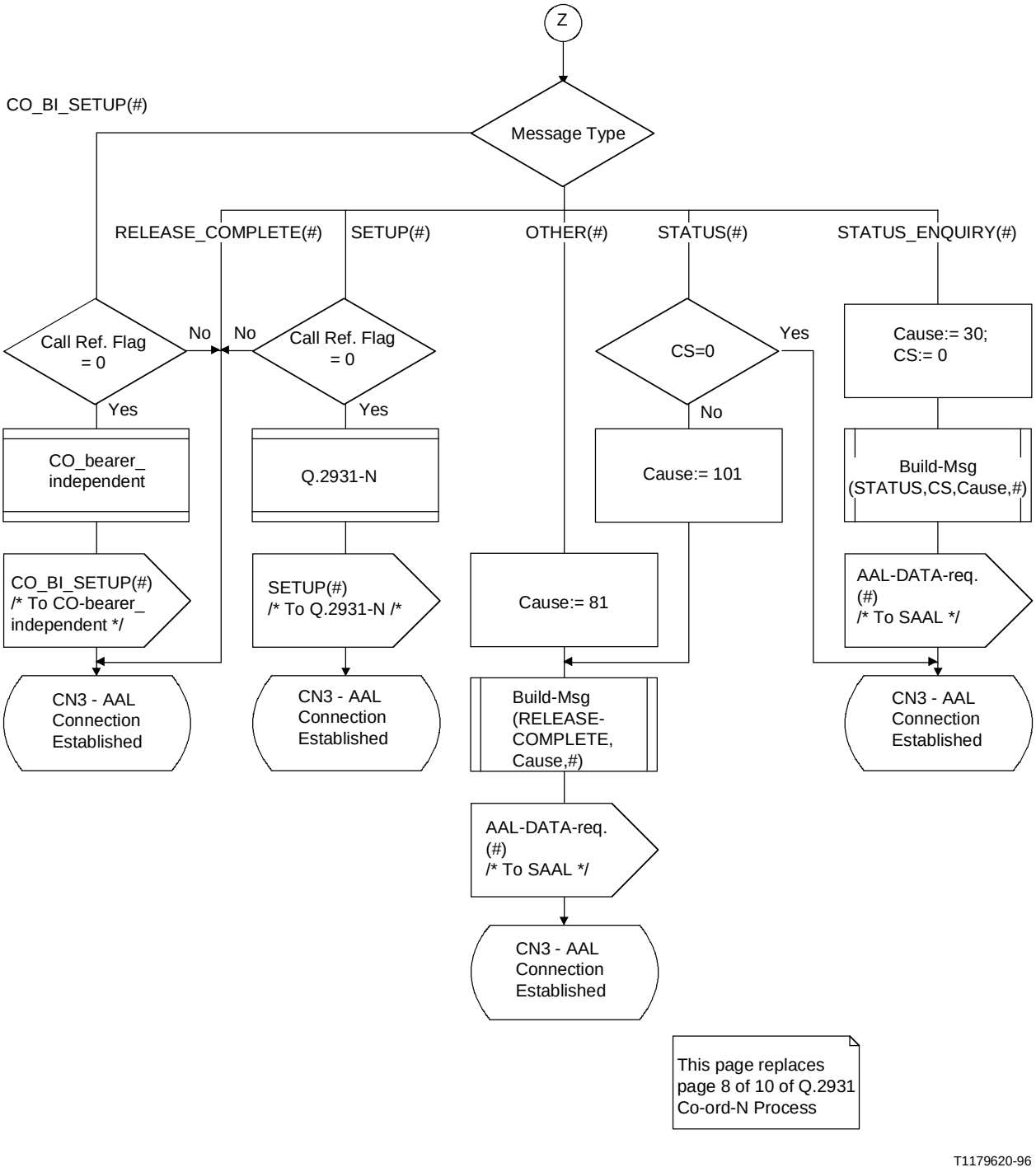


FIGURE 8/Q.2932.1 (sheet 3 of 7)

PROCESS Co-ord-N

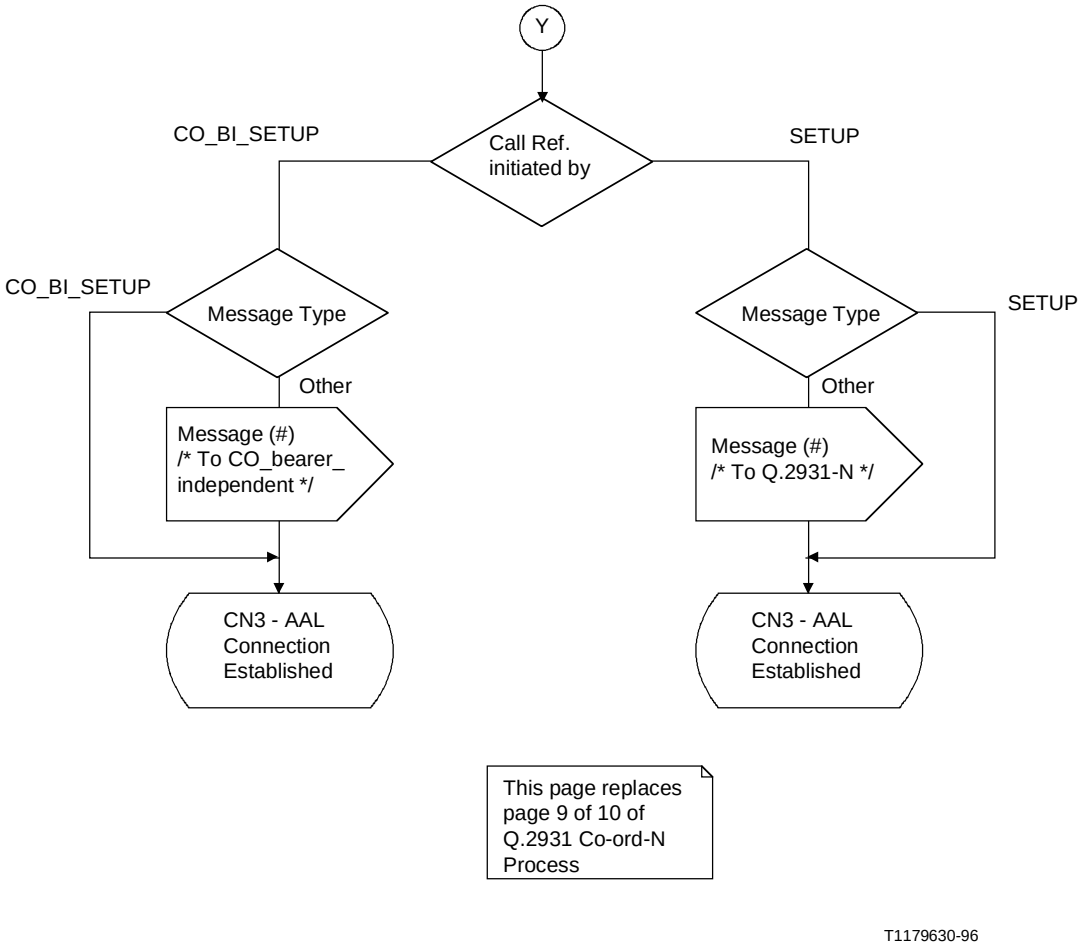


FIGURE 8/Q.2932.1 (sheet 4 of 7)

PROCESS Co-ord-N

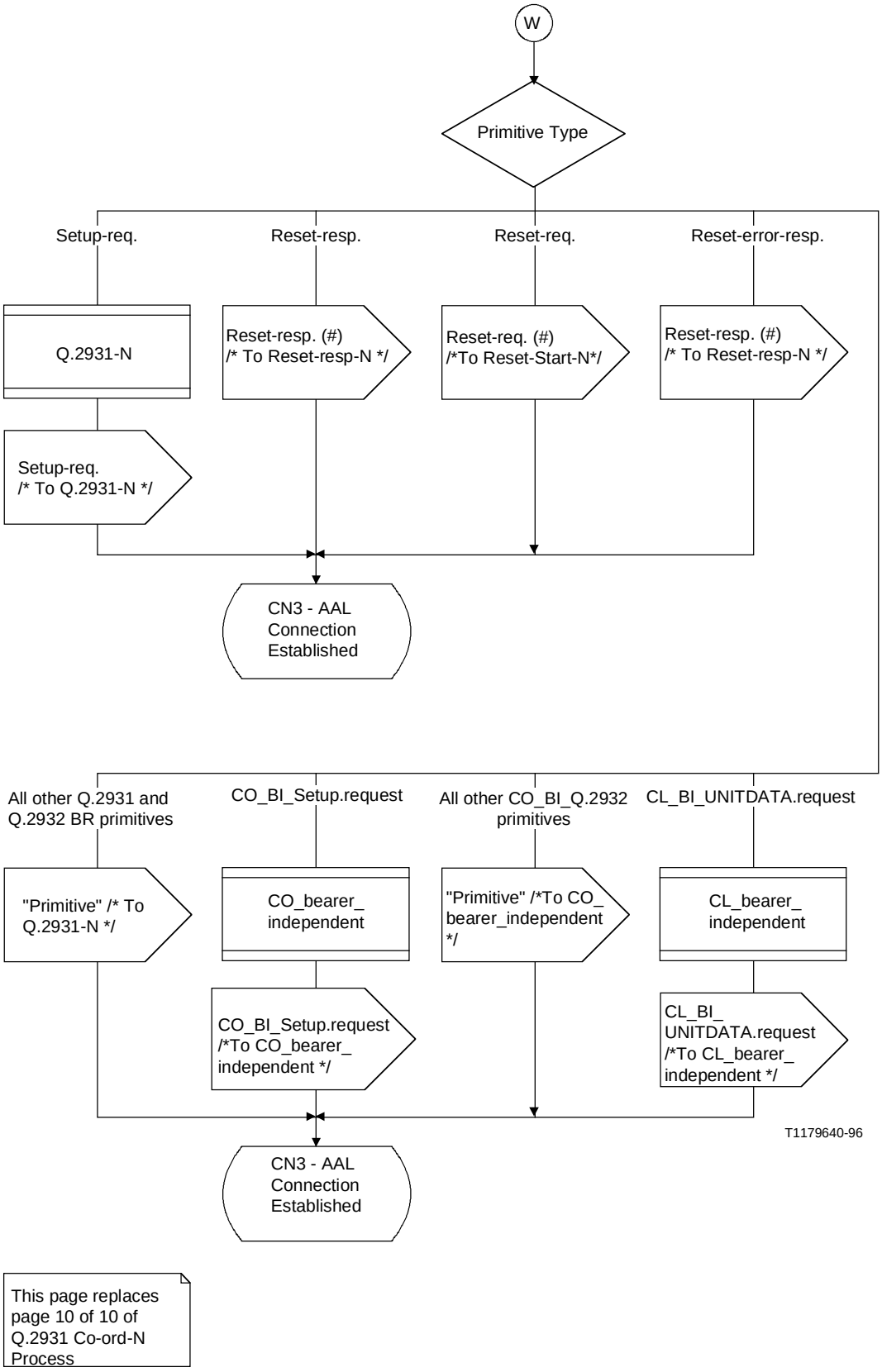


FIGURE 8/Q.2932.1 (sheet 5 of 7)

PROCESS Co-ord-N

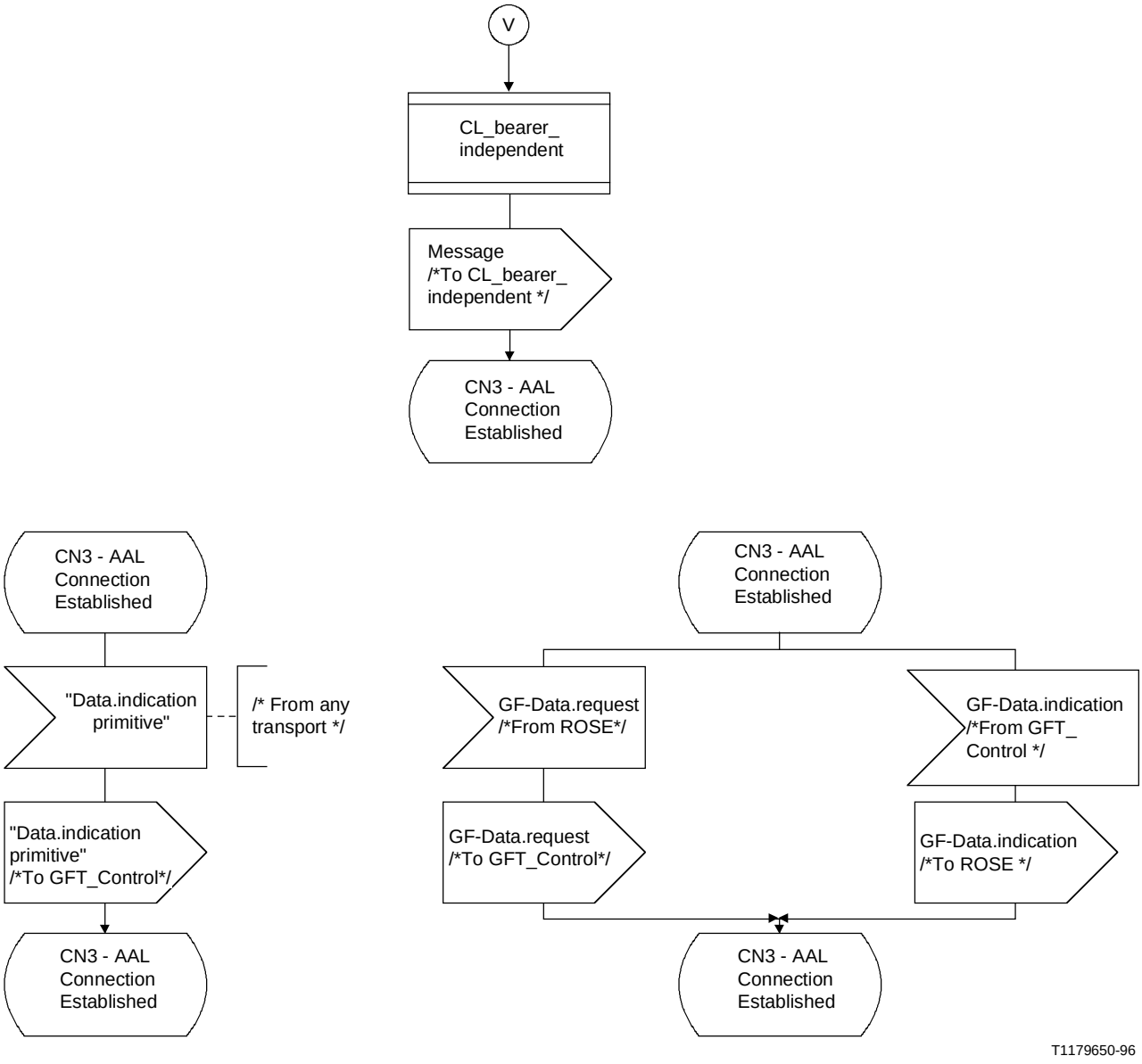


FIGURE 8/Q.2932.1 (sheet 6 of 7)

PROCESS Co-ord-N

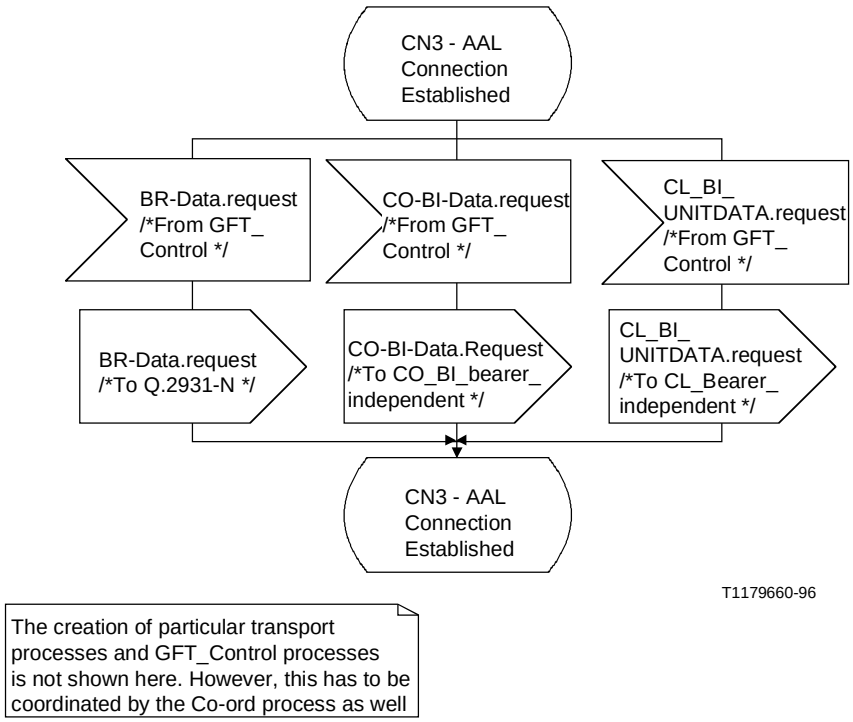


FIGURE 8/Q.2932.1 (sheet 7 of 7)

PROCESS Co-ord-N

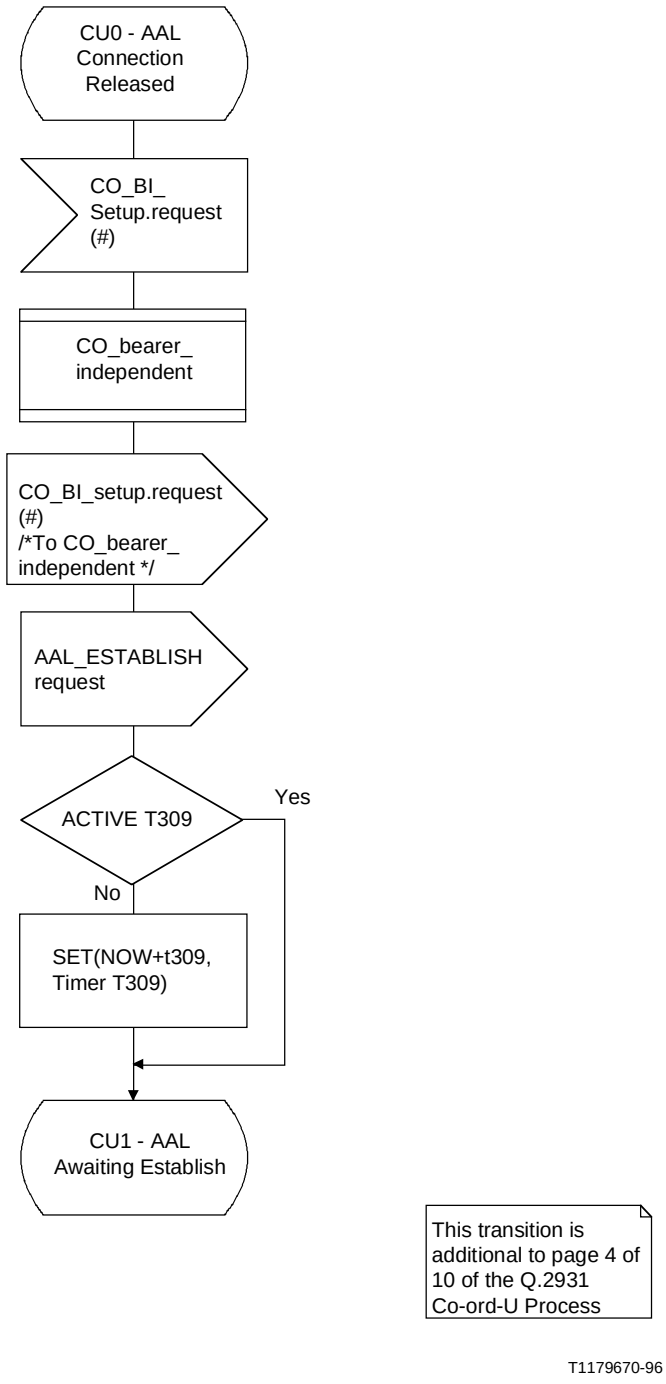


FIGURE 9/Q.2932.1 (sheet 1 of 7)

PROCESS Co-ord-U

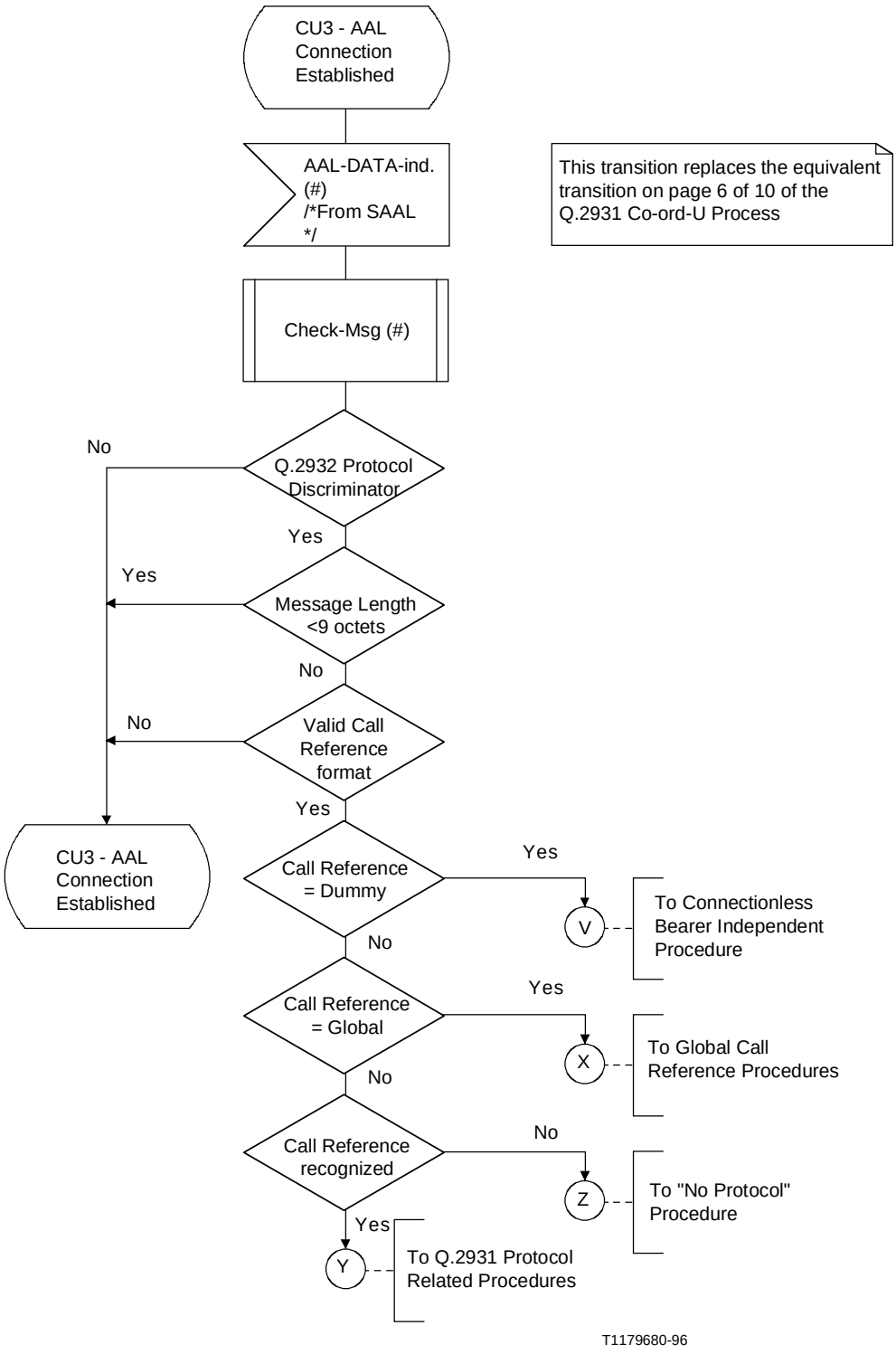


FIGURE 9/Q.2932.1 (sheet 2 of 7)

PROCESS Co-ord-U

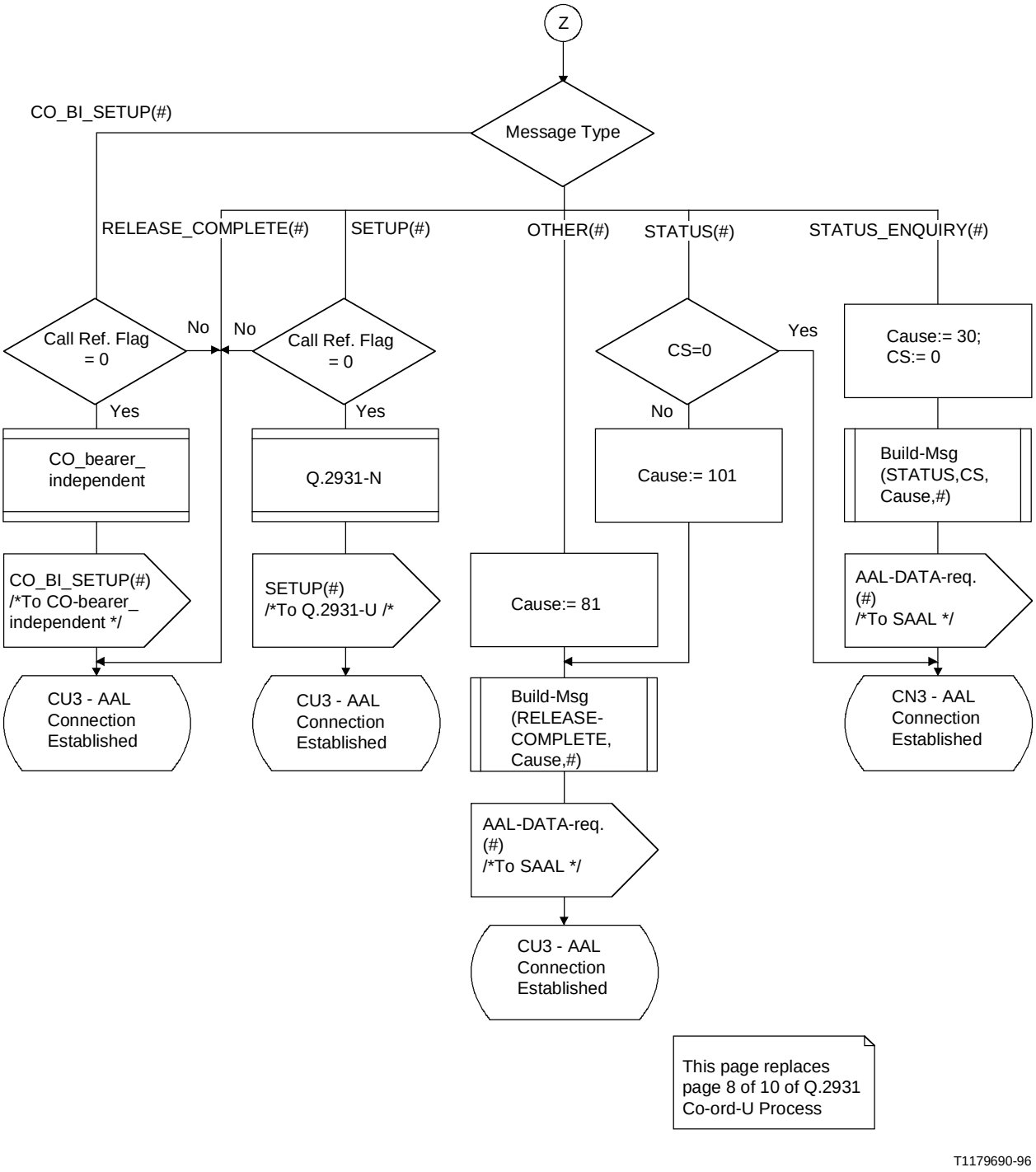


FIGURE 9/Q.2932.1 (sheet 3 of 7)

PROCESS Co-ord-U

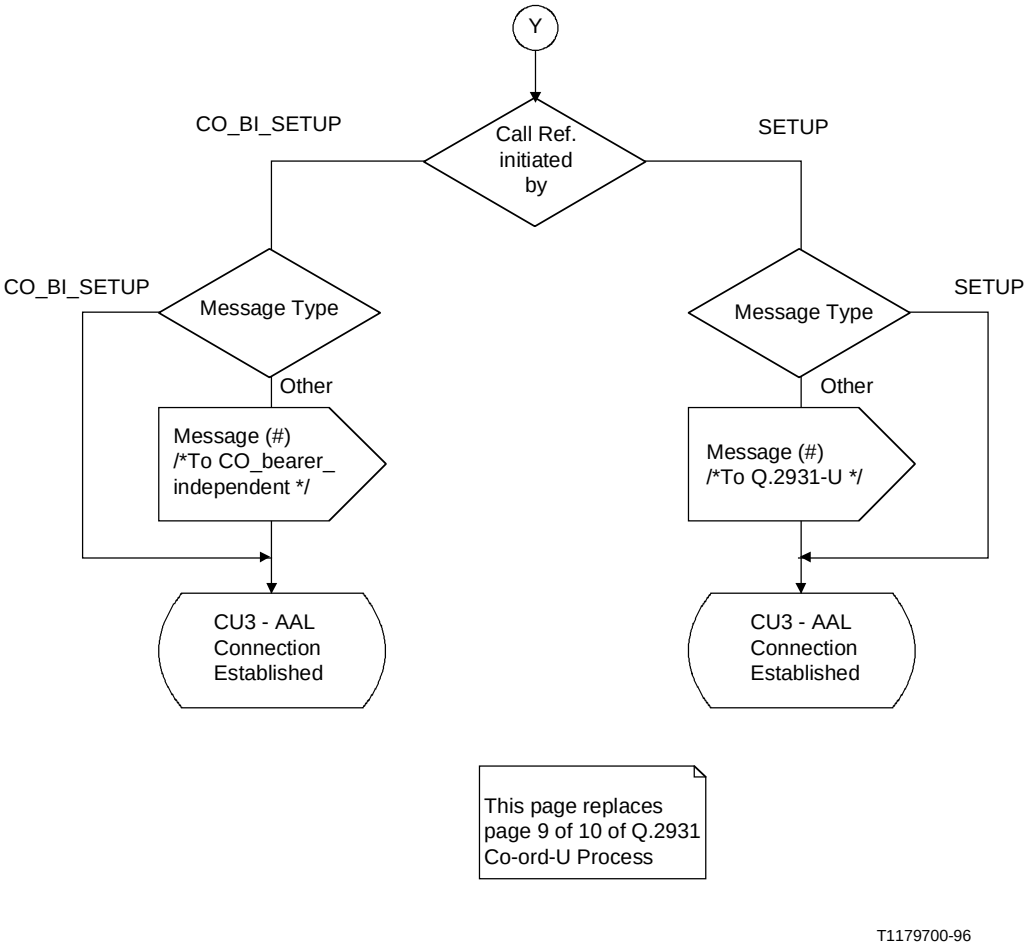


FIGURE 9/Q.2932.1 (sheet 4 of 7)

PROCESS Co-ord-U

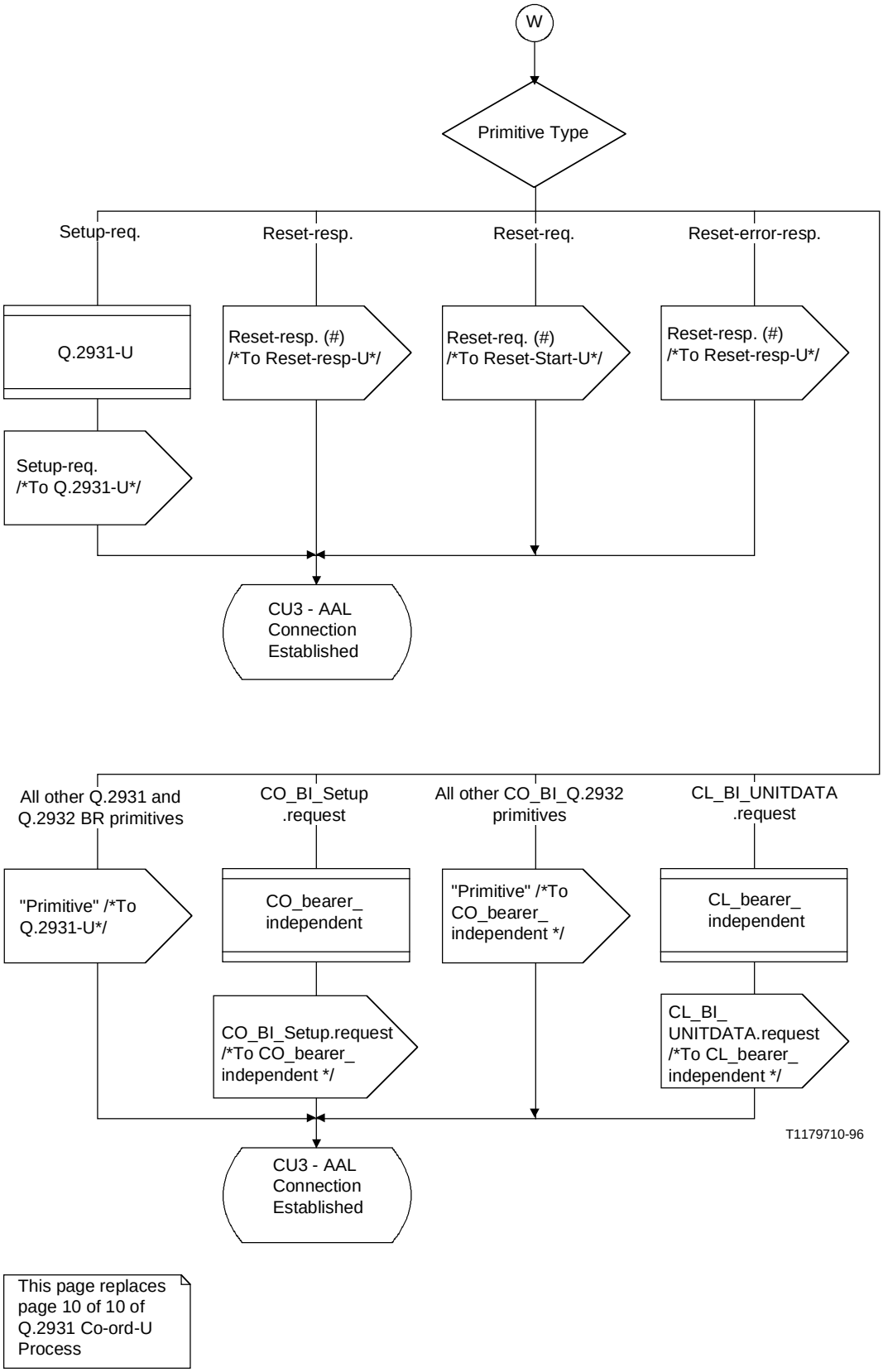


FIGURE 9/Q.2932.1 (sheet 5 of 7)

PROCESS Co-ord-U

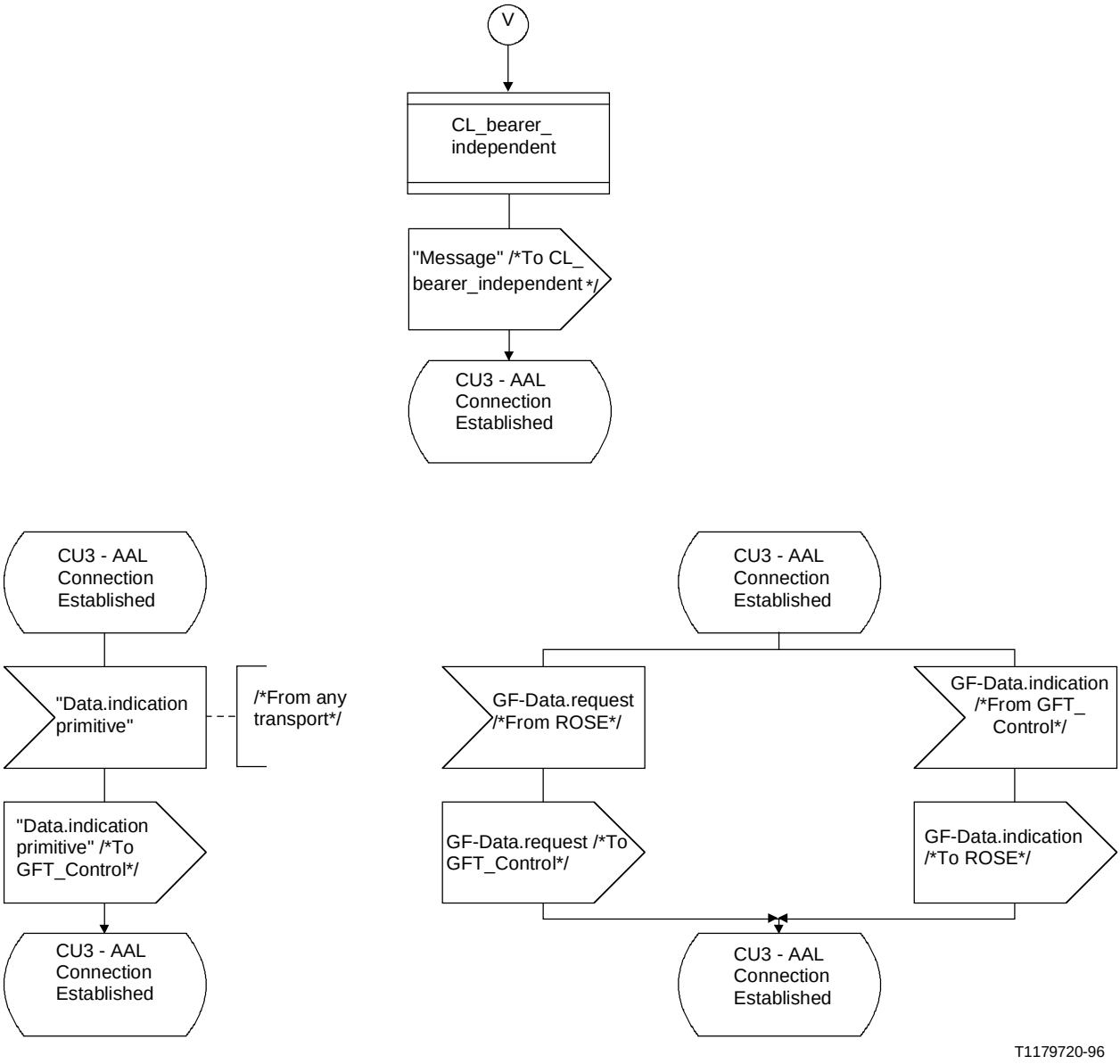


FIGURE 9/Q.2932.1 (sheet 6 of 7)

PROCESS Co-ord-U

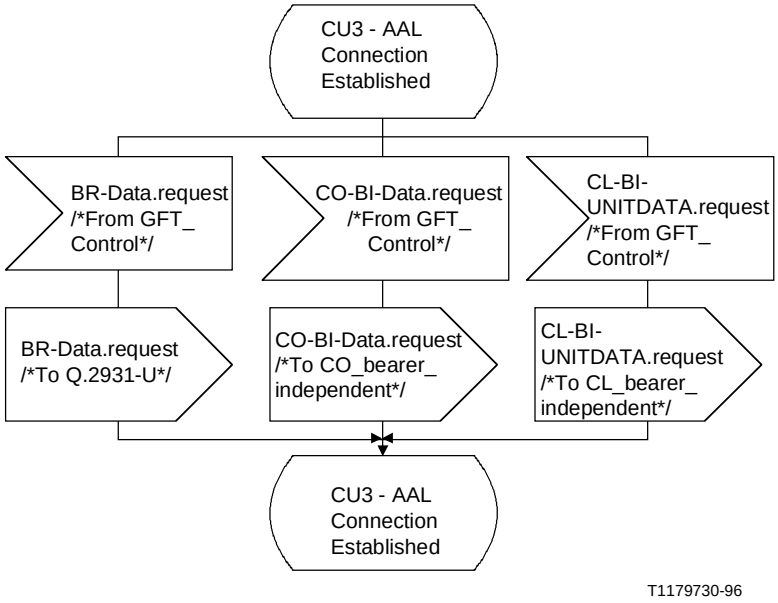


FIGURE 9/Q.2932.1 (sheet 7 of 7)

PROCESS Co-ord-U

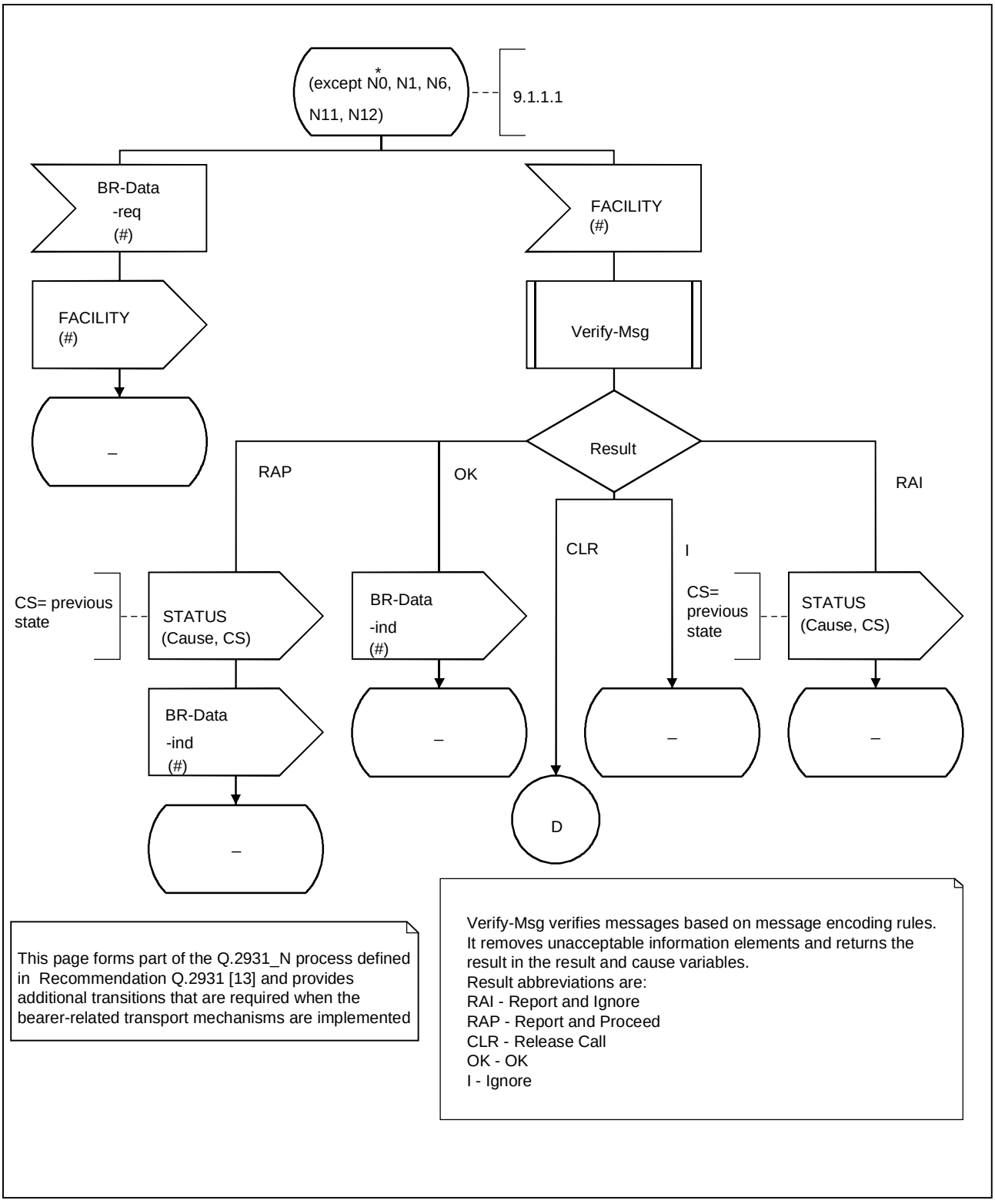


FIGURE 10/Q.2932.1

Process Q.2931_N

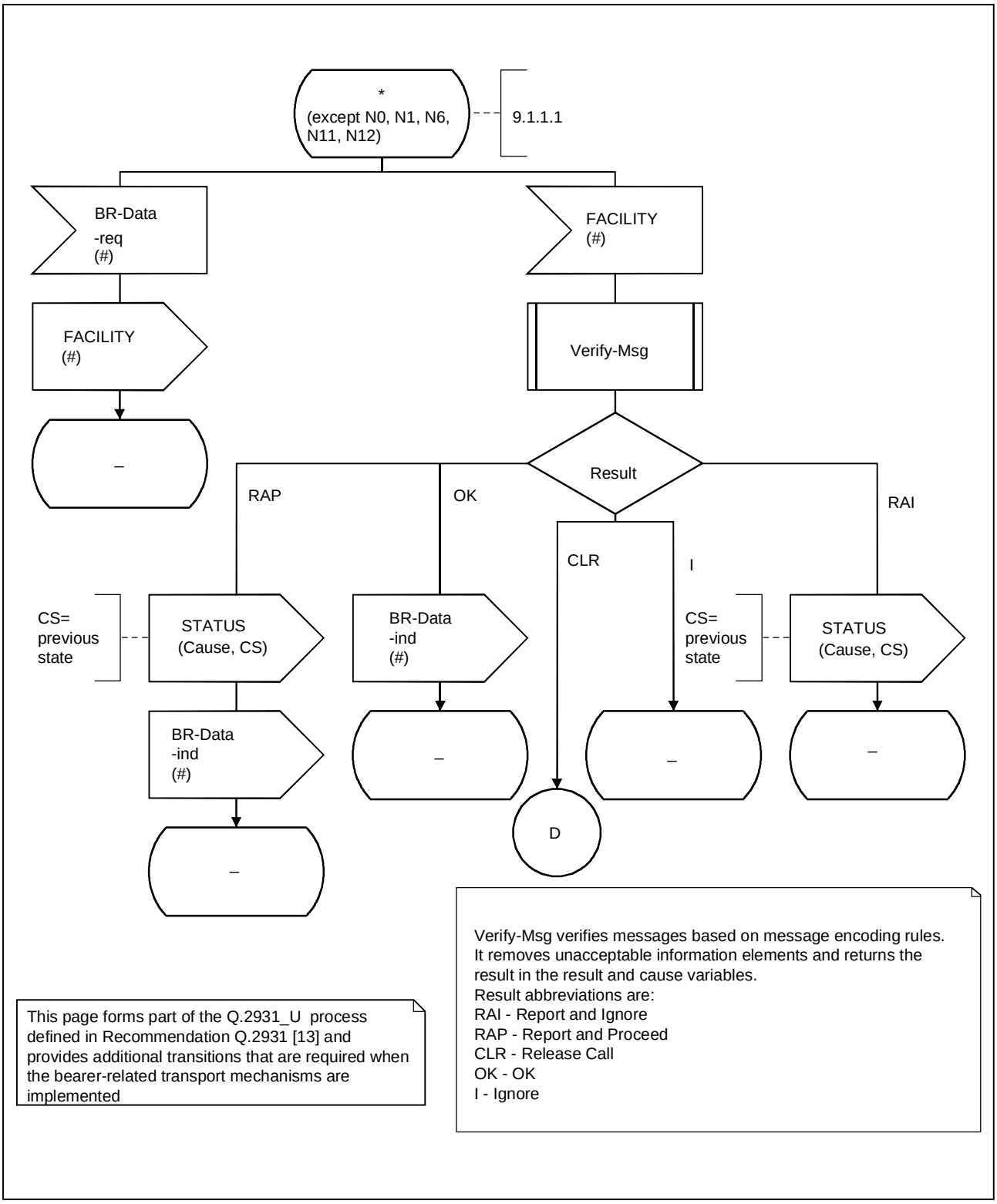


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FIGURE 11/Q.2932.1

Process Q.2931_U

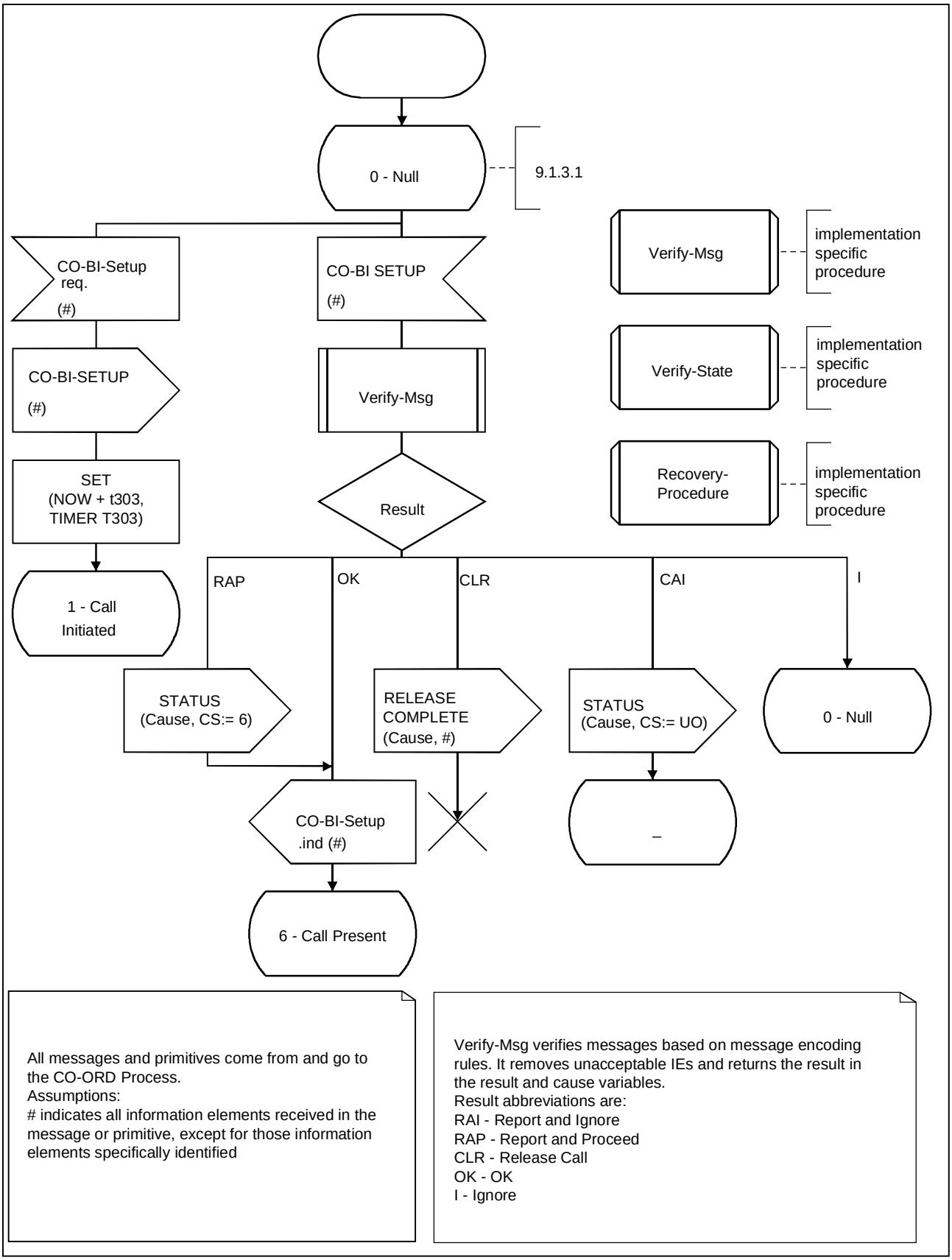

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FIGURE 12/Q.2932.1 (sheet 1 of 14)

Process CO_bearer_independent

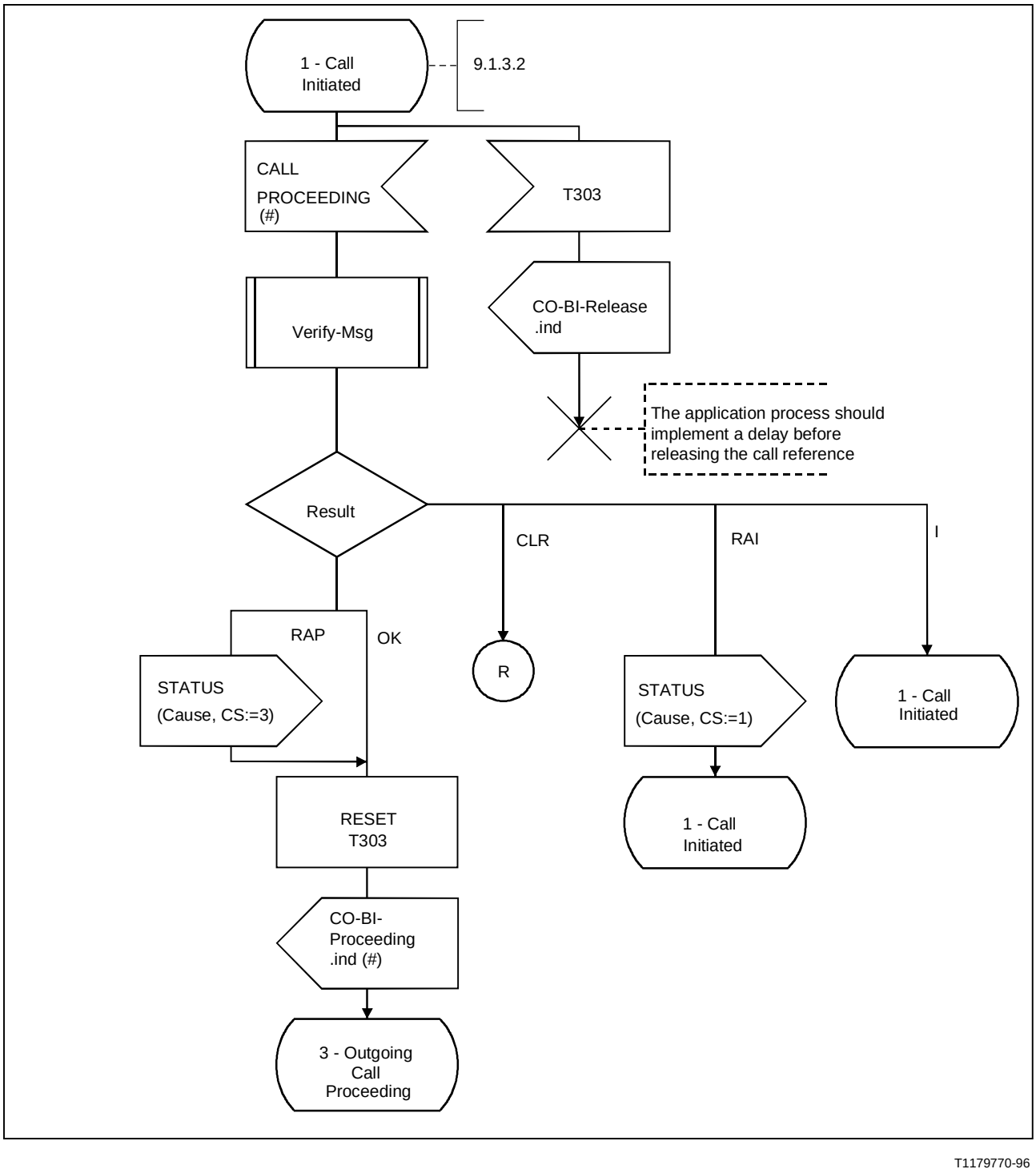

FIGURE 12/Q.2932.1 (sheet 2 of 14)

Process CO_bearer_independent

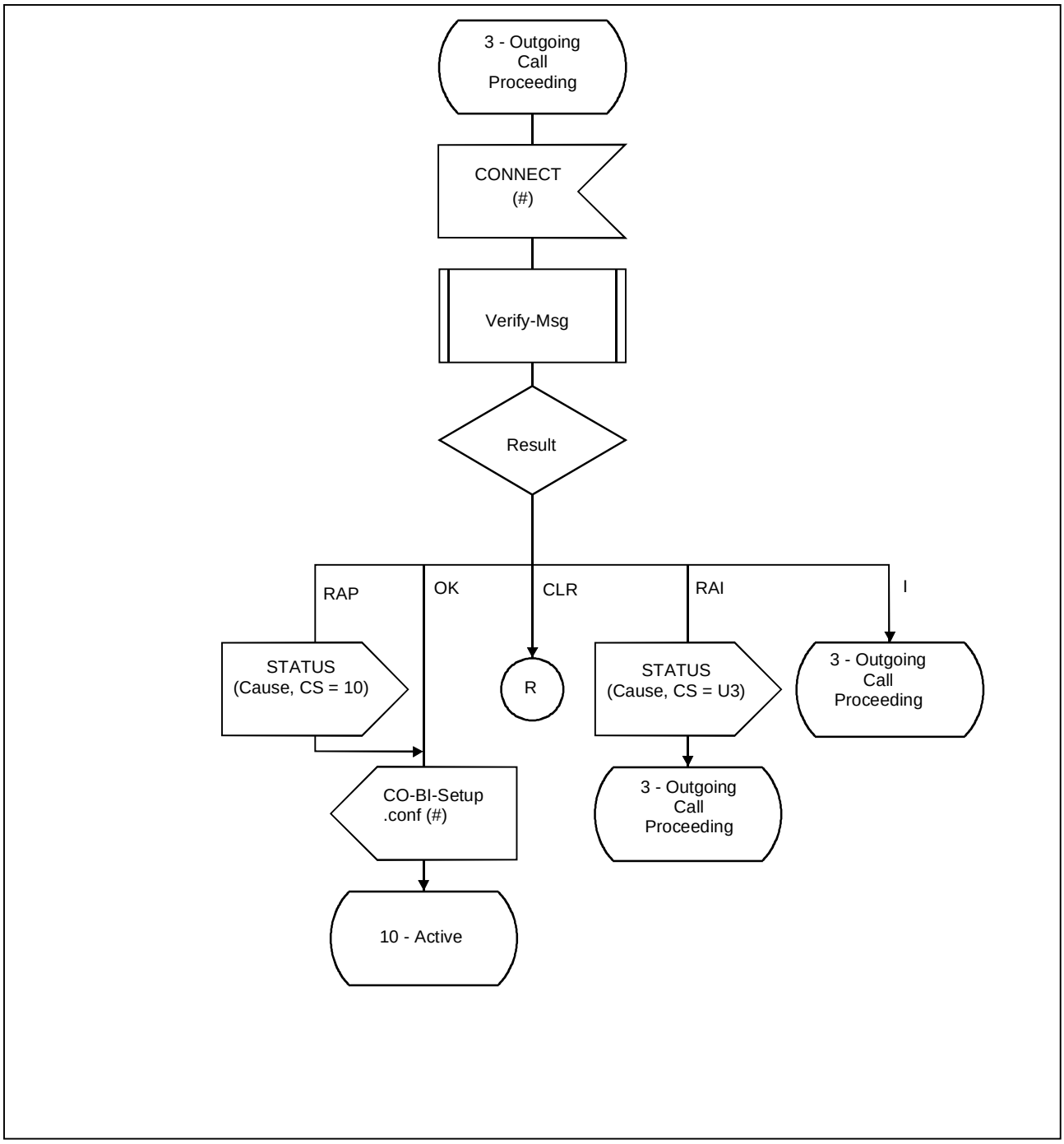

FIGURE 12/Q.2932.1 (sheet 3 of 14)

Process CO_bearer_independent

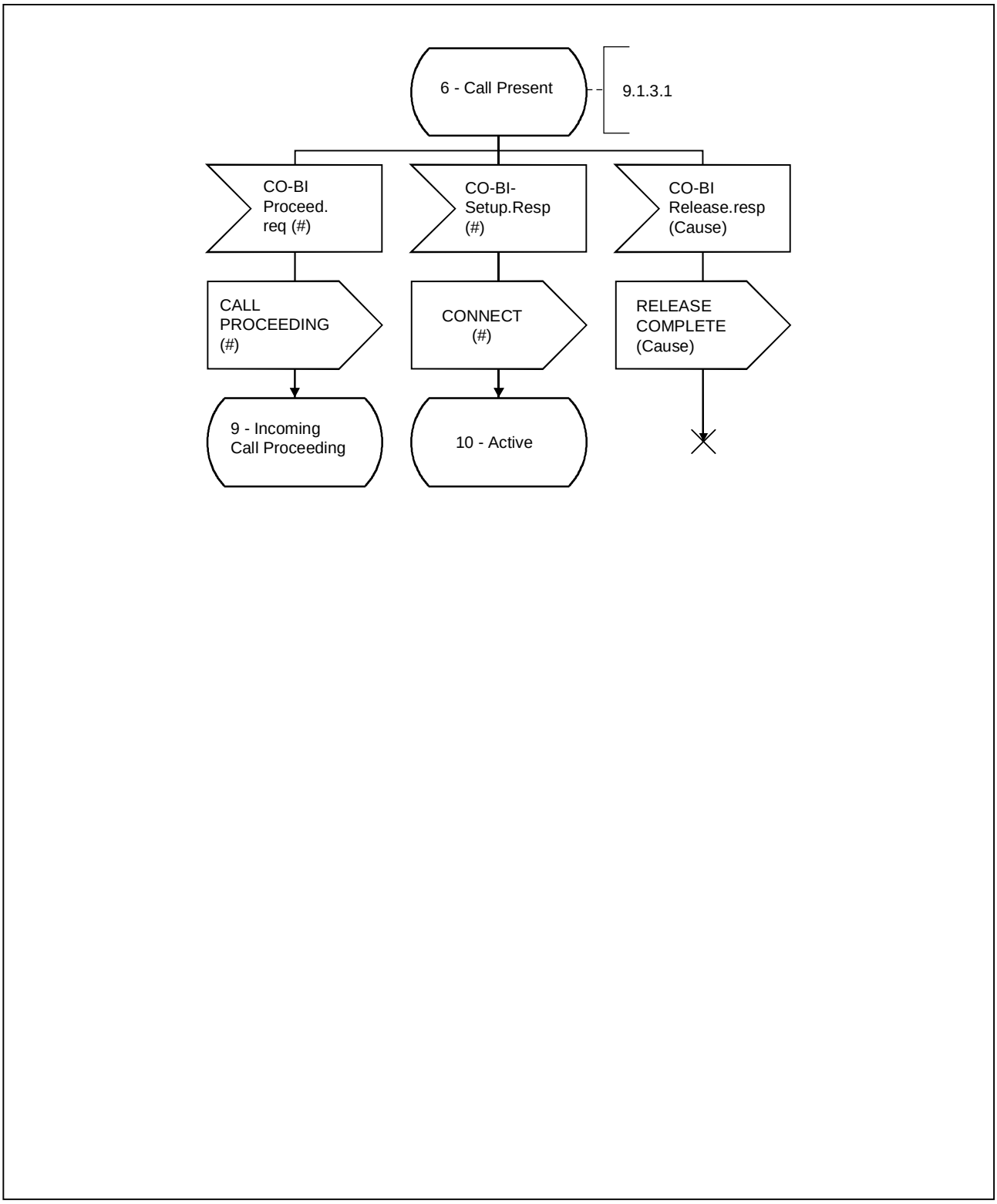

FIGURE 12/Q.2932.1 (sheet 4 of 14)

Process CO_bearer_independent

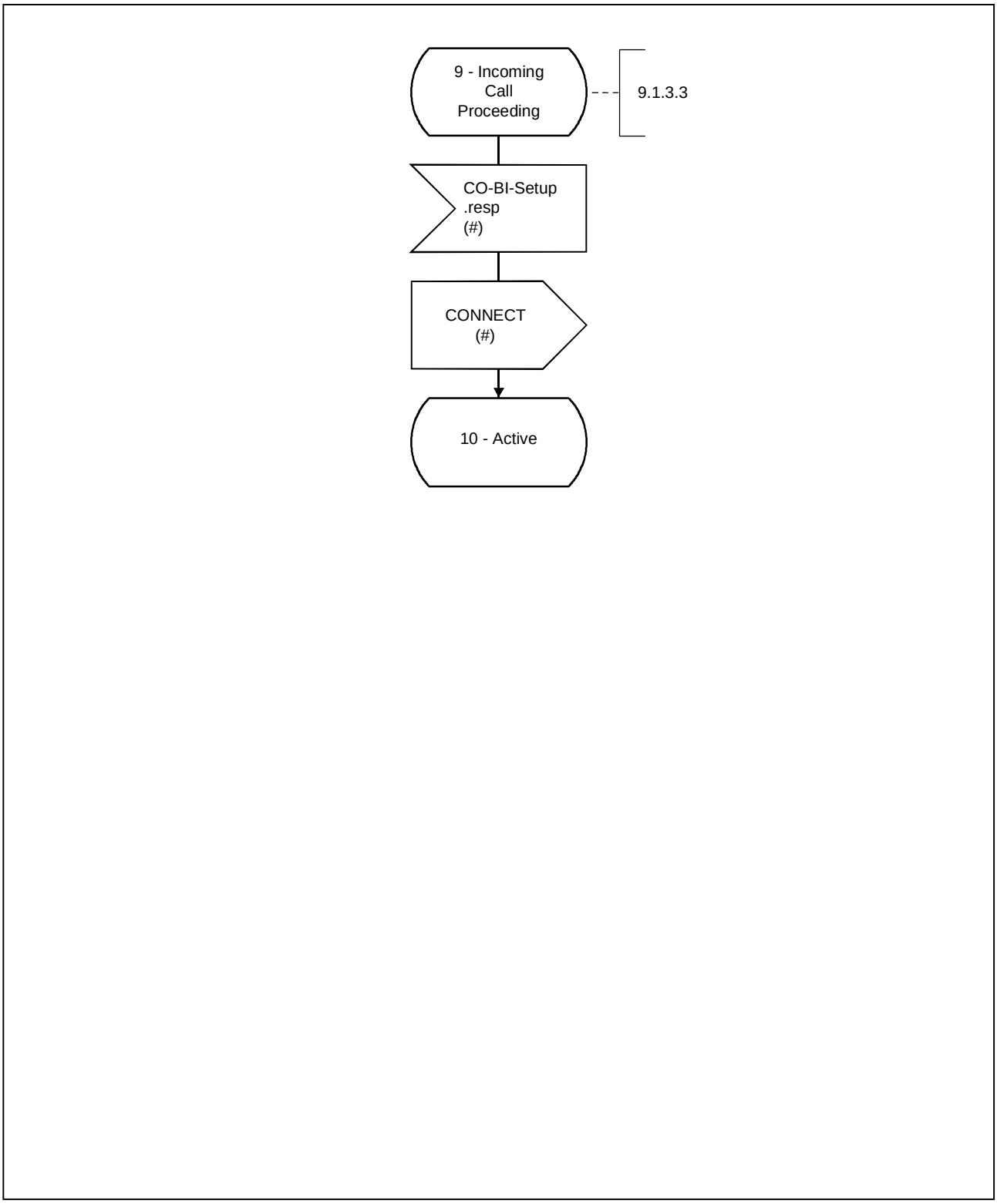

FIGURE 12/Q.2932.1 (sheet 5 of 14)

Process_CO_bearer_independent

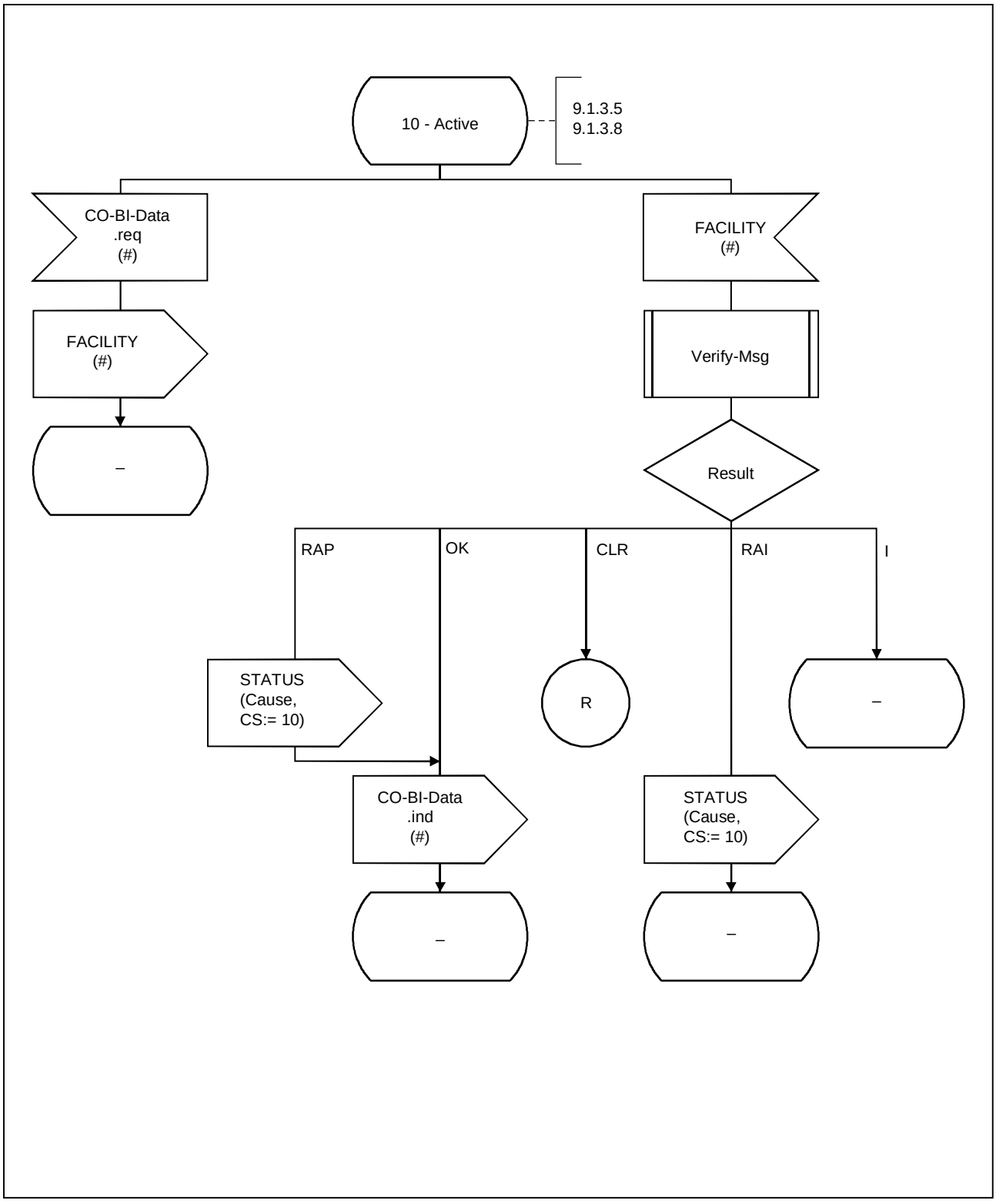

FIGURE 12/Q.2932.1 (sheet 6 of 14)

Process CO_bearer_independent

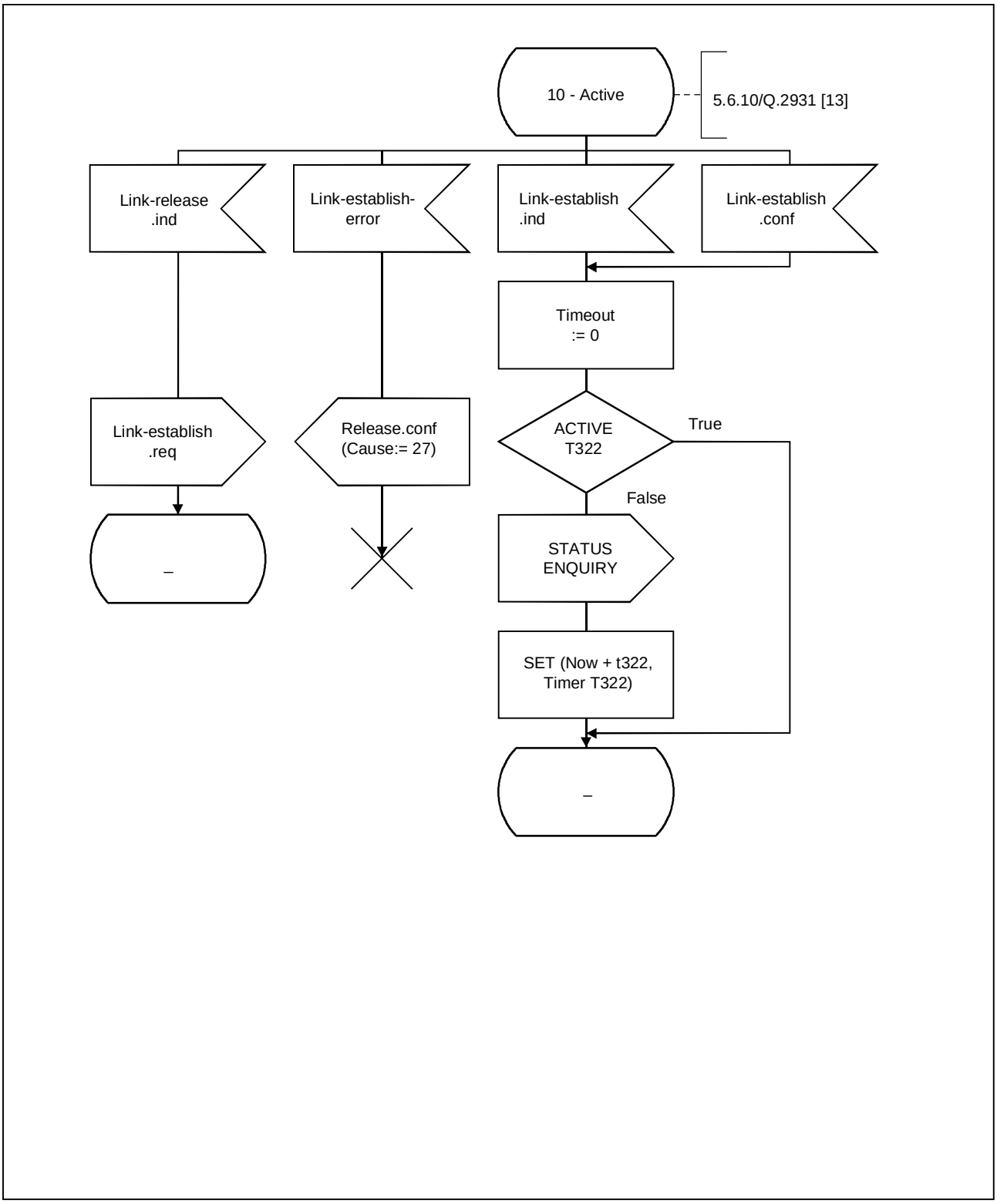

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FIGURE 12/Q.2932.1 (sheet 7 of 14)

Process CO_bearer_independent

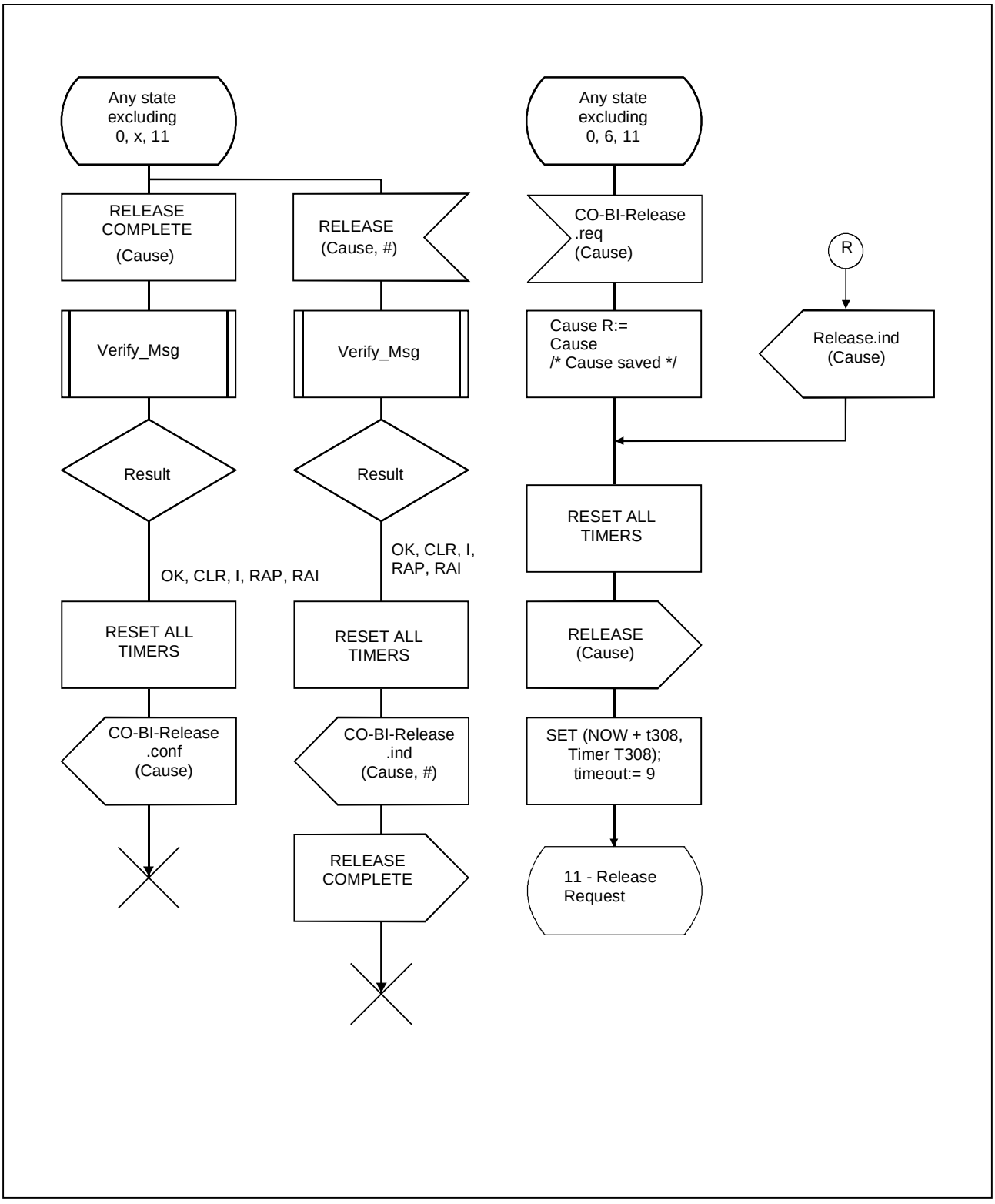

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FIGURE 12/Q.2932.1 (sheet 8 of 14)

Process CO_bearer_independent

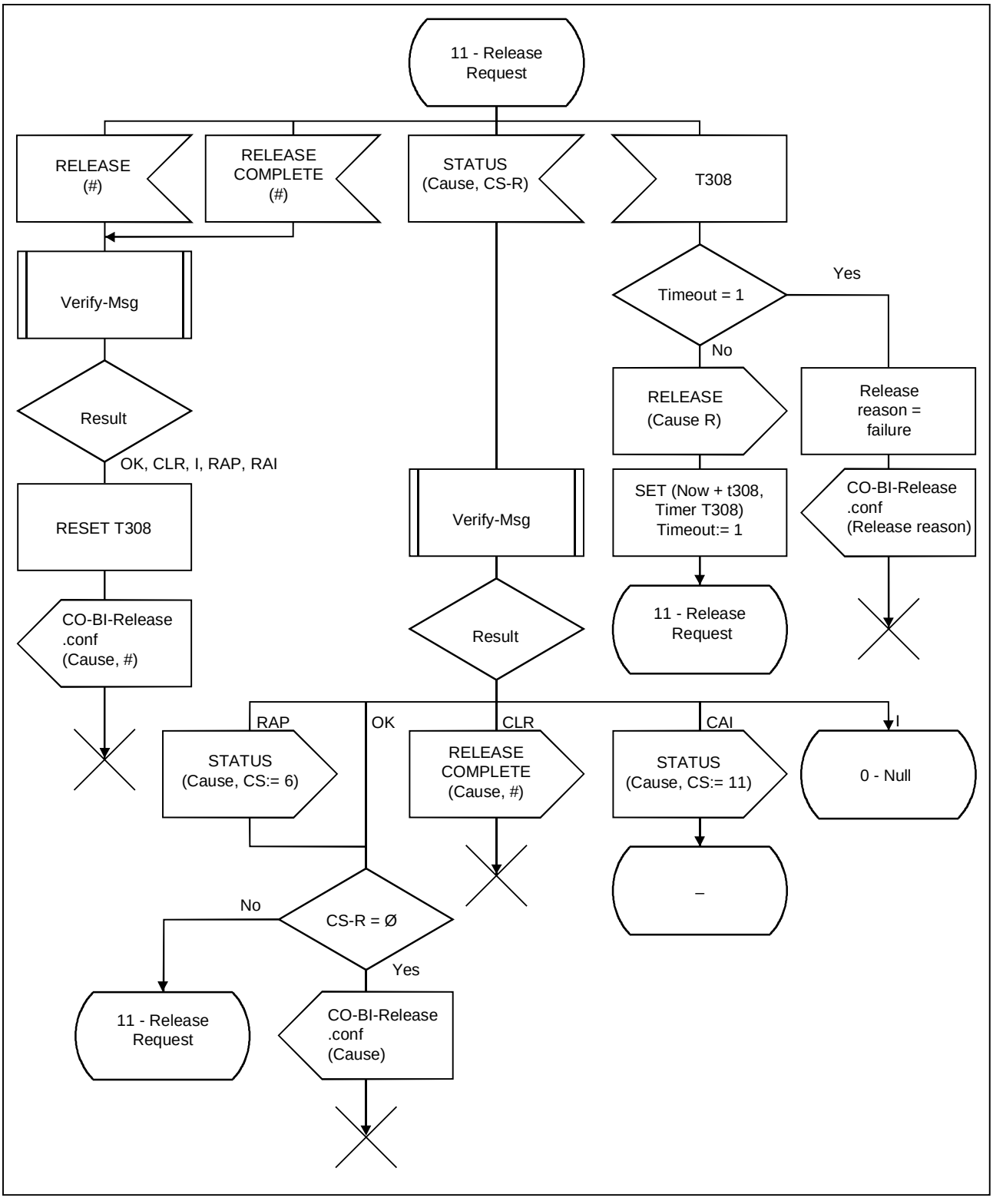

FIGURE 12/Q.2932.1 (sheet 9 of 14)

Process CO_bearer_independent

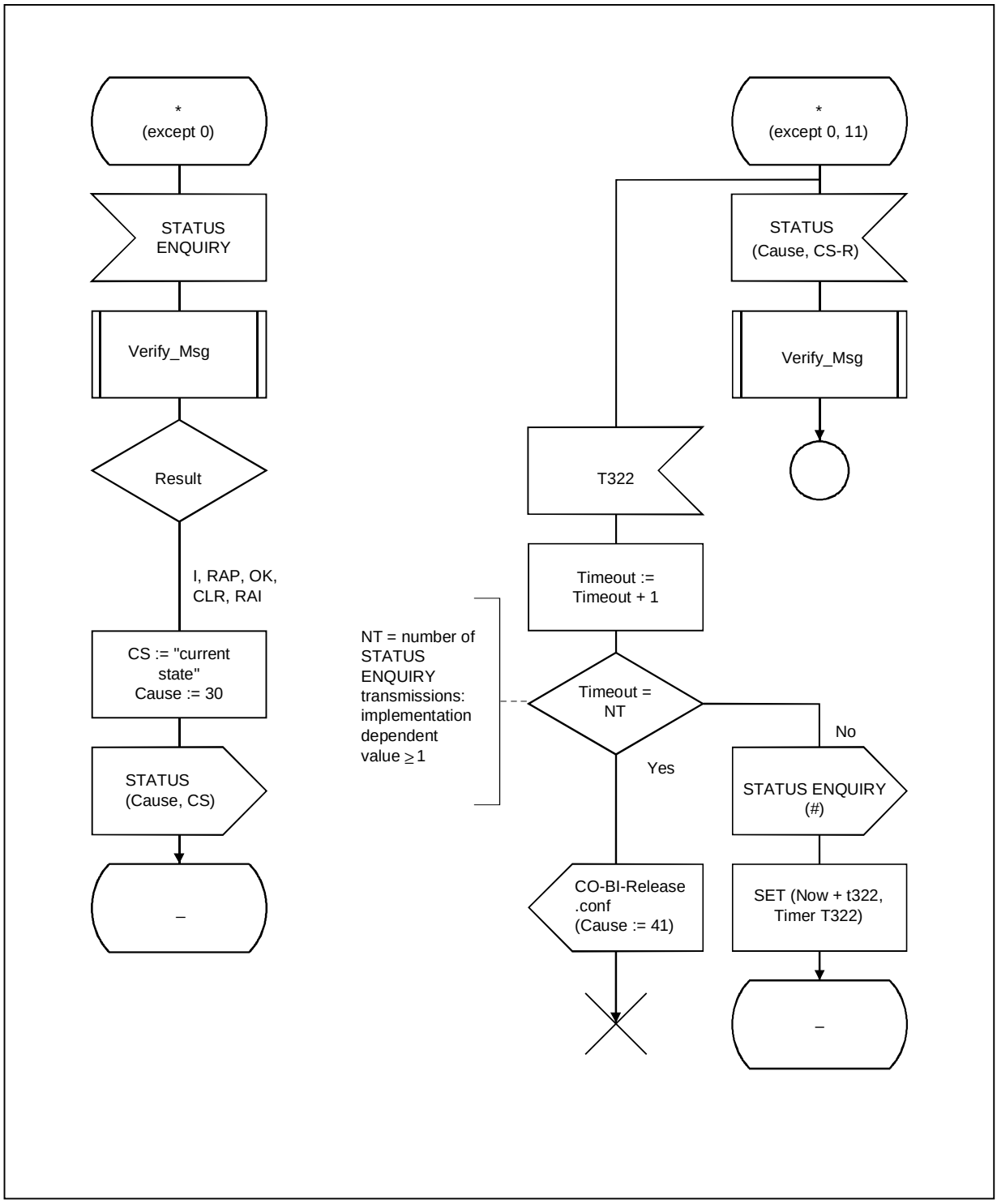

FIGURE 12/Q.2932.1 (sheet 10 of 14)

Process CO_bearer_independent

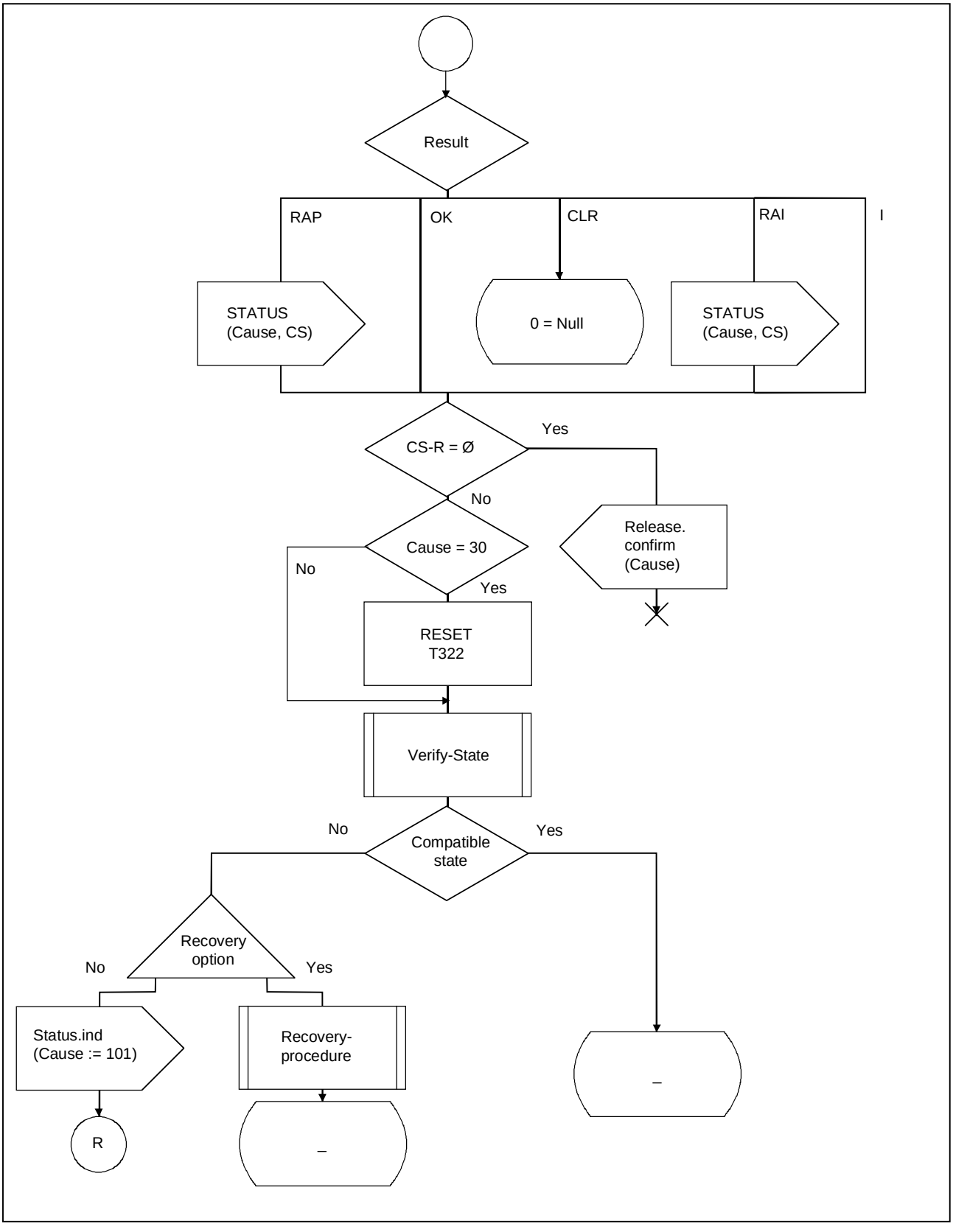

FIGURE 12/Q.2932.1 (sheet 11 of 14)

Process CO_bearer_independent

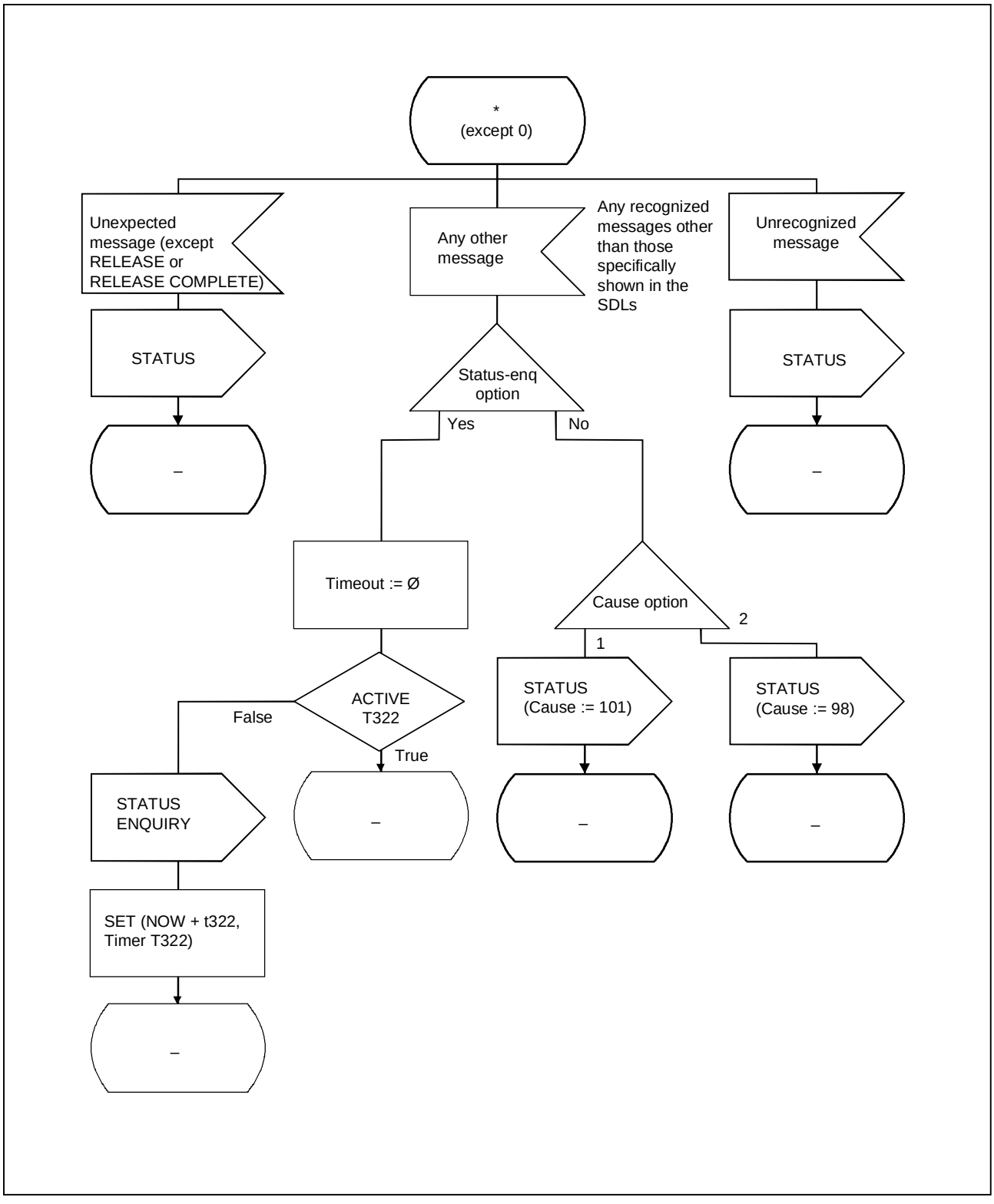

FIGURE 12/Q.2932.1 (sheet 12 of 14)

Process CO_bearer_independent

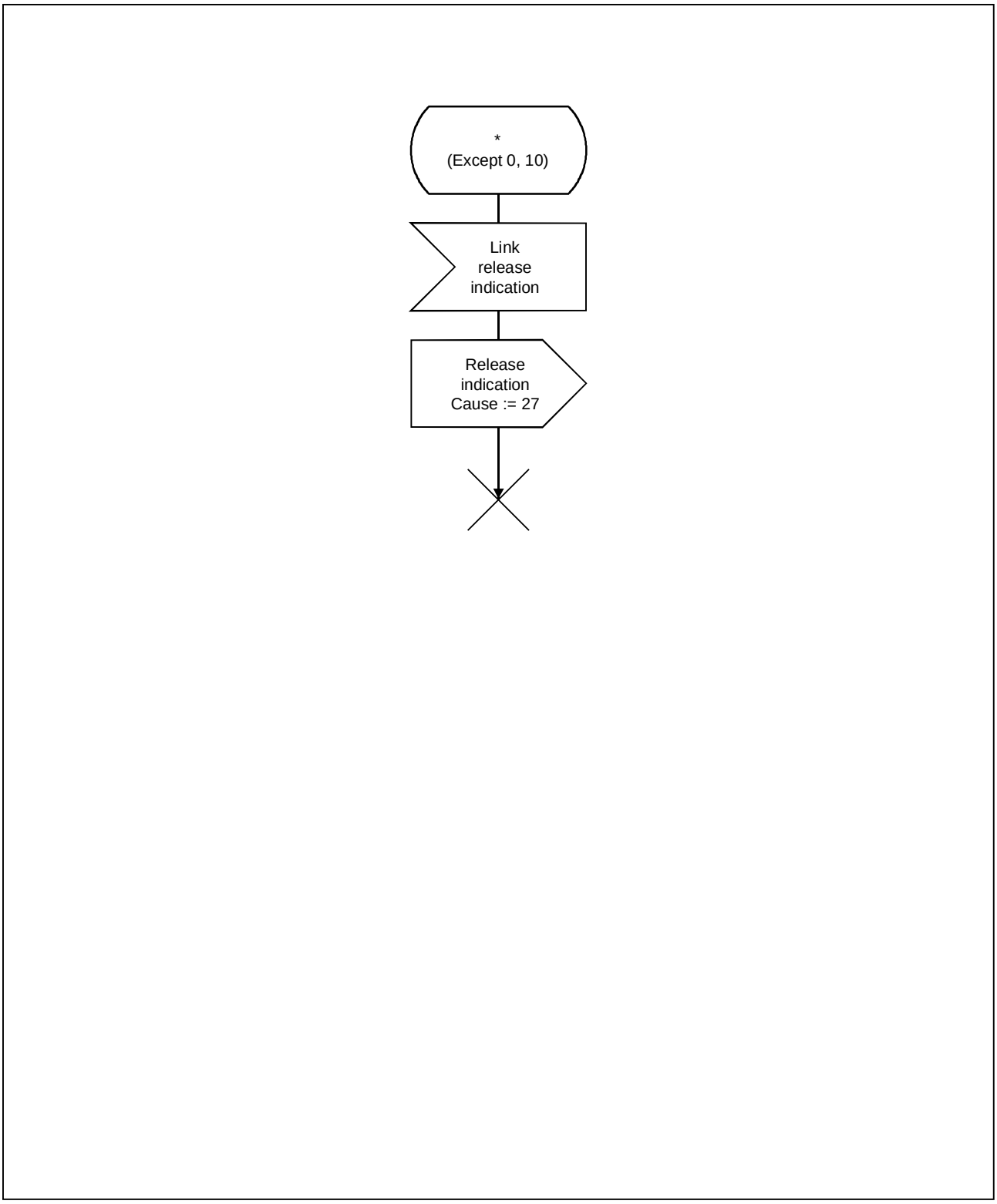

FIGURE 12/Q.2932.1 (sheet 13 of 14)

Process CO_bearer_independent

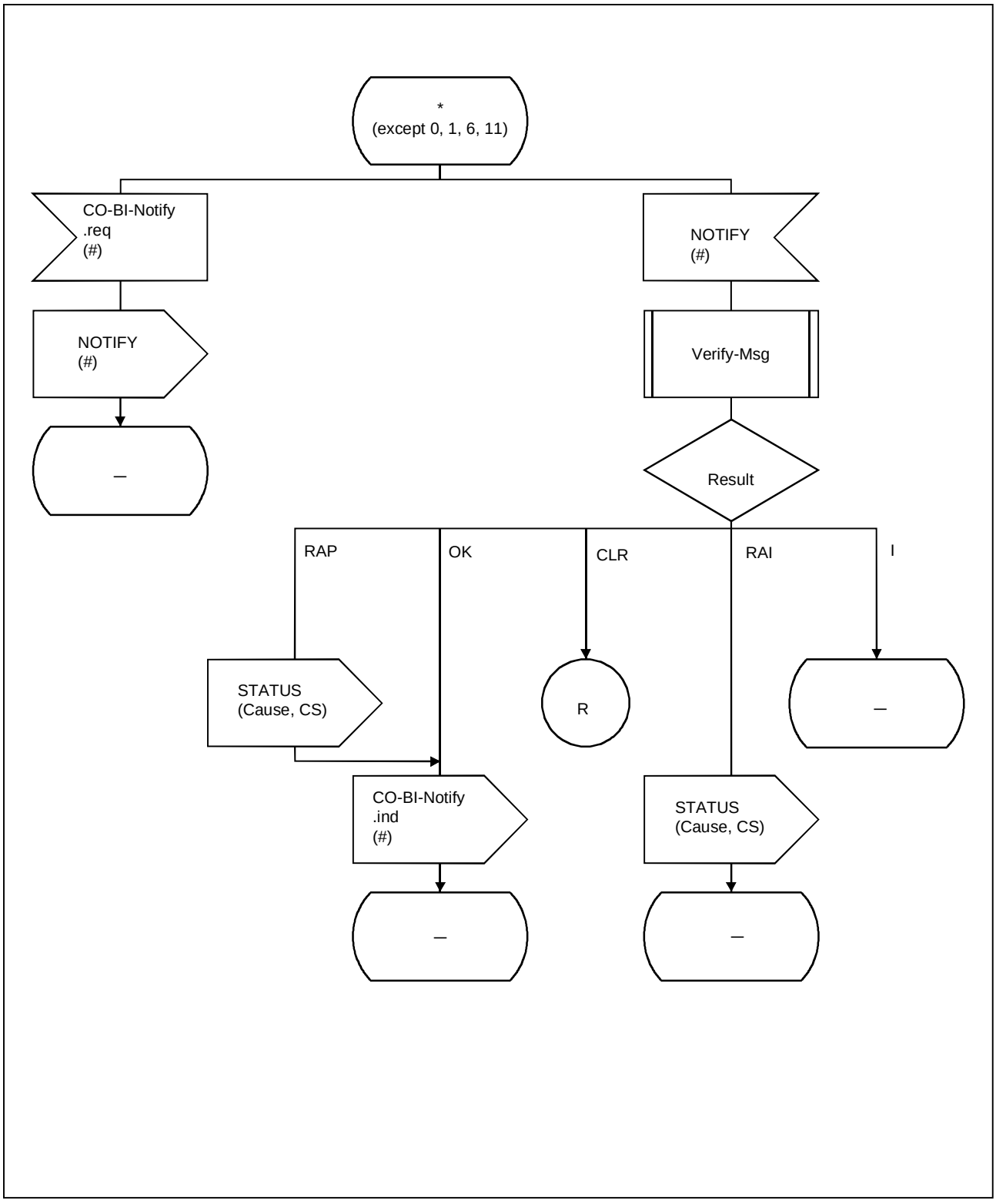

FIGURE 12/Q.2932.1 (sheet 14 of 14)

Process CO_bearer_independent

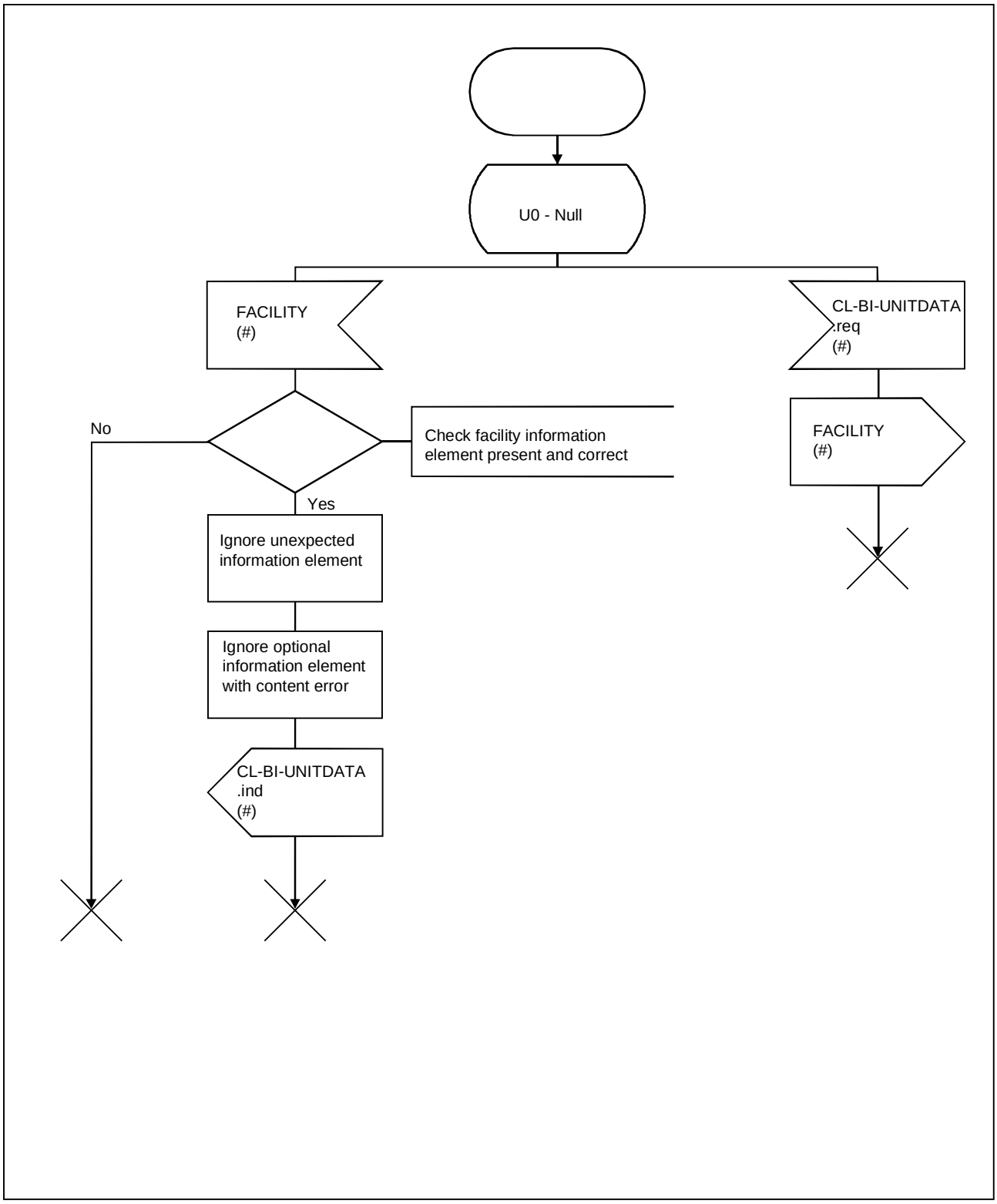

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FIGURE 13/Q.2932.1

Process CL_bearer_independent

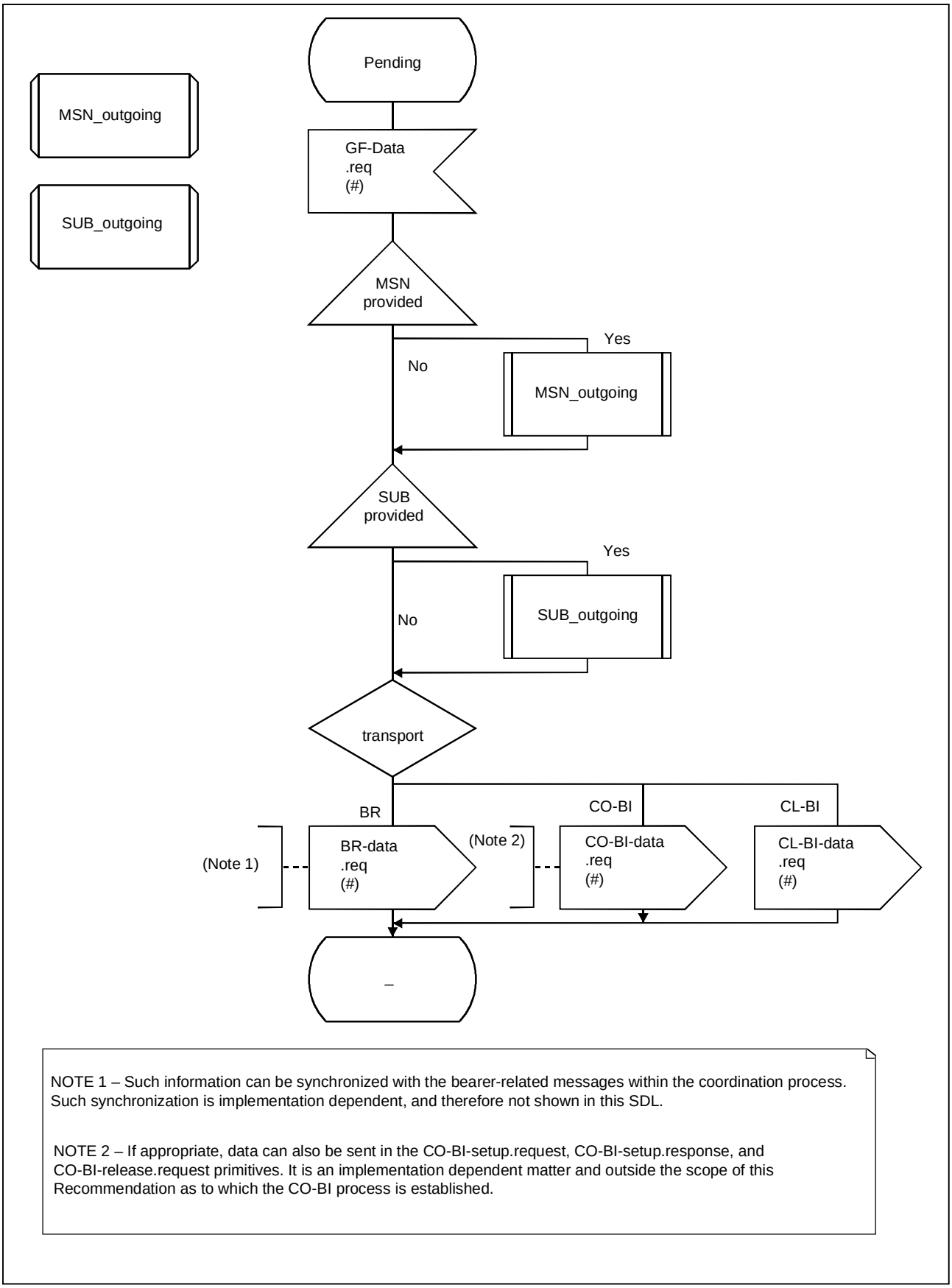

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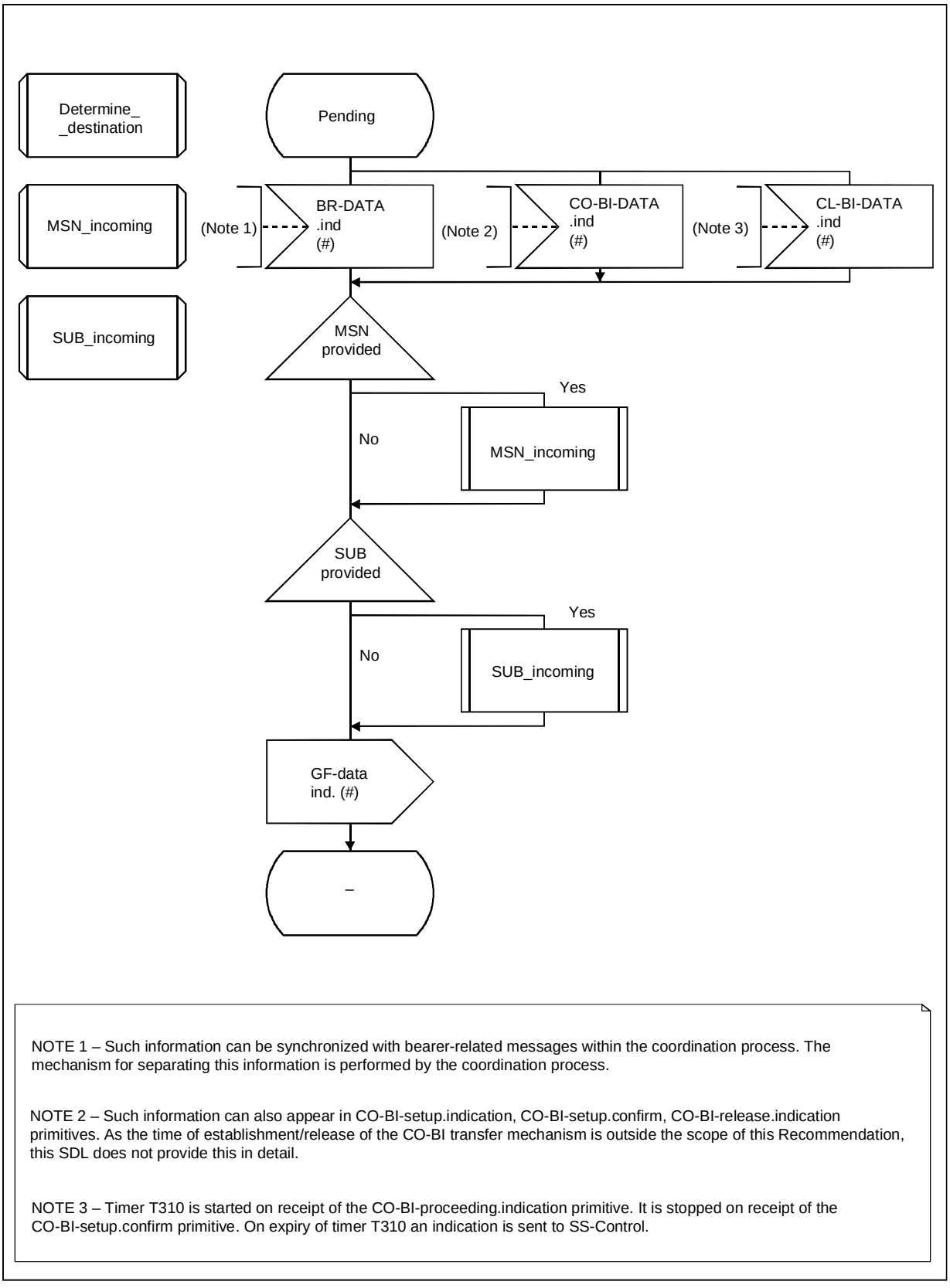
FIGURE 14/Q.2932.1 (sheet 1 of 2)
Process GFT_Control



NOTE 1 – Such information can be synchronized with bearer-related messages within the coordination process. The mechanism for separating this information is performed by the coordination process.

NOTE 2 – Such information can also appear in CO-BI-setup.indication, CO-BI-setup.confirm, CO-BI-release.indication primitives. As the time of establishment/release of the CO-BI transfer mechanism is outside the scope of this Recommendation, this SDL does not provide this in detail.

NOTE 3 – Timer T310 is started on receipt of the CO-BI-proceeding.indication primitive. It is stopped on receipt of the CO-BI-setup.confirm primitive. On expiry of timer T310 an indication is sent to SS-Control.

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FIGURE 14/Q.2932.1 (sheet 2 of 2)

Process GFT_Control

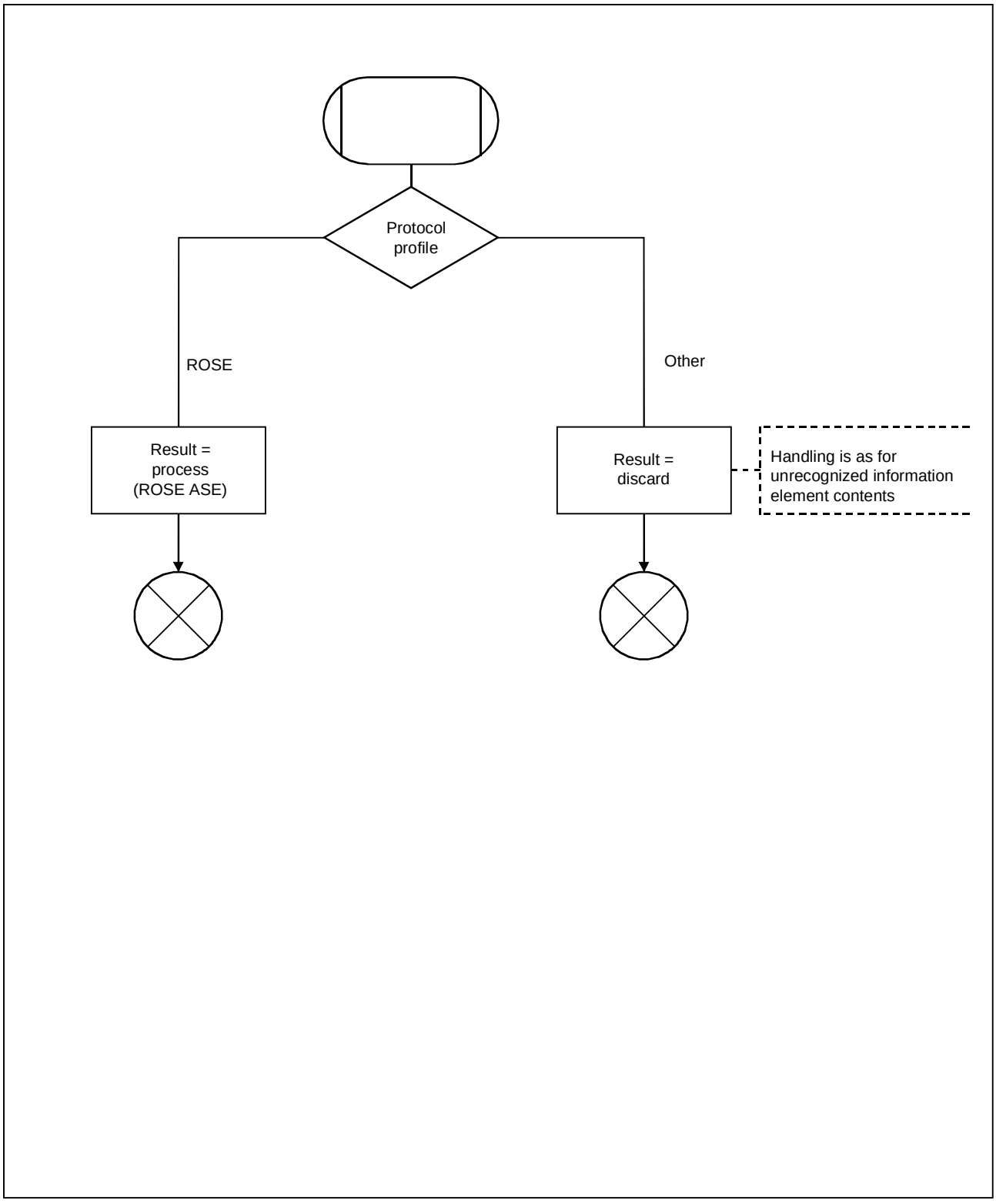


FIGURE 15/Q.2932.1

Procedure determine_destination

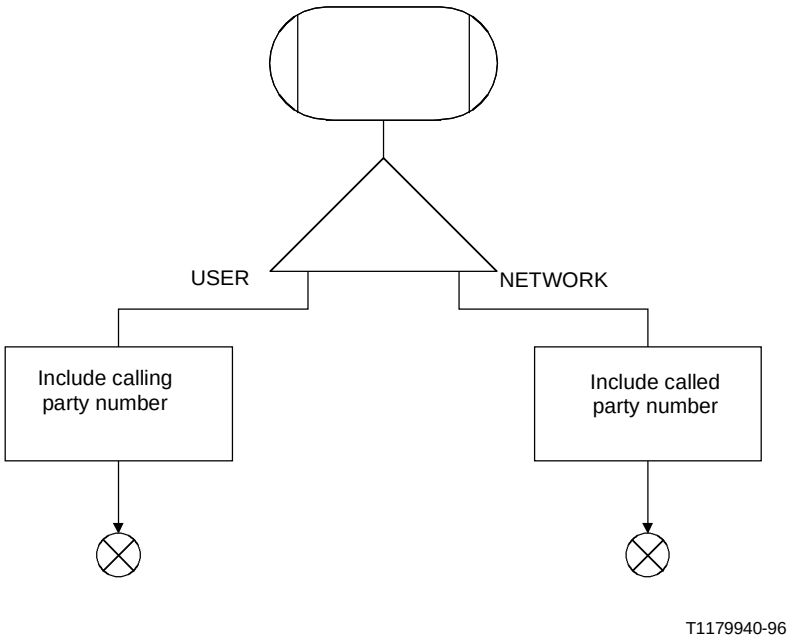


FIGURE 16/Q.2932.1

PROCEDURE MSN_outgoing

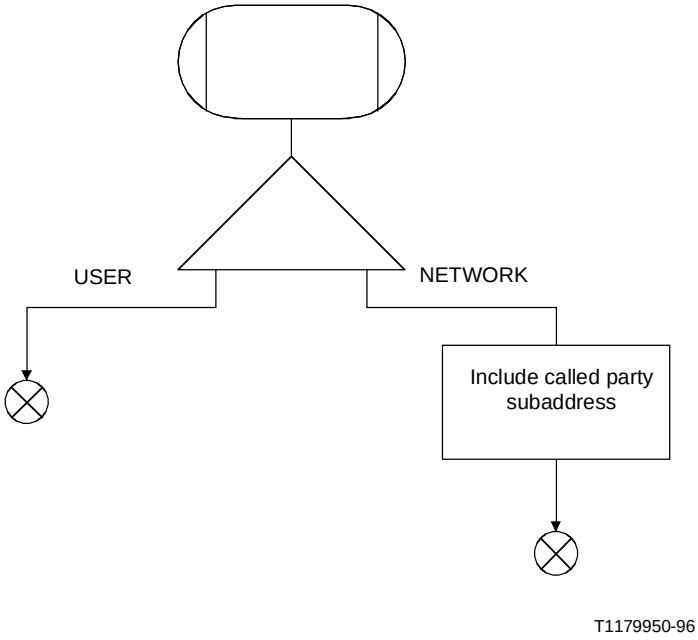


FIGURE 17/Q.2932.1

PROCEDURE SUB_outgoing

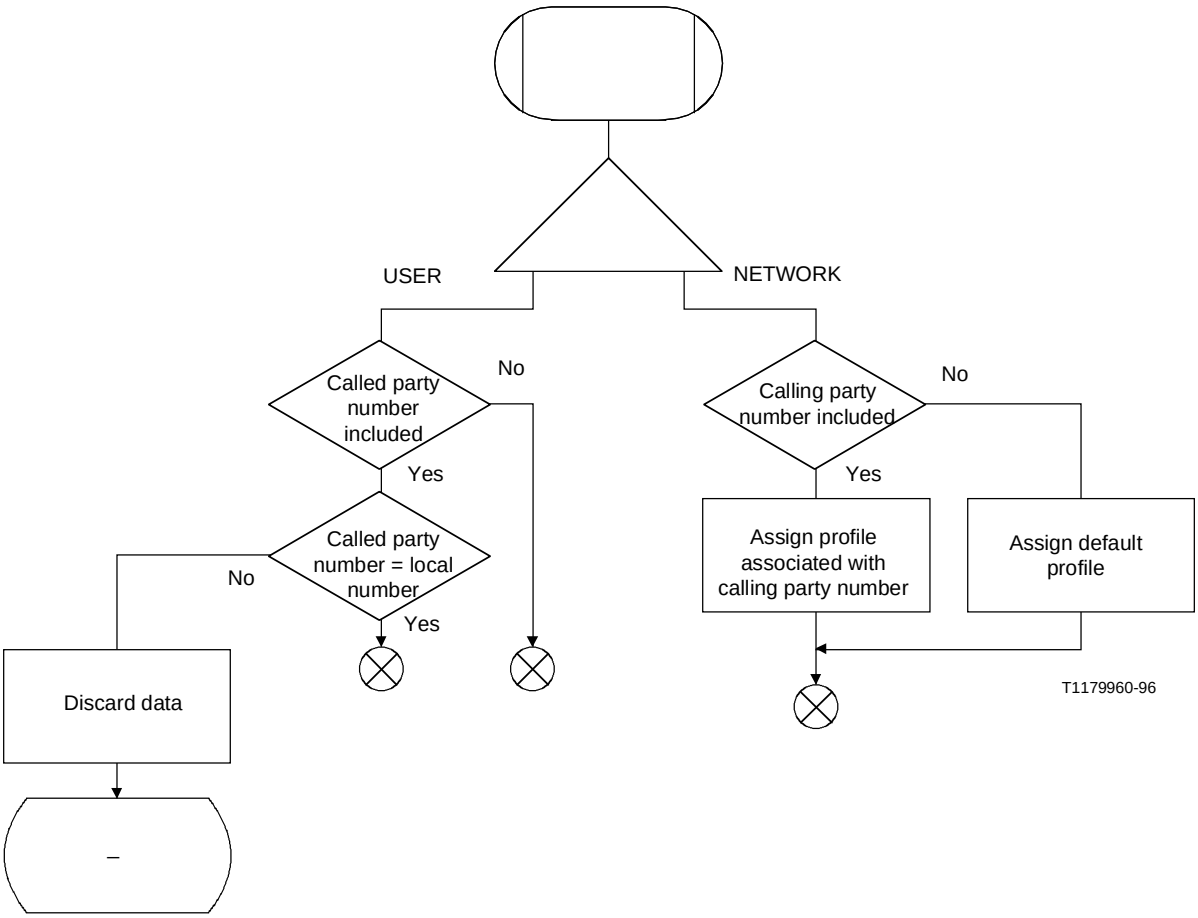


FIGURE 18/Q.2932.1

PROCEDURE MSN_incoming

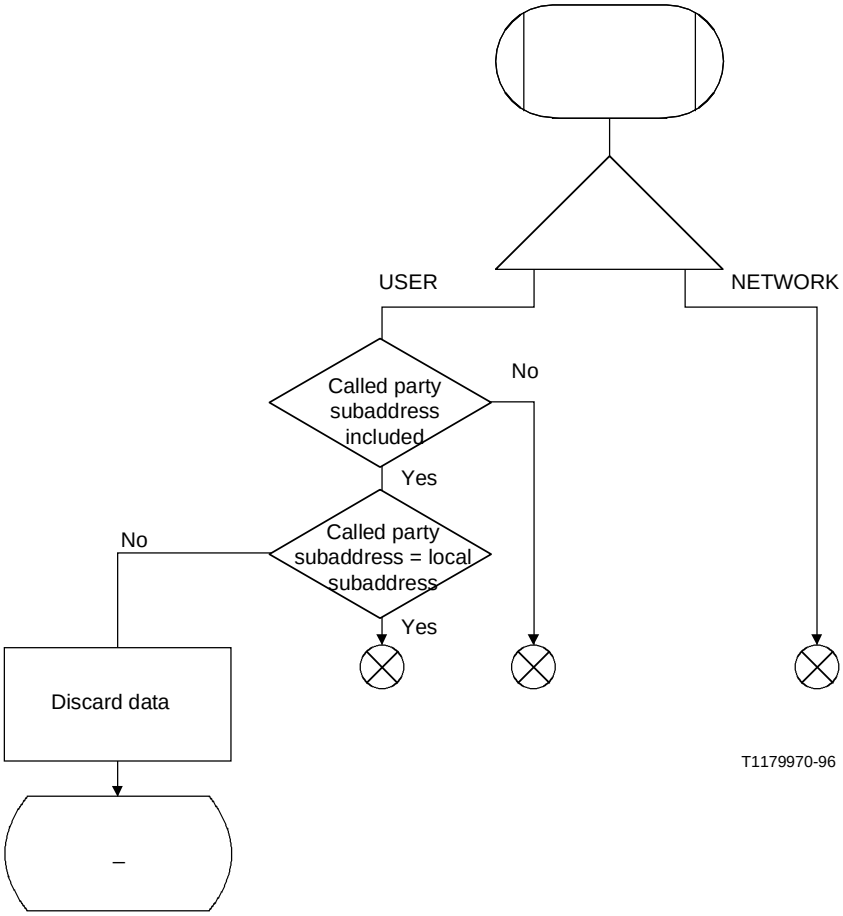


FIGURE 19/Q.2932.1

PROCEDURE SUB_incoming

Annex A

Formal definition of data types using Recommendation X.208 [6]

This Annex provides the ASN.1 modules defined for the purpose of this Recommendation.

A.1 APDU types

Table A.1 shows the formal definition of the APDU data types used in the functional protocol.

TABLE A.1

APDU types

```
Facility-Information-Element-APDU {ccitt recommendation q 2932 facility-information-element-APDU(3)}
DEFINITIONS ::=
BEGIN
EXPORTS          InvokeIDType, APDU;
```

```
IMPORTS          OPERATION, ERROR
                     FROM Remote-Operation-Notation
                       {joint-iso-ccitt remote-operations(4) notation(0)};
APDU             ::= CHOICE {
                       invokeAPDU [1] IMPLICIT InvokeAPDU,
                       returnResultAPDU [2] IMPLICIT ReturnResultAPDU,
                       returnErrorAPDU [3] IMPLICIT ReturnErrorAPDU,
                       rejectAPDU [4] IMPLICIT RejectAPDU}
InvokeAPDU       ::= SEQUENCE {
                       invokeID InvokeIDType,
                       linked-ID [0] IMPLICIT InvokeIDType OPTIONAL,
                       operation-value OPERATION,
                       argument ANY DEFINED BY operation-value OPTIONAL}
                       -- ANY is filled by the single ASN.1 data type following the keyword
                       -- ARGUMENT in the type definition of a particular operation.
InvokeIDType     ::= INTEGER (-32768..32767)
ReturnResultAPDU
                 ::= SEQUENCE {
                       invokeID InvokeIDType,
                       SEQUENCE {
                                operation-value OPERATION,
                                result ANY DEFINED BY operation-value
                                -- ANY is filled by the single ASN.1 data type following the keyword
                                -- RESULT in the type definition of a particular operation.
                       }OPTIONAL}
ReturnErrorAPDU
                 ::= SEQUENCE {
                       invokeID InvokeIDType,
                       error-value ERROR,
                       parameter ANY DEFINED BY error-value OPTIONAL}
                       -- ANY is filled by the single ASN.1 data type following the keyword
                       -- PARAMETER in the type definition of a particular error
RejectAPDU       ::= SEQUENCE {
                       invokeID CHOICE {
                                InvokeIDType,
                                NULL},
                       problem CHOICE {
                                [0] IMPLICIT GeneralProblem,
                                [1] IMPLICIT InvokeProblem,
                                [2] IMPLICIT ReturnResultProblem,
                                [3] IMPLICIT ReturnErrorProblem}}
GeneralProblem   ::= INTEGER { -- ROSE-provider detected
                       unrecognizedAPDU (0),
                       mistypedAPDU (1),
                       badlyStructuredAPDU (2)}
```

```
InvokeProblem          ::= INTEGER { -- ROSE-user detected
                           -- supplementary service entity
                           duplicateInvocation (0),
                           unrecognizedOperation (1),
                           mistypedArgument (2),
                           resourceLimitation (3),
                           initiatorReleasing (4),
                           unrecognizedLinkedID (5),
                           linkedResponseUnexpected (6),
                           unexpectedChildOperation (7)}
ReturnResultProblem    ::= INTEGER { -- ROSE-user detected
                           unrecognizedInvocation (0),
                           resultResponseUnexpected (1),
                           mistypedResult (2)}
ReturnErrorProblem     ::= INTEGER { -- ROSE-user detected
                           unrecognizedInvocation (0),
                           errorResponseUnexpected (1),
                           unrecognizedError (2),
                           unexpectedError (3),
                           mistypedParameter (4)}
END -- of Facility-Information-Element-APDU
```

A.2 Definition of Q.2931 information elements

Table A.2 contains the ASN.1 definition of a general applicable type used to include DSS 2 information elements in ASN.1 definitions.

The DSS 2 information elements to be used shall be indicated as comment at the point where the type DSS2InformationElement is used.

TABLE A.2/Q.2932.1

Definition of embedded DSS 2 information elements

```
Embedded-DSS2-Types {ccitt recommendation q 2932 embedded-dSS2-types(7)}
DEFINITIONS EXPLICIT TAGS ::=
BEGIN
EXPORTS    DSS2InformationElement;
DSS2InformationElement  ::= [APPLICATION 0] IMPLICIT OCTET STRING
END -- of Embedded-dSS2-Types
```

Annex B

Formal definition of data types using Recommendation X.680 [8]

This Annex provides the ASN.1 modules defined for the purpose of this Recommendation.

B.1 APDU types

Table B.1 shows the formal definition of the APDU data types used in the functional protocol.

TABLE B.1/Q.2932.1

APDU types

```
Revised-Facility-Information-Element-Components
                    {ccitt recommendation Q.2932 revised-facility-information-element-components(13)}
DEFINITIONS
IMPLICIT TAGS ::=
BEGIN
-- exports everything
IMPORTS OPERATION, ERROR FROM {joint-iso-ccitt remote-operations(4) informationObjects(5)
version1(0)};
ROS {InvokeId:InvokeIdSet, OPERATION:Invokable, OPERATION:Returnable} ::= CHOICE
        {
            invoke              [1]     Invoke{{InvokeIdSet}, {Invokable}},
            returnResult        [2]     ReturnResult {{Returnable}},
            returnError         [3]     ReturnError {{Errors{{Returnable}}}},
            reject              [4]     Reject
        }
(CONSTRAINED BY {-- must conform to the above definition --}
            ! RejectProblem : general-unrecognizedPDU)
Invoke {InvokeId:InvokeIdSet, OPERATION:Operations} ::= SEQUENCE
        {
            invokeId    InvokeId        (InvokeIdSet)
                                        (CONSTRAINED BY {-- must be unambiguous --}
                                        !RejectProblem : invoke-duplicateInvocation).
            Linkedid    CHOICE
                                {
                                present  [0]        IMPLICIT    present <    InvokeId,
                                absent   [1]        IMPLICIT NULL
                                }
                                (CONSTRAINED BY {-- must identify an outstanding operation --}
                                ! RejectProblem : invoke-unrecognizedLinkedId)
                                (CONSTRAINED BY {-- which has one or more linked operations --}
                                ! RejectProblem : invoke-linkedResponseUnexpected)
                                        OPTIONAL
            opcode      OPERATION.&operationCode
                                        ({Operations}
                                        ! RejectProblem : invoke-unrecognizedOperation),
            argument    OPERATION.&ArgumentType
                                        ({Operations} {@opcode}
                                        ! RejectProblem : invoke-mistypedArgument)
                                            OPTIONAL
        }
```

```
(CONSTRAINED BY {-- must conform to the above definition --}
        ! RejectProblem : general-mistypedPDU)
(       WITH COMPONENTS
        {…,
                linkedid ABSENT
        }
        WITH COMPONENTS
        {…,
                linkedid PRESENT,
                opcode
                (CONSTRAINED BY {-- must be in the &Linked field of the associated operation --}
                ! RejectProblem : invoke-unexpectedLinkedOperation)
        }
)
ReturnResult {OPERATION:Operations} ::=SEQUENCE
        {
                invokeId        InvokeId
                                (CONSTRAINED BY {-- must be that for an outstanding operation --}
                                ! RejectProblem : returnResult-unrecognizedInvocation)
                                (CONSTRAINED BY {-- which returns a result --}
                                ! RejectProblem : returnResult-resultResponseUnexpected),
                result SEQUENCE
                {
                opcode          OPERATION.&operationCode
                                (({Operations})(CONSTRAINED BY {-- identified by invokeId --}
                                ! RejectProblem : returnResult-unrecognizedInvocation)),
                result          OPERATION.&ResultType
                                ({Operations} {@opcode}
                                ! RejectProblem : returnResult-mistypedResult)
                } OPTIONAL
        }
(CONSTRAINED BY {-- must conform to the above definition --}
! RejectProblem : general-mistypedPDU)
ReturnError {ERROR:Errors} ::=      SEQUENCE
        {
                invokeId        InvokeId
                                CONSTRAINED BY {-- must be that for an outstanding operation --}
                                ! RejectProblem : returnError-unrecognizedInvocation)
                                (CONSTRAINED BY {-- which returns an error --}
                                ! RejectProblem : returnError-errorResponseUnexpected),
                errcode         ERROR.&errorCode
                                        ({Errors}
                                        ! RejectProblem : returnError-unrecognizedError)
                                        (CONSTRAINED BY
                                                {-- must be in the &Errors field of the associated opÕn --}
                                        ! RejectProblem : returnError-unexpectedError),
                parameter       ERROR.&ParameterType
                                        ({Errors}{@errcode}
                                        ! RejectProblem : returnError-mistypedParameter) OPTIONAL
        }
(CONSTRAINED BY { -- must conform to the above definition --}
! RejectProblem : general-mistypedPDU)
```

```
Reject ::=      SEQUENCE
                {
                        invokeId        InvokeId
                        problem         CHOICE
                                        {
                                        general                 [0]     GeneralProblem,
                                        invoke          [1]     InvokeProblem,
                                        returnResult            [2]     ReturnResultProblem,
                                        returnError             [3]     ReturnErrorProblem
                                        }
                }
(CONSTRAINED BY {-- must conform to the above definition --}
! RejectProblem : general-mistypedPDU)
GeneralProblem ::=          INTEGER
                {
                        unrecognizedComponent (0),
                        mistypedComponent (1),
                        badlyStructuredComponent (2)
                }
InvokeProblem ::=INTEGER
                {
                        duplicateInvocation (0),
                        unrecognizedOperation (1),
                        mistypedArgument (2),
                        resourceLimitation (3),
                        releaseInProgress (4),
                        unrecognizedLinkedId (5),
                        linkedResponseUnexpected (6),
                        unexpectedLinkedOperation (7),
                }
ReturnResultProblem ::=INTEGER
                {
                        unrecognizedInvocation (0),
                        resultResponseUnexpected (1),
                        mistypedResult (2)
                }
ReturnErrorProblem ::= INTEGER
                {
                        unrecognizedInvocation (0),
                        errorResponseUnexpected (1),
                        unrecognizedError (2),
                        unexpectedError (3),
                        mistypedParameter (4)
                }
```

```
RejectProblem ::=           INTEGER
                {
                        general-unrecognizedPDU (0),
                        general-mistypedPDU (1),
                        general-badlyStructuredPDU (2),
                        invoke-duplicateInvocation (10),
                        invoke-unrecognizedOperation (11),
                        invoke-mistypedArgument (12),
                        invoke-resourceLimitation (13),
                        invoke-releaseInProgress (14),
                        invoke-unrecognizedLinkedId (15),
                        invoke-linkedResponseUnexpected (16),
                        invoke-unexpectedLinkedOperation (17),
                        returnResult-unrecognizedInvocation (20),
                        returnResult-resultResponseUnexpected (21),
                        returnResult-mistypedResult (22),
                        returnError-unrecognizedInvocation (30),
                        returnError-errorResponseUnexpected (31),
                        returnError-unrecognizedError (32)
                        returnError-unexpectedError (33)
                        returnError-mistypedParameter (34)
                }
InvokeId ::= CHOICE
                {
                        present         INTEGER
                        absent          NULL
                }
noInvokeId InvokeId ::= absent:NULL
NoInvokeId InvokeId ::= {noInvokeId}
Errors (OPERATION:Operations} ERROR ::=         {Operations.&Errors}
END -- end of generic ROS PDU definitions
```

TABLE B.2/Q.2932.1

Definition of embedded DSS 2 information elements

```
Embedded-DSS2Types {ccitt recommendation q2932 embedded-dSS2types(7)}
DEFINITIONS EXPLICIT TAGS ::=
BEGIN
EXPORTS                 DSS2InformationElement;
DSS2InformationElement ::=[APPLICATION 0] IMPLICIT OCTET STRING
END -- of Embedded-dSS2Types
```

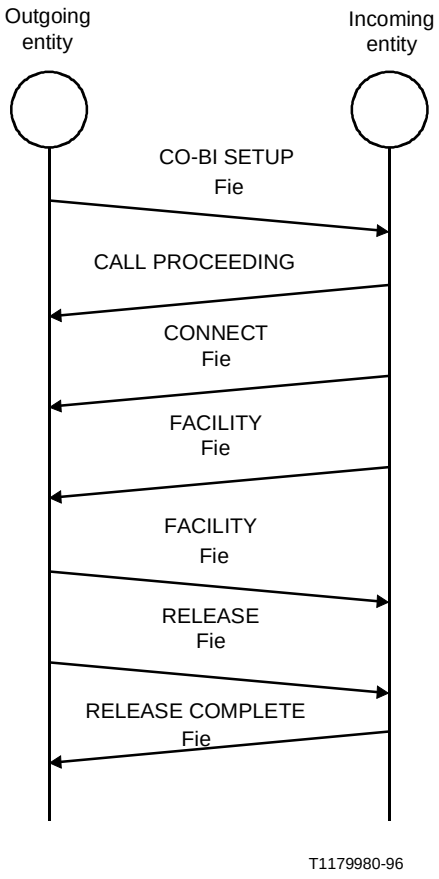
Appendix I

Information flows

I.1 Connection-oriented bearer-independent transport mechanism

I.1.1 Bearer independent establishment and data transfer

An example of the information flow for the connection-oriented bearer-independent transport mechanism is shown in Figure I.1.



Fie Facility information element

FIGURE I.1/Q.2932.1

Connection-oriented bearer-independent transport mechnaisim

Appendix II

Instruction indicators

The following abbreviations have been used in Tables II.1 to II.4:

used = Follow explicit instructions

not used = instruction field not significant

N = network

U = user

TABLE II.1/Q.2932.1

Typical use of instruction indicators for Q.2932.1 messages which are used for bearer-related transport

Message	Flag	Origin	Action indicator
FACILITY	(Note)	N&U	(Note)
NOTE – If the instruction indicator in any Facility information element is set to "clear call" then the instruction indicator of the FACILITY message should also be set to that value, else the flag is not used and the action indicator not significant.			

TABLE II.2/Q.2932.1

Typical use of instruction indicators for Q.2932.1 messages which are used for connection-oriented bearer-independent transport

Message	Flag	Origin	Action indicator
CALL PROCEEDING	not used	N&U	not significant
CO-BI SETUP	not used	N&U	not significant
CONNECT	not used	N&U	not significant
FACILITY	(Note)	N&U	(Note)
NOTIFY	not used	N&U	not significant
RELEASE	not used	N&U	not significant
RELEASE COMPLETE	not used	N&U	not significant
STATUS	not used	N&U	not significant
STATUS ENQUIRY	not used	N&U	not significant
NOTE – If the instruction indicator in any Facility information element is set to "clear call" then the instruction indicator of the FACILITY message should also be set to that value, else the flag is not used and the action indicator not significant.			

TABLE II.3/Q.2932.1

Typical use of instruction indicators for Q.2932.1 messages which are used for connectionless bearer-independent transport

Message	Flag	Origin	Action indicator
FACILITY	not used	N&U	not significant

TABLE II.4/Q.2932.1

Typical use of instruction indicators for Q.2932.1 information elements

Information element	Flag	Origin	Action indicator
Facility	Note	N&U	(Note)
NOTE – The value contained in this field is specified by other Recommendations specifying use of Q.2932.1 procedures. The values where two Recommendations specify different values for the same field is implementation dependent, but in this case, consideration should be given to using multiple Facility information elements to contain multiple ADPUs.			

Appendix III

Formal definitions of remote operations notation using Recommendation X.208 [6]

TABLE III.1/Q.2932.1

Formal definition of remote operations data types (extract of Figure 4/X.219 [3])

```
Remote-Operation-Notation {joint-iso-ccitt remote-operations(4) notation(0)}
DEFINITIONS ::=
BEGIN
EXPORTS                 OPERATION, ERROR;
-- macro definition for operations
OPERATION MACRO ::=
BEGIN
TYPE NOTATION       ::=     Argument Result Errors LinkedOperations
VALUE NOTATION      ::=     value (VALUE CHOICE {
                            localValue INTEGER,
                            globalValue OBJECT IDENTIFIER})
Argument            ::=     "ARGUMENT" NamedType | empty
Result              ::=     "RESULT" ResultType | empty
ResultType          ::=     NamedType | empty
Errors              ::=     "ERRORS" "{" ErrorNames "}" | empty
LinkedOperations    ::=     "LINKED" "{" LinkedOperationNames "}" | empty
ErrorNames          ::=     ErrorList | empty
ErrorList           ::=     Error | ErrorList "," Error
Error               ::=     value (ERROR)           -- shall reference an error value
                            | type                  -- shall reference an error type if no error
                                                    -- value is specified
LinkedOperationNames ::=    OperationList | empty
OperationList       ::=     Operation | OperationList "," Operation
Operation           ::=     value (OPERATION)       -- shall reference an operation value
                            | type                  -- shall reference an operation type if no
                                                    -- operation value is specified
NamedType           ::=     identifier type | type
END -- of OPERATION MACRO
```

```
-- macro definition for operations errors
ERROR MACRO          ::=
BEGIN
TYPE NOTATION        ::=    Parameter
VALUE NOTATION       ::=    value (VALUE CHOICE {
                            localValue INTEGER,
                            globalValue OBJECT IDENTIFIER})
Parameter            ::=    "PARAMETER" NamedType | empty
NamedType            ::=    identifier type | type
END -- of ERROR MACRO
END -- end of Remote-Operation-Notation
```

Appendix IV

Formal definitions of remote operations notation using Recommendation X.680 [8]

TABLE IV.1/Q.2932.1

Formal definition of remote operations data types (extract of Annex A/X.880 [17])

```
Remote-Operations-Information-Objects
                    {joint-iso-itu-t remote-operations(4) informationObjects(5) version 1(0)}
DEFINITIONS ::=
BEGIN
-- exports everything
IMPORTS emptyBind, emptyUnbind
                        FROM {joint-iso-ccitt remote-operations(4) useful-definitions(7) version1(0)}
OPERATIONS ::= CLASS
            {
                &ArgumentType                           OPTIONAL,
                &argumentTypeOptional   BOOLEAN         OPTIONAL,
                &returnResult           BOOLEAN         DEFAULT TRUE,
                &ResultType                             OPTIONAL,
                &resultTypeOptional     BOOLEAN         OPTIONAL,
                &Errors                 ERROR           OPTIONAL,
                &Linked                 OPERATION       OPTIONAL,
                &synchronous            BOOLEAN         DEFAULT FALSE,
                &alwaysReturns          BOOLEAN         DEFAULT TRUE,
                &InvokePriority         Priority        OPTIONAL,
                &ResultPriority         Priority        OPTIONAL,
                &operationCode          Code UNIQUE     OPTIONAL
            }
```

```
WITH SYNTAX
                {
                    [ARGUMENT                &ArgumentType    [OPTIONAL  &argumentTypeOptional]]
                    [RESULT                  &ResultType      [OPTIONAL  &resultTypeOptional]]
                    [RETURN RESULT           &returnResult]
                    [ERRORS                  &Errors]
                    [LINKED                  &Linked]
                    [SYNCHRONOUS             &synchronous]
                    [ALWAYS RESPONDS         &alwaysReturns]
                    [INVOKE PRIORITY         &InvokePriority]
                    [RESULT PRIORITY         &ResultPriority]
                    [CODE                    &operationCode]
                }
ERROR ::=  CLASS
            {
                &ParameterType                                  OPTIONAL,
                &parameterTypeOptional   BOOLEAN                OPTIONAL,
                &ErrorPriority           Priority               OPTIONAL,
                &errorCode               Code UNIQUE            OPTIONAL
            }
WITH SYNTAX
            {
                [PARAMETER               &ParameterType  [OPTIONAL  &parameterTypeOptional]]
                [PRIORITY                &ErrorPriority]
                [CODE                    &errorCode]
            }
OPERATION-PACKAGE ::= CLASS
            {
                &Both                    OPERATION              OPTIONAL,
                &Consumer                OPERATION              OPTIONAL,
                &Supplier                OPERATION              OPTIONAL,
                &id                      OBJECT IDENTIFIER UNIQUE OPTIONAL
            }
WITH SYNTAX
            {
                [OPERATIONS              &Both]
                [CONSUMER INVOKES        &Supplier]
                [SUPPLIER INVOKES        &Consumer]
                [ID                      &id]
            }
CONNECTION-PACKAGE ::= CLASS
            {
                &bind                    OPERATION              DEFAULT emptyBind,
                &unbind                  OPERATION              DEFAULT empyUnbind,
                &responderCanUnbind      BOOLEAN                DEFAULT FALSE,
                &unbindCanFail           BOOLEAN                DEFAULT FALSE,
                &id                      OBJECT IDENTIFIER UNIQUE OPTIONAL
            }
```

```
WITH SYNTAX
        {
            [BIND                       &bind]
            [UNBIND                     &unbind]
            [RESPONDER UNBIND           &responderCanUnbind]
            [FAILURE TO UNBIND          &unbindCanFail]
            [ID                         &id]
        }
CONTRACT ::= CLASS
        {
            &connection                 CONNECTION-PACKAGE OPTIONAL,
            &OperationsOf               OPERATION-PACKAGE OPTIONAL,
            &InitiatorConsumerOf        OPERATION-PACKAGE OPTIONAL,
            &InitiatorSupplierOf        OPERATION-PACKAGE OPTIONAL,
            &id                         OBJECT IDENTIFIER UNIQUE OPTIONAL
        }
WITH SYNTAX
        {
            [CONNECTION                 &connection]
            [OPERATIONS OF              &OperationsOf]
            [INITIATOR CONSUMER OF      &InitiatorConsumerOf]
            [RESPONDER CONSUMER OF      &InitiatorSupplierOf]
            [ID                         &id]
        }
ROS-OBJECT-CLASS ::= CLASS
        {
            &Is                         ROS-OBJECT-CLASS OPTIONAL,
            &Initiates                  CONTRACT OPTIONAL,
            &Responds                   CONTRACT OPTIONAL,
            &InitiatesAndResponds       CONTRACT OPTIONAL,
            &id                         OBJECT IDENTIFIER UNIQUE
        }
WITH SYNTAX
        {
            [IS                         &Is]
            [BOTH                       &InitiatesAndResponds]
            [INITIATES                  &Initiates]
            [RESPONDS                   &Responds]
            ID                          &id
        }
Code ::=    CHOICE
        {
            local                       INTEGER,
            global                      OBJECT IDENTIFIER
        }
Priority ::= INTEGER (0..MAX)
END -- end of Information Object specifications
```

Appendix V

Assignment of object identifiers

The following object identifiers are assigned within this Recommendation.

ccitt recommendation q 2932 facility-information-element-APDU(3)
ccitt recommendation q 2932 revised-facility-information-element-APDU(3)
ccitt recommendation q 2932 embedded-dSS2-types(7)

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