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Abstract

Attached is the revised text of Chapter 1, 2 and 3 of Q.2931. This text reflects the results of the June 1994 B-ISDN Signalling interim meeting in Edinburgh.

Draft Recommendation Q.2931:

Broadband Integrated Services Digital Network (B-ISDN)
Digital Subscriber Signalling System No. 2 (DSS 2)
User Network Interface Layer 3 Specification for Basic Call/Connection Control

1. Scope

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

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

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

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

Other Recommendations will provide the specification of supplementary services.

Other recommendations may use additional messages, additional operations (using Facility information element), additional information elements and/or modification of existing information elements to support additional capabilities in DSS2.

1.1 Definitions, abbreviations and references

These are provided by Annex J/Q.2931.

1.2 Application to interface structure

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

1.3   Capabilities supported by this recommendation

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

1. Demand (switched virtual) channel connections.

2. Point-to-point switched channel connections.

3. Connections with symmetric or asymmetric bandwidth requirements.

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

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

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

7. Request and indication of signalling parameters.

8. VPCI/VCI negotiation

9. A single, statically defined out-of-band channel for all signalling messages.

10. Error recovery.

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

12 End-to-end compatibility parameter identification.

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

14. Forward compatibility

The following sections describe each capability in more detail.

1.3.1 Support of demand (switched) channel connections

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

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

1.3.2 Support of point-to-point connections

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

1.3.3 Support of connections with symmetric or asymmetric bandwidth

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

1.3.4 Support of a single connection per call

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

1.3.5 Protocol support for basic signalling functions

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

 * Call/Connection Setup

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

 * Call/Connection Request

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

 * Call/Connection Answer

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

 * Call/Connection Clearing

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

 * Reason for Clearing

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

 * Out of Band Signalling

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

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

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

Class C service is a connection oriented variable bit rate (Note 1) ATM transport service. Class C service has no end-to-end timing requirements. The user chooses the desired bandwidth and QOS with appropriate information elements in a SETUP message to establish a Class C connection.

     Note 1- For Bearer Class C, the network may allocate resources, as if Bearer Class A was requested.

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

1.3.7 Support of signalling parameter request and indication

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

1.3.8 VPCI/VCI support

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

The following list describes the Release 1 Signalling capabilities with respect to VPCIs, and VCIs. The Release 1 Signalling specified in this document:

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

2. does not (in Release 1) include negotiations of VPCIs, but does include negotiation of VCIs.

3. does not support provisioning of VPCI/VCI ranges. This is outside the scope of this recommendation.

1.3.9 Support of single signalling virtual channel

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

1.3.10 Support of error recovery

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

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

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

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

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

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

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

1.3.11 Support of public UNI ATM addressing

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

1.3.12 Support of end-to-end compatibility parameter identification

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

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

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

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

4. Protocols above the network layer.

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

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

The following are the underlying assumptions:

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

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

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

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

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

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

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

1.3.14 Forward compatibility

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

2. Overview of Call/Connection control

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

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

2.1 B-ISDN call/connection states

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

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

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

2.1.1.1 Null(U0): No call exists.

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

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

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

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

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

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

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

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

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

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

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

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

2.1.2.1 Null(N0): No call exists.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

2.3.1.1 Null(Rest 0): No transaction exists.

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

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

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

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

2.3.2.1 Null(Rest 0): No transaction exists.

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

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

3. Message functional definitions and content

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

(1) A brief description of the message direction and use, including whether the message has:
> (a) Local significance, i.e., relevant only in the originating or terminating access;
> (b) Access significance, i.e., relevant in the originating and terminating access, but not in the network;
> (c) Dual significance, i.e., relevant in either the originating or terminating access and in the network; or,
> (d) Global significance, i.e., relevant in the originating and terminating access and in the network.

(2) A table listing the codeset 0 information elements. For each information element, the table indicates:
> (a) the section of this Recommendation describing the information element;
> (b) the direction in which it may be sent; i.e., user to network ('u -> n'), network to user ('n ->u'), or both;
>> Note- The user-network terminology in this chapter refers to the interface structures between B-ISDN terminal equipment and B-ISDN public network (TE - LCRF), and between B-ISDN customer network and B-ISDN public network (CN - LCRF); the terms TE, CN and LCRF being used as defined in Rec. I.327.
> (c) whether inclusion is mandatory ('M') or optional ('O'), with a reference to notes explaining the circumstances under which the information element shall be included; and
> (d) the length of the information element (or permissible range of lengths), in octets, where "*" denotes an undefined maximum length, which may be network or service dependent.

(3) Further explanatory notes, as necessary

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

3.1 Messages for B-ISDN call and connection control

TABLE 3-1/Q.2931 summarizes the messages for B-ISDN call or connection control.

TABLE 3-1/Q.2931
Messages for B-ISDN call and connection control

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

3.1.1 ALERTING

This message is sent by the called user to the network and by the network to the calling user to indicate that the called user alerting has been initiated. See Table 3-2/Q.2931.

TABLE 3-2/Q.2931
ALERTING message content

Message type: ALERTING
Significance: global
Direction: both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Connection identifier	4.5	~~both~~u→n	O (Note 1)	4-9
Notification indicator	4.5	both	O (Note 2)	4-5

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

Note 2- This indicator may be present whenever notification is delivered.

3.1.2 CALL PROCEEDING

This message is sent by the called user to the network or by the network to the calling user to indicate that the requested call establishment has been initiated and no more call establishment information will be accepted. See Table 3-3/Q.2931.

TABLE 3-3/Q.2931
CALL PROCEEDING message content

Message type: CALL PROCEEDING
Significance: local
Direction: both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Connection identifier	4.5	both	O (Note 1)	4-9
Notification indicator	4.5	both	O (Note 2)	4-5

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

Note 2- This indicator may be present whenever notification is delivered.

3.1.3 CONNECT

This message is sent by the called user to the network and by the network to the calling user to indicate call acceptance by the called user. See Table 3-4/Q.2931.

TABLE 3-4/Q.2931
CONNECT message content

Message type: CONNECT
Significance: global
Direction: both

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

Note 1- Included in the user-to-network direction when the called user wants to pass ATM adaptation layer parameters information to the calling user, and the ATM adaptation layer parameters information element was present in the SETUP message. Included in the network-to-user direction if the called user included an ATM adaptation layer parameters information element in the CONNECT message. See Annex F/Q.2931.

Note 2- Included in the user-to-network when the answering user wants to return low layer information to the calling user. Included in the network-to-user direction if the user awarded the call included a Broadband low layer information information element in the CONNECT message. Optionally included for Broadband low layer information negotiation, but some networks may not transport this information element to the calling user (see Annex C/Q.2931).

Note 3- ~~Mandatory in the network-to-user direction if this message is the first message in response to a SETUP message.~~ Mandatory in the user-to-network direction if this message is the first message in response to a SETUP message, unless the user accepts the connection identifier indicated in the SETUP message.

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

Note 5- This indicator may be present whenever notification is delivered.

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

3.1.4 CONNECT ACKNOWLEDGE

This message is sent by the network to the called user to indicate the user has been awarded the call. It is also sent by the calling user to the network to allow symmetrical call control procedures. See Table 3-5/Q.2931.

TABLE 3-5/Q.2931
CONNECT ACKNOWLEDGE message content

Message type: CONNECT ACKNOWLEDGE
Significance: local
Direction: both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Notification indicator	4.5	both	O (Note 1)	4-5

Note 1- This indicator may be present whenever notification is delivered.

3.1.5 RELEASE

This message is sent by the user to request the network to clear the end-to-end connection (if any) or is sent by the network to indicate that the end-to-end connection is cleared and that the receiving equipment ~~should~~ release<u>s</u> the connection identifier and prepare to release its ~~local~~ <u>call</u> reference value after sending RELEASE COMPLETE. See Table 3-6/Q.2931.

TABLE 3-6/Q.2931
RELEASE message content

Message type: RELEASE
Significance: global
Direction: both

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

Note 1- This information element may appear twice in the message.

Note 2- This indicator may be present whenever notification is delivered.

3.1.6 RELEASE COMPLETE

This message is sent by the user or the network to indicate that the equipment sending the message has released its ~~local~~ call reference value and, if appropriate, the connection identifier. The connection identifier, if released, is available for reuse. The receiving equipment shall release its ~~local~~ call reference value. See Table 3-7/Q.2931.

TABLE 3-7/Q.2931
RELEASE COMPLETE message content

Message type: RELEASE COMPLETE
Significance: local(Note 1)
Direction: both

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

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

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

3.1.7 SETUP

This message is sent by the calling user to the network and by the network to the called user to initiate B-ISDN call and connection establishment. See Table 3-8/Q.2931.

TABLE 3-8/Q.2931
SETUP message content

Message type: SETUP
Significance: global
Direction: both

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

Note 1- Included in the user-to-network direction when the calling user wants to pass AAL information to the called user. Included in the network-to-user direction if the calling user included an AAL parameter information element in the SETUP message. See Annex F/Q.2931.

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

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

Note 4- Included in the user-to-network direction when the calling user wants to pass Broadband low layer compatibility information to the called user. Included in the network-to-user direction if the calling user included a Broadband low layer information information element in the SETUP message. Two or three information elements may be included in descending order of priority, i.e., highest priority first, if the Broadband low layer information negotiation procedures are used.   See Annex C/Q.2931.

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

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

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

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

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

Note 10- Included in the user-to-network direction when the calling user wants to specify end-to-end transit delay requirements for this call and/or the cumulative transit delay expected for the transmission of user data from the calling user to the network boundary. When included, an end-to-end transit delay information element will be delivered to the called user. Included in the network-to-user direction if end-to-end transit delay information is to be delivered to the called user (see Annex K/Q.2931).

Note 11- This indicator may be present whenever notification is delivered.

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

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

Note 14- Included by the calling user to select a particular transit network (see Annex D /Q.2931). This information element may appear four times in the message.

3.1.8 STATUS

This message is sent by the user or the network in response to a STATUS ENQUIRY message or at any time to report certain error conditions as listed in §5 See Table 3-9/Q.2931.

TABLE 3-9/Q.2931
STATUS message content

Message type: STATUS
Significance: local
Direction: both

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

Note 1- This message may be sent with the global call reference defined in §4.3.

3.1.9 STATUS ENQUIRY

This message is sent by the user or the network at any time to solicit a STATUS message from the peer layer 3 entity. Sending a STATUS message in response to a STATUS ENQUIRY message is mandatory. See Table 3-10/Q.2931.

TABLE 3-10/Q.2931
STATUS ENQUIRY message content

Message type: STATUS ENQUIRY
Significance: local
Direction: both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2

3.1.10 NOTIFY

This message is sent by the user or the network to indicate information pertaining to a call/connection. See Table 3-11/Q.2931.

TABLE 3-11/Q.2931
NOTIFY message content

Message type: NOTIFY
Significance: access
Direction: both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Notification Indicator	4.5	both	M	5

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

TABLE 3-12/Q.2931 summarizes the messages for B-ISDN call or connection control.

TABLE 3-12/Q.2931
Messages related to interworking requirements

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

3.2.1 ALERTING

This message is sent by the called user to the network and by the network to the calling user to indicate that called user alerting has been initiated. See Table 3-13/Q.2931.

TABLE 3-13/Q.2931
ALERTING message content

Message type: ALERTING
Significance: global
Direction: both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Connection identifier	4.5	~~both~~u→n	O(Note 1)	4-9
Narrowband bearer capability	4.6	both	O(Note 2)	4-14
Narrowband high layer compatibility	4.6	both	O(Note 3)	4-~~8~~ 7
Notification indicator	4.5	both	O(Note 4)	4-5
Progress indicator	4.6	both	O(Note 5)	4-6

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

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

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

Note 4- This indicator may be present whenever notification is delivered.

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

3.2.2 CALL PROCEEDING

This message is sent by the called user to the network or by network to the calling user to indicate that the requested call establishment has been initiated and no more call establishment information will be accepted. See Table 3-14/Q.2931.

TABLE 3-14/Q.2931
CALL PROCEEDING message content

Message type: CALL PROCEEDING
Significance: local
Direction: both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Connection identifier	4.5	both	O(Note 1)	4-9
Narrowband bearer capability	4.6	both	O(Note 2)	4-14
Narrowband high layer compatibility	4.6	both	O(Note 3)	4-8 7
Notification indicator	4.5	both	O(Note 4)	4-5
Progress indicator	4.6	both	O(Note 5)	4-6

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

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

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

Note 4- This indicator may be present whenever notification is delivered.

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

3.2.3 CONNECT

This message is sent by the called user to the network and by the network to the calling user to indicate call acceptance by the called user. See Table 3-15/Q.2931.

TABLE 3-15/Q.2931
CONNECT message content

Message type: CONNECT
Significance: global
Direction: both

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

Note 1- Included in the user-to-network direction when the called user wants to pass ATM adaptation layer parameters information to the calling user, and the ATM adaptation layer parameters information element was present in the SETUP message. Included in the network-to-user direction if the called user included an ATM adaptation layer parameters information element in the CONNECT message. See Annex F/Q.2931.

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

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

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

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

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

Note 7- This indicator may be present whenever notification is delivered.

Note 89- Included in the event of interworking or in connection with the provision of in-band information/patterns. This information element may appear twice in the message.

3.2.4 INFORMATION

This message is sent by the user or the network to provide additional information. It may be used to provide information for call establishment (e.g. overlap sending) or miscellaneous call-related information. See Table 3-16/Q.2931.

TABLE 3-16/Q.2931
INFORMATION message content

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

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

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

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

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

3.2.5 PROGRESS

This message is sent by the user or the network to indicate the progress of a call in the event of interworking. See Table 3-17/Q.2931.

TABLE 3-17/Q.2931
PROGRESS message content

Message type: PROGRESS
Significance: global
Direction: both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Narrowband bearer capability	4.6	both	O(Note 1)	4-14
Narrowband high layer compatibility	4.6	both	O(Note 2)	4-8 <u>7</u>
Notification indicator	4.5	both	O(Note 3)	4-5
Progress Indicator	4.6	both	M(Note 4)	6

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

Note 2- The ~~Broadband~~ <u>Narrowband</u> high layer compatibility information element is included when the optional procedures of §5.12/Q.931 for high layer compatibility selection apply. The ~~High~~ <u>Narrowband high</u> layer compatibility information element indicates the high layer compatibility now being used for the call.

Note 3- This indicator may be present whenever notification is delivered.

Note 4- This information element may appear twice in the message.

3.2.6 RELEASE

This message is sent by the user or the network to indicate that the equipment sending the message has disconnected the B-ISDN connection and intends to release the connection identifier (if any) and the call reference, and that the receiving equipment should releases the connection identifier and prepare to release the call reference after sending RELEASE COMPLETE. See Table 3-18/Q.2931.

TABLE 3-18/Q.2931
RELEASE message content

Message type: RELEASE
Significance: global
Direction: both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Cause	4.5	both	M(Note 1)	6-34
Notification indicator	4.5	both	O(Note 2)	4-5
Progress indicator	4.6	both	O(Note 3)	4-6

Note 1- This information element may appear twice in the message.

Note 2- This indicator may be present whenever notification is delivered.

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

3.2.7 SETUP

This message is sent by the calling user to the network and by the network to the called user to initiate a call in B-ISDN for a 64kbit/s based circuit-mode ISDN service. See Table 3-19/Q.2931.

TABLE 3-19/Q.2931
SETUP message content

Message type: SETUP
Significance: global
Direction: both

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

Note 1- Included in the user-to-network direction when the calling user wants to pass AAL information to the called user. Included in the network-to-user direction if the calling user included a AAL parameter information element in the SETUP message. (See Annex F/Q.2931.)

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

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

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

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

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

Note 7- Included in the user-to-network direction when the calling user wants to specify end-to-end transit delay requirements for this call and/or the cumulative transit delay expected for the transmission of user data from the calling user to the network boundary. When included, an end-to-end transit delay information element will be delivered to the called user. Included in the network-to-user direction if end-to-end transit delay information is to be delivered to the called user (see Annex K/Q.2931).

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

Note 9- Mandatory for N-ISDN services (see §6/Q.2931). May be repeated if the Narrowband bearer capability negotiation procedure is used (see Annex L/Q.931). For Narrowband bearer capability negotiation, three Narrowband bearer capability information elements may be included in descending order of priority, i.e., highest priority first. Although support of multiple Narrowband bearer capability information elements may not be supported on all networks, on networks that do support it, and through suitable subscription arrangements, three Narrowband bearer capability information elements may be included (see §5.11/Q.931). When they are not preceded by a Broadband repeat indicator information element, they are included in ascending order of priority.

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

Note 11- The Broadband repeat indicator is included when two or more Narrowband low layer compatibility information element are included for low layer compatibility negotiation.

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

Note 13- This indicator may be present whenever notification is delivered.

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

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

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

Note 17- Included by the calling user to select a particular transit network (see Annex D/Q.2931). This information may appear up to four times in the message.

3.2.8 SETUP ACKNOWLEDGE

This message is sent by the network to the calling user, or by the called user to the network, to indicate that call establishment has been initiated, but additional information may be required. See Table 3-20/Q.2931.

TABLE 3-20/Q.2931
SETUP ACKNOWLEDGE message content

Message type: SETUP ACKNOWLEDGE
Significance: local
Direction: both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Connection identifier	4.5	both	O(Note 1)	4-9
Notification indicator	4.5	both	O(Note 2)	4-5
Progress indicator	4.6	both	O(Note 3)	4-6

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

Note 2- This indicator may be present whenever notification is delivered.

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

3.3 Messages used with the global call reference

TABLE 3-21/Q.2931 summarizes the messages which shall use the global call reference defined in §4.3.

TABLE 3-21/Q.2931
Messages used with the global call reference

Message	Reference
Messages:	
RESTART	3.3.1
RESTART ACKNOWLEDGE	3.3.2
STATUS	3.1.8

3.3.1 RESTART

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

TABLE 3-22/Q.2931
RESTART message content

Message type: RESTART
Significance: local
Direction: both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M(Note 1)	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Connection identifier	4.5	both	O(Note 2)	4-9
Restart indicator	4.5	both	M	5

Note 1- This message is sent with the global call reference defined in §4.3.

Note 2- Included when necessary to indicate the particular virtual channel(s) to be restarted.

3.3.2 RESTART ACKNOWLEDGE

This message is sent to acknowledge the receipt of a RESTART message and to indicate that the requested restart is complete. See Table 3-23/Q.2931.

TABLE 3-23/Q.2931
RESTART ACKNOWLEDGE message content

Message type: RESTART ACKNOWLEDGE
Significance: local
Direction: both

Information element	Reference	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M(Note 1)	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Connection identifier	4.5	both	O(Note 2)	4-9
Restart indicator	4.5	both	M	5

Note 1- This message is sent with the global call reference defined in §4.3.

Note 2- Included when necessary to indicate the particular virtual channel(s) which have been restarted.