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SERIES Q: SWITCHING AND SIGNALLING

Broadband ISDN – B-ISDN application protocols for
access signalling

**Broadband integrated services digital network
(B-ISDN) – Digital subscriber signalling No. 2
(DSS2) – Q.2931-based separated call control
protocol**

ITU-T Recommendation Q.2982

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION Q.2982

BROADBAND INTEGRATED SERVICES DIGITAL NETWORK (B-ISDN) – DIGITAL SUBSCRIBER SIGNALLING No. 2 (DSS2) – Q.2931-BASED SEPARATED CALL CONTROL PROTOCOL

Summary

This Recommendation belongs to the DSS2 family of ITU-T Recommendations and specifies extensions to Recommendation Q.2931 to specify the additional DSS2 protocol elements (messages, information elements, procedures and functions) required to support the separated control (establishment and clearing) of a point-to-point call. This Q.2931-based separated call control protocol requires the use of the bearer control protocol defined in Recommendation Q.2983 to add and remove bearers to/from the call.

Source

ITU-T Recommendation Q.2982 was prepared by ITU-T Study Group 11 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on 3 December 1999.

Keywords

Bearer control, call control, separation.

FOREWORD

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NOTE

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Recommendation Q.2982

BROADBAND INTEGRATED SERVICES DIGITAL NETWORK (B-ISDN) – DIGITAL SUBSCRIBER SIGNALLING No. 2 (DSS2) – Q.2931-BASED SEPARATED CALL CONTROL PROTOCOL

(Geneva, 1999)

1 Scope

This Recommendation specifies the procedures for establishing, maintaining and clearing calls in a separated call and bearer control environment. Only point-to-point call control is specified in this Recommendation.

The call control protocol defined in this Recommendation is based on the Q.2931 [1] call/connection basic call control protocol with the relevant extensions and adaptations needed to enable the control of a call independently of the bearers, which can be subsequently added to the call and dropped from the call through the use of a bearer control protocol which is the subject of a separate Recommendation.

The procedures specified by this Recommendation are applicable at the T_B reference point or coincident S_B and T_B reference point as defined in Recommendation I.413 [2] by means of the Digital Subscriber Signalling System No. 2 (DSS2).

The Q.2931-based separated call control protocol defined by this Recommendation is applicable to control calls independently of bearers, which are controlled and associated separately to an existing call by means of the separated bearer control protocol defined by Recommendation Q.2983 [3].

2 References

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

- [1] ITU-T Recommendation Q.2931 (1995), *Digital subscriber signalling system No. 2 – User-network interface (UNI) layer 3 specification for basic call/connection control*.
- [2] ITU-T Recommendation I.413 (1993), *B-ISDN user-network interface*.
- [3] ITU-T Recommendation Q.2983 (1999), *Broadband integrated services digital network (B-ISDN) – Digital subscriber signalling system No. 2 (DSS2) – Bearer control protocol*.
- [4] ITU-T Recommendation I.327 (1993), *B-ISDN functional architecture*.
- [5] ITU-T Recommendation Q.2130 (1994), *B-ISDN signalling ATM adaptation layer – Service specific coordination function for support of signalling at the user-network interface (SSCF at UNI)*.
- [6] ITU-T Recommendation Q.2984 (1999), *Broadband integrated services digital network (B-ISDN) and broadband private integrated services network (B-PISN) – Pre-negotiation*.
- [7] ITU-T Recommendation Q.2941.1 (1997), *Digital subscriber signalling system No. 2 – Generic identifier transport*.

- [8] ITU-T Recommendation Q.2932.1 (1996), *Digital subscriber signalling system No. 2 – Generic functional protocol: Core functions*.

3 Definitions

This Recommendation defines the following terms:

- 3.1 bearer:** A connection for the transport of user plane information between users involved in a call.
- 3.2 bearer control:** Functionality and signalling in and between networks and terminals to effect the control of a bearer, that bearer being part of a call.
- 3.3 bearer control entity (BC entity):** An entity that is located in a terminal or a network and that participates in bearer control.
- 3.4 call:** An association between two or more users using a telecommunication service to communicate through one or more networks.
- 3.5 call control:** Functionality and signalling in and between networks and terminals to effect the control of a call.
- 3.6 call control entity (CC entity):** An entity that is located in a terminal or a network and that participates in call control.

4 Abbreviations

This Recommendation uses the following abbreviations:

AAL	ATM Adaptation Layer
ATM	Asynchronous Transfer Mode
BC	Bearer Control
B-ISDN	Broadband Integrated Services Digital Network
CC	Call Control
DSS2	Digital Subscriber Signalling System No. 2
SAAL	Signalling ATM Adaptation Layer
SDL	Specification and Description Language
TE	Terminal Equipment (see Recommendation I.327 [4])
UNI	User-Network Interface

5 Description

5.1 Application to interface structure

The Call control protocol specified in the present Recommendation applies to the interface structures defined in Recommendation I.413 [2]. It uses the functions and services provided by layer 2. This layer 3 protocol requests the services of the underlying layer (SAAL) and receives information from it using the primitives defined in Recommendation Q.2130 [5]. These primitives are used to illustrate the communication between the protocol layers and are not intended to specify or constrain implementations.

5.2 Capabilities supported by this Recommendation

This Recommendation specifies the procedures, messages and information elements needed for establishing, maintaining and clearing a call separately and independently from the control of the bearers that may exist within the context of that call. Only the point-to-point call is covered by this Recommendation.

This Recommendation builds upon the capabilities defined in Recommendation Q.2931 [1] (see 1.5/Q.2931).

When the call has been initiated or has progressed to the active state, one or more bearers can be added to, respectively released from, the call by successive bearer establishment requests, respectively bearer release requests from the calling party or the called party, using the procedures defined in Recommendation Q.2983 [3]. Bearers may be established or released from the call at any time after the establishment request has been indicated to be in progress, and before call clearing has been initiated.

Bearer capability pre-negotiation may, optionally, be invoked before a given bearer establishment is initiated, using the pre-negotiation protocol defined in Recommendation Q.2984 [6]. Annex A specifies additional protocol requirements to enable, as a user option applicable when the capability is provided as a network option, the bearer pre-negotiation prior to a corresponding subsequent bearer establishment.

Appendix I specifies the additional protocol requirements that would enable the simultaneous establishment of the call and of the first bearer associated to the call being established. Appendix I identifies the additional protocol requirements that would enable (by inheritance from the DSS2 Q.2931 basic call and combined bearer control protocol [1]), the simultaneous establishment of the first bearer together with the call.

6 Operational requirements

6.1 Provision and withdrawal

It is a user and a network option to provide the separated Call control capability described in this Recommendation. A bilateral agreement between the user and the network provider concerning the availability of the Q.2931-based separated call and bearer capabilities is assumed to exist. This may be the subject of a subscription option or may be made generally available.

6.2 Requirements on the originating network side

None beyond the support of the Q.2931-based separated call control capability.

6.3 Requirements on the destination network side

None beyond the support of the Q.2931-based separated call control capability.

7 Primitive definitions and state definitions

7.1 Primitive definitions

Clause 8/Q.2931[1] shall apply. No additional primitives between the DSS2 entity and the Signalling ATM adaptation Layer (SAAL) are defined for the purpose of this Recommendation.

7.2 State definitions

7.2.1 Call states

The call states are the states which are known by the Call control entity for a given call identifier. The Q.2982 call states at the user or network side of the user-network interface coincide with the call/connection states defined in clause 2/Q.2931 [1].

The call states corresponding to the additional call/connection states relating to interworking requirements, as defined in 2.2/Q.2931, are applicable only if the call point-to-point call/connection control capability (using the Q.2931 basic call control protocol) interworking with existing services or networks (i.e. operating exclusively the combined call/bearer control protocols) is supported.

7.2.2 Bearer states

The bearer states are the states which are known by the bearer control entity for a given bearer identifier. The bearer states at the user or network side of the user-network interface are defined in Recommendation Q.2983.

8 Coding requirements

8.1 Messages for separated call control

This subclause defines the messages to be used for the control of a separated call. The structure and content of the CALL SETUP message specifically defined in this Recommendation to support the establishment of a separated point-to-point capable call is defined in 8.1.7.

8.1.1 ALERTING

See 3.1.1/Q.2931 [1].

8.1.2 CALL PROCEEDING

See 3.1.2/Q.2931 [1].

8.1.3 CONNECT

See 3.1.3/Q.2931 [1].

8.1.4 CONNECT ACKNOWLEDGE

See 3.1.4/Q.2931 [1].

8.1.5 RELEASE

See 3.1.5/Q.2931 [1].

8.1.6 RELEASE COMPLETE

See 3.1.6/Q.2931 [1].

8.1.7 CALL SETUP

This message is sent by the calling user to the network and by the network to the called user to initiate a separated call establishment without any bearer at the time the call is being established. The structure of the CALL SETUP message is shown in Table 8-1.

Table 8-1/Q.2982 – CALL SETUP message contents

Message type: CALL SETUP Significance: Global Direction: Both				
Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2/Q.2931	Both	M	1
Call reference	4.3/Q.2931	Both	M	4
Message type	8.2.1/Q.2982	Both	M	2
Message length	4.4/Q.2931	Both	M	2
Call identifier	8.2.2/Q.2982	Both	M	7
Call capability	8.2.3/Q.2982	Both	M	5
Called party number	4.5/Q.2931	Both	M	4-*
Called party subaddress	4.5/Q.2931	Both	O	4-25
Calling party number	4.5/Q.2931	Both	O	4-*
Calling party subaddress	4.5/Q.2931	Both	O	4-25
Generic identifier transport	8.2.1/Q.2941.1	Both	O (Note 1)	4-63
Notification indicator	4.5.23/Q.2931	Both	O (Note 2)	4-*
NOTE 1 – May be included to transfer an appropriate identifier from the calling user to the called user. See Recommendation Q.2941.1 [7].				
NOTE 2 – Included whenever a notification is to be delivered.				

8.1.8 STATUS

See 3.1.8/Q.2931 [1].

8.1.9 STATUS ENQUIRY

See 3.1.9/Q.2931 [1].

8.1.10 NOTIFY

See 3.1.10/Q.2931 [1].

8.2 Information elements

The information elements included in the messages identified in 8.1 above are coded as specified in clause 4/Q.2931, except the Message type for the CALL SETUP message, the Call identifier and the Call capability information elements which are defined in the following subclauses.

8.2.1 Message type

In addition to those defined in Recommendation Q.2931 [1], the following codepoint is defined for the message type identification octet:

bits

8	7	6	5	4	3	2	1
0	0	0	1	1	0	0	0

CALL SETUP

8.2.2 Call identifier

The purpose of the Call identifier information element is to identify a call at the local user-to-network interface in the context of a separated call and bearer control environment. The Call

identifier has local significance between the adjacent Call Control entities on each side of the interface.

The Call identifier value is assigned by the call originating side of the first message referring to the establishment of the Q.2931-based separated call.

The Call identifier information element is coded as shown in Figure 8-1 and Table 8-2.

8	7	6	5	4	3	2	1	Octets
Call identifier information element								
1	0	0	1	0	0	0	0	1
ext. 1	Coding Standard		Flag	Res.	IE instruction field IE Action Ind.			2
Length of Call identifier contents								3
Length of Call identifier contents (continued)								4
0/1 Call identifier flag		Call identifier value						5
Call identifier value (continued)								6
Call identifier value (continued)								7

Figure 8-1/Q.2982 – Call identifier information element

Table 8-2/Q.2982 – Call identifier information element

Call identifier flag (octet 5)

Bit

8

0 The message is sent from the side that originated the call identifier.

1 The message is sent to the side that originated the call identifier.

Call identifier value (octets 5, 6 and 7)

The call identifier is a 23-bit integer (coded in binary) to uniquely identify a call.

8.2.3 Call capability

The Call capability information element is used to explicitly indicate the configuration potentiality of the call (e.g. point-to-point call).

The Call identifier information element is coded as shown in Figure 8-2 and Table 8-3.

8	7	6	5	4	3	2	1	Octets
Call capability information element								
1	0	0	1	0	0	1	0	1
ext. 1	Coding standard		Flag	Res.	IE instruction field IE Action Ind			2
Length of Call capability contents								3
Length of Call capability contents (continued)								4
ext. 1	Call capability							5

Figure 8-2/Q.2982 – Call capability information element

Table 8-3/Q.2982 – Call capability information element

<i>Call capability (octet 5)</i>	
Bits	
<u>7 6 5 4 3 2 1</u>	
0 0 0 0 0 1	Point-to-point separated call
All other codes are reserved	

9 Signalling procedures at the coincident S_B and T_B reference point

Procedures to control the call separately from the control of bearers are described in the following subclauses. The Q.2931-based separated call control procedures are based on those in clause 5/Q.2931 [1], with the only differences being the SETUP message is replaced by the CALL SETUP message, the overlap sending and receiving procedures for call establishment are not used, and the ATM Virtual Channels (VC) related actions are not applicable.

9.1 Establishment of a separated call at the originating interface

Before these procedures are invoked, an assured mode Signalling AAL connection must be established between the user and the network, as specified in 5.1/Q.2931.

9.1.1 Call request

The calling party initiates call establishment by transferring a CALL SETUP message on the assigned signalling virtual channel across the interface and starts timer T303. Following the transmission of the CALL SETUP message, the call is considered by the calling party to be in the Call Initiated state.

The message shall contain a call reference, with a value selected according to the procedures given in 4.3/Q.2931 [1]. In selecting a call reference, the dummy call reference value shall not be used. The call reference value identifies the state machine instance associated to each call.

The message shall also contain a Call identifier information element which includes a call identifier flag and a call identifier value selected according to procedures identical to those applicable to the call reference value selection. The call control entity shall establish and maintain during the lifetime of the call a one-to-one relationship between the call reference and the call identifier values.

The Call capability and Called party number information elements are mandatory in the CALL SETUP message.

En bloc procedures shall be used.

The CALL SETUP message shall contain all the information required by the network to process the call. In particular, the called party address information is contained in the Called party number information element optionally supplemented by the Called party subaddress information element.

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

9.1.2 Invalid call control information

If upon receiving the CALL SETUP message, the network determines that the call information received from the user is invalid (e.g. invalid number), then the network shall initiate call clearing in accordance with 9.3 using one of the following cause value:

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

9.1.3 Call proceeding

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

If the network determines that a requested service is not authorized or is not available, the network shall initiate call clearing in accordance with 9.3 with cause No. 63, "service or option not available, unspecified".

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

9.1.4 Call confirmation indication

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

9.1.5 Call acceptance

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

On receipt of the CONNECT message, the calling user shall stop timer T310 (if running); stop any user-generated alerting indication; send a CONNECT ACKNOWLEDGE message and enter the Active state.

At this point, the call is established end-to-end.

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

9.1.6 Call rejection

Upon receiving an indication that the network or the called user is unable to accept the call, the network shall initiate clearing at the originating user-network interface as described in 9.3.3, using the cause provided by the terminating network or the called user.

9.2 Call establishment at the destination interface

9.2.1 Incoming call request

The network indicates the arrival of a call at the user-network interface by transferring a CALL SETUP message across the interface. The message shall contain a call reference, with a value selected according to the procedures given in 4.3/Q.2931 [1]. In selecting a call reference, the dummy call reference value shall not be used. The call reference value identifies the state machine instance associated to each call.

The message shall also contain a Call identifier information element which includes a call identifier flag and a call identifier value selected according to procedures identical to those applicable to the call reference selection. The call control entity shall establish and maintain during the lifetime of the call a one-to-one relationship between the call reference and the call identifier values.

The network shall then start timer T303 and enter the Call Present state.

The CALL SETUP message shall contain all the information required by the called user to process the call.

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

If timer T303 expires for the first time (i.e. no response is received by the network to the first CALL SETUP message transmitted), the network shall retransmit the CALL SETUP message and restart timer T303. If timer T303 expires for the second time (i.e. a response is also not received by the network to the second CALL SETUP message transmitted), the network shall follow the procedures of 9.2.2.4.

The user shall evaluate called party addressing information received in the CALL SETUP message and proceed as described in B.3.1/Q.2931.

9.2.2 Call confirmation

9.2.2.1 Response to CALL SETUP

When the user determines that valid call set-up information has been received and is able to proceed with the call establishment, the user shall respond with either a CALL PROCEEDING, ALERTING, or CONNECT message and enter the Incoming Call Proceeding, Call Received, or Connect Request states, respectively.

If the user wishes to reject the call, a RELEASE COMPLETE message shall be sent with cause No. 21, "call rejected", and the user returns to the Null state. The network shall process this RELEASE COMPLETE message in accordance with 9.2.2.3.

9.2.2.2 Receipt of CALL PROCEEDING and ALERTING

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

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

9.2.2.3 Called user clearing during incoming call establishment

If a RELEASE COMPLETE or RELEASE message is received before a CONNECT message has been received, the network shall stop timer T303, timer T310 or timer T301 (if running); continue to clear the call to the called user as described in 9.3.2; and clear the call to the calling user with the cause received in the RELEASE COMPLETE or RELEASE message.

9.2.2.4 Call failure

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

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

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

9.2.3 Call acceptance

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

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

9.2.4 Active indication

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

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

When timer T313 expires prior to receipt of a CONNECT ACKNOWLEDGE message, the called user shall initiate clearing with cause No. 102, "recovery on timer expiry", in accordance with 9.3.2.

9.3 Call clearing

9.3.1 Exception conditions

Under normal conditions, call clearing is usually initiated when the user or the network sends a RELEASE message and follows the procedures defined in 9.3.2 and 9.3.3 respectively. The only exception to the above rule is in response to a CALL SETUP message, where the user or network can reject a call by responding with a RELEASE COMPLETE message provided no other response has been sent previously, then release the call identifier (and the associated call reference) and enter the Null state.

9.3.2 Call clearing initiated by the user

Apart from the exceptions identified in 9.3.1 and 9.5, the user shall initiate call clearing by sending a RELEASE message; starting timer T308; and entering the Release Request state.

The network shall enter the Release Request state upon receipt of a RELEASE message. This message then prompts to initiate procedures for clearing the call to the remote user. The network

shall send a RELEASE COMPLETE message to the user; release the call identifier (and the associated call reference); and enter the Null state. In addition, the network shall internally release the outstanding bearers associated to the call if any, i.e. for each, release the call reference associated to the bearer and the virtual channel (i.e. the connection identifier and the related resources); and enter the Null state.

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

On receipt of the RELEASE COMPLETE message, the user shall stop timer T308; release call identifier (and the associated call reference); and return the call to the Null state. In addition, the user shall internally release the outstanding bearers associated to the call if any, i.e. for each, release the call reference associated to the bearer and the virtual channel (i.e. the connection identifier and the related resources); and enter the Null state.

If timer T308 expires for the first time, the user shall retransmit a RELEASE message to the network with the cause number originally contained in the first RELEASE message; restart timer T308; and remain in the Release Request state. In addition, the user may indicate a second Cause information element with cause No. 102, "recovery on timer expiry". If no RELEASE COMPLETE message is received from the network before timer T308 expires a second time, the user shall release the call identifier (and the associated call reference); and return to the Null state. In addition, the user shall internally release the outstanding bearers associated to the call if any, i.e. for each, release the call reference associated to the bearer and the virtual channel (i.e. the connection identifier and the related resources); and enter the Null state.

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

9.3.3 Clearing initiated by the network

Apart from the exception conditions identified in 9.3.1 and 9.5, the network shall initiate clearing by sending a RELEASE message; starting T308; and entering the Release Indication state.

The user shall enter the Release Indication state upon receipt of a RELEASE message. The user shall send a RELEASE COMPLETE message to the network; release the call identifier (and the associated call reference); and return to the Null state. In addition, the user shall internally release the outstanding bearers associated to the call if any, i.e. for each; release the call reference associated to the bearer and the virtual channel (i.e. the connection identifier and the related resources); and enter the Null state.

On receipt of the RELEASE COMPLETE message, the network shall stop timer T308; release the call identifier (and the associated call reference) and return to the Null state. In addition, the network shall internally release the outstanding bearers associated to the call if any, i.e. for each; release the call reference associated to the bearer and the virtual channel (i.e. the connection identifier and the related resources); and enter the Null state.

If timer T308 expires for the first time, the network shall retransmit the RELEASE message to the user with the cause number originally contained in the first RELEASE message; start timer T308; and remain in the Release Indication state. In addition, the network may indicate a second Cause information element with cause No. 102, "recovery on timer expiry". If no RELEASE COMPLETE message is received from the user before timer T308 expires a second time, the network shall release the call identifier (and the associated call reference), and return to the Null state. In addition, the network shall internally release the outstanding bearers associated to the call if any, i.e. for each; release the call reference associated to the bearer and the virtual channel (i.e. the connection identifier and the related resources); and enter the Null state.

9.3.4 Call clearing collision

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

9.3.5 Interaction between call control and bearer control

9.3.5.1 Interaction between call clearing and bearer clearing

This type of collision can occur when simultaneously one side sends a RELEASE message to release the call and the other side sends a RELEASE message to release a bearer (see Recommendation Q.2983 [3]). The entity receiving the RELEASE message for the bearer shall release the bearer as in Recommendation Q.2983 by sending a RELEASE COMPLETE message. The entity receiving the RELEASE message for the call shall act as described in 9.3.2 and 9.3.3.

9.3.5.2 Interaction between call clearing and bearer establishment

This type of collision can occur when one side sends a RELEASE message to release the call and the other side simultaneously sends a SETUP message to add a bearer to the call (see Recommendation Q.2983 [3]). The entity receiving the SETUP message for the bearer shall reject the bearer establishment by sending a RELEASE COMPLETE message as described in Recommendation Q.2983. The one receiving the RELEASE message for the call shall act as described in 9.3.2 and 9.3.3.

9.4 Restart procedures

The procedures described in 5.5/Q.2931 shall apply with the following additions:

"When a RESTART message is either sent or received and the Restart indicator information element is coded:

- 1) "All virtual channels controlled by the layer 3 entity which sends the RESTART message";
- 2) "Indicated virtual channel" and the Connection identifier information element indicates the VPCI/VCI value of the Signalling virtual channel on which the RESTART message is sent;
- 3) "All user plane virtual channels in the indicated VPC controlled via signalling in which the RESTART message is sent" and the Connection identifier information element indicates the VPCI value of the Signalling virtual channel,

the user and the network shall release all the related calls (i.e. calls to which one or more of the identified virtual channels are related) and the associated bearers (i.e. the bearer identifier values and all the related resources).

9.5 Handling of error conditions

The procedures described in 5.6/Q.2931 shall apply with the following modifications:

- Replace any reference to the SETUP message by the CALL SETUP message.
- Actions regarding the handling of virtual channels in Recommendation Q.2931 are not applicable (e.g. when receiving a RELEASE message or a RELEASE COMPLETE message for the call, the actions such as "release the virtual channel", "release the network connection" are not applicable).

- In addition, when an action leads to the release of the call, the outstanding bearers (and the related call reference and resources) associated to the call, if any, shall be released internally.
- Replace references to 5.4/Q.2931, respectively 5.7/Q.2931 by references to 9.3, respectively 9.6.

9.6 Error procedures with explicit action indication

The procedures described in 5.7/Q.2931 shall apply with the following modifications:

- In addition, when an action leads to the release of the call, the outstanding bearers (and the related call references and resources) associated to the call, if any, shall be released internally.
- Replace references to 5.4/Q.2931, respectively 5.4.3/Q.2931, respectively 5.4.4/Q.2931 by references to, respectively, 9.3, 9.3.2 and 9.3.3.

9.7 Notification procedures

The delivery of call-related notifications shall use an active call reference of the call the notification is associated with. In this context, a call reference shall be active from the initiation of call establishment (i.e. the CALL SETUP message) to the initiation of call clearing (i.e. the RELEASE message).

If the delivery of the notification coincides with call establishment or clearing procedures, the notification information can be carried in the corresponding call control messages. In all other cases, the notification information shall be delivered in a NOTIFY message. In addition, a NOTIFY message may be sent or received by the user or by the network only after the first response to a SETUP message has been sent or received and before clearing of the call reference is initiated.

If a notification is received by the network, the network shall optionally ensure that the contents of the notification are a valid coding, and forward the notification to the other user involved in the call.

No call state change shall occur at either side of the interface following the sending or receipt of a NOTIFY message.

10 Signalling procedures at the T_B reference point

The procedures of clause 9 shall apply.

11 Interworking with other networks

Interworking with user or network entities not supporting the Q.2931-based separated call control capability is an implementation option. The interworking specifications are beyond the scope of the present Recommendation.

12 Interactions with supplementary services

Beyond the scope of the present Recommendation.

13 Parameter values

The timers summarized in Table 7-1/Q.2931 (Network side) and in Table 7-3/Q.2931 (User side) apply.

14 Dynamic description SDLs

Annex A/Q.2931 shall apply, with the replacement of the SETUP message with the CALL SETUP message, the removal of the overlap sending and receiving procedures for call establishment and without any bearer (i.e. Virtual Channel) related actions.

NOTE – Call and Bearer state machine coordination functions are beyond the scope of this Recommendation as they are internal DSS2 entity functions which do not require detailed specification.

ANNEX A

Additional procedures for pre-negotiation (Optional)

Before establishing additional bearers associated to the call, the user may invoke pre-negotiation of the bearer characteristics, independently for each of the intended additional bearer establishment.

Since this is an optional network capability, this requires a prior bilateral agreement between the user and the network provider at subscription time.

The use of this capability requires the support of the bearer characteristics Pre-negotiation protocol defined in Recommendation Q.2984 [6]. It implies the support of the following additional protocol elements:

- the sending and the receipt of the FACILITY message as defined in Recommendation Q.2932.1 [8];
- the inclusion of the Facility information element defined in Recommendation Q.2932.1 [8] in the CALL SETUP message or in a FACILITY message for the invocation of the Pre-negotiation of bearer characteristics at call establishment or in the course of an established call, respectively, and in a FACILITY message for returning the corresponding confirmation or rejection.

APPENDIX I

Additional procedures for simultaneous establishment of the first bearer with the call

This appendix outlines possible additional protocol requirements that may be used to the simultaneous call and bearer establishment, i.e. when a first bearer is being established simultaneously with the establishment of the call.

I.1 State definitions

In the case of the simultaneous establishment of the first bearer with the call, the SETUP message (containing both a Call identifier information element and a Bearer identifier information element) shall be used in order to trigger the simultaneous establishment of a Call state machine and of a Bearer state machine.

The Call state machine and the Bearer state machine are maintained separately and they evolve in a synchronized and parallel fashion during the establishment phase.

The following terminology is used in the text below in order to distinguish between the two separate state machines for the call and the first bearer:

- The **call reference value related to the first bearer** corresponds to the call reference value in the Call Reference information element in the SETUP message used to establish simultaneously the call and the first bearer.

- The **call reference value related to the call** corresponds to the call identifier value in the Call Identifier information element in the SETUP message used to establish simultaneously the call and the first bearer.

The bearer states associated to the call reference value related to the first bearer are those specified in 2.1/Q.2931.

The call states associated to the call reference value related to the call coincides with the states defined in 2.1/Q.2931.

NOTE – The SETUP message in this case is functionally equivalent to the simultaneous sending/receipt of both a Recommendation Q.2931 [1] defined SETUP message (where a state machine is created for the bearer, associated to the call reference value included in the SETUP message) and of a CALL SETUP message defined in the present Recommendation (where a specific state machine is created for the call, associated to the call identifier value included in the CALL SETUP message).

I.2 Coding requirements

I.2.1 Messages

The messages defined in 3.1/Q.2931 are applicable except that the SETUP message shall be as described in I.2.1.1.

I.2.1.1 SETUP

This message is sent by the calling user to the network and by the network to the called user to initiate a call establishment with the simultaneous establishment of the first bearer associated to the call. The structure and content of the SETUP message is as defined in 3.1.7/Q.2931 with the modifications shown in Table I.1. The procedures using this message for simultaneous establishment of a first bearer with the call are specified in I.3.

Table I.1/Q.2982 – SETUP message additional contents

Message type: SETUP				
Significance: Global				
Direction: Both				
Information element	Reference	Direction	Type	Length
Call identifier	8.2.2	Both	O (Note)	7
Bearer identifier	8.2.2	Both	O (Note)	7
Call capability	8.2.3	Both	O (Note)	5
NOTE – Mandatory when the SETUP message is used to establish a call simultaneously with the first associated bearer.				

I.3 Procedures

I.3.1 Simultaneous call and bearer establishment

The procedures of 5.1, 5.2 and 5.3/Q.2931 [1], except the overlap sending and receiving related ones, apply for the establishment of the first bearer.

The values for the call references related respectively to the call and to the bearer and the values for the call and bearer identifiers are assigned according to the procedures given in 4.3/Q.2931 [1] with the following additional constraints and rules of use:

- The call reference value in the SETUP message is related to the Bearer state machine and associated to the bearer identifier value; this call reference value shall be used in subsequent

signalling messages relating to both the call and the first bearer establishment and to those messages relating specifically to the control of this bearer.

- The call reference value related to the Call state machine and associated to the call identifier value is created implicitly at the time the SETUP message is sent or received; this is achieved by assigning to the call reference related to the Call state machine a value equal to the call identifier value. This call reference value shall be used in subsequent signalling messages relating specifically to call control.
- A one-to-one relationship between the call reference related to the Call state machine and the call identifier shall be maintained during the lifetime of the call (Note 1).
- A one-to-one relationship between the call reference related to the Bearer state machine and the bearer identifier shall be maintained during the lifetime of the bearer (Note 2).
- The call identifier value shall be included in the Call association information element present in subsequent SETUP messages used to separately establish other bearers associated to the call.

NOTE 1 – This relationship is straight since the value assigned to the call reference related to the call is the same as the one assigned to the Call identifier.

NOTE 2 – There is no particular requirement to assign to the call reference related to the Bearer state machine the same value as the one assigned to the Bearer identifier. However a straightforward relationship is obtained if an implementation chooses to assign the same value to both.

In addition, the Call state machine associated to the call reference corresponding to the Call identifier value assigned in the SETUP message and the Bearer state machine associated to the Call reference value assigned in the same SETUP message (and related to the bearer identifier also assigned in the same SETUP message) will progress in parallel during the simultaneous call and bearer establishment phase towards the active state, in a synchronized fashion. Both the Call state machine and the first Bearer state machine shall be in the same states while in call and first bearer establishment phase. Different state transitions for the Call state machine and the first Bearer state machine are not possible until the call and first bearer have reached the active state.

Call reference values assignment in the Call Reference information element and in the Call Identifier information element requires coordination through the Call and Bearer coordination function to ensure uniqueness of values assigned to the call instances and the bearer instances. The call reference values and the call identifier values shall be taken from a common pool of values.

I.3.2 First bearer clearing

The bearer established simultaneously with the call may be cleared independently of the call at any time but only after the call (and the combined first bearer) is in the Active state by applying the procedures of 9.3/Q.2983 [3]. The RELEASE message shall include in the Call reference information element the **call reference value related to the first bearer** (i.e. the call reference value in the Call reference information element in the SETUP message used to establish simultaneously the call and the first bearer, see I.2).

I.3.3 Call clearing

The procedures in 9.3 shall apply. **The call reference value related to the call** (i.e. the call identifier value in the Call Identifier information element in the SETUP message used to establish simultaneously the call and the first bearer; see I.2) shall be included in the call reference of the RELEASE message.

APPENDIX II

Protocol model and related entities

This appendix provides a simplified modular (and easily extensible) DSS2 architecture model showing the separated Q.2931-based Call control and Bearer control protocols within the overall DSS2 architecture, in particular amongst other UNI services/features control protocols.

II.1 Field of application

The separated Call control protocol defined in this Recommendation and the Bearer control protocol defined in Recommendation Q.2983 apply at the S_B/T_B and T_B reference points provided that both the CC and BC are available and co-located within the adjacent DSS2 terminating entities at both sides of the user-network interface.

They support separated calls but imply that all connections associated to a call are routed across the same interface as the one supporting the call.

Figure II.1 shows the peer-to-peer call and bearer control elements at the user-network interface and their relationships.

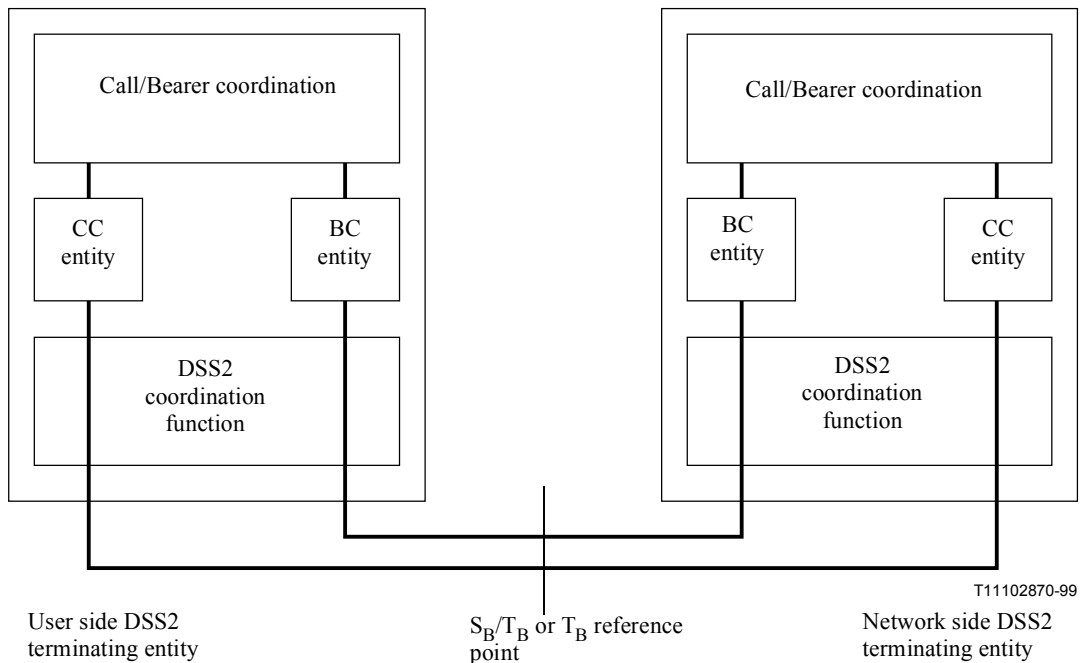


Figure II.1/Q.2982 – Call and Bearer control elements relationships at UNI

The Call identifier provides the required association between corresponding peer Call object instances and the Bearer identifier is used to associated corresponding peer Bearer object instances at each side of the user-network interface. The Call identifier is also used at Bearer establishment to associate it with the related call instance.

II.2 Call and Bearer control protocols in the DSS2 architecture

DSS2 consists of a set of service, application or feature control protocol elements, which communicate with their peer control element at the other side of the interface via a Coordination Function. The CF also ensures communication between different local control elements to enable coordinated actions on the state machines of the controlled objects where relationships exist. This is

precisely the case between Call and Bearer control elements when used separately to support separated calls, where the call instance state machine and the associated Bearer state machines require coherent state coordination (e.g. a bearer cannot remain active if the associated call is being cleared and returns to null state).

Figure II.2 shows the Call control and the Bearer control elements within the general DSS2 protocol architecture model. This model is extensible to introduce other service or application control elements.

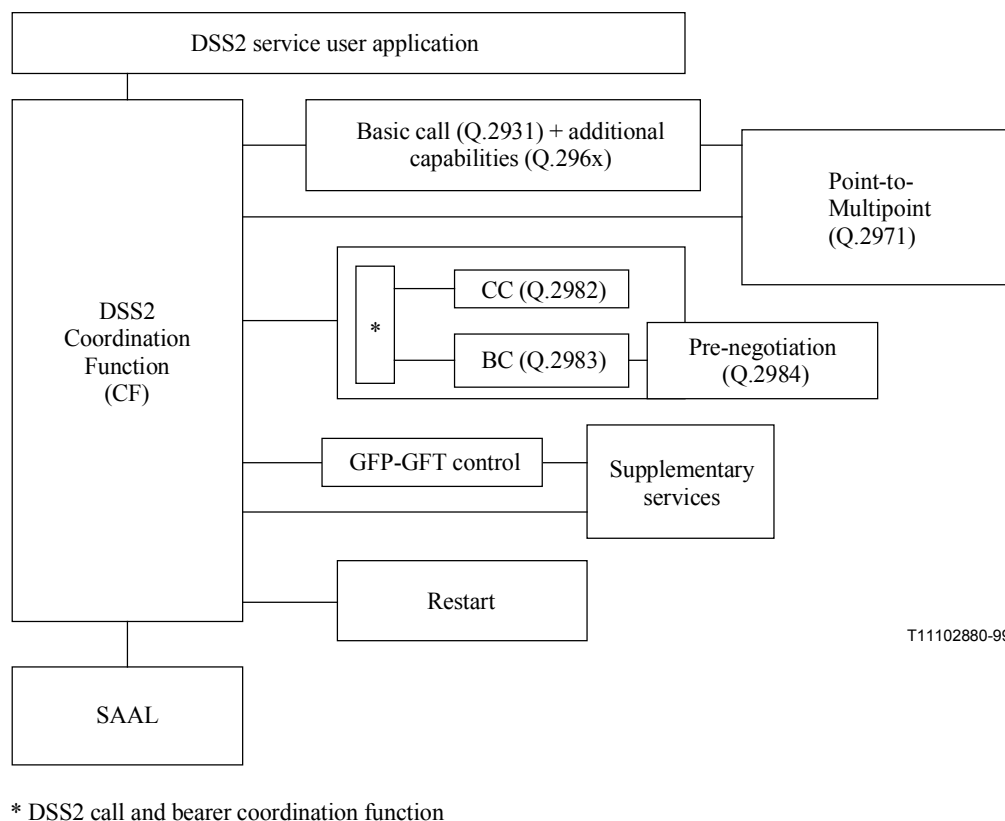


Figure II.2/Q.2982 – General DSS2 architecture

The CF together with all the service/application/feature control elements constitutes a DSS2 (terminating) Entity (also referred to as DSS2 Application Entity in other contexts).

The DSS2-related protocol elements are specified in terms of object states, PDU (including messages and information elements coding exchanged between peer elements across the user-network interface), procedures and system parameters. In general internal DSS2 Entity interfaces (such as between CF and the surrounding elements) are defined only for the purpose of providing SDL for individual control elements.

II.3 Object identifiers

The Call identifier information element is used to identify call object instances. A Call reference value is created at call set-up and related to the Call state machine and also associated to the Call identifier value. Since each DSS2 call control message contains a Call reference, this avoids the inclusion of the Call identifier in subsequent messages relating specifically to the call.

The Bearer identifier information element is used to identify bearer object instances.

The association of subsequently established bearers to a call is made by including the Call association information element containing the Call identifier in the SETUP message used to establish additional bearers.

APPENDIX III

Guidelines for the use of the instruction indicator

This appendix provides guidelines for the setting of the instruction indicator field in the CALL-SETUP Message type, in the Call identifier, Bearer identifier and the Call capability information elements. An implementation may choose to set the instruction indicator differently, depending on possible specific requirements beyond those covered within the present Recommendation.

Recommended setting of the instruction indicator for all is as follows:

Flag: "clear call"

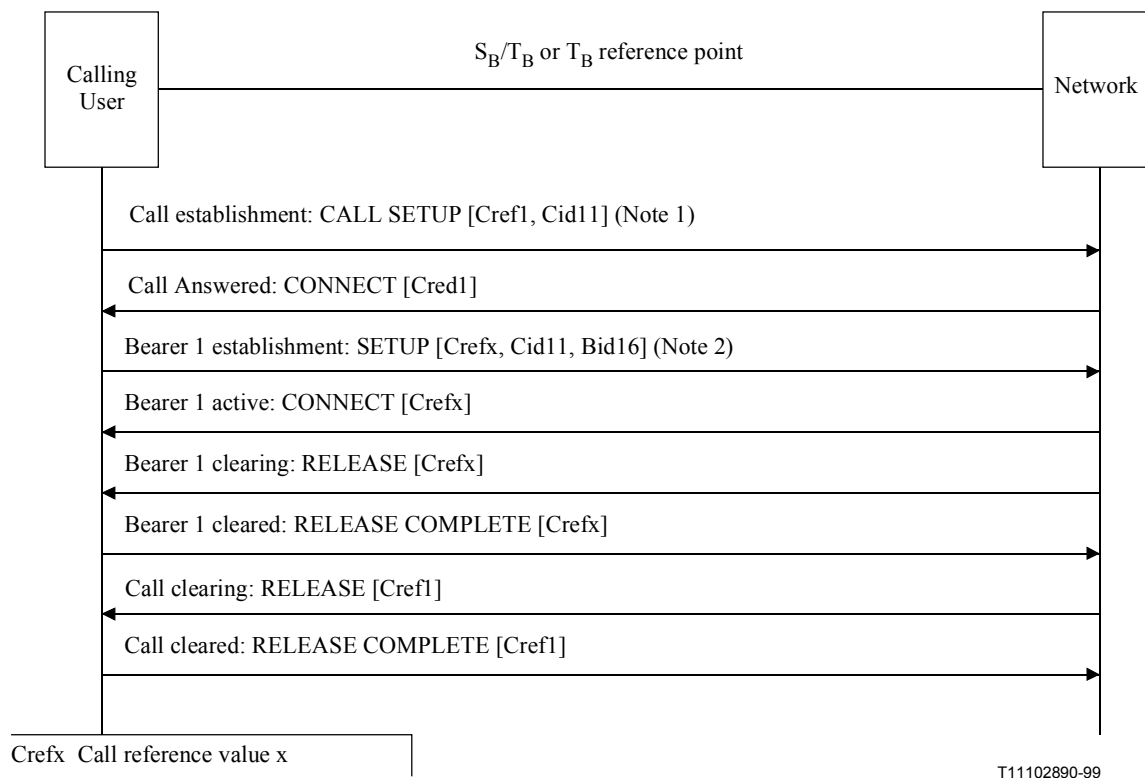
Action indicator: "significant"

APPENDIX IV

Examples of message flows for separated call and bearer control

This appendix provides separated call and bearer control message sequence examples at the user-network interface. It assumes coordinated CC and BC entities at both user and network sides of the interface.

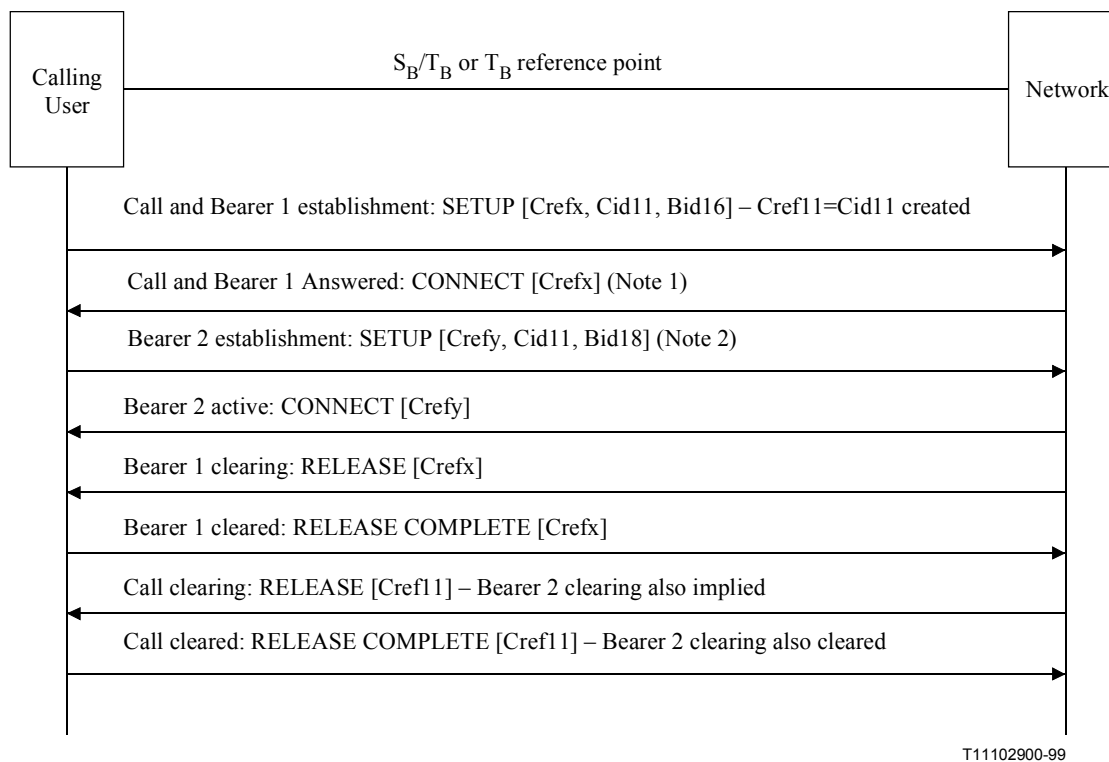
Not all call control messages are shown. Only Call reference, Call identifier and Bearer identifier values included in the signalling messages are shown (see Figures IV.1 and IV.2).



NOTE 1 – A Call state machine related to Cref1, to which is also associated Cid11 is created at the adjacent CC entities residing at each side of the interface.

NOTE 2 – A Bearer state machine related to Crefx, to which is also associated Bid16 is created at the adjacent BC entities residing at each side of the interface.

Figure IV.1/Q.2982 – Separated and sequential call and bearer establishment and clearing



NOTE 1 – The CONNECT message indicates the simultaneous acceptance of the call and the first bearer.

NOTE 2 – May be initiated in either direction once the call has entered the active state.

Figure IV.2/Q.2982 – Simultaneous call and bearer establishment and clearing

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