INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

X.36

Amendment 1
(10/96)

SERIES X: DATA NETWORKS AND OPEN SYSTEM COMMUNICATION

Public data networks – Interfaces

Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for public data networks providing frame relay data transmission service by dedicated circuit

Amendment 1: Switched Virtual Circuit (SVC) signalling and refinements of Permanent Virtual Circuit (PVC) signalling

ITU-T Recommendation X.36 – Amendment 1
Superseded by a more recent version

(Previously CCITT Recommendation)

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For further details, please refer to ITU-T List of Recommendations.

Superseded by a more recent version

FOREWORD

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

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

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

Amendment 1 to ITU-T Recommendation X.36, was prepared by ITU-T Study Group 7 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 5th of October 1996.

NOTE

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

CONTENTS

Superseded by a more recent version

SUMMARY

This Recommendation consists of two parts: the first one is the corrigendum to the published text of Recommendation X.36 agreed upon at the last meeting of Study Group 7 in 1995. This corrigendum consists of edited pages of Recommendation X.36 reflecting the appropriate changes.

The second part consists of a new clause: clause 10 and a new annex to X.36. Clause 10 defines the signalling for SVC at the DTE/DCE interface and the following three network facilities: closed user group, reverse charging and transit network selection.

Amendment 1 to Recommendation X.36

INTERFACE BETWEEN DATA TERMINAL EQUIPMENT (DTE) AND DATA CIRCUIT-TERMINATING EQUIPMENT (DCE) FOR PUBLIC DATA NETWORKS PROVIDING FRAME RELAY DATA TRANSMISSION SERVICE BY DEDICATED CIRCUIT

AMENDMENT 1
Switched Virtual Circuit (SVC) signalling and refinements of Permanent Virtual Circuit (PVC) signalling

(Geneva, 1996)

PART I – MODIFICATIONS TO RECOMMENDATION X.36
(PERMANENT VIRTUAL CIRCUIT PART)

1) Clause 1; Note, second sentence:

Change: Deliberate differences in this Recommendation catering for the different environment to the definitions for the ISDN environment are clearly marked in Appendix III.

To: The deliberate differences in this Recommendation from the ISDN environment are clearly marked in Appendix III.

2) Subclause 8.2.4; first line

Change: The information transfer rate for a particular PVC

To: The information transfer rate for a particular VC

3) Subclause 9.2.3; second line

Change: 9.2.5

To: 9.2.4

4) Figure 3/X.36

Change: The 3 occurrences of “C/R”

To: *

5) Figure 3/X.36

Change: C/R Command Response Bit

To: * Bit intended to support a command/response indication. The coding is application specific (see 9.3.3.2).

6) Subclause 9.4.5; item b)

Change: has fewer than two octets

To: has fewer than 3 octets

7) Subclause 9.4.5; Note 1

Replace: Note 1

By: Item b) above means that frames with an information field length equal to 0 are invalid frames. In case there is no traffic on a given direction, the DTE or the DCE may use such invalid frames to send information about congestion in the opposite direction by means of the BECN bit set to 1 or 0. This use of invalid frames with an information field length equal to 0 is a network option. Further, these frames are used locally, the DCE will not transfer them to the remote DTE/DCE interface.

8) Subclause 11.1; last paragraph

Replace: the last paragraph of 11.1

By: The support of these procedures is mandatory for the DTE and DCE. In addition, the bidirectional procedures described in 11.5 are optional to the DTE and the DCE. They may be used if the DCE supports them and if the DTE has indicated at subscription time that it will use them. The use of the bidirectional procedures are strongly recommended when the DTE is a private network.

9) Subclause 11.2.2; first paragraph; last sentence

Change: may occur several times.

To: may be repeated.

10) Subclause 11.2.2; Table 3; line starting with "Link integrity verification"

Replace: (Note)

By: (Note 1)

11) Subclause 11.2.2; Table 3; line starting with "PVC status"

Add: (Note 2)

After: PVC status

12) Subclause 11.2.2; Table 3; line starting with "PVC status"

Replace: (Note)

By: (Note 3)

13) Subclause 11.2.2; Table 3; Note

Replace: the Note

With: the following three Notes:

NOTES

1 Mandatory if the type of report is "full status" or "link integrity verification only". Not included in the optional asynchronous status message (report type equal to "Single asynchronous PVC status").

2 Included in the case of a full status message. This is a STATUS message that contains the status of all PVCs on the interface. There is one PVC status information element for each PVC configured. The PVC status information elements are arranged in the messages in ascending order of DLCIs; the PVC with the lowest DLCI is first, the second lowest DLCI is second, and so on. The maximum number of PVCs that can be indicated in a message is limited by the maximum frame size. The optional asynchronous STATUS message contains a single PVC status information element.

3 Mandatory if the report type information element indicated "full status" or "single asynchronous PVC status" and there are PVCs configured.

14) Subclause 11.4.1.1; item 2); after the first sentence

Add: after the first sentence:

If the STATUS ENQUIRY requests full status, the DCE must respond with a STATUS message with the type of report specifying full status.

15) Section 11.4.1.5; fourth paragraph; second and third to last sentences

Not applicable.

16) Subclause 11.4.1.6; second paragraph; second bullet

Replace: the second bullet starting with "Protocol errors ..."

By: *Protocol errors:* Protocol errors are handled according to 10.6.7, "Handling of error conditions" of Recommendation X.36.

17) Subclause 11.4.1.6.1; the line starting with "Note – The DCE continues periodic polling ..."

Replace: the Note

By: NOTE – The DCE continues periodic polling procedure regardless of the value of the received receive sequence number (i.e. the DCE answers to every STATUS ENQUIRY message that does not contain a protocol error). However, if the STATUS ENQUIRY contains an invalid receive sequence number, an error is logged.

18) Subclause 11.4.1.6.2

Cross-reference: item 17 of TD 2172 (liaison to SG 7, source SG 11, Geneva, 26 June - 7 July 1995).

19) Subclause 11.5

Cross-reference: item 18 of TD 2172 (liaison to SG 7, source SG 11, Geneva, 26 June - 7 July 1995).

20) Subclause 11.5 header

Replace: **Optional bidirectional network procedures**

By: **Optional bidirectional procedures**

21) Subclause 11.6; Table 5-2

Add a column labelled "Stopped" after the column labelled "Started".

Add an entry for the row labelled "T391" and the column labelled "Stopped" containing the following character "–".

Add an entry for the row labelled "T392" and the column labelled "Stopped" containing the following text: "Receive STATUS ENQUIRY".

Add after T392 (Note 3).

Replace Note 3 by the following:

3 T392 should be greater than T391.

22) Annex A; Table A.1; Row "Support of PVC management"

Change: "Optional"

To: "Mandatory"

23) Annex A; Table A.1; Row "Support of PVC bidirectional procedure"

Delete the row labelled "Support of PVC bidirectional procedure" and the two rows below it labelled "T391" and "T392".

24) Annex B; Table B.1

Replace: "DTE" in the last column title

By: "DCE"

24a) Annex B; Table B.1

Change row PC1 under DTE: "Optional" *to* "Mandatory"
Change row PC1 under DCE: "Optional" *to* "(Note)"
Change row PC2 under DTE: "Optional" *to* "(Note)"
Change row PC11 under DTE: "Optional" *to* "(Note)"
Change row PC12 under DTE: "Optional" *to* "Mandatory"
Change row PC12 under DCE: "Optional" *to* "(Note)"

Add a Note to the bottom of the table as follows:

NOTE – Mandatory if bidirectional procedures are implemented.

25) Annex D; second paragraph starting with "Guidance is also provided ..."

Add: the following text after the first sentence:

Encapsulation procedures shall be used only on PVCs that have been explicitly configured for its use or on SVCs that are established with multiprotocol encapsulation specified during call set-up.

26) Annex D; D.1; fifth paragraph starting with "The protocol identifiers are defined ..."

Replace: "The protocol identifiers ..."

By: "The network layer protocol identifiers ..."

27) Annex D; D.1 after Figure D.1

Add a new paragraph after Figure D.1 as follows:

If a protocol can be encapsulated in more than one multiprotocol header format, the first format from the list below, which provides a code point for the protocol, shall be used:

1) Direct NLPID – Protocols for which a NLPID value is defined in TR 9577; e.g. IP, CLNP (ISO 8473) and ISO 8208.
2) SNAP encapsulation – Using SNAP NLPID followed by SNAP, e.g. LAN bridging and connectionless protocols which have a SNAP value.
3) NLPID followed by four octets indicating layer 2 and layer 3 identifications, i.e. connection-oriented protocols and other protocols which cannot be supported by the other two methods.

28) Annex D; D.4; first line

Replace: "Some protocol have not an assigned protocol identifier ..."

With: "Some connectionless protocols do not have an assigned protocol identifier ..."

29) Annex D; at the end of Annex D

Add the following text:

"D.5.8 Other protocols

Some protocols do not have a specific NLPID assigned to them. When packets of such protocols are sent over a frame relay connection supporting multiprotocol encapsulation, they use NLPID 0 x 08 (which indicates Recommendation Q.933). The four bytes following NLPID include both layer 2 and layer 3 protocol identifications. The code points for most protocols are currently defined in Recommendation Q.933 low layer compatibility information element (see 4.5.21, octets 6 and 7 codings). There is also an escape for defining non-standard protocols (see Figure D.12).

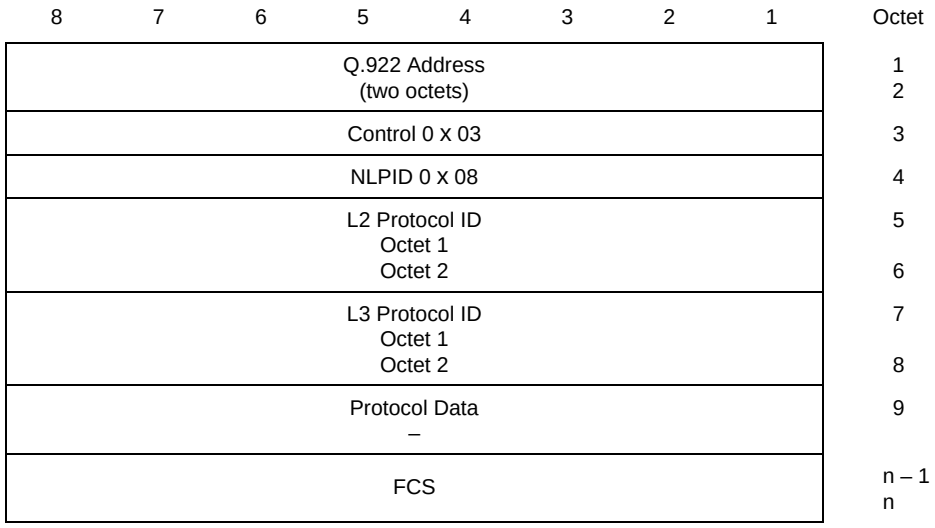


FIGURE D.12/X.36

Format of other protocol frame using Q.933 NLPID

D.5.8.1 ISO 8802/2 with user specified layer 3

See Figure D.13.

D.5.9 Fragmentation issues

Fragmentation allows the exchange of packets that are greater than the maximum frame size supported by the underlying network. In the case of frame relay, the network may support a maximum frame size as small as 262 octets, although support of maximum frame size of at least 1600 octets (i.e. large enough to carry an unfragmented IEEE 802.3 frame) is strongly recommended. Because of this small maximum size, it is advantageous to support fragmentation and reassembly.

The scope of frame relay fragmentation procedure is limited to the boundary (or TEs) of the frame relay network.

8	7	6	5	4	3	2	1	Octet
Q.922 Address (two octets)								1 2
Control 0 x 03								3
NLPID 0 x 08								4
8802/2 0 x 4C 0 x 80 (Note 1)								5 6
User Spec. 0 x 70 (Note 2)								7 8
DSAP								9
SSAP								10
Control (Note 3)								11
remainder of PDU –								
FCS								n – 1 n

NOTES

1 Required for padding.

2 Indicates the code point for user specified layer 3 protocol.

3 Control field is two octets for I-format and S-format frames (see 8802/2).

FIGURE D.13/X.36

Format of frame with 802.2 (layer 2) and user specified (layer 3)

The general format of fragmented packets is the same as any other encapsulated protocol. The most significant difference is that the fragmented packet will contain the encapsulation header. That is, a packet is first encapsulated (with the exception of the address and control fields) as defined above. Large packets are then broken up into frames appropriate for the given frame relay network and are encapsulated using the frame relay fragmentation format. In this way, a station receiving fragments may reassemble them and then put the reassembled packet through the same processing path as a packet that had not been fragmented.

Within frame relay, fragments are encapsulated using the SNAP format with an OUI of 0 x 00 - 80 - C2 and a PID of 0 x 00 - 0D. Individual fragments will, therefore, have the following format given in Figure D.14.

The sequence field is a two octet identifier that is incremented every time a new complete message is fragmented. It allows detection of lost frames and is set to a random value at initialization.

The reserved field is 4 bits long and is not currently defined. It must be set to 0.

The final bit is a 1-bit field set to 1 on the last fragment and set to 0 for all other fragments.

The offset field is an 11-bit value representing the logical offset of this fragment in bytes divided by 32. The first fragment must have an offset of zero.

Fragments must be sent in order starting with a zero offset and ending with the final fragment. These fragments must not be interrupted with other packets or information intended for the same DLC. An end station must be able to reassemble up to 2K octets and is suggested to support up to 8K octet reassembly. If at any time during this packet reassembly process a fragment is corrupted or a fragment is missing, the entire packet is dropped. The upper layer protocol is responsible for any retransmission in this case.

This fragmentation algorithm is not intended to reliably handle all possible failure conditions. As with IP fragmentation, there is a small possibility of reassembly error and delivery of an erroneous packet. Inclusion of a higher layer checksum greatly reduces this risk.

8	7	6	5	4	3	2	1	Octet
Q.922 Address (two octets)								1 2
Control 0 x 03								3
pad 0 x 00								4
NLPID 0 x 80								5
OUI 0 x 00 OUI 0 x 80 OUI 0 x C2								6 7 8
PID 0 x 00 - 0D								9 10
Sequence number								11 12
F	RSVD				Offset			13
Offset (continue)								14
Fragmented data –								15
FCS								n – 1 n

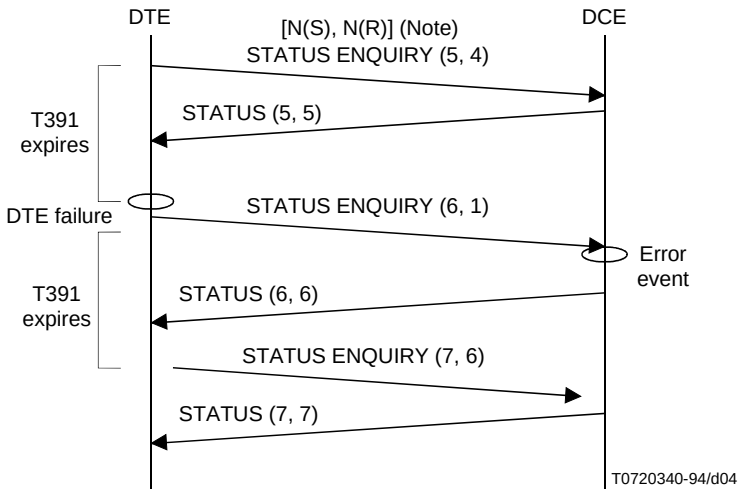
FIGURE D.14/X.36

Format of individual fragment"

30) Change Figures I.3 and I.4 as shown:

Figure I.3 shows an error event of the Receive Sequence Number in a STATUS ENQUIRY message.

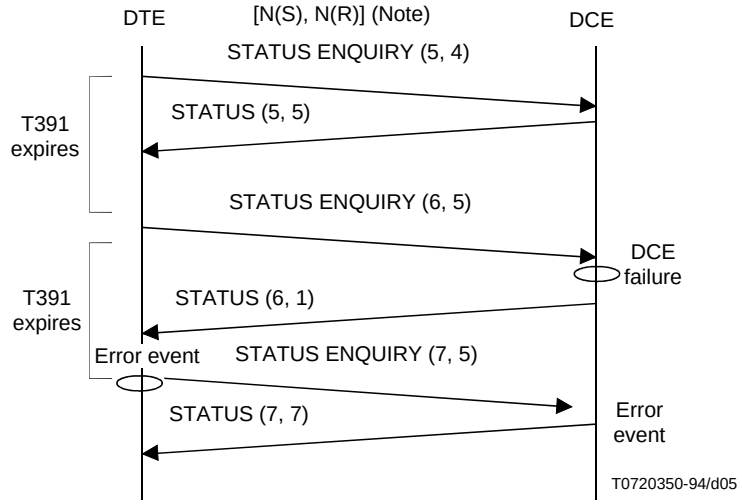
Figure I.4 shows an error event of the Receive Sequence Number in a STATUS message.



NOTE – For each STATUS message and STATUS ENQUIRY message (,) stands for sequence number [N(S), N(R)] sent in those messages.

FIGURE I.3/X.36

Error event by Receive Sequence Number error in STATUS ENQUIRY message



NOTE – For each STATUS message and STATUS ENQUIRY message (,) stands for sequence number [N(S), N(R)] sent in those messages.

FIGURE I.4/X.36

Error event by Receive Sequence Number error in STATUS message

PART II – NEW MATERIALS TO RECOMMENDATION X.36

2 References

– ITU-T Recommendation E.160 (1993), *Definitions relating to national and international numbering plans*.

– CCITT Recommendation E.164 (1991), *Numbering plan for the ISDN era*.

– CCITT Recommendation E.166 (1992)/X.122 (1992), *Numbering plan interworking for the E.164 and X.121 numbering plans*.

– ITU-T Recommendation Q.850 (1993), *Usage of cause and location in the digital subscriber Signalling System No. 1 and the Signalling System No. 7 ISDN user part*.

– ITU-T Recommendation Q.921 (1993), *ISDN user-network interface – Data link layer specification*.

– CCITT Recommendation Q.922 (1992), *ISDN data link layer specification for frame mode bearer services*.

– ITU-T Recommendation Q.931 (1993), *Digital Subscriber Signalling System No. 1 (DSS 1) – ISDN user-network interface layer 3 specification for basic call control*.

– ITU-T Recommendation Q.933 (1995), *Integrated Services Digital Network (ISDN) Digital Subscriber Signalling System No. 1 (DSS 1) – Signalling specifications for frame mode switched and permanent virtual connection control and status monitoring*.

– CCITT Recommendation Q.951 (1992), *Stage 3 description for number identification supplementary services using DSS 1*.

– CCITT Recommendation T.50 (1992), *International Reference Alphabet (IRA)*.

– CCITT Recommendation X.121 (1992), *International numbering plan for public data networks*.

3 Definitions

3.1 **calling/called DTE**: A calling DTE is the entity which initiates or originates a request to set up a Frame Relay switched virtual circuit. The called DTE is the DTE to which a Frame relay switched virtual circuit set-up request is directed.

3.2 **connected DLCI**: A DLCI is "connected" when it is being used in a frame relay switched virtual circuit.

3.3 **disconnected DLCI**: A DLCI is "disconnected" when it is no longer being used in a frame relay switched virtual circuit but is not yet available for use in a new frame relay switched virtual circuit.

3.4 **released DLCI**: A DLCI is "released" when it is not being used in a frame relay switched virtual circuit but is available for use in a new frame relay switched virtual circuit.

3.5 **incoming/outgoing switched virtual circuit set-up request**: At a DTE/DCE interface, the terms *incoming* and *outgoing* refer to the direction of a switched virtual circuit set-up request from the DTE perspective. An incoming switched virtual circuit set-up request is a request received by a DTE and an outgoing switched virtual circuit set-up request is a request originated from a DTE. This terms are local to the DTE/DCE interface.

4 Abbreviations

LAPF Link Access Protocol F

SVCSwitched Virtual Circuit

10 Switched virtual circuit signalling

10.1 General

This clause defines the signalling for frame relay Switched Virtual Circuits (SVCs) control at the DTE/DCE interface of a public data network providing a frame relay service. The following optional facilities also are defined: Closed user group, reverse charging indication and prevention and transit network selection.

10.2 Signalling channel

Recommendation Q.922 defines the link layer protocol known as LAPF to provide a reliable data link connection for the exchange of SVC signalling messages defined in this clause across a DTE/DCE interface (see Figure 10-1).

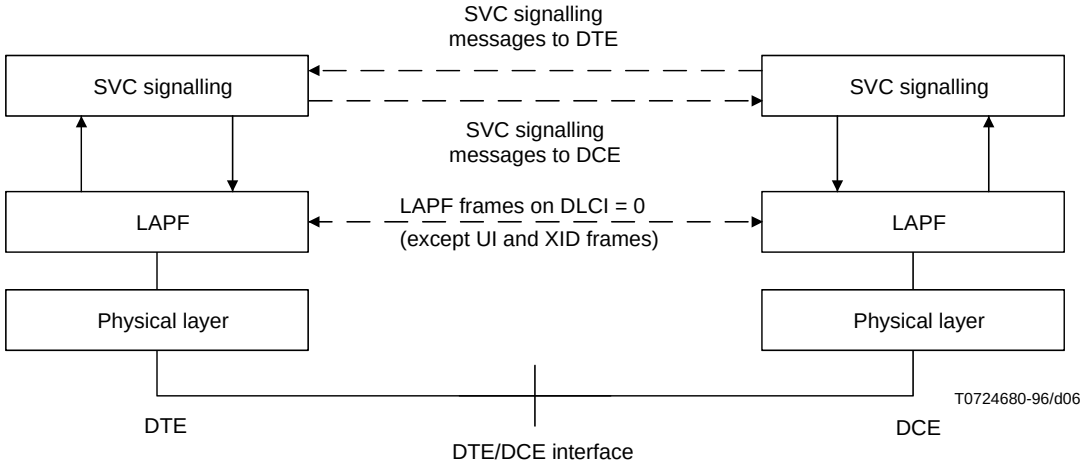


FIGURE 10-1/X.36

DTE/DCE protocol layers for signalling

The following frame types identified in Recommendation Q.922 and defined in Recommendation Q.921 must be supported:

- Set Asynchronous Balanced Mode Extended (SABME) command;
- Disconnection (DISC) command;
- Receive Ready (RR) command and response;
- Reject (REJ) command/response;
- Receive Not Ready (RNR) command/response;
- I-frames;
- Unnumbered Acknowledgment (UA) response;
- Disconnected Mode (DM) response;
- Frame Reject (FRMR) response.

XID frames are not used and Unnumbered Information (UI) frames are used for PVC signalling. SVC signalling does not affect PVC signalling since for SVC signalling, I-frames are used whereas for PVC signalling UI frames are used.

In order to exchange SVC signalling messages across the DTE/DCE interface, a LAPF link has to be established using DLCI = 0. After establishment of LAPF link, the data link connection identified with DLCI = 0 is automatically ready for the exchange of the signalling messages across the DTE/DCE interface. This LAPF link is known as the signalling channel.

On the signalling channel, FECN, BECN and DE bits are not used. They must be set to 0 upon transmission and must not be interpreted upon reception.

10.3 Call states

10.3.1 Call states of the DTE

The following states are the DTE states that may exist at the DTE side of the DTE/DCE interface:

- **Null (U0)** – No switched virtual circuit exists.
- **Call Initiated (U1)** – This state exists for an outgoing switched virtual circuit when the DTE has sent a request to the DCE to establish a frame relay switched virtual circuit.
- **Outgoing Call Proceeding (U3)** – This state exists for an outgoing switched virtual circuit when the DTE has received an indication that the DCE has received the necessary information to establish the frame relay switched virtual circuit.
- **Call Present (U6)** – This state exists for an incoming switched virtual circuit when the DTE has received a request to establish a frame relay switched virtual circuit but has not yet responded.
- **Incoming Call Proceeding (U9)** – This state exists for an incoming call when the DTE has acknowledged the receipt of the request to establish a frame relay switched virtual circuit.
- **Active (U10)** – This state exists for an incoming or outgoing switched virtual circuit when the frame relay switched virtual circuit has been established and data transfer phase can begin.
- **Disconnect Request (U11)** – This state exists when the DTE has requested the DCE to disconnect the frame relay switched virtual circuit and is waiting for a response.
- **Disconnect Indication (U12)** – This state exists when the DTE has received an invitation to disconnect the frame relay switched virtual circuit and has not replied yet.
- **Release request (U19)** – This state exists when the DTE has sent a request to the DCE to release the frame relay switched virtual circuit and is waiting for the response.

10.3.2 Call states of the DCE

The following states are the DCE states that may exist at the DCE side of the DTE/DCE interface:

- **Null (N0)** – No call exists.
- **Call Initiated (N1)** – This state exists for an outgoing switched virtual circuit when the DCE has received a request to establish a frame relay switched virtual circuit but has not yet responded.
- **Outgoing Call Proceeding (N3)** – This state exists for an outgoing switched virtual circuit when the DCE has acknowledged the receipt of the information necessary to establish the frame relay switched virtual circuit.
- **Call Present (N6)** – This state exists for an incoming switched virtual circuit when the DCE has sent a request to establish a frame relay switched virtual circuit but the DTE has not responded.
- **Incoming Call Proceeding (N9)** – This state exists for an incoming switched virtual circuit when the DCE has received an acknowledgment that the called DTE has received the request to set up the frame relay switched virtual circuit.
- **Active (N10)** – This state exists for an incoming or outgoing switched virtual circuit when the frame relay connection has been established and the data transfer phase can begin.
- **Disconnect Request (N11)** – This state exists when the DCE has received a request from the DTE to disconnect the frame relay switched virtual circuit.
- **Disconnect Indication (N12)** – This state exists when the DCE has disconnected the frame relay switched virtual circuit and has sent an invitation to disconnect and is waiting for the reply from the DTE.
- **Release Request (N19)** – This state exists when the DCE has requested the DTE to release the frame relay switched virtual circuit and is waiting for the response.

10.3.3 States used with the restart facility

The following states are associated with the restart facility:

- **Null (Rest0)** – No restart request exists.
- **Restart request (Rest1)** – This state exists after a DTE or a DCE has sent a restart request to the other side of the DTE/DCE interface and is waiting for an acknowledgment.
- **Restart (Rest2)** – This state exists when one side of the DTE/DCE interface has received a request for a restart and has not returned an acknowledgment yet.

10.4 Message definitions

This subclause provides an overview of the message structure, which highlights the functional definition and information content 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 at a DTE/DCE interface;
   b) global significance, i.e. relevant at both the local and remote DTE/DCE interfaces and in the network.
2) A table listing the information elements in the order of their appearance in the message. For each information element the table indicates:
   a) the clause of this Recommendation describing the information element;
   b) the direction in which it may be sent, i.e. DTE to DCE, DCE to DTE or both;
   c) whether the information element inclusion in the message is mandatory (M), or optional (O), with a reference to notes explaining the circumstances under which the information element shall be included.
   d) the length of the information element (or permissible range of length) in octets. "*" denotes an undefined length which may be network or DTE/DCE dependent.
   e) further explanatory notes as necessary.

Table 10-1 summarizes the messages for frame relay SVC. These messages are a subset of the messages defined and specified in Recommendations Q.931 and Q.933.

Every message transferred across the DTE/DCE interface on the logical data link identified by DLCI = 0, consists of at least five octets. These five octets contain a Protocol Discriminator (1 octet), a Call Reference (3 octets) and a Message Type (1 octet). Other information elements are included as required.

TABLE 10-1/X.36

Messages for frame relay SVC signalling

Message	Reference
Virtual circuit establishment messages:	
CALL PROCEEDING	10.4.1
CONNECT	10.4.2
SETUP	10.4.8
Virtual circuit clearing messages:	
DISCONNECT	10.4.3
RELEASE	10.4.4
RELEASE COMPLETE	10.4.5
Miscellaneous messages:	
RESTART	10.4.6
RESTART ACKNOWLEDGE	10.4.7
STATUS	10.4.9
STATUS ENQUIRY	10.4.10

10.4.1 CALL PROCEEDING

This message is sent by the DCE to the calling DTE and by the called DTE to the DCE to indicate that the set-up request for the switched virtual connection has been initiated. This message acknowledges the receipt of the SETUP message, (see Table 10-2).

TABLE 10-2/X.36

CALL PROCEEDING message content

Message type: CALL PROCEEDING Direction: both Significance: local				
Information element	Reference	Direction	Type	Length
Protocol discriminator	10.5.1	Both	Mandatory	1
Call reference	10.5.2	Both	Mandatory	3
Message type	10.5.3	Both	Mandatory	1
Data Link Connection Identifier	10.5.14	Both	Mandatory	4-6

10.4.2 CONNECT

This message is sent by the called DTE to the DCE and by the DCE to the calling DTE to indicate that the called DTE has accepted the request to establish a switched virtual circuit (see Table 10-3).

TABLE 10-3/X.36

CONNECT message content

Message type: CONNECT Direction: both
Significance: global

Information element	Reference	Direction	Type	Length
Protocol discriminator	10.5.1	Both	Mandatory	1
Call reference	10.5.2	Both	Mandatory	3
Message type	10.5.3	Both	Mandatory	1
Data Link Connection Identifier	10.5.14	Both	Optional (Note 1)	4-6
Link layer core parameter	10.5.15	Both	Optional (Note 2)	2-27
Connected number	10.5.12	Both	Optional (Note 3)	2-*
Connected subaddress	10.5.13	Both	Optional (Note 4)	2-23
User-user	10.5.20	Both	Optional (Note 5)	2-131

NOTES

1 Mandatory in the DTE-to-DCE direction when the called DTE replies to the incoming SETUP message with a CONNECT message. In all other cases it is optional.

2 Mandatory in both directions to indicate the final parameters to be used for the call.

3 If included by the called DTE in the DTE-to-DCE direction, then its presence is optional in the DCE-to-DTE direction if it is the same as the Called party number presented to the called DTE in the SETUP message. Its presence is mandatory in the DCE-to-DTE direction if it is different from the called party number presented to the called DTE in the SETUP message.

4 Included in the DCE-to-DTE direction at the calling DTE/DCE interface if it was included in the DTE-to-DCE direction at the called DTE/DCE interface to identify the connected subaddress to the calling DTE.

5 Included in the DCE-to-DTE direction at the calling DTE/DCE interface if it was included in the DTE-to-DCE direction at the called DTE/DCE interface to pass user data from the answering DTE to the calling DTE.

10.4.3 DISCONNECT

This message is sent by a DTE to the DCE, and by a DCE to a DTE to disconnect the frame relay SVC (see Table 10-4).

TABLE 10-4 /X.36

DISCONNECT message content

Message type: DISCONNECT Direction: both
Significance: global

Information element	Reference	Direction	Type	Length
Protocol discriminator	10.5.1	Both	Mandatory	1
Call reference	10.5.2	Both	Mandatory	3
Message type	10.5.3	Both	Mandatory	1
Cause	10.5.10	Both	Mandatory	4-*

10.4.4 RELEASE

This message is sent by a DTE to the DCE, and by the DCE to the DTE to clear the frame relay SVC (see Table 10-5).

TABLE 10-5/X.36

RELEASE message content

Message type: RELEASE Direction: both Significance: local (Note 1)				
Information element	Reference	Direction	Type	Length
Protocol discriminator	10.5.1	Both	Mandatory	1
Call reference	10.5.2	Both	Mandatory	3
Message type	10.5.3	Both	Mandatory	1
Cause	10.5.10	Both	(Note 2)	4-*

NOTES

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

2 Mandatory if the RELEASE message is the first call clearing message sent as a result of an error handling condition, otherwise it is optional. This information element may be repeated to indicate multiple clearing causes.

10.4.5 RELEASE COMPLETE

This message is sent by a DTE to the DCE and by the DCE to the other DTE as part of the clearing process (see Table 10-6).

TABLE 10-6/X.36

RELEASE COMPLETE message content

Message type: RELEASE COMPLETE Direction: both Significance: local (Note 1)				
Information element	Reference	Direction	Type	Length
Protocol discriminator	10.5.1	Both	Mandatory	1
Call reference	10.5.2	Both	Mandatory	3
Message type	10.5.3	Both	Mandatory	1
Cause	10.5.10	Both	(Note 2)	4-*

NOTES

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

2 Mandatory if the RELEASE COMPLETE message is the first call clearing message sent as a result of an error handling condition, otherwise it is optional. This information element may be repeated to indicate multiple clearing causes.

10.4.6 RESTART

This message is sent by a DTE to a DCE or a DCE to a DTE to request the recipient to restart (i.e. return to an idle condition) the DTE/DCE interface (see Table 10-7).

TABLE 10-7/X.36

RESTART message content

Message type: RESTART Direction: both Significance: local				
Information element	Reference	Direction	Type	Length
Protocol discriminator	10.5.1	Both	Mandatory	1
Call reference	10.5.2	Both	Mandatory (Note 1)	3
Message type	10.5.3	Both	Mandatory	1
NOTE – The RESTART message is sent with the global call reference.				

10.4.7 RESTART ACKNOWLEDGE

This message is sent by a DTE to a DCE or a DCE to a DTE to acknowledge the receipt of the restart message and to indicate that the requested restart is complete (see Table 10-8).

TABLE 10-8/X.36

RESTART ACKNOWLEDGE message content

Message type: RESTART ACKNOWLEDGE Direction: both Significance: local				
Information element	Reference	Direction	Type	Length
Protocol discriminator	10.5.1	Both	Mandatory	1
Call reference	10.5.2	Both	Mandatory (Note)	3
Message type	10.5.3	Both	Mandatory	1
NOTE – The RESTART message is sent with the global call reference.				

10.4.8 SETUP

This message is sent by the calling DTE to the DCE, and by the DCE to the called DTE to initiate the establishment of the Frame Relay switched virtual circuit (see Table 10-9).

TABLE 10-9/X.36

SETUP message content

Message type: SETUP Direction: both
Significance: global

Information element	Reference	Direction	Type	Length
Protocol discriminator	10.5.1	Both	Mandatory	1
Call reference	10.5.2	Both	Mandatory	3
Message type	10.5.3	Both	Mandatory	1
Bearer capability	10.5.4	Both	Mandatory	5
Data Link Connection Identifier	10.5.14	n -> u	Mandatory (Note 1)	4-6
Closed user group	10.5.11	Both	Optional	4-7
Link layer core parameters	10.5.15	Both	Optional (Note 2)	2-27
Link layer protocol parameters	10.5.16	Both	Optional	2-*
Reverse charging indication	10.5.18	Both	Optional	3
Calling party number	10.5.8	Both	Optional (Note 3)	2-*
Calling party subaddress	10.5.9	Both	Optional (Note 4)	2-23
Called party number	10.5.6	Both	Optional (Note 5)	2-*
Called party subaddress	10.5.9	Both	Optional (Note 6)	2-23
Transit network selection	10.5.19	Both	Optional	2-*
Low layer compatibility	10.5.17	Both	Optional (Note 6)	2-*
User-user	10.5.20	Both	Optional (Note 6)	2-131

NOTES

1 Mandatory in the DCE-to-DTE direction. Not allowed in the DTE-to-DCE direction.

2 Included in the DTE-to-DCE direction when the calling DTE wants to indicate the proposed link layer core parameters to the network. Always include in the DCE-to-DTE direction. If the link layer core parameters information element is missing or partially specified, in the DTE-to-DCE direction, the network will use default values and will present them to the called DTE.

3 Mandatory in the DCE-to-DTE direction to identify the calling user. Optional in the DTE-to-DCE direction.

4 Included in the DCE-to-DTE direction if the calling party included this information element in the DTE-to-DCE direction.

5 Mandatory in the DTE-to-DCE direction to identify the called user. Included in the DCE-to-DTE direction when called party number information is to be conveyed to the called DTE (e.g. when the called DTE is a private network).

6 Included in the DCE-to-DTE direction at the called DTE/DCE interface if it was included by the calling DTE.

10.4.9 STATUS

This message is sent by the DCE to a DTE and by a DTE to the DCE in response to a STATUS ENQUIRY or at any time to report certain error condition (see Table 10-10).

TABLE 10-10/X.36

STATUS message content

Message type: STATUS Direction: both Significance: local				
Information element	Reference	Direction	Type	Length
Protocol discriminator	10.5.1	Both	Mandatory	1
Call reference	10.5.2	Both	Mandatory	3
Message type	10.5.3	Both	Mandatory	1
Cause	10.5.10	Both	Mandatory	4-*
Call State	10.5.5	Both	Mandatory	3

10.4.10 STATUS ENQUIRY

This message is sent by a DTE to the DCE and by the DCE to a DTE at any time to solicit a STATUS message (see Table 10-11).

TABLE 10-11/X.36

STATUS ENQUIRY message content

Message type: STATUS ENQUIRY Direction: both Significance: local				
Information element	Reference	Direction	Type	Length
Protocol discriminator	10.5.1	Both	Mandatory	1
Call reference	10.5.2	Both	Mandatory	3
Message type	10.5.3	Both	Mandatory	1

10.5 General message format and information element coding

This subclause describes the information elements which are included in the various signalling messages defined in the previous subclause.

Every message of this protocol shall consist of the following parts:

a) protocol discriminator;

b) call reference;

c) message type;

d) other information elements.

Information elements a), b), c) are common to all the messages and shall always be present. Each message will have additional information elements. This organization is shown in Figure 10-2.

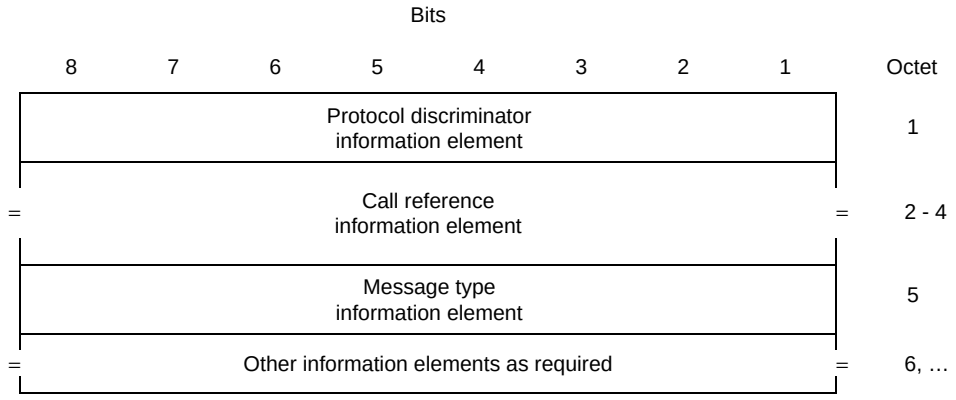


FIGURE 10-2/X.36

General message organization example

Unless specified otherwise, a particular information element may be present only once in a given message.

The information elements used for frame relay SVC are:

- Protocol discriminator;
- Call reference;
- Message type;
- Bearer Capability;
- Call State;
- Called party number;
- Called party subaddress;
- Calling party number;
- Calling party subaddress;
- Connected party number;
- Connected party subaddress;
- Cause;
- Closed user group;
- Data link connection identifier;
- Link layer core parameters;
- Link layer protocol parameters;
- Low layer compatibility;
- Reverse charge indication;
- Transit network selection;
- User-user.

The coding of the information elements other than the first three mandatory information elements (protocol discriminator, call reference and message type) is as follows:

- The information elements used with frame relay call control are of variable length. They are described in alphabetical order. However, there is a particular order of appearance for each information element in a message. The code values of the variable length information element identifiers are assigned in numerical order according to the actual order of appearance of each information element in a message. This allows a receiver to detect the presence or absence of a particular information element without scanning through the entire message.

- Information element identifier values (first octet of a variable length information element) with bits 5-8 coded "0000" are for future information elements for which comprehension by the receiver is required.

- When the description of the information elements contains spare bits, these bits are indicated as being set to "0".

- The second octet of a variable length information element indicates the total length of the contents starting with octet 3. It is the binary coding of the number of octets of the contents, with bit 1 as the least significant bit.

- Each octet of a variable length information element is numbered.

- Optional octet(s) are marked with asterisks (*).

- An octet group is a self contained entity, it contains one or more octets. For frame relay information elements, the internal structure of an octet group is defined by using the following extension mechanism:

  – The first octet of an octet group is identified by a number (N). The subsequent octets are identified as Na, Nb, Nc, ... Bit 8 of each octet is the *extension bit*. The value "0" of bit 8 indicates that the octet group continues to the next octet. The value "1" of bit 8 indicates that this octet is the last octet of the octet group. If one octet (Nc) must be present, the preceding octets (N, Na and Nb) must also be present.

  – In the description of the information elements, bit 8 is marked "0/1 ext." if another octet follows. Bit 8 is marked "1 ext." if this is the last octet of the octet group.

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

10.5.1 Protocol discriminator

The protocol discriminator is the first part (first octet) of every message. It is coded as shown in Figure 10-3.

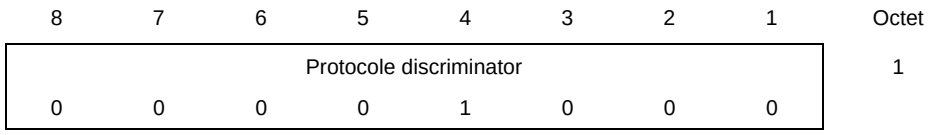


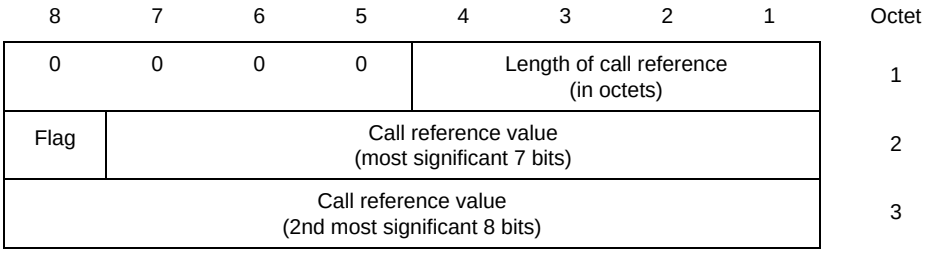
FIGURE 10-3/X.36

Protocol discriminator

10.5.2 Call reference

The purpose of the call reference is to identify the switched virtual circuit to which the particular message applies. The call reference does not have end-to-end significance. The call reference is the second part of every message.

The call reference is coded as shown in Figure 10-4. Only call reference values of two octets (15 bits) are supported in this Recommendation. The encoding of the call reference value always uses two octets even if the value can be encoded in one octet only. Hence, the length field will always have a binary value of "0010". The most significant bit of the call reference value is bit 7 of octet 2 and the least significant bit is bit 1 of octet 3.



Flag (octet 2)

Bit

8

0 The message is sent **from** the side of the DTE/DCE interface that originates the call reference.

1 The message is sent **to** the side of the DTE/DCE interface that originates the call reference.

FIGURE 10-4/X.36

Call reference information element

The purpose of the call reference flag is to identify who allocated the call reference value for a call. The call reference flag is used to resolve simultaneous attempts to allocate the same call reference value.

The call reference flag can take the binary values "0" or "1". The call reference flag is used to identify which end of the DTE/DCE interface originated a call reference. The origination side always sets the call reference flag to "0". The recipient side always sets the call reference flag to "1".

The call reference value will always have two octets. The call reference value is coded as a 15-bit binary number. A call reference value equal to zero is reserved for the global call reference value. The global call reference has also a length of 2 octets.

10.5.3 Message type

The purpose of the message type is to identify the message being sent. The message type is the third part of every message (see Figure 10-5 and Table 10-12).

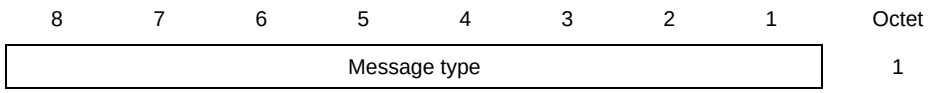


FIGURE 10-5/X.36

Message type

TABLE 10-12/X.36

Message types

Bits 8 7 6 5 4 3 2 1	
SVC establishment messages:	
0 0 0 0 0 0 1 0	CALL PROCEEDING
0 0 0 0 0 1 1 1	CONNECT
0 0 0 0 0 1 0 1	SETUP
SVC clearing messages:	
0 1 0 0 0 1 0 1	DISCONNECT
0 1 0 0 1 1 0 1	RELEASE
0 1 0 1 1 0 1 0	RELEASE COMPLETE
Miscellaneous messages:	
0 1 0 0 0 1 1 0	RESTART
0 1 0 0 1 1 1 0	RESTART ACKNOWLEDGE
0 1 1 1 1 1 0 1	STATUS
0 1 1 1 0 1 0 1	STATUS ENQUIRY

10.5.4 Bearer capability

The purpose of the bearer capability information element is to request a bearer service. The only bearer service supported is the Frame Relay bearer service. The bearer capability information element is coded as shown in Figure 10-6.

8	7	6	5	4	3	2	1	Octet
Bearer capability information element identifier								1
0	0	0	0	0	1	0	0	
Length of the bearer capability contents								2
0	0	0	0	0	0	1	1	
1 ext.	Coding Standard		Information Transfer capability					3
	0	0	0	1	0	0	0	
1 ext.	Transfer mode		Reserved					4
	0	1	0	0	0	0	0	
1 ext.	Layer 2 ident.		User information layer 2 protocol					6
	1	0	0	1	1	1	1	

FIGURE 10-6/X.36

Bearer capability information element

10.5.5 Call state

The purpose of the Call state information element is to describe the current state of a frame relay connection. The Call state information element is coded as shown in Figure 10-7 and Table 10-13.

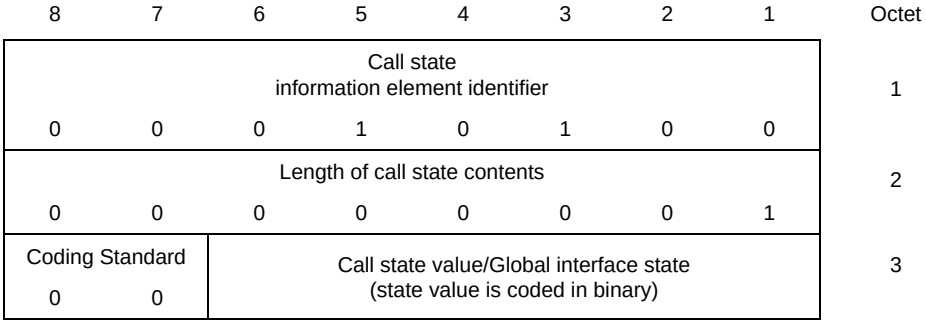


FIGURE 10-7/X.36

Call state information element

TABLE 10-13/X.36

Call state information element

Call state value (octet 3)

Bits		DTE state		DCE state	
6 5 4	3 2 1				
0 0 0	0 0 0	U0	Null	N0	Null
0 0 0	0 0 1	U1	Call initiated	N1	Call initiated
0 0 0	0 1 1	U3	Outgoing call proceeding	N3	Outgoing call proceeding
0 0 0	1 1 0	U6	Call present	U6	Call present
0 0 1	0 0 1	U9	Incoming call proceeding	N9	Incoming call proceeding
0 0 1	0 1 0	U10	Active	N10	Active
0 0 1	0 1 1	U11	Disconnect request	N11	Disconnect request
0 0 1	1 0 0	U12	Disconnect indication	N12	Disconnect indication
0 1 0	0 1 1	U19	Release request	N19	Release request

Global interface state value (octet 3)

Bits		State	
6 5 4	3 2 1		
0 0 0	0 0 0	REST0	Null
1 1 1	1 0 1	REST1	Restart request
1 1 1	1 1 0	REST2	Restart

All other values are reserved.

10.5.6 Called party number

The purpose of the Called party number information element is to identify the called party of a call. The Called party number information element is coded as shown in Figure 10-8 and Table 10-14.

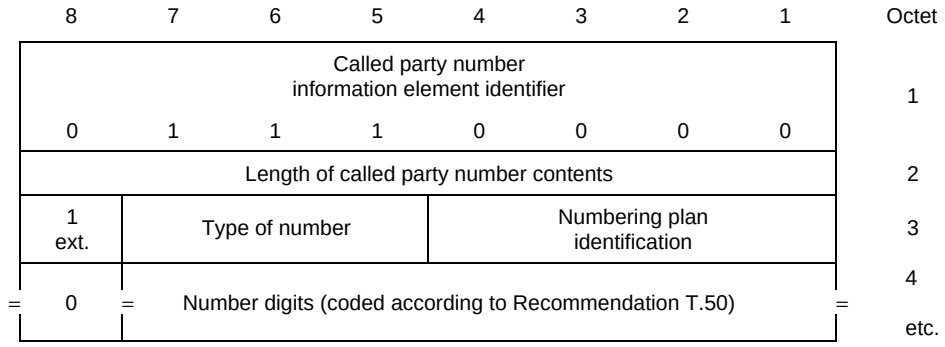


FIGURE 10-8/X.36

Called party number information element

TABLE 10-14/X.36

Called party number information element

Type of number (octet 3)

Bits 7 6 5	
0 0 1	International number (Note 1)
0 1 0	National number (Note 1)
0 1 1	Network specific number (for use in private network)
1 0 0	Complementary address without main address/subscriber number (Note 2)
1 0 1	Alternative address (see Numbering plan identification) (Note 3)
1 1 1	Reserved for extensions

All other values are reserved.

NOTE 1 – Prefix or escape digits shall not be included in the number digits.

NOTE 2 – The use of this code point is a network option (see Appendix V).

NOTE 3 – The use of this code point is *for further study*.

Numbering plan identification (octet 3)

Bits 4 3 2 1	
0 0 0 0	Unknown
0 0 0 1	ISDN/telephony numbering plan (Rec. E.164)
0 0 1 1	Data numbering plan (Rec. X.121)
1 0 0 1	Private numbering plan (for use with private networks)

All other values are reserved.

Numbering plan identification coding (octet 3) when type of address is alternative address:

Bits 4 3 2 1	
0 0 0 0	Character string coded in accordance with CCITT Rec. T.50 and ISO/IEC 646.
0 0 0 1	ISO NSAP address coded in accordance with ITU-T Rec. X.213 | ISO/IEC 8348.
0 0 1 0	Media Access Control (MAC) address coded in accordance with ISO/IEC 10039.
0 0 1 1	Internet address coded in accordance with RFC 1166.

All other values are reserved.

NOTE 4 – Number digits (octet 4 etc.)

The number digits appear in multiple octets starting at octet 4. One digit is coded per octet such that the leftmost digit is coded in octet 4. Each digit corresponds to a T.50 character.

TABLE 10-14/X.36 *(concluded)*

Called party number information element

Valid combinations of type of number and numbering plan fields		
Type of numbering	Numbering plan identification	Format
International	E.164	CC + N(S)N
International	X.121	DNIC + NTN
National	E.164	N(S)N
National	X.121	NTN or NN
Network specific	Private numbering plan	According to the private numbering plan
Complementary address without main address	Unknown	User-specific

10.5.7 Called party subaddress

The purpose of the Called party subaddress information element is to identify the subaddress of the called party of the call. The network does not interpret this information element. It is carried transparently between the calling and called interface. The Called party subaddress information element is coded as shown in Figure 10-9 and Table 10-15.

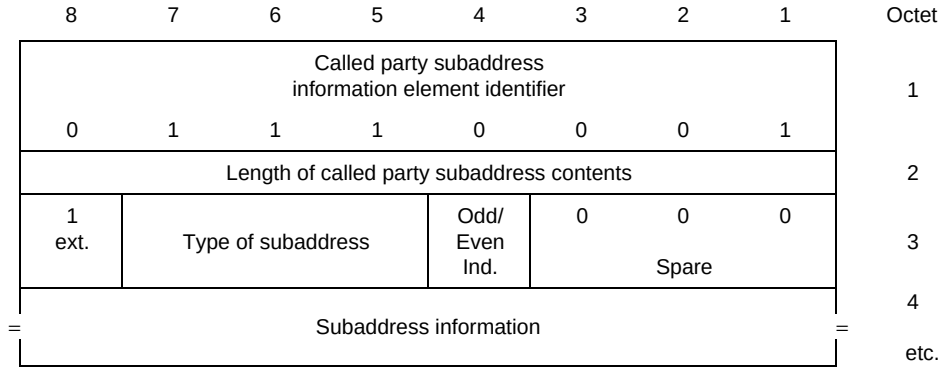


FIGURE 10-9/X.36

Called party subaddress information element

TABLE 10-15/X.36

Called party subaddress information element

Type of subaddress (octet 3)

Bits 7 6 5	
0 0 0	NSAP (ITU-T Rec. X.213 | ISO/IEC 8348)
0 1 0	User specified

All other values are reserved.

Odd/even indicator (octet 3)

Bit 4	
0	Even number of subaddress digits
1	Odd number of subaddress digits

NOTE – The odd/even indicator is used when the type of subaddress (octet 3) is user specified and the coding is BCD.

Subaddress information (octet 4 etc.)

The subaddress information is formatted according to the coding of the type of subaddress field (octet 3).

10.5.8 Calling party number

The purpose of the Calling party number information element is to identify the origin of a frame relay switched virtual circuit. The Calling party number information element is coded as shown in Figure 10-10 and Table 10-16.

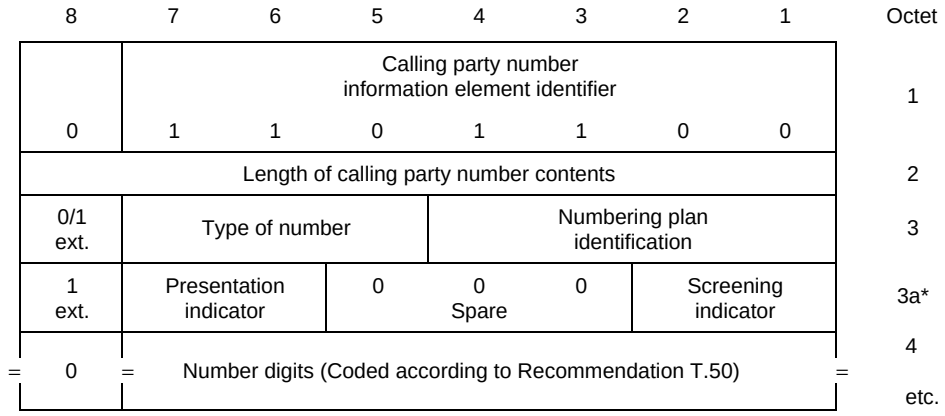


FIGURE 10-10/X.36

Calling party number information element

TABLE 10-16/X.36

Calling party number information element

Type of number (octet 2)

0 0 1	International number (Note 1)
0 1 0	National number (Note 1)
0 1 1	Network specific number (for use in private network)
1 0 0	Complementary address without main address/subscriber number (Note 2)
1 0 1	Alternative address (See Numbering plan identification) (Note 3)
1 1 1	Reserved for extensions

All other values are reserved.

NOTE 1 – Prefix or escape digits shall not be included in the number digits.

NOTE 2 – The use of this code point is a network option (see Appendix V).

NOTE 3 – The use of this code point is *for further study*.

Numbering plan identification (octet 3)

Bits 4 3 2 1	
0 0 0 0	Unknown
0 0 0 1	ISDN/telephony numbering plan (Rec. E.164)
0 0 1 1	Data numbering plan (Rec. X.121)
1 0 0 1	Private numbering plan

All other values are reserved.

NOTE 4 – For use with private networks.

Numbering plan identification coding (octet 3) when type of address is alternative address:

Bits 4 3 2 1	
0 0 0 0	Character string coded in accordance with CCITT Rec. T.50 and ISO/IEC 646.
0 0 0 1	ISO NSAP address coded in accordance ITU-T Rec. X.213 | ISO/IEC 8348.
0 0 1 0	Media Access Control (MAC) address coded in accordance with ISO/IEC 10039.
0 0 1 1	Internet address coded in accordance with RFC 1166.

All other values are reserved.

TABLE 10-16/X.36 *(continued)*

Calling party number information element

Valid combinations of type of number and numbering plan fields		
Type of numbering	Numbering plan identification	Format
International	E.164	CC + N(S)N
International	X.121	DNIC + NTN
National	E.164	N(S)N
National	X.121	NTN or NN
Network specific	Private numbering plan	According to the private numbering plan
Complementary address without main address	Unknown	User-specific

TABLE 10-16/X.36 *(concluded)*

Calling party number information element

Presentation indicator (octet 3a) (Note 1)

Bits

7 6

0 0 Presentation allowed

All other values are reserved.

Screening indicator (octet 3a) (Note 1)

Bits

2 1

0 0 User provided not screened. Not used in Rec. X.36.

0 1 User provided verified and passed (Note 2).

1 0 User provided verified and failed. Not used in Rec. X.36.

1 1 Network provided.

All other values are reserved.

NOTES

1 The DCE shall always provide octet 3a.

2 Since in some cases the network cannot guarantee that the complete number identifies an DTE, the term “verified” implies matching the user provided number or part of this number with the range(s) of numbers stored at the network. It implies also at least a valid format of user provided number information.

3 Number digits (octet 4, etc.)

The number digits appear in multiple octets starting at octet 4. One digit is coded per octet such that the leftmost digit is coded in octet 4. Each digit corresponds to a character coded according to Recommendation T.50.

10.5.9 Calling party subaddress

The purpose of the Calling party subaddress information element is to identify the subaddress of the originator of the frame relay call. This information element is carried transparently across the network. The Calling party subaddress information element is coded as shown in Figure 10-11 and Table 10-17.

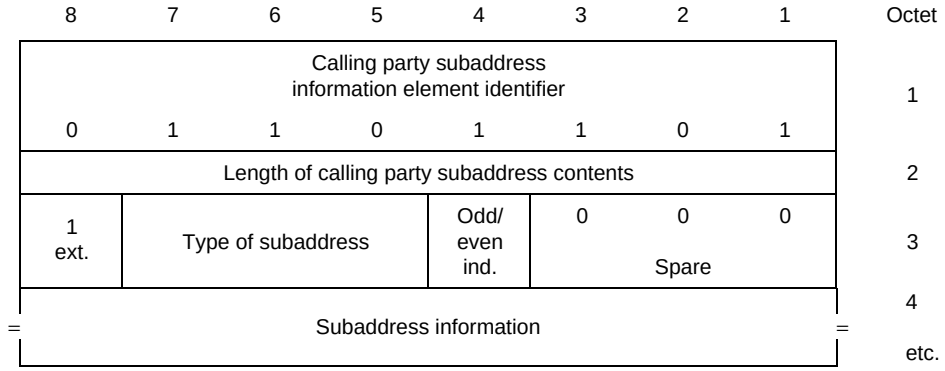


FIGURE 10-11/X.36

Calling party subaddress information element

TABLE 10-17/X.36

Calling party subaddress information element

Type of subaddress (octet 3)

Bits 7 6 5

0 0 0	NSAP (ITU-T Rec. X.213 | ISO/IEC 8348)
0 1 0	User specified

All other values are reserved.

Odd/even indicator (octet 3)

Bit 4

0	Even number of subaddress digits
1	Odd number of subaddress digits

NOTE – The odd/even indicator is used when the type of subaddress (octet 3) is user specified and the coding is BCD.

Subaddress information (octet 4 etc.)

The subaddress information is formatted according to the coding of the type of subaddress field (octet 3).

10.5.10 Cause

The purpose of the Cause information element is to identify an event that occured to a frame relay SVC, a DTE/DCE interface or the frame relay network and to provide a reason for clearing a frame relay SVC. The Cause information element is coded as shown in Figure 10-12 and Table 10-18. Annex E provides detailed information on the use and coding of the Cause information element fields.

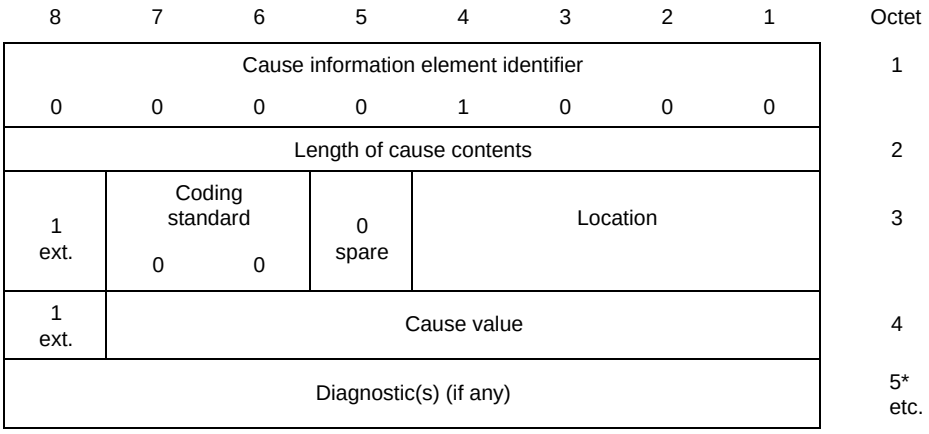


FIGURE 10-12/X.36

Cause information element

TABLE 10-18/X.36

Cause information element

Location (octet 3) (see Annex E on *Location field generation*)

Bits

4 3 2 1

0 0 0 0	User (U)
0 0 0 1	Private network serving the local user (LPN)
0 0 1 0	Public network serving the local user (LN)
0 0 1 1	Transit network (TN)
0 1 0 0	Public network serving the remote user (RLN)
0 1 0 1	Private network serving the remote user (RPN)
0 1 1 1	International network (INTL)
1 0 1 0	Network beyong interworking point (BI)

All other values are reserved.

Cause value (octet 4 bits 1 to 7)

The cause value is divided into two fields, a class (bit 5 to 7) and a value within the class (bits 1 to 4). The class indicates the general nature of the event:

Octet 4

Bits

7 6 5

0 0 0	Normal event
0 0 1	Normal event
0 1 0	Resource unavailable
0 1 1	Service or option not available
1 0 0	Service or option not implemented
1 0 1	Invalid message
1 1 0	Protocol error
1 1 1	Interworking

See Annex E on *Cause values* for the relevant cause values.

- Diagnostic(s) (octet 5): See Annex E on *Coding of the diagnostic field* for the relevant diagnostic codes. Further, the diagnostic field is optional and will not necessarily be provided by the DCE or the DTE even if a diagnostic is available for a cause value.

10.5.11 Closed user group

The purpose of the Closed user group information element is to indicate the closed user group to be used for the SVC being established and to indicate the Outgoing Access selection facility. The Closed user group information element is coded as shown in Figure 10-13 and Table 10-19.

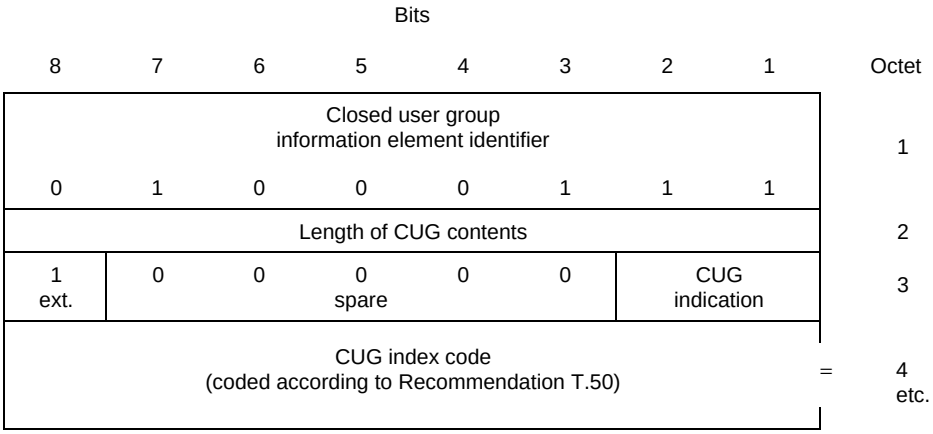


FIGURE 10-13/X.36

Closed user group information element

TABLE 10-19/X.36

Closed user group information element

CUG indication (octet 3)

Bits 3 2 1	
0 0 1	Closed user group selection
0 1 0	Closed user group with outgoing access selection

CUG index code (octet 4, etc.)

The CUG index code is represented by up to four octets coded according to Recommendation T.50:

Bits 7 6 5 4 3 2 1	
0 1 1 0 0 0 0	0
0 1 1 0 0 0 1	1
0 1 1 0 0 1 0	2
0 1 1 0 0 1 1	3
0 1 1 0 1 0 0	4
0 1 1 0 1 0 1	5
0 1 1 0 1 1 0	6
0 1 1 0 1 1 1	7
0 1 1 1 0 0 0	8
0 1 1 1 0 0 1	9

10.5.12 Connected number

The purpose of the connected number is to identify the responding party of the call. The encoding of the connected number is shown in Figure 10-14. The coding of the Connected number information element is the same as that of the Calling party number information element. This information element is carried transparently across the network.

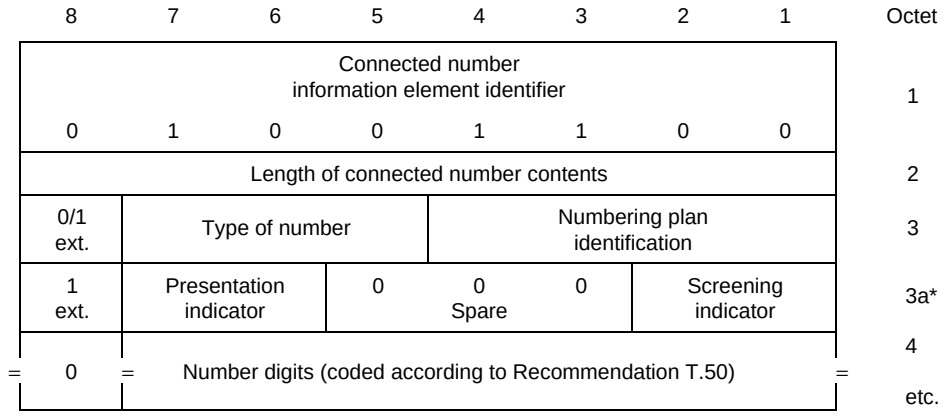


FIGURE 10-14/X.36

Connected number information element

10.5.13 Connected subaddress

The purpose of the connected subaddress is to identify the subaddress of the responding party of a call. The network does not interpret this information element. It has only to recognize and carry it transparently between the called and calling user. The encoding of the connected subaddress information element is shown in Figure 10-15 and Table 10-20.

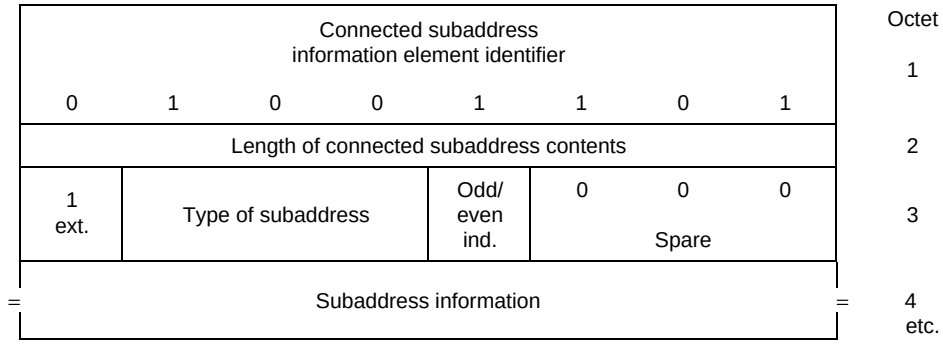


FIGURE 10-15/X.36

Connected subaddress information element

TABLE 10-20/X.36

Connected party subaddress information element

Type of subaddress (octet 3)

Bits 7 6 5

0 0 0	NSAP (ITU-T Rec. X.213 | ISO/IEC 8348)
0 1 0	User specified

All other values are reserved.

Odd/Even indicator (octet 3)

Bit 4

0	Even number of subaddress digits
1	Odd number of subaddress digits

NOTE – The odd/even indicator is used when the type of subaddress (octet 3) is user specified and the coding is BCD.

Subaddress information (octet 4, etc.)

The subaddress information is formatted according to the coding of the type of subaddress field (octet 3).

10.5.14 Data link connection identifier

The Data Link Connection Identifier information element identifies the Data Link Connection Identifier (DLCI) assigned to the SVC. The DLCI is coded as shown in Figure 10-16. The default length of the DLCI values is two octets (10 bits). Optionally some networks may support DLCI values with three or four octets at the DTE/DCE interface by subsciption.The data link connection identifier value is coded as a binary number.

8	7	6	5	4	3	2	1	Octet
Data link connection identifier information element identifier								1
0	0	0	1	1	0	0	1	
Length of data link connection identifier contents								2
0 ext.	Pref./ excl. 1	Data link connection identifier (Most significant 6 bits)						3
1	Data link connection identifier (2nd most significant 4 bits)				0	0	0 (Reserved)	3a
1 ext.	Data link connection identifier (3rd most significant 6 bits)						0 Res.	3b* (Note 1)
0 ext.	Data link connection identifier (3rd most significant 7 bits)							3b* (Note 2)
1 ext.	Data link connection identifier (4th most significant 6 bits)						0 Res.	3c* (Note 2)

NOTES

1 This octet shall be included only when subscription allows a three octet DLCI (16 bits).

2 These octets shall both be included only when subscription allows DLCIs of four octets (23 bits).

FIGURE 10-16/X.36

Data link connection identifier information element

10.5.15 Link layer core parameters

The purpose of the link layer parameters information element is to indicate requested frame relay Quality of Service parameters to be used for the SVC. The Link layer core parameters information element is coded as shown in Figure 10-17 and Table 10-21.

8	7	6	5	4	3	2	1	Octet
Link layer core parameters information element identifier								1
0	1	0	0	1	0	0	0	(Notes 1, 2)
Length of link layer core parameters contents								2
0	Maximum Frame Relay Information Field (FRIF) size							3
ext.	0	0	0	1	0	0	1	
0	Outgoing maximum FRIF size							3a
ext.								
0/1	Outgoing maximum FRIF size (cont.)							3b
ext.								
0	Incoming maximum FRIF size							3c*
ext.								
1	Incoming maximum FRIF size (cont.)							3d*
ext.								
0	Throughput							4*
ext.	0	0	0	1	0	1	0	
0	Outgoing magnitude				Outgoing multiplier			4a*
ext.								
0/1	Outgoing multiplier (cont.)							4b*
ext.								
0	Incoming magnitude				Incoming multiplier			4c*
ext.								
1	Incoming multiplier (cont.)							4d*
ext.								
0	Minimum acceptable throughput							5*
ext.	0	0	0	1	0	1	1	(Note 3)
0	Outgoing magnitude				Outgoing multiplier			5a*
ext.								
0/1	Outgoing multiplier (cont.)							5b*
ext.								
0	Incoming magnitude				Incoming multiplier			5c*
ext.								
1	Incoming multiplier (cont.)							5d*
ext.								
0	Committed burst size							6*
ext.	0	0	0	1	1	0	1	
0	Outgoing committed burst size value							6a*
ext.								
0/1	Outgoing committed burst size value (cont.)							6b*
ext.								
0	Incoming committed burst size value							6c*
ext.								
1	Incoming committed burst size value (cont.)							6d*
ext.								
0	Excess burst size							7*
ext.	0	0	0	1	1	1	0	
0	Outgoing excess burst size value							7a*
ext.								
0/1	Outgoing excess burst size value (cont.)							7b*
ext.								
0	Incoming excess burst size value							7c*
ext.								
1	Incoming excess burst size value (cont.)							7d*
ext.								
0	Committed burst size magnitude							8*
ext.	0	0	1	0	0	0	0	
1	Spare		Incoming Bc magnitude			Outgoing Bc magnitude		8a*
ext.								
0	Excess burst size magnitude							9*
ext.	0	0	1	0	0	0	1	
1	Spare		Incoming Be magnitude			Outgoing Be magnitude		9a*
ext.								

FIGURE 10-17/X.36

Link layer core parameters information element

Notes relative to Figure 10-17/X.36.

NOTES

1 Except for the maximum Frame Relay Information field (FRIF) size (octets 3, 3a and 3b) all the parameters are optional and position independent. If a parameter is not included, a default value will be used. The term *outgoing* corresponds to the calling to called DTE direction and the term *incoming* refers to the direction from the called to the calling DTE.

Several fields of the link layer core parameters information element are coded as binary numbers using 2 octets. The Most Significant Bit (MSB) of the field is the bit with the highest bit number of the first octet and the Least Significant Bit (LSB) is bit 1 of the second octet. When a field is coded as a binary number and requires one octet or less than 8 bits, the LSB is bit 1 and the MSB is the highest bit number allocated to the field.

2 When octet N (N = 3, 4, 5, 6 or 7) is present, octets Na and Nb shall also be present but the presence of octets Nc and Nd is not mandatory.

3 Octet group 5 (minimum acceptable throughput) may be included only in the SETUP message.

TABLE 10-21/X.36

Link layer core parameters information element

Maximum frame mode information field (octet group 3):

The maximum frame mode information field, when present, follows the address field and precedes the frame check sequence field. The default maximum size is 1600 octets.

If the maximum frame mode information field is symmetrical (same size in the incoming and outgoing directions) octets 3c and 3d are not coded and the value in octets 3a and 3b are used for both directions.

Throughput (octet group 4):

The throughput (also known as CIR or Committed Information Rate) is the average number of bits of the frame mode information field transferred per second across a DTE/DCE interface in one direction. The throughput is measured over an interval of duration "T" known also as the Committed rate measurement interval (T_c).

The throughput can be asymmetrical if the values in the incoming and outgoing directions differ. If the throughput is symmetrical, octets 4c and 4d are not coded and the value in octets 4a and 4b are used for both directions.

Minimum acceptable throughput (octet group 5):

The purpose of the minimum acceptable throughput is to negotiate the throughput of the call. Minimum acceptable throughput is the lowest throughput value the calling user is willing to accept for the call.

This field which is present only in the SETUP message is carried unchanged through the network(s). Its value may not be greater than the requested throughput (octet group 4).

The minimum acceptable throughput can be asymmetrical (the values in the incoming and outgoing directions differ). If the minimum acceptable throughput is symmetrical, octets 5c and 5d are not coded and the value in octets 4a and 4b are used for both directions.

Throughput and minimum acceptable throughput are expressed as an order of magnitude (in powers of 10) and an integer multiplier. The multiplier shall be encoded as the smallest possible number. For example a throughput of 64 kbit/s shall be expressed as 64×10^3 and not 640×10^2.

TABLE 10-21/X.36 *(continued)*

Link layer core parameters information element

Magnitude (octets 4a, 4c, 5a and 5c)

Bits 7 6 5	
0 0 0	10^0
0 0 1	10^1
0 1 0	10^2
0 1 1	10^3
1 0 0	10^4
1 0 1	10^5
1 1 0	10^6

All other values are reserved.

Multiplier (octets 4a, 4b, 4c, 4d, 5a, 5b, 5c, and 5d)

This field indicates in binary the value by which the magnitude shall be multiplied to obtain the throughput and the minimum acceptable throughput.

Committed burst size (octet group 6):

This field indicates the maximum amount of data (in bits) that the network agrees to transfer over the measurement interval T. This data may appear in one or more frames possibly with inter-frame idle flags.

This field specifies a number of octets. Therefore the committed burst size is 8 x the contents of this field. If the committed burst size is symmetrical, octets 6c and 6d are not coded and the value in octets 6a and 6b are used for both directions.

Excess burst size (octet group 7):

This field indicates the maximum amount of uncommitted data (in bits) that the network will attempt to deliver over the measurement interval T. This data may appear in one or more frames possibly with inter-frame idle flags. Excess burst may be marked Discard Eligible (DE) by the network.

This field specifies a number of octets. Therefore the excess burst size is 8 x the contents of this field. If the excess burst size is symmetrical, octets 7c and 7d are not coded and the value in octets 7a and 7b are used for both directions.

NOTE – The same default values and range of values for the CIR, burst size, excess burst size, committed measurement interval and algorithms used for PVC should also be used in the case of SVC.

TABLE 10-21/X.36 *(concluded)*

Link layer core parameters information element

Committed burst size magnitude (octets 8 and 8a):

The Committed burst size magnitude field indicates the magnitude of the Committed burst size. It is expressed as a power of 10. It is multiplied by the Committed burst size value (octet group 6) to give the actual value of the Committed burst size. When the incoming committed burst size field is not included (in octet group 6), the incoming magnitude has no significance.

The outgoing and incoming Bc magnitudes are coded as a power of 10 as follows:

Bits 3 2 1	
0 0 0	10^0
0 0 1	10^1
0 1 0	10^2
0 1 1	10^3
1 0 0	10^4
1 0 1	10^5
1 1 0	10^6

All other values are reserved.

The values coded in octet 8a shall be the smallest values required to represent the outgoing and incoming committed burst sizes.

Excess burst size magnitude (octets 9 and 9a):

The Excess burst size magnitude field indicates the magnitude of the Excess burst size. It is expressed as a power of 10. It is multiplied by the Excess burst size value (octet group 7) to give the actual value of the Excess burst size. When the incoming Excess burst size field is not included (in octet group 7), the incoming magnitude has no significance.

The outgoing and incoming Be magnitudes are coded as a power of 10 as follows:

Bits 3 2 1	
0 0 0	10^0
0 0 1	10^1
0 1 0	10^2
0 1 1	10^3
1 0 0	10^4
1 0 1	10^5
1 1 0	10^6

All other values are reserved.

The values coded in octet 9a shall be the smallest values required to represent the outgoing and incoming excess burst sizes.

10.5.16 Link layer protocol parameters

The purpose of the Link layer protocol parameters information element is to indicate requested layer 2 parameters values for the link layer elements of procedures to be used for the SVC. All parameters are optional and position independent. The default values defined in Recommendation Q.922 apply end-to-end. If any parameter is omitted from the information element, the default value specified for the end-to-end link layer protocol applies. The procedures associated with these parameters are used end-to-end between the two DTEs. The Link layer protocol parameters information element is coded as shown in Figure 10-18 and Table 10-22.

8	7	6	5	4	3	2	1	Octet
Link layer protocol parameters information element identifier								1
0	1	0	0	1	0	0	1	
Length of link layer protocol parameters contents								2
0 ext.	Transmit window size identifier							3*
	0	0	0	0	1	1	1	
1 ext.	Transmit window value							3a*
0 ext.	Retransmission timer identifier							4*
	0	0	0	1	0	0	1	
0 ext.	Retransmission timer value							4a*
1 ext.	Retransmission timer value (cont.)							4b*
0 ext.	Mode of operation							5*
	0	0	0	1	1	1	1	(Note)
1 ext.	Spare						Mode indication	5a*

NOTE – Mode of operation is only included when the LLC octet 6 "user information layer 2 protocol" is coded with one of the code points: Recommendation X.25 link layer, Recommendation X.25 multilink, extended LAPB for half duplex operation (see Recommendation T.71) and Recommendation X.75 Single Link Procedures (SLP).

FIGURE 10-18/X.36

Link layer protocol parameters information element

TABLE 10-22/X.36

Link layer protocol parameters information element

Transmit window value (octet 3a)

The value of the maximum number of outstanding transmit I-frames (window) is encoded as a binary value between 1 and 127.

Retransmission timer value (octets 4a, 4b)

The retransmission timer (e.g. LAPF T200) value is binary encoded in multiples of tenths of a second.

Mode indication (octet 5a)

Bits 2 1	
0 1	Basic mode – Modulo 8 (Note – This mode is the default mode)
1 0	Extended mode – Modulo 128

All other values are reserved.

10.5.17 Low layer compatibility

The purpose of the Low layer compatibility information element is to provide a means which should be used for compatibility checking by an addressed entity (e.g. remote DTE or an interworking unit or a high layer function of a DCE node addressed by the calling DTE). The Low layer compatibility information element is transferred transparently by a frame relay network between the calling DTE and the addressed entity. The Low layer compatibility information element is coded as shown in Figure 10-19 and Table 10-23.

8	7	6	5	4	3	2	1	Octet
Low layer compatibility information element identifier								1
0	1	1	1	1	1	0	0	
Length of low layer compatibility contents								2
0/1 ext.	Coding standard		Information transfer capability					3
	0	0	0	1	0	0	0	
1 ext.	Transfer mode		Reserved					4
	0	1	0	0	0	0	0	
0/1 ext.	Layer 2 ident.		User info. layer 2 protocol					6* (Note)
	1	0						
1 ext.	0	0	0	0	0	Address inclusion		6a*
1 ext.	User specified							6a*
0/1 ext.	Layer 3 ident.		User info. layer 3 protocol					7*
	1	1						
1 ext.	Optional layer 3 protocol information							7a*

NOTE – Octet group 5 defined in Recommendation Q.933 is not used in Recommendation X.36.

FIGURE 10-19/X.36

Low layer compatibility information element

TABLE 10-23/X.36

Low layer compatibility information element

Information transfer capability (octet 3)

Bits

5 4 3 2 1	
0 1 0 0 0	Unrestricted digital information

All other values are reserved.

User information layer 2 protocol (octet 6)

Bits

5 4 3 2 1	
0 0 0 0 1	Basic ISO 1745
0 0 1 1 0	Rec. X.25 link level (Note 1)
0 0 1 1 1	Rec. X.25 multilink level (Note 2)
0 1 0 0 0	Extended LAPB for half duplex operation (Rec. T.71) (Note 1)
0 1 0 0 1	HDLC ARM (ISO/IEC 4335) (Note 3)
0 1 0 1 0	HDLC NRM (ISO/IEC 4335) (Note 3)
0 1 0 1 1	HDLC ABM (ISO/IEC 4335) (Note 3)
0 1 1 0 0	LAN logical link control (ISO/IEC 8802/2) (Notes 4 and 5)
0 1 1 0 1	Rec. X.75 Single Link Procedure (SLP) (Note 1)
0 1 1 1 0	Rec. Q.922 (Note 6)
0 1 1 1 1	Core aspects of Annex A/Q.922 (Note 7)
1 0 0 0 0	User specified (Note 8)
1 0 0 0 1	ISO/IEC 7776 DTE to DTE operation (Note 1)

All other values are reserved.

NOTE 1 – Normally the LAPB address is not provided. When provided, octet 6a will indicate that the address is present. When the LAPB address is provided, the calling DTE assumes address A (value 3) and the called DTE assumes address B (value 1).

NOTE 2 – Normally the X.25 multilink address is not provided. When provided, octet 6a will indicate that the address is present. When the X.25 multilink address is provided, the calling DTE assumes address C (value 15) and the called DTE assumes address D (value 7).

NOTE 3 – Normally the HDLC address is not provided. When provided, octet 6a will indicate that the address is present.

NOTE 4 – Destination Service Access Point (DSAP) and Source Service Access Point (SSAP) are included. When a logical link control frame (which contains a logical link control PDU) is required (transparent inter-connection of similar LANs by frame relay), octet 6a will indicate that the logical link control frame is encapsulated. The contents of a logical link control frame is defined in the LAN Media Access Control (MAC) standards (e.g. ISO/IEC 8802/5).

NOTE 5 – The indication of command or response bit in the frame relay address will be ignored.

TABLE 10-23/X.36 *(concluded)*

Low layer compatibility information element

NOTE 6 – Address is not encapsulated.

NOTE 7 – This code point is not used in Recommendation X.36.

NOTE 8 – When this coding is included, octet 6a will include the code point for user specified layer 2 protocol.

Octet 6a coding for user specified code point:

User information layer 2 protocol (octet 6a) (applies for layer 2 = User specified).

User specified.

Octet 6a coding for Address inclusion:

User information layer 2 protocol (octet 6a) (Note 9)

Bits 2 1	
0 1	Address included (Note 10)
1 0	Encapsulation of logical control frame (Note 11)

All other values are reserved.

NOTE 9 – When the octet is present, the indication of C/R bit in the frame relay core aspects address will be ignored.

NOTE 10 – Applies for the following layer 2 protocols specified in octet 6: Recommendation X.25 link layer, Recommendation X.25 multilink, extended LAPB for half duplex operation (see Recommendation T.71) HDLC ARM, HDLC NRM, HDLC ABM and Recommendation X.75 Single Link Procedures (SLP).

NOTE 11 – Applies for the following layer 2 protocol specified in octet 6: LAN logical link control (ISO/IEC 8802/2).

User information layer 3 protocol (octet 7a)

Bits 5 4 3 2 1	
0 0 1 1 0	Rec. X.25 packet level
0 0 1 1 1	ISO/IEC 8208 (X.25 packet level protocol for DTE)
0 1 0 0 0	Recommendation X.223 or ISO/IEC 8878 (use of ISO/IEC 8208 and X.25 to provide the OSI-CONS)
0 1 0 0 1	ISO/IEC 8473 (OSI connectionless mode protocol)
0 1 0 1 0	Recommendation T.70 minimum network layer
0 1 0 1 1	ISO/IEC TR 9577 (Protocol identification in the network layer)
1 0 0 0 0	User specified (Note 12)

All other values are reserved.

NOTE 12 – When this coding is included, octet 7a will include the code point for user specified layer protocol.

Optional layer 3 protocol information (octet 7a)

User specified.

10.5.18 Reverse charging indication

The purpose of the reverse charging indication information element is to indicate that reverse charging has been requested for that frame relay SVC. The reverse charging indication is coded as shown in Figure 10-20 and Table 10-24.

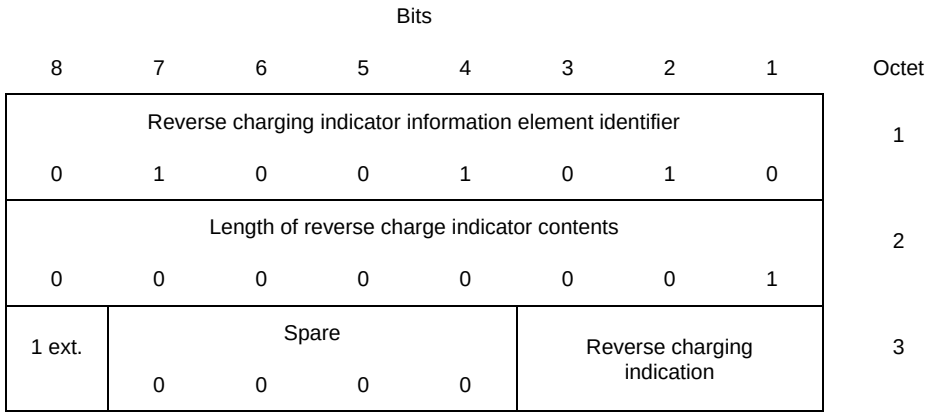


FIGURE 10-20/X.36

Reverse charging indication information element

TABLE 10-24/X.36

Reverse charging indication information element

Reverse charging indication (octet 3)
Bits
3 2 1
0 0 1 Reverse charging requested
All other values are reserved.

10.5.19 Transit network selection

The purpose of the Transit network selection information element is to identify one requested transit network. The Transit network selection information element is coded as shown in Figure 10-21 and Table 10-25.

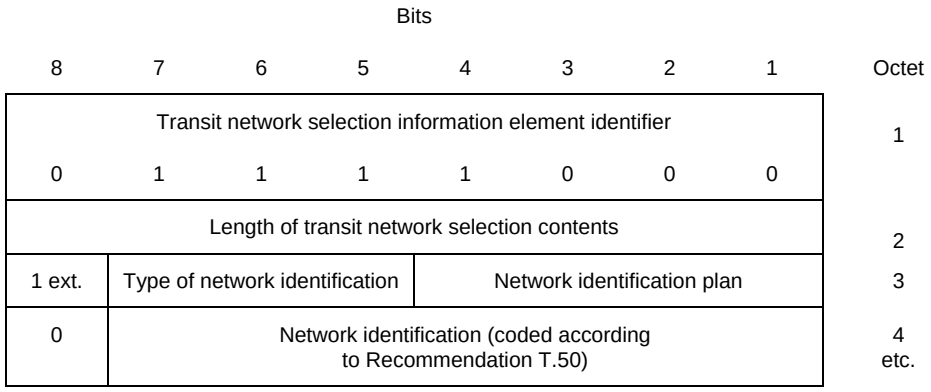


FIGURE 10-21/X.36

Transit network selection information element

TABLE 10-25/X.36

Transit network selection information element

Type of network identification (octet 3)

Bits

7 6 5

0 1 1 International network identification

All other values are reserved.

Network identification plan (octet 3)

Bits

4 3 2 1

0 0 0 0 Unknown (Note 1)

0 0 0 1 Carrier identification code (Note 2)

0 0 1 1 Data network identification code (Recommendation X.121)

All other values are reserved.

NOTE 1 – Not used in Recommendation X.36. This code point is for use in private networks.

NOTE 2 – This code point is used to identify public frame relay networks numbered under the E.164 numbering plan (see Appendix VI).

Network identification (octet 4)

These characters coded according to Recommendation T.50 are organized according to the network identification plan specified in octet 3.

10.5.20 User-user

The purpose of the user-user information element is to convey information between the users. This information is not interpreted by the network but carried transparently and delivered to the recipient. The user-user information element is coded as shown in Figure 10-22. The network needs only to understand the first 2 octets. The maximum length of the user-user information element is 131.

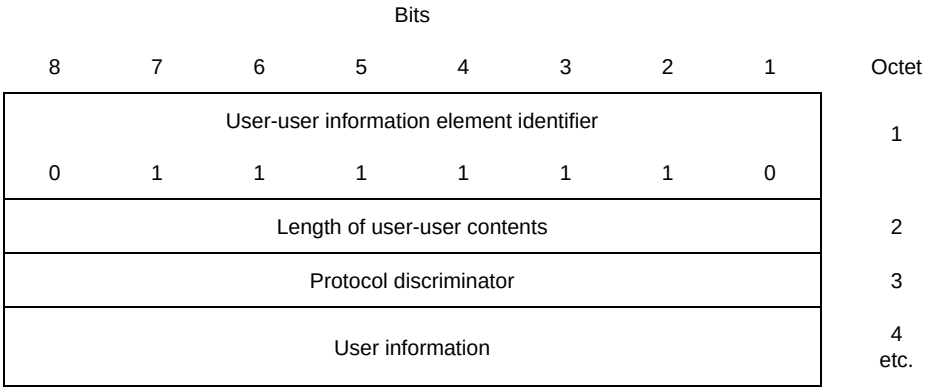


FIGURE 10-22/X.36

User-to-user information element

10.6 Call establishment procedures

10.6.1 Call establishment at the calling DTE/DCE interface

10.6.1.1 Actions by the DTE

Switched virtual circuit set-up: A DTE initiates the establishment of a Switched Virtual Circuit (SVC) by transferring a SETUP message across the DTE/DCE interface on DLCI = 0. Following the transmission of the SETUP message, the SVC shall be considered by the DTE in the call initiated state (U1).

The DTE shall not include in the SETUP message the Data Link Connection Identifier information element. The network shall select one and include it in the first reply message to the call SETUP.

After sending the SETUP message, the DTE shall start timer T303, enter state U1 (Call initiated) and wait for the DCE reply. At the first expiry of timer T303, the DTE shall retransmit the SETUP message. At the second expiry of timer T303, the DTE shall clear the SVC by following the clearing procedures before reaching the active state with cause No. 102 *Recovery on timer expiry* and return to the null state U0.

Call proceeding: At the receipt of the CALL PROCEEDING message, the DTE shall stop timer T303, start timer T310 and enter state U3 (Outgoing call proceeding). At the expiry of timer T310, the SVC shall be cleared according to the normal release procedure.

Call connected: Upon receiving a CONNECT message from the network indicating that the called party has accepted the call, the calling DTE shall stop timer T310 and enter the call active state U10. The SVC is now established and data transfer can begin.

In the CONNECT message received from the network, the link layer core parameters information element indicates the final Quality of Service parameters to be used. If they are not acceptable, the DTE may clear the SVC using the normal clearing procedure.

10.6.1.2 Actions by the DCE

Call proceeding: At the receipt of the SETUP message, the DCE shall enter state N1 (Call initiated). If the DCE determines that the DTE set-up request is not authorized or cannot be supported, it shall clear the SVC by following the clearing procedures before reaching the active state. Otherwise, the DCE shall send a CALL PROCEEDING message to the DTE to acknowledge the SETUP message and to indicate that the SVC is being processed and shall enter call state N3 (Outgoing call proceeding).

Calling party number screening and presentation: The screening and presentation indicators of the calling party number information element shall be transmitted to the remote DTE and the presentation indicator (octet 3a bits 6 and 7) shall be coded *Presentation allowed*.

The network at the calling DTE/DCE interface shall perform the screening of the calling party number as follows:

1) When the calling DTE provides its address or a complementary address in the Calling party number information element, the DCE can only verify that the address is allocated to that DTE. If the screening is successful, the screening indicator (octet 3a bits 1 and 2) shall be coded *User provided verified and passed*.
2) If the calling DTE does not provide its address or provides one that the DCE considers invalid, the screening is not successful. In this case, the DCE shall provide a default address assigned to the calling DTE and the screening indicator shall be coded *Network provided*.

In any case, the calling DTE address transmitted to the called DTE will be a valid complete address.

If octet 3a is provided by the calling user, it shall be ignored by the DCE at the originating interface. The network shall encode the screening and presentation indicators of the calling party number as described above.

Call connected: Upon receiving an indication that the called DTE has accepted the switched virtual circuit set-up request, the DCE shall send a CONNECT message to the calling DTE and enter the call active state N10. The CONNECT message sent to the calling DTE shall include the link layer core parameters to indicate the final traffic parameters of the switched virtual circuit.

Call rejection: Upon receiving an indication from the called DTE that the switched virtual connection set-up request cannot be accepted, the originating DTE shall initiate clearing at the originating DTE/DCE interface according to the clearing procedure before reaching the active state.

10.6.1.3 Link layer core parameters negotiation

If the calling DTE does not supply some or all of the traffic parameters, the network will use default values for:

- outgoing and incoming throughputs (CIR);
- outgoing and incoming minimum throughputs;
- outgoing and incoming committed burst sizes;
- outgoing and incoming excess burst sizes.

NOTE – The default values for the incoming link layer core parameters can be the same as the default values for the outgoing parameters.

After examining the traffic parameters, if supplied by the DTE, or the default ones for the parameters not supplied by the calling DTE, the DCE can take one of the following actions:

- If it is able to provide the requested Quality of Service and able to support the indicated link layer core parameter values, the DCE will progress the switched virtual circuit set-up request to the remote DTE with the original parameters.
- If unable to provide the requested traffic parameters but able to provide at least the lowest acceptable parameters, the DCE will progress the switched virtual circuit set-up request to the remote DCE after adjusting the appropriate parameters. The adjusted parameters will support at least the lowest acceptable values.

  When progressing the set-up of the switched virtual circuit set-up, a network, if necessary, may reduce further the requested traffic parameters but not below the lowest acceptable values. If unable to support the lowest acceptable values, the network will clear the switched virtual circuit with the calling DTE.
- If unable to provide at least the lowest acceptable traffic parameters, the network will reject the SVC set-up request with cause No. 49 *Quality of Service not available* by following the clearing procedure before reaching the active state.

10.6.1.4 DLCI allocation

The calling DTE shall not include the Data link connection identifier information element in the SETUP message. It is the responsibility of the network to allocate the DLCI at the calling DTE/DCE interface. As a result of processing the SETUP message received from the calling DTE, the network will allocate an available DLCI and will return it in the data link Connection identifier information element of the CALL PROCEEDING message sent in response to the SETUP message of the calling DTE.

If no DLCI is available at the calling DTE/DCE interface, the network rejects the SVC establishment request with cause No 34 *No circuit/channel available* by following the clearing procedure before reaching the active state.

10.6.2 Call establishment at the called DTE/DCE interface

10.6.2.1 Actions by the DCE

The DCE shall indicate the arrival of a switched virtual circuit set-up request at the destination DTE/DCE interface by transferring a SETUP message across the interface. The SETUP message shall contain the DLCI with the Pref./Excl. field set to *Exclusive* and appropriate information elements to help the called DTE determines whether to accept or not the call.

The DCE shall present the calling party number by including the calling number information element in the SETUP message. Octet 3a of the calling party number information element shall be coded according to the information provided by the DCE at the originating interface.

The link layer core parameters information element shall reflect any reduction performed by the network while progressing the switched virtual circuit set-up request. If the network did not change the traffic parameters while progressing the switched virtual circuit set-up request to the called DTE, the value supplied by the calling DTE, or the default value supplied by the DCE at the originating DTE/DCE interface, shall be transmitted to the called DTE.

The SETUP message shall include any end-to-end information element supplied by the calling DTE at the originating interface. After sending the SETUP message, the DCE shall start timer T303 and enter state N6 (Call present). If no response to the SETUP is received from the called DTE before the first expiration of timer T303, the SETUP message shall be retransmitted and timer T303 restarted. At the second expiry, the DCE at the originating DTE/DCE interface shall perform the normal clearing procedure with the calling DTE and shall indicate cause No. 18 *No user responding*. The DCE at the destination DTE/DCE interface shall perform the clearing procedure with the called DTE by following the clearing procedure before reaching the active state with cause No. 102 *Recovery on timer expiry* and return to the null state N0.

Call proceeding: At the receipt of a CALL PROCEEDING message from the called DTE, the DCE shall stop timer T303, and start timer T310 and enter call state N9 (Incoming call proceeding). At the expiry of timer T310, the switched virtual circuit shall be cleared with the calling and called DTE according to the clearing procedure before reaching the active state.

NOTE – Sending a CALL PROCEEDING by the called DTE to the DCE is not mandatory. It is allowed for the called DTE to reply to the SETUP message with a CONNECT message.

Call connected: Upon receiving a CONNECT message indicating that the called DTE has accepted the call, the DCE shall stop timer T310 (or timer T303, if T310 is not running and T303 is) and enter the call active state N10.

Connected number screening and presentation: If the called DTE provides a connected number information element in the CONNECT message, the screening and presentation indicators of the connected number information element will be transmitted to the originating interface and the presentation indicator (octet 3a bits 6 and 7) shall be coded *Presentation allowed*.

The DCE at the called DTE/DCE interface shall perform the screening of the connected number as follows:

1) When the called DTE provides an address or a complementary address in the Connected number information element, the DCE can only verify that the address is allocated to that DTE. If the screening is successful, the screening indicator (octet 3a bits 1 and 2) shall be coded *User provided verified and passed.*
2) If the called DTE provides an address or a complementary address in the Connected number information element that the DCE considers invalid, the screening is not successful. In this case, the DCE shall provide a default address assigned to the called DTE in the connected number information element and the screening indicator shall be coded *Network provided*.

In any case, the connected number transmitted to the calling DTE will be a valid and complete address.

If octet 3a of the Connected number information element is provided by the called DTE, it shall be ignored by the DCE. The network shall encode the screening and presentation indicators of the connected number as described above.

10.6.2.2 Actions by the called DTE

After receiving the SETUP message from the DCE, the called DTE shall enter call state U6 (call present) and respond with the following sequence of messages:

- A CALL PROCEEDING to acknowledge the receipt of the SETUP message and enter state U9 (Incoming call proceeding). In the CALL PROCEEDING message, the DTE shall include the DLCI value provided by the network in the SETUP message and code the *Excl./Pref.* field as *exclusive*.

  NOTE – Sending a CALL PROCEEDING message by the DTE is optional. The called DTE can also reply with a CONNECT message to the SETUP message sent by the DCE.

- A CONNECT message to notify the DCE of the acceptance of the switched virtual circuit set-up request and enter the Active state U10. In the CONNECT message, the DTE shall include the DLCI value provided by the DCE in the SETUP message and code the *Excl./Pref.* field as *exclusive* if the CONNECT message is the first response to the SETUP message.

If the called DTE wishes to refuse the switched virtual circuit set-up request, it shall initiate call clearing at the called DTE/DCE interface, with cause No. 21 *Call rejected*, according to the clearing procedure before reaching the active state, release the call reference and the DLCI and return to the null state U0.

In the SETUP message, the DCE will have included the DLCI value to use with the switched virtual circuit. If this DLCI value is unacceptable to the called DTE, the switched virtual circuit may be cleared according to the clearing procedure before reaching the active state of 10.6.4.1.

Call accepted: A called DTE indicates acceptance of an incoming switched virtual circuit set-up request by sending a CONNECT message to the DCE. The CONNECT message shall contain the link layer core parameters information element acceptable to the called DTE.

10.6.2.3 Link layer core parameters negotiation

At the called DTE/DCE interface, the DCE will examine the traffic parameters received from the calling DCE. If it is unable to provide at least the lowest acceptable traffic parameters, the network will clear the switched virtual circuit set-up request towards the calling DTE with cause No. 49 *Quality of Service not available*, by following the clearing procedure before reaching the active state.

Otherwise the DCE shall include in the Link layer core parameters information element of the SETUP message to be sent to the called DTE values, not below the lowest acceptable parameter values, for the following parameters:

- maximum frame mode information field;
- throughput that may be smaller or equal to the one requested by the calling DTE but always greater or equal to minimum acceptable throughput;
- minimum acceptable throughput as requested by the calling DTE;
- committed burst size that may be smaller or equal to the one requested by the calling DTE;
- excess burst size that may be smaller or equal to the one requested by the calling DTE.

After examining the link layer core parameters information element supplied by the DCE, the called DTE can take one of the following actions:

- If the requested traffic parameters are acceptable, the called DTE shall include them in the CONNECT message returned to the DCE.
- If the requested traffic parameters are not acceptable, but the called DTE can support lowest acceptable parameters (in particular the minimum throughput), the reduced values shall be included in the CONNECT message returned to the DTE.
- If the called DTE is unable to support even the lowest possible traffic parameters, the called DTE will reject the switched virtual circuit set-up request with cause No. 49 *Quality of Service not available*, by following the clearing procedure before reaching the active state.

10.6.2.4 DLCI allocation

At the called DTE/DCE interface, it is the responsibility of the network to allocate the DLCI. The network indicates to the called DTE the allocated DLCI in the data link connection identifier information element included in the SETUP message sent to the called DTE.

If no DLCI is available at the called DTE/DCE interface, the network clears the switched virtual circuit in the backward direction with cause No 34 *No circuit/channel available*, by following the clearing procedure before reaching the active state.

If no DLCI is available at the called DTE/DCE interface, the network shall clear the SVC establishment request towards the calling DTE with cause No 34 *No circuit/channel available*, by following the clearing procedure before reaching the active state.

In its reply to the SETUP message received from the DCE, the called DTE shall include the received DLCI value in the data link connection identifier information element in the first message (CALL PROCEEDING or CONNECT message). In case the called DTE does not follow this procedure, the network clears the SVC with the called DTE and calling DTE by following the clearing procedure before reaching the active state with one of the following cause values:

- No. 96 *Mandatory information element is missing* if the Data link connection identifier information element is absent;
- No. 100 *Invalid information element contents* if the DLCI value encoded in the data link connection identifier differs from the value allocated by the network.

10.6.3 Frame relay data transfer phase

Upon establishing the SVC, the frame relay data transfer phase procedures, as described in clause 9, are followed. Since signalling messages and FR frames do not follow the same path at least at the DTE/DCE interfaces, it is possible that the called DTE starts transmitting FR frames on a SVC before the corresponding CONNECT message is received by the calling DTE. Some FR frames may not be delivered for this reason.

After the clearing of a SVC has been initiated by a DTE or a DCE, the data frames in transit in both direction may be lost and not delivered to their destination.

10.6.4 Call clearing

Three clearing cases are identified:

- clearing in the active state which is initiated by sending a DISCONNECT message;
- clearing when an entity is not in the null state but has not reached the active state, initiated by sending a RELEASE message;
- clearing in the null state which is initiated by sending a RELEASE COMPLETE message.

10.6.4.1 Clearing in the active state

10.6.4.1.1 Clearing in the active state initiated by the DTE

Actions by the DTE: The DTE shall initiate switched virtual circuit clearing by disconnecting the DLCI, informing the DL-core sublayer entity of the initiation of switched virtual circuit clearing, sending a DISCONNECT message, starting timer T305 and entering the Disconnect request state (U11).

On receipt of the RELEASE message, the DTE shall stop timer T305, send a RELEASE COMPLETE message, release the call reference and the DLCI and return to the Null state (U0).

If timer T305 expires, the DTE shall send a RELEASE message to the DCE with the cause number originally contained in the DISCONNECT message, start timer T308 and enter the release request state (U19). The DTE may indicate a second cause information element with cause No. 102 *Recovery on timer expiry*.

If timer T308 expires, the DTE shall resend the RELEASE message, restart timer T308 and stay in the release request state (U19). In the RELEASE message, the DTE may include a second cause information element with cause No. 102 *Recovery on timer expiry*. If timer T308 expires for a second time, the DTE shall release the call reference and the DLCI and return to the Null state (U0).

Actions by the DCE: On the receipt of the DISCONNECT message, the DCE shall enter the Disconnect request state (N11), disconnect the DLCI, inform the U-plane DL-core sublayer entity of the initiation of switched virtual circuit clearing, send a RELEASE message to the DTE, start timer T308 and enter the Release request state (N19).

Following the receipt of the RELEASE COMPLETE message from the DTE, the DCE shall stop timer T308, release the call reference and the DLCI and return to the Null state (N0).

If timer T308 expires, the DCE shall resend the RELEASE message and restart timer T308. In addition, the DCE may indicate a second cause information element with cause No. 102 *Recovery on timer expiry*. If timer T308 expires for a second time, the DCE shall release the call reference and the DLCI and return to the Null state (N0).

10.6.4.1.2 Clearing in the active state initiated by the DCE

Actions by the DCE: The DCE shall initiate clearing by disconnecting the DLCI, sending a DISCONNECT, starting timer T305 and entering the Disconnect indication state (N12).

On receipt of the RELEASE message from the DTE, the DCE shall stop timer T305, send a RELEASE COMPLETE message, release the call reference and the DLCI and return to the Null state (N0).

If timer T305 expires, the DCE shall send a RELEASE message to the DTE with the cause number originally contained in the DISCONNECT message, start timer T308 and enter the release request state (N19). The DCE may indicate a second cause information element with cause No. 102 *Recovery on timer expiry*.

If timer T308 expires, the DCE shall resend the RELEASE message, restart timer T308 and stay in the release request state (N19). In the RELEASE message, the DCE may include a second cause information element with cause No. 102 *Recovery on timer expiry*. If timer T308 expires for a second time, the DCE shall release the call reference and the DLCI and return to the Null state (N0).

Actions by the DTE: On the receipt of the DISCONNECT message, the DTE shall enter the Disconnect indication state (U12), disconnect the DLCI, inform the U-plane DL-core sublayer entity of the initiation of switched virtual circuit clearing, send a RELEASE message to the DCE, start timer T308 and enter the Release request state (U19).

Following the receipt of the RELEASE COMPLETE message from the DCE, the DTE shall stop timer T308, release the call reference and the DLCI and return to the Null state (U0).

If timer T308 expires, the DTE shall resend the RELEASE message and restart timer T308. In addition, the DTE may indicate a second cause information element with cause No. 102 *Recovery on timer expiry*. If timer T308 expires for a second time, the DTE shall release the call reference and the DLCI and return to the Null state (U0).

10.6.4.2 Clearing before reaching the active state

Before reaching the active state, the clearing procedure is initiated by the DTE or the DCE by sending a RELEASE message except when the entity is in the null state (U0 or N0).

When an entity is in the null state, the clearing procedure is initiated with the RELEASE COMPLETE message. After sending or receiving a RELEASE COMPLETE message, the sending or receiving entity will remain in the null state.

10.6.4.2.1 Clearing initiated by the DTE

When a DTE initiates switched virtual circuit clearing by sending a RELEASE message, the following procedure applies: the DTE shall disconnect the DLCI, send a RELEASE message to the DCE, start timer T308 and enter the Release request state (U19).

Following the receipt of the RELEASE COMPLETE message from the DCE, the DTE shall stop timer T308, release the call reference and the DLCI and return to the Null state (U0).

If timer T308 expires, the DTE shall resend the RELEASE message, restart timer T308 and stay in the release request state (U19). In the RELEASE message, the DTE may indicate a second cause information element with cause No. 102 *Recovery on timer expiry*. If timer T308 expires for a second time, the DTE shall release the call reference and the DLCI and return to the Null state (U0).

10.6.4.2.2 Clearing initiated by the DCE

When the DCE initiates switched virtual circuit clearing by sending a RELEASE message, the following procedure applies: the DCE shall disconnect the DLCI, inform the U-plane DL-core sublayer entity of the initiation of switched virtual circuit clearing, send a RELEASE message to the DTE, start timer T308 and enter the Release request state (N19).

Following the receipt of the RELEASE COMPLETE message from the DTE, the DCE shall stop timer T308, release the call reference and the DLCI and return to the Null state (N0).

If timer T308 expires, the DCE shall resend the RELEASE message, restart timer T308 and stay in the release request state (N19). In the RELEASE message, the DCE may indicate a second cause information element with cause No. 102 *Recovery on timer expiry*. If timer T308 expires for a second time, the DCE shall release the call reference and the DLCI and return to the Null state (N0).

10.6.4.3 Clearing collision

A clearing collision happens when the DTE or the DCE after sending a DISCONNECT message receives a DISCONNECT message with the same call reference value. A clearing collision happens in state U11 (Disconnect request) or N12 (Disconnect indication). When a clearing collision is detected, the DCE and the DTE shall stop the running timers T305, send a RELEASE message, start timers T308 and enter the release request states (U19 and N19) and follow the rest of the clearing procedures.

A clearing collision can also occur when both sides of a DTE/DCE interface simultaneously transfer a RELEASE message related to the same call reference value. This clear collision type occurs when both sides are in the Release request states (U19 and N19). When this type of clearing collision occurs, the entity receiving a RELEASE message while in the Release request state, shall stop timer T308, release the call reference and the DLCI and return to the Null state (U0 or N0) without sending a RELEASE COMPLETE message.

10.6.5 Status enquiry and status procedures

10.6.5.1 Status enquiry procedure

Whenever an entity (DTE or DCE) wishes to check the correctness of a call state at the peer entity, a STATUS ENQUIRY message may be sent. Upon sending the STATUS ENQUIRY message, timer T322 shall be started in anticipation of receiving a STATUS message. While timer T322 is running, only one outstanding request for call state information shall exist per call reference. If switched virtual circuit clearing is received while timer T322 is running, it shall be stopped and clearing shall continue.

Upon receipt of a STATUS ENQUIRY message, the receiver shall respond with a STATUS message, reporting the current call state and cause No. 30 *Response to STATUS ENQUIRY*. Sending or receiving a STATUS message does not result in a state change.

The side having received the STATUS message shall inspect the cause information element. If it is not No. 30 *Response to STATUS ENQUIRY*, timer T322 shall continue to time for an explicit response to the STATUS ENQUIRY message. If a STATUS message is received with the cause No. 30, timer T322 shall be stopped and the appropriate action taken based on the information in that STATUS message about the call state of the sender and the current call state of the receiver.

If timer T322 expires and a STATUS was received with another cause value than No. 30, appropriate actions based on the cause received and the call state of the sender shall be taken.

If timer T322 expires and no STATUS was received, the STATUS ENQUIRY message may be retransmitted one or more times until a response is received. The number of times a STATUS ENQUIRY is retransmitted is an implementation dependent value.

The switched virtual circuit shall be cleared with cause No. 41 *Temporary failure*, if the STATUS ENQUIRY message is retransmitted the maximum number of times.

10.6.5.2 Receiving a STATUS message

On receipt of a STATUS message reporting an incompatible state, the receiving entity shall:

- clear the call by sending the appropriate clearing message with cause No. 101 *Message not compatible with call state*; or
- take other actions which attempt to recover from a mismatch and which are an implementation option.

Except for the following rules, the determination of which states are incompatible is left as an implementation decision:

- if the receiver is in the Null state and the STATUS message indicates the Null state, then no action shall be taken by the receiver other than discarding the message and staying in the Null state;
- if the receiver is in any state except the Null state and the STATUS message indicates the Null state, then the receiver shall release all resources, the DLCI and the call reference and move to the Null state;
- if the receiver is in the Release request state (U19 or N19) and the STATUS message indicates any state except the Null state, then no action shall be taken;
- if the receiver is in the Null state and the STATUS message indicates any state except the Null state, then the receiver shall send:
  - a RELEASE COMPLETE message with cause No. 101 *Message not compatible with call state* and remain in the Null State.

If a STATUS message is received in a compatible state but contains one of the following causes:

- No. 96 Mandatory information element missing;
- No. 97 Message type non-existent or not implemented;
- No. 99 Information element non-existent or not implemented;
- No. 100 Invalid information element contents,

the actions to be taken are an implementation option. If no other procedure is defined, the receiver shall clear the call with the appropriate procedure defined in 10.6.4 using the cause value specified in the received STATUS message.

10.6.5.3 Receipt of the STATUS message with the global call reference

On receipt of a STATUS message with the Global call reference, no action shall be taken on the STATUS message. On receipt of another message with the Global call reference than the STATUS message, a STATUS message with cause No. 81 *Invalid call reference values* is returned; the call reference information element is coded with the global call reference and the call state is coded as REST0.

10.6.6 Restart procedure

The restart procedure is used by a DTE or DCE to return a frame relay DTE/DCE interface to a idle or null state. The restart procedure is used by a DTE or DCE to recover from internal failure, after power-up or after internal re-initialization. The restart procedure affects only the switched virtual circuits and has no effect on the permanent virtual circuit. A result of the execution of the restart procedure, the switched virtual circuits will be cleared and will return to the null state.

10.6.6.1 Sending a RESTART message

A RESTART message is sent by a DTE or a DCE across the DTE/DCE interface in order to return the whole interface to the Null or idle state. Upon transmitting the RESTART message, the sender enters the Restart Request state, starts timer T316 and waits for the a RESTART ACKNOWLEDGE message. Also, no further RESTART messages shall be sent until a RESTART ACKNOWLEDGE message is received or timer T316 expires. Receipt of a RESTART ACKNOWLEDGE message stops timer T316, frees the DLCI and call reference values for re-use, and causes the receiver to enter the Null state for each switched virtual circuit restarted.

If a RESTART ACKNOWLEDGE message is not received prior to the expiry of timer T316, one or more subsequent RESTART messages may be sent until a RESTART ACKNOWLEDGE message is returned. Meanwhile, no calls shall be place or accepted over the interface. The number of unsuccessful restart attempts is limited to a default value of two. When this limit is reached, the originator of the restart attempt shall consider the restart procedure successfully completed and the DTE/DCE interface is available for new calls.

The RESTART and RESTART ACKNOWLEDGE messages shall contain the global call reference value. The call reference flag of the global call reference applies to restart procedures. In the case where both sides of the DTE/DCE initiate simultaneously restart requests, they shall be handled independently, the DTE/DCE interface shall not be considered for re-use until all the relevant restart procedures are completed.

10.6.6.2 Receipt of a RESTART message

Upon receiving a RESTART message, the recipient shall enter the Restart state associated to the global call reference and start timer T317; it shall then initiate the appropriate internal actions to clear all calls on the interface and to return the interface to the idle state. Upon completion of internal clearing, timer T317 shall be stopped and a RESTART ACKNOWLEDGE message transmitted to the originator, and the Null state entered. If timer T317 expires prior to completion of internal clearing, an indication shall be sent to the maintenance entity.

Even if all call references are in the Null state and all data link connections are in the idle condition, the receiving entity shall transmit a RESTART ACKNOWLEDGE message to the originator upon receiving a RESTART message.

10.6.7 Handling of error conditions

Detailed error handling procedures are implementation dependent. This subclause provides general rules required by each implementation to facilitate the orderly treatment of error conditions.

The following error types are covered in this subclause:

- protocol discriminator error;
- message too short;
- call reference error;
- message type or message sequence errors;
- general information element errors;
- mandatory information element errors;
- non-mandatory information element errors;
- data link reset and data link failure.

10.6.7.1 Protocol discriminator error

When a message is received with a protocol discriminator coded other than *Q.931 user-network call control message* (0000 1000), the message shall be ignored (discarded) and no further action will be taken.

10.6.7.2 Message too short

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

10.6.7.3 Call reference error

10.6.7.3.1 Invalid call reference format

1) if the call reference information element octet 1, bits 5-8 do not equal '0000', then the message shall be ignored;
2) when a message is received with a dummy call reference, it shall be ignored.

10.6.7.3.2 Call reference procedural errors

1) Whenever a message (CALL PROCEEDING, CONNECT or DISCONNECT) except SETUP, RELEASE, RELEASE COMPLETE, STATUS OR STATUS ENQUIRY is received specifying a call reference which it does not recognize as related to an active SVC or a SVC set-up request in progress, the receiving entity shall send a RELEASE COMPLETE message with cause No. 81 *Invalid call reference value* and remain in the Null state (U0 or N0). The RELEASE COMPLETE message will specify the call reference received in the message in error.

2) When a RELEASE message is received that specifies a call reference which it does not recognize as related to an active switched virtual connection or a switched virtual connection set-up request in progress, the receiving entity shall send a RELEASE COMPLETE message with cause No. 81 *Invalid call reference value* and remain in the Null state (U0 or N0).

3) When a RELEASE COMPLETE is received that specifies a call reference which it does not recognize as related to an active switched virtual connection or a switched virtual connection set-up request in progress, no action should be taken.

4) When a SETUP message is received that specifies a call reference which is recognized as related to an active switched virtual connection or a switched virtual connection set-up request in progress or with a call reference flag incorrectly set to B'1', that message shall be ignored.

5) When any message except RESTART, RESTART ACKNOWLEDGE or STATUS is received using the global call reference, no action should be taken on this message and a STATUS message using the global call reference with cause No. 81 *Invalid call reference value* and a call state indicating REST0 shall be returned.

6) When a STATUS message is received that specifies a call reference which is not recognized as related to an active switched virtual connection or a switched virtual connection set-up request in progress, the procedures of 10.6.4 shall apply.

7) When a STATUS ENQUIRY message is received that specifies a call reference which is not recognized as related to an active switched virtual connection or a switched virtual connection set-up request in progress, the procedures of 10.6.4 shall apply.

10.6.7.4 Message type or message sequence errors

1) Whenever an unexpected RELEASE message is received, the DCE or the DTE shall stop all timers, send a RELEASE COMPLETE message, release the DLCI and the call reference and return to the Null state (U0 or N0). In addition, the DCE shall clear the SVC with the remote DTE.

2) Whenever an unexpected RELEASE COMPLETE message is received, the DCE or the DTE shall stop all timers and return to the Null state (U0 or N0). In addition, the DCE shall clear the switched virtual connection with the remote DTE before returning to the Null state.

3) Whenever an unexpected message, except RELEASE, RELEASE COMPLETE, or an unrecognized message is received in any state other than the Null state, a STATUS message shall be returned with cause No. 98 *Message not compatible with switched virtual connection state or message type non-existent or not implemented* and the message type code point in the diagnostic field of the cause information element.

   Instead of cause No. 98, the following cause values may be returned depending on the message received (unrecognized/not implemented or unexpected in the current state):

   a) Cause No. 97 *Message type non-existent or not implemented*; or

   b) Cause No. 101 *Message not compatible with switched virtual connection state*.

   Alternatively, instead of sending a STATUS message, a STATUS ENQUIRY message may be sent requesting the call state of the sender. This alternative is not applicable to messages using the global switched virtual connection reference.

   No state change shall be made after sending either the STATUS or STATUS ENQUIRY message.

10.6.7.5 General information element errors

10.6.7.5.1 Information element out of sequence

A variable length information element which has a code value lower than the code value of the variable length information element preceding it shall be considered as out of sequence information element.

If the DCE or the DTE receives a message containing an out of sequence information element, it may ignore this information element and continue to process the message. If the DCE or the DTE chooses to ignore this out of sequence information element, then the error handling procedure for missing mandatory information elements as described below shall apply. If the out of sequence information element is non-mandatory, the receiver continues to process the message.

NOTE – Some implementation may choose to process all information elements received in a message regardless of the order in which they are placed.

10.6.7.5.2 Duplicated information elements

1) If an information element is repeated in a message in which repetition of the information element is not permitted, only the contents of the first instance of the information element shall be considered and all subsequent instances shall be ignored.
2) When repetition of an information element is permitted and if the limit of repetition of the information element is exceeded, the contents of the instances of the information element appearing up to the limit of repetition shall be handled and all subsequent repetitions of the information element shall be ignored.

10.6.7.6 Mandatory information element errors

10.6.7.6.1 Mandatory information element missing

1) When a RELEASE COMPLETE message is received, as a first clearing message, with the cause information element missing, it will be assumed that cause No. 31 *Normal, unspecified* was received.
2) When a DISCONNECT or RELEASE message is received, as a first clearing message, with the cause information element missing, it will be assumed that cause No. 31 *Normal, unspecified* was received. However the reply, RELEASE or RELEASE COMPLETE respectively, shall be sent to the other side of the UNI with the cause value No. 96, *Mandatory information element is missing.*
3) When a SETUP message is received which has one or more mandatory information element missing, the receiving entity shall clear the SVC by following the clearing procedures before reaching the active state as described in 10.6.4.2 and a message with cause No. 96 *Mandatory information element is missing* shall be returned.
4) When a message other than SETUP, DISCONNECT, RELEASE COMPLETE is received which has one or more mandatory information elements missing, no action should be taken on the message and no state change should occur. A STATUS message shall be returned with cause No. 96 *Mandatory information element is missing.*

10.6.7.6.2 Mandatory information element content error

1) An implementation should consider as valid an information element with a length exceeding the maximum length defined in 10.5.
2) When a RELEASE COMPLETE message is received with an invalid content of the cause information element, it will be assumed that cause No. 31 *Normal, unspecified* was received.
3) When a DISCONNECT or RELEASE message is received with an invalid content of the cause information element, it will be assumed that cause No. 31 *Normal, unspecified* was received. However the reply, RELEASE or RELEASE COMPLETE respectively, shall be sent to the other side of the UNI with the cause value No. 100 *Invalid information element contents*.

4) When a SETUP or RELEASE message is received which has one or more mandatory information element with an invalid content, the receiving entity shall clear the SVC by following the clearing procedures before reaching the active state as described in 10.6.4.2 with cause No. 100 *invalid information element contents.*

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

10.6.7.7 Non-mandatory information element errors

The following subclauses identify actions on information element not recognized as mandatory. When a message is received which has one or more unrecognized information elements, the receiving entity shall check whether any are encoded to indicate "comprehension required". If any unrecognized information element is encoded to indicate "comprehension required", then the procedures of 10.6.7.6.2 are followed, i.e. as if a "missing mandatory information element" error condition has occurred. If all unrecognized information elements are not encoded to indicate "comprehension required", then the receiving entity shall proceed as specified in the following subclauses.

10.6.7.7.1 Unrecognized information element

1) When a RELEASE COMPLETE message is received which has one or more unrecognized information elements, no action shall be taken on the unrecognized information elements.

2) When a RELEASE message is received which has one or more unrecognized information elements, a RELEASE COMPLETE message is returned with cause No. 99 *Information element non-existent or not implemented*, the diagnostic field, if present, shall contain the information element identifier for each information element which was unrecognized.

3) When a DISCONNECT message is received which has one or more unrecognized information elements, a RELEASE message is returned with cause No. 99 *Information element non-existent or not implemented*, the diagnostic field, if present, shall contain the information element identifier for each information element which was unrecognized.

4) When a message is received which has one or more unrecognized information elements, action shall be taken on the message and those information elements which have a valid content. When the received message is other than DISCONNECT, RELEASE or RELEASE COMPLETE, A STATUS message may be returned indicating the call state of the sender before taking action on the valid information elements of the message. The cause information element shall contain cause No. 99 *Information element non-existent or not implemented*, and the diagnostic field, if present, shall contain the information element identifier for each information element which was unrecognized. Subsequent actions are determined by the sender of the faulty message.

NOTE – The diagnostic of cause No. 99 facilitates the decision in selecting an appropriate recovery procedure at the reception of a STATUS message. Therefore, it is recommended to provide cause No. 99 with diagnostic information.

10.6.7.7.2 Non-mandatory information element content error

When a message is received which has one or more non-mandatory information elements with invalid content, action shall be taken on the message and those information elements which have a valid content. A STATUS message may be returned indicating the call state of the sender before taking action on the valid information elements of the message. The cause information element shall contain cause No. 100 *Invalid information element contents* and the diagnostic field, if present, shall contain the information element identifier for each information element which was unrecognized. Subsequent actions are determined by the sender of the faulty message.

10.6.7.7.3 Unexpected recognized information element

- When a message is received with a recognized information element not defined to be contained in that message, the receiving entity shall treat the information element as an unrecognized information element and follow the procedures for handling non-mandatory unrecognized information elements.

10.6.7.8 Data link reset

Whenever an entity is informed of a data link reset, no special actions shall be taken; the appropriate procedures (normal procedures or error handling procedures) described above shall be performed.

10.6.7.9 Data link failure

Any switched virtual connection shall be cleared internally.

10.6.8 Closed user group facility

10.6.8.1 General

A set of Closed User Group (CUG) optional user facilities enables users to form groups of DTEs to and/or from which access is restricted. A DTE belonging only to one or several CUGs (i.e. not having the outgoing or incoming access described below) can only communicate with DTEs belonging also to one of these CUGs: the network will clear any call not fitting with this condition. From an administrative point of view, a DTE may subscribe to a given CUG only with the authorization of the subscriber who is responsible for the CUG.

In addition to the CUGs, the open part is defined which is composed of all the DTEs which have not subscribed to any closed user group related facilities.

A DTE having subscribed to outgoing access may call the open part and DTEs having subscribed to incoming access.

A DTE having subscribed to incoming access may be called by the open part and by DTEs having subscribed to the outgoing access.

10.6.8.2 Subscription options

The DTE may subscribe either to simple CUG facility or to CUG selection facility.

The simple CUG facility enables the DTE to belong to one CUG in a way that is completely transparent, i.e. without any specific signalling procedures.

The CUG selection facility enables the DTE to belong to one or several CUGs and for each virtual circuit to select or to receive the information to which CUG the particular virtual circuit belongs to.

In addition, the DTE may subscribe to outgoing access and or incoming access.

10.6.8.3 Per call options

The CUG facilities defined on a per call basis are:

- No CUG – It is equivalent to a call with called DTE in the open part or having subscribed to incoming access.
- CUG specified.
- CUG specified with outgoing access.

10.6.8.4 Simple CUG

Simple CUG is an optional user facility agreed for a period of time and applies to the entire DTE/DCE interface for virtual circuits. This facility, if subscribed to, enables the DTE to belong to a CUG in a way that is completely transparent.

At subscription time the user simply indicates its CUG profile:

- the CUG it wants to belong to (only one);
- the outgoing access or not;
- the incoming access or not.

In all these combinations, no closed user group information element is needed nor permitted in the SETUP messages received and transmitted by the DTE.

10.6.8.4.1 SETUP message from the DTE to the DCE

The SETUP message transmitted by the DTE should not contain any closed user group information element. If any closed user group information element is present in a SETUP message received from a DTE having subscribed to the simple CUG facility, the DCE must clear the switched virtual circuit with cause No. 50 *Requested facility not subscribed*.

To determine whether or not the call can proceed and if it can, the type of the call regarding CUG possibilities, the DCE processes the CUG profile of the calling DTE as described in Table 10-26.

TABLE 10-26/X.36

DCE check on outgoing calls for simple CUG

CUG profile of the calling DTE	Type of call regarding CUG possibilities
Simple CUG	CUG specified
Simple CUG plus outgoing access	CUG specified with OA

10.6.8.4.2 SETUP message from the DCE to the DTE

To determine whether the call can be presented to the called DTE or must be cleared, the DCE processes the type of call regarding CUG possibilities and the user profile of the called DTE as described in Table 10-27.

NOTE – In the following tables on CUG, the numbers in parentheses refer to cause values.

TABLE 10-27/X.36

DCE check on incoming calls for simple CUG

CUG profile of the called DTE	Type of the call regarding CUG possibilities				
	No CUG	CUG specified		CUG specified with OA	
		Match	No match	Match	No match
Simple CUG	Clear call (87)	Call allowed	Clear call (87)	Call allowed	Clear call (87)
Simple CUG with IA	Call allowed	Call allowed	Clear call (87)	Call allowed	Call allowed

The SETUP message transmitted by the DCE must not contain any closed user group information element.

10.6.8.5 CUG selection

CUG selection is an optional user facility agreed for a period of time for virtual circuits and applies for the entire DTE/DCE interface. This facility, if subscribed to, enables the DTE to belong to one or several CUGs and for each virtual circuit to select or to receive the information to which CUG the particular virtual circuit belongs to.

At subscription, the user indicates its CUG profile:

- the CUG(s) it wants to belong to;
- the outgoing access or not;
- the incoming access or not.

10.6.8.5.1 SETUP message from the DTE to the DCE

The SETUP message transmitted by the DTE may contain or not the closed user group information element. To determine whether or not the call can proceed and if it can, the type of the call regarding CUG possibilities, the DCE processes the content of the closed user group information element (if present) and the CUG profile of the calling DTE as described in Table 10-28.

NOTE – The presence of the closed user group information element with a coding error is handled as a non-mandatory information element error.

TABLE 10-28/X.36

DCE check on outgoing calls for CUG selection

CUG profile of the calling DTE	Type of the call specified in the SETUP message				
	Not a CUG call	CUG call		CUG call with OA	
		Match	No match	Match	No match
CUG selection	Clear call (50)	Call with specified CUG	Clear call (90)	Clear call (50)	Clear call (90)
CUG selection with OA	Normal call	Call with specified CUG	Clear call (90)	Call with specified CUG + OA	Normal call

10.6.8.5.2 SETUP message from the DCE to the DTE

To determine whether the call can be presented to the called DTE or must be cleared, the DCE processes the type of the call regarding CUG possibilities and the CUG profile of the called DTE as described in Table 10-29. When the call can be presented, Table 10-29 provides also the CUG signalling to the DTE.

TABLE 10-29/X.36

DCE check and signalling on incoming calls for CUG selection

CUG profile of the called DTE	Type of the call specified in the SETUP message				
	Not a CUG call	CUG call		CUG call with OA	
		Match	No match	Match	No match
CUG selection	Clear call (87)	Call with specified CUG	Clear call (87)	Call with specified CUG	Clear call (87)
CUG selection with incoming access	Normal call	Call with specified CUG	Clear call (87)	Call with specified CUG + OA	Normal call

10.6.8.6 No CUG

In case DTEs have subscribed neither to simple CUG nor to CUG selection facilities, this subclause describes DCE check and signalling on outgoing and incoming calls.

10.6.8.6.1 SETUP message from the DTE to the DCE

The SETUP message transmitted by the DTE should not include the closed user group information element. If any closed user group information element is present in a SETUP message received from a DTE having subscribed neither to simple CUG nor CUG selection facilities, the DCE must clear the virtual circuit with cause No. 50 *Requested facility not subscribed*. If present, the diagnostic includes the information element identifier of the closed user group information element.

The per call facility used such a DTE is “call with no CUG”.

10.6.8.6.2 SETUP message from the DCE to the DTE

To determine whether the call can be presented to the called DTE or must be cleared, the DCE processes the type of the call regarding CUG possibilities and the fact that the called DTE has not subscribed to any CUG facilities, as described in Table 10-30.

TABLE 10-30/X.36

DCE check on incoming calls for No CUG

CUG profile of the called DTE	Type of the call specified in the SETUP message				
	Not a CUG call	CUG call		CUG call with OA	
No CUG	Normal call		Clear call (87)	Normal call	

10.6.9 Transit network selection facility

It is a network option to support the transit network selection facility. In the case where the network does not support the transit network selection capability and a transit network selection information element is received in the SETUP message, that information element is processed according to the rules for unimplemented non-mandatory information elements.

When the transit network selection capability is supported, the user may identify one and only one transit network in the SETUP message in a Transit network selection information element. If a Transit network selection information element is included in the SETUP message and the network cannot route through the transit network specified, it shall not route through another route but clear the call with cause No. 2 *No route to specified transit network.*

A network may screen the transit network selection information element to:

- ensure an appropriate business relationship exists between selected networks; or
- ensure compliance with national and local regulations.

If the transit network is of an incorrect format, or fails to meet the above criteria, the network shall initiate call clearing with cause No. 91 *Invalid transit network selection*.

10.6.10 Reverse charging facility

10.6.10.1 Reverse charging request and acceptance

Reverse charging is an optional facility which may be requested by a calling DTE for a given SVC establishment request. To request reverse charging, the calling DTE includes in the SETUP message the Reverse charging indication information element. The network will transmit to the called DTE a SETUP message with the Reverse charging indication information element. The called DTE may reject the Reverse charging indication request with cause No. 29 *Facility rejected.*

In the absence of this information element in the SETUP message at the calling DTE/DCE interface, the network will not transmit to the called DTE the Reverse charging indication information element and normal charging will apply.

10.6.10.2 Reverse charging prevention

The Reverse charging prevention is an optional facility activated by subscription. The network will not transmit to a called DTE which has subscribed to this facility a SETUP message requesting reverse charging. But will clear the call towards the calling DTE with cause No. 29 *Facility rejected.*

10.6.11 Frame transfer priority facility

The Frame transfer priority facility is *for urgent further study*.

NOTE – An information element identifier has been reserved in the digital Subscriber Signalling System No. 1 (DSS 1) set of identifiers for variable length information elements to signal a requested priority level at the NNI.

This information element is known as “Frame transfer priority information element” and the reserved identifier (to be coded in the first octet) is 0110 1010.

10.7 List of timers

10.7.1 DTE timers

The DTE timers are specified in Recommendation Q.931. The following timers are supported: T303, T305, T308, T310, T316, T317 and T322. Timers T305, T308, T316 and T317 are mandatory (see Table 10-31).

TABLE 10-31/X.36

DTE timers

Timer No.	Default value	Cause for start	Normal stop	1st expiry	2nd expiry
T303	4 s	SETUP sent	CALL PROCEEDING or clearing message received	Retransmit SETUP Restart T303	Not restarted Clear call
T305	30 s	DISC sent	Clearing message received	Send RELEASE message	Not restarted
T308	4 s	REL sent	Clearing message received	Retransmit RELEASE Restart T308	Not restarted Release call reference
T310	30-40 s	CALL PROC received	CONNECT or clearing message received	Clear call	Not restarted
T316	120 s	RESTART sent	RESTART ACKNOWLEDGE received	RESTART may be transmitted several times	RESTART may be transmitted several times
T317		RESTART ACK received	Internal clearing of call references	Maintenance notification	Timer is not restarted
T322	4 s	STAT ENQ sent	STATUS or a clearing message received	STATUS ENQUIRY retransmitted	May be transmitted several times

10.7.2 DCE timers

The DCE timers are specified in Recommendation Q.931. The following timers are supported: T303, T305, T308, T310, T316, T317 and T322. All of them are mandatory for the DCE (see Table 10-32).

TABLE 10-32/X.36

DCE timers

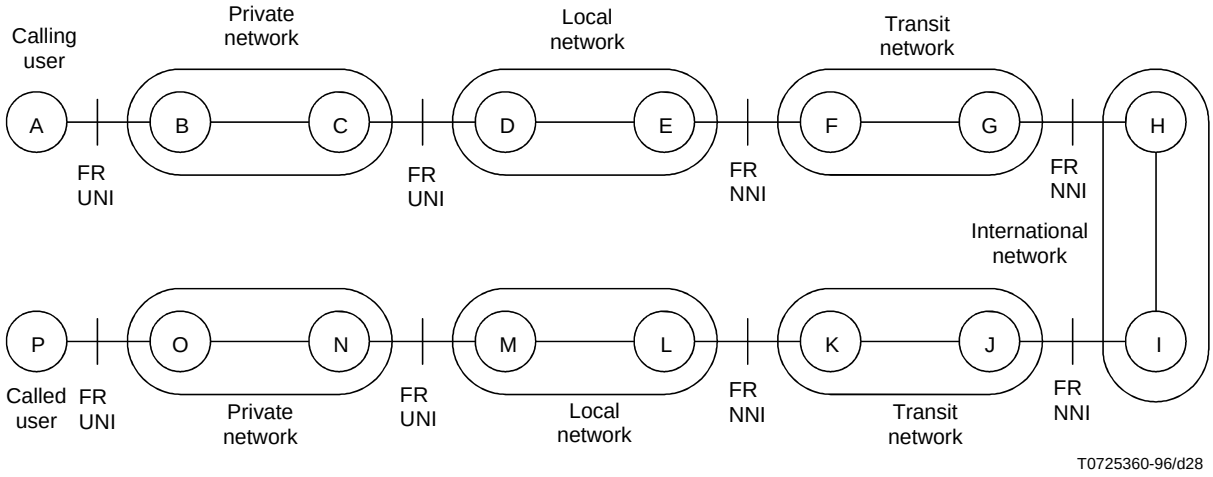
Timer No.	Default value	Cause for start	Normal stop	1st expiry	2nd expiry
T303	4 s	SETUP sent	CALL PROCEEDING, CONNECT or a clearing message received	Retransmit SETUP Restart T303	Not restarted Clear call
T305	30 s	DISC sent	Clearing message received	Send RELEASE message	Not restarted
T308	4 s	REL sent	Clearing message received	Retransmit RELEASE Restart T308	Not restarted Release call reference
T310	30-40 s	CALL PROC received	CONNECT or clearing message received	Clear call	Not restarted
T316	120 s	RESTART sent	RESTART ACKNOWLEDGE received	RESTART may be transmitted several times	RESTART may be transmitted several times
T317		RESTART ACK received	Internal clearing of call references	Maintenance notification	Timer is not restarted
T322	4 s	STAT ENQ sent	STATUS or a clearing message received	STATUS ENQUIRY retransmitted	May be transmitted several times

Annex E

Usage of Cause and Location

E.1 Location field generation

This annex defines the encoding of the cause value, the location and diagnostic fields of the Cause information element. It also defines the semantics of each cause value to be used for frame relay SVC signalling at the DTE/DCE interface (see Figure E.1 and Table E.1).



NOTE – The interface A-B, C-D, M-N and O-P is assumed to be Frame relay UNI.

FIGURE E.1/X.36

Reference configuration for location field generation

TABLE E.1/X.36

Location field values

Node generating location field	Location field setting	Location setting expected by user A
B	LPN	LPN
C	LPN	LPN
D	LN	LN
E	LN	LN
F	TN	TN
G	TN	TN
H	INTL	INTL
I	INTL	INTL
J	TN	TN
K	TN	TN
L	LN or RLN	RLN
M	LN or RLN	RLN
N	LPN or RPN	RPN
O	LPN or RPN	RPN
P	U	U

NOTE – When both DTEs are connected to the same public network, both "public network serving the remote DTE" and "public network serving the local DTE" can be received by a DTE. "Public network serving the remote DTE" refers to the remote DTE/DCE interface and "public network serving the local DTE" refers to the local DTE/DCE interface.

E.2 Cause values

The cause values are defined in Recommendation Q.850. They are applicable to different protocols and services. The cause values relevant to frame relay switched virtual circuits are provided below.

Cause value: **No. 1 – Unallocated (unassigned number)**
Class (octet 4 bits 7 6 5): 0 0 0
Value (octet 4 bits 4 3 2 1): 0 0 0 1
Definition: This cause indicates that the called party cannot be reached because, although the number is in a valid format, it is not currently allocated (assigned).
Diagnostic: Condition

Cause value: **No. 2 – No route to specified transit network**
Class (octet 4 bits 7 6 5): 0 0 0
Value (octet 4 bits 4 3 2 1): 0 0 1 0
Definition: This cause indicates that the equipment sending this cause has received a request to route the call to a particular transit network which it does not recognize, either because the transit network does not exist or because while it does exist, does not serve the equipment which is sending this cause.
Diagnostic: Transit network identity

Cause value: **No. 3 – No route to destination**
Class (octet 4 bits 7 6 5): 0 0 0
Value (octet 4 bits 4 3 2 1): 0 0 1 1
Definition: This cause indicates that the called party cannot be reached because the network through which the call has been routed does not serve the destination.
Diagnostic: Condition

Cause value: **No. 6 – Channel unacceptable**
Class (octet 4 bits 7 6 5): 0 0 0
Value (octet 4 bits 4 3 2 1): 0 1 1 0
Definition: This cause indicates that the channel identified is not acceptable to the sender of this cause value. This cause value is used with an ISDN access.
Diagnostic: Not defined

Cause value: **No. 7 – Call awarded and being delivered in an established channel**
Class (octet 4 bits 7 6 5): 0 0 0
Value (octet 4 bits 4 3 2 1): 0 1 1 1
Definition: This cause indicates that the user has been awarded the incoming call and that the incoming call is being connected to a channel already established to that user for similar calls. This cause is used when the frame relay service is accessed through an ISDN circuit mode connection.
Diagnostic: Not defined

Cause value: **No. 16 – Normal call clearing**
Class (octet 4 bits 7 6 5): 0 0 1
Value (octet 4 bits 4 3 2 1): 0 0 0 0
Definition: This cause indicates that the call is being cleared because one of the users has requested that the call be cleared.
Diagnostic: Condition

Cause value: **No. 17 – User busy**
Class (octet 4 bits 7 6 5): 0 0 1
Value (octet 4 bits 4 3 2 1): 0 0 0 1
Definition: This cause indicates that the called party is unable to accept another call because a busy condition has been encountered. This cause value may be generated by either the called user or the network.
Diagnostic: Not applicable to the frame relay service

Cause value: **No. 18 – No user responding**
Class (octet 4 bits 7 6 5): 0 0 1
Value (octet 4 bits 4 3 2 1): 0 0 1 0
Definition: This cause indicates that the called user does not respond to a call establishment message within the prescribed period of time allocated.
Diagnostic: Not defined

Cause value: **No. 21 – Call rejected**
Class (octet 4 bits 7 6 5): 0 0 1
Value (octet 4 bits 4 3 2 1): 0 1 0 1
Definition: This cause indicates that the equipment sending this cause does not wish to accept this call, although it could have accepted the call because it is neither busy nor incompatible.
Diagnostic: Call rejected condition

Cause value: **No. 27 – Destination out of order**
Class (octet 4 bits 7 6 5): 0 0 1
Value (octet 4 bits 4 3 2 1): 1 0 1 1
Definition: This cause indicates that the destination cannot be reached because the interface is not functioning correctly. The phrase *functioning correctly* indicates that a signalling message was unable to be delivered to the called user.
Diagnostic: Not defined

Cause value: **No. 28 – Invalid number format (address incomplete)**
Class (octet 4 bits 7 6 5): 0 0 1
Value (octet 4 bits 4 3 2 1): 1 1 0 0
Definition: This cause indicates that the called party cannot be reached because the called party number is not in a valid format or is not complete.
Diagnostic: Not defined

Cause value: **No. 29 – Facility rejected**
Class (octet 4 bits 7 6 5): 0 0 1
Value (octet 4 bits 4 3 2 1): 1 1 0 1
Definition: This cause is returned when a supplementary service requested by the user cannot be provided by the network.
Diagnostic: Facility identification

Cause value: **No. 30 – Response to STATUS ENQUIRY**

Class (octet 4 bits 7 6 5): 0 0 1
Value (octet 4 bits 4 3 2 1): 1 1 1 0
Definition: This cause is included in the STATUS message when the reason for generating the STATUS message was the receipt of a STATUS ENQUIRY message.
Diagnostic: Not defined

Cause value: **No. 31 – Normal, unspecified**
Class (octet 4 bits 7 6 5): 0 0 1
Value (octet 4 bits 4 3 2 1): 1 1 1 1
Definition: This cause is used to report a normal event only when no other cause in the normal call applies.
Diagnostic: Not defined

Cause value: **No. 34 – No circuit/channel available**
Class (octet 4 bits 7 6 5): 0 1 0
Value (octet 4 bits 4 3 2 1): 0 0 1 0
Definition: This cause indicates that there is no appropriate circuit/channel presently available to handle the call.
Diagnostic: Not defined

Cause value: **No. 38 – Network out of order**
Class (octet 4 bits 7 6 5): 0 1 0
Value (octet 4 bits 4 3 2 1): 0 1 1 0
Definition: This cause indicates that the network is not functioning correctly and that the condition is likely to last a relatively long period of time. Immediately re-attempting the call is not likely to be successful.
Diagnostic: Not defined

Cause value: **No. 39 – Permanent frame mode connection out of service**
Class (octet 4 bits 7 6 5): 0 1 0
Value (octet 4 bits 4 3 2 1): 0 1 1 1
Definition: This cause is included in a STATUS message to indicate that a permanently established frame mode connection is out of service due to equipment.
Diagnostic: Not defined

Cause value: **No. 40 – Permanent frame mode connection operational**
Class (octet 4 bits 7 6 5): 0 1 0
Value (octet 4 bits 4 3 2 1): 0 1 0 0
Definition: This cause is included in a STATUS message to indicate that a permanently established frame mode connection is operational and capable of carrying user information.
Diagnostic: Not defined

Cause value: **No. 41 – Temporary failure**
Class (octet 4 bits 7 6 5): 0 1 0
Value (octet 4 bits 4 3 2 1): 1 0 0 1
Definition: This cause indicates that the network is not functioning correctly and that the condition is not likely to last a long period of time. The user may wish to try another call attempt almost immediately.
Diagnostic: Not provided in Recommendation Q.850

Cause value: **No. 42 – Switching equipment congestion**
Class (octet 4 bits 7 6 5): 0 1 0
Value (octet 4 bits 4 3 2 1): 1 0 1 0
Definition: This cause indicates that the switching equipment generating this cause is experiencing a period of high traffic.
Diagnostic: Not defined

Cause value: **No. 43 – Access information discarded**
Class (octet 4 bits 7 6 5): 0 1 0
Value (octet 4 bits 4 3 2 1): 1 0 1 1
Definition: This cause indicates that the network could not deliver access information to the remote user as requested (subaddress, low layer compatibility, ...) as indicated in the diagnostic. It is noted that the particular type of access information discarded is optionally included in the diagnostic.
Diagnostic: Discarded information element identifier

Cause value: **No. 44 – Requested circuit/channel not available**
Class (octet 4 bits 7 6 5): 0 1 0
Value (octet 4 bits 4 3 2 1): 1 1 0 0
Definition: This cause is returned when the circuit or channel indicated by the requesting entity cannot be provided by the other side of the interface.
Diagnostic: Not defined

Cause value: **No. 49 – Quality of Service not available**
Class (octet 4 bits 7 6 5): 0 1 1
Value (octet 4 bits 4 3 2 1): 0 0 0 1
Definition: This cause indicates that the requested Quality of Service (specified in the link layer core parameters information element) cannot be provided.
Diagnostic: Condition

Cause value: **No. 50 – Requested facility not subscribed**
Class (octet 4 bits 7 6 5): 0 1 1
Value (octet 4 bits 4 3 2 1): 0 0 1 0
Definition: This cause indicates that the user has requested a supplementary service which is implemented by the equipment which generated this cause, but the user is not authorized to use.
Diagnostic: Facility identification

Cause value: **No. 57 – Bearer capability not authorized**
Class (octet 4 bits 7 6 5): 0 1 1
Value (octet 4 bits 4 3 2 1): 1 0 0 1
Definition: This cause indicates that the user has requested a bearer capability which is implemented but for which he is not authorized to use.
Diagnostic: Attribute identity

Cause value: **No. 58 – Bearer capability not presently available**
Class (octet 4 bits 7 6 5): 0 1 1
Value (octet 4 bits 4 3 2 1): 1 0 1 0
Definition: This cause indicates that the user has requested a bearer capability which is implemented but which is not available at this time.
Diagnostic: Attribute identity

Cause value: **No. 63 – Service or option not available, unspecified**
Class (octet 4 bits 7 6 5): 0 1 1
Value (octet 4 bits 4 3 2 1): 1 1 1 1
Definition: This cause is used to report a service or option *not available event* only when no other cause in the *service or option not available class* (class 011) applies.
Diagnostic: Not defined

Cause value: **No. 65 – Bearer capability not implemented**
Class (octet 4 bits 7 6 5): 1 0 0
Value (octet 4 bits 4 3 2 1): 0 0 0 1
Definition: This cause indicated that the equipment sending this cause does not support the bearer capability requested.
Diagnostic: Attribute identity

Cause value: **No. 66 – Channel type not implemented**
Class (octet 4 bits 7 6 5): 1 0 0
Value (octet 4 bits 4 3 2 1): 0 0 1 0
Definition: This cause indicates that the equipment sending this cause does not support the channel type requested. This cause is used with an ISDN access to the frame relay network.
Diagnostic: Not applicable to a non-ISDN access to the frame relay

Cause value: **No. 70 – Only restricted digital information bearer capability is available**
Class (octet 4 bits 7 6 5): 1 0 0
Value (octet 4 bits 4 3 2 1): 0 1 1 0
Definition: This cause indicates that the calling party has requested an unrestricted bearer service but that the equipment sending this cause only supports the restricted version of the requested bearer capability.
Diagnostic: Not defined

Cause value: **No. 79 – Service or option not implemented, unspecified**
Class (octet 4 bits 7 6 5): 1 0 0
Value (octet 4 bits 4 3 2 1): 1 1 1 1
Definition: This cause is used to report a *service or option not implemented event* only when no other cause in the *service or option not implemented class* (class 100) applies.
Diagnostic: Not defined

Cause value: **No. 81 – Invalid call reference value**
Class (octet 4 bits 7 6 5): 1 0 1
Value (octet 4 bits 4 3 2 1): 0 0 0 1
Definition: This cause indicates that the equipment sending this cause has received a message with a call reference which is not currently in use on the UNI.
Diagnostic: Not defined

Cause value: **No. 82 – Identified channel does not exist**
Class (octet 4 bits 7 6 5): 1 0 1
Value (octet 4 bits 4 3 2 1): 0 0 1 0
Definition: This cause indicates that the equipment sending this cause has received a request to use a channel not activated on the interface. This cause is mainly used when an ISDN circuit mode connection is used to access the frame relay network. This cause is used, for example, when a user has subscribed to those channels on a primary rate interface numbered from 1 to 12 and the user equipment or the network attempts to use channels 13 to 23.
Diagnostic: For further study

Cause value: **No. 87 – User not member of CUG**
Class (octet 4 bits 7 6 5): 1 0 1
Value (octet 4 bits 4 3 2 1): 0 1 1 1
Definition: This cause indicates that the called user for the incoming CUG call is not a member of the specified CUG or that the calling user is an ordinary subscriber calling a CUG subscriber.
Diagnostic: Not defined

Cause value: **No. 88 – Incompatible destination**
Class (octet 4 bits 7 6 5): 1 0 1
Value (octet 4 bits 4 3 2 1): 1 0 0 0
Definition: This cause indicates that the equipment sending this cause has received a request to establish a call which has a compatibility attributes (information element) which cannot be accommodated.
Diagnostic: (Incompatible) information element identifier

Cause value: **No. 90 – Non-existent CUG**
Class (octet 4 bits 7 6 5): 1 0 1
Value (octet 4 bits 4 3 2 1): 0 1 1 1
Definition: This cause indicates that the specified CUG does not exist.
Diagnostic: Not defined

Cause value: **No. 91 – Invalid transit network selection**
Class (octet 4 bits 7 6 5): 1 0 1
Value (octet 4 bits 4 3 2 1): 1 0 1 1
Definition: This cause indicates that a transit network identification was received which is of an incorrect format as defined in Annex C/Q.931.
Diagnostic: Not defined

Cause value: **No. 95 – Invalid message, unspecified**
Class (octet 4 bits 7 6 5): 1 0 1
Value (octet 4 bits 4 3 2 1): 1 1 1 1
Definition: This cause is used to report an *invalid message event* only when no other cause in the *invalid message class* (class 101) applies.
Diagnostic: Not defined

Cause value: **No. 96 – Mandatory information element is missing**
Class (octet 4 bits 7 6 5): 1 1 0
Value (octet 4 bits 4 3 2 1): 0 0 0 0
Definition: This cause indicates that the equipment sending this cause has received a message which is missing a mandatory information element.
Diagnostic: Information element identifier

Cause value: **No. 97 – Message type non-existent or not implemented**
Class (octet 4 bits 7 6 5): 1 1 0
Value (octet 4 bits 4 3 2 1): 0 0 0 1
Definition: This cause indicates that the equipment sending this cause has received a message type it does not recognize either because it is not defined or it is defined but not implemented.
Diagnostic: Message type

Cause value: **No. 98 – Message not compatible with call state or message type non-existent or not implemented**
Class (octet 4 bits 7 6 5): 1 1 0
Value (octet 4 bits 4 3 2 1): 0 0 1 0
Definition: This cause indicates that the equipment sending this cause has received a message not expected in the current call state. This cause is also sent when a STATUS message was received indicating an incompatible call state.
Diagnostic: Message type

Cause value: **No. 99 – Information element/parameter non-existent or not implemented**
Class (octet 4 bits 7 6 5): 1 1 0
Value (octet 4 bits 4 3 2 1): 0 0 1 1
Definition: This cause indicates that the equipment sending this cause has received a message which includes information element(s) not defined or not implemented. This cause indicates that the information element(s) was (were) discarded and not required to process the message.
Diagnostic: Information element identifier

Cause value: **No. 100 – Invalid information element contents**
Class (octet 4 bits 7 6 5): 1 1 0
Value (octet 4 bits 4 3 2 1): 0 1 0 0
Definition: This cause indicates that the equipment sending this cause has received an information element which it has implemented; however, the encoding of one or more fields of the information element is not supported or implemented.
Diagnostic: Information element identifier

Cause value: **No. 101 – Message not compatible with call state**
Class (octet 4 bits 7 6 5): 1 1 0
Value (octet 4 bits 4 3 2 1): 0 1 0 1
Definition: This cause indicates that a message has been received which is incompatible with the call state.
Diagnostic: Message type

Cause value: **No. 102 – Recovery on timer expiry**
Class (octet 4 bits 7 6 5): 1 1 0
Value (octet 4 bits 4 3 2 1): 0 1 1 0
Definition: This cause indicates that a procedure has been initiated by the expiry of a timer in association with error handling procedures.
Diagnostic: Timer number

Cause value: **No. 111 – Protocol error, unspecified**
Class (octet 4 bits 7 6 5): 1 1 0
Value (octet 4 bits 4 3 2 1): 1 1 1 1
Definition: This cause is used to report a *protocol error event* only when no other cause in the *protocol error class* (110) applies.
Diagnostic: Not defined

Cause value: **No. 127 – Interworking, unspecified**
Class (octet 4 bits 7 6 5): 1 1 1
Value (octet 4 bits 4 3 2 1): 1 1 1 1
Definition: This cause indicates that there has been interworking with a network which does not provide causes for actions it takes. Thus, the precise cause for a message which is being sent cannot be ascertained.
Diagnostic: Not defined

The following cause values are not relevant to Recommendation X.36:

No. 4 – Send special information tone
No. 5 – Misdialled trunk prefix
No. 8 – Preemption
No. 9 – Preemption – Circuit reserved for re-use
No. 19 – No answer from user (user alerted)
No. 20 – Subscriber absent
No. 22 – Number changed
No. 26 – Non-selected user clearing
No. 29 – Facility rejected
No. 46 – Precedence call blocked
No. 47 – Resource unavailable, unspecified
No. 53 – Outgoing calls barred within CUG
No. 55 – Incoming calls barred within CUG
No. 62 – Inconsistency in designated outgoing access information and subscriber class
No. 69 – Requested facility not implemented
No. 83 – A suspended call exits, but this call identity does not
No. 84 – Call identity in use
No. 85 – No call suspended
No. 86 – Call having the requested identity has been cleared
No. 103 – Parameter non-existent or not implemented, passed on (used by ISUP only)
No. 110 – Message with unrecognized parameter discarded (used by ISUP only)

E.3 Coding of the diagnostic field

E.3.1 Coding of condition

The condition diagnostic (octet 5) is coded as follows:

Bit
8
1

Bits
7 6 5
0 0 0

Bit 4	
0	Network service provider
1	Network service user

Bit 3	
0	Normal
1	Abnormal

Bits 2 1	
0 0	Unknown
0 1	Permanent
1 0	Transient

E.3.2 Coding of Transit network identity

The diagnostic field contains the entire transit network selection information element.

E.3.3 Coding of call rejected diagnostic

The format of the diagnostic field for cause number 21 is shown in Figure E.2 and Table E.2.

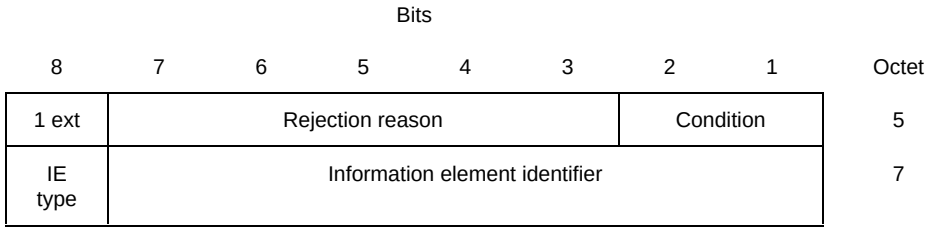


FIGURE E.2/X.36

Coding of diagnostic field for cause number 21

TABLE E.2/X.36

Coding of diagnostic field for cause number 21

Rejection reason (octet 5)

Bits	
7 6 5 4 3	
0 0 0 0 1	Information element missing
0 0 0 1 0	Information element contents are not sufficient

All other values are reserved.

Condition (octet 5)

Bits	
2 1	
0 0	Unknown
0 1	Permanent
1 1	Transient

IE type (octet 7)

Bit	
8	
0	Variable length information element
1	Fixed length information element

IE identifier (octet 7)

Bits 7-1 are encoded with the information element identifier of the missing or insufficient information element (See E.2 for the code values).

E.3.4 Coding of timer value

The timer number is coded using characters defined in Recommendation T.50, one character per decimal digit. The following coding is used in each octet starting with octet 5 of the diagnostic field:

Bit 8: Spare B'0'

Bits 7-1: IA5 character

NOTE – The most significant decimal digit of the timer is coded first (in octet 5), the other digits are coded in subsequent octets.

E.3.5 Coding of message type

The message type is coded as specified in 10.6.7.4.

E.3.6 Coding of the facility type

The code point of the information element associated with the facility rejected, except for the simple CUG since it is not possible to code the code point of an information element.

Appendix IV

Handling of physical layer loopback conditions when using frame relay PVC bi-directional procedures

IV.1 Recommended procedures for DTE/DCE that can detect loopback at the physical layer

DTE/DCE should internally remove the interface from service as long as they can detect physical layer loopback conditions. It is strongly recommended that the DTE/DCE declares a service affecting condition at the DTE/DCE interface for the duration of the loopback condition.

IV.2 Recommended procedures for DTE/DCE that cannot detect loopback at the physical layer

DTE/DCE that cannot detect loopback at the physical layer may perform the following sequence number processing to handle a loopback condition.

NOTE 1 – The procedures described here cannot detect the loopback is occurring at the physical layer. They only detect there is a loopback condition somewhere on the interface.

The DTE/DCE suspects a loopback condition exists if the send sequence number on a STATUS message received by a procedure is equal to the send sequence count of the opposite procedure (i.e. if the send sequence number of a received STATUS is equal to the send sequence count of the polling response procedure, or if the send sequence number of a received STATUS ENQUIRY is equal to the send sequence count of the polling initiation procedure). A STATUS message meeting this condition is discarded. The DTE/DCE then attempts to confirm the loopback condition.

NOTE 2 – Both DTE and DCE on an interface starting with the same send sequence number produces an initial false loopback condition. It is strongly recommended that the send sequence counts for the polling initiation and polling response procedures of both DTE and DCE be initialized to unique and different values. This significantly reduces the probability of an initial false loopback condition.

The procedure that suspects a loopback condition confirms it by incrementing its send sequence count by a value that may be fixed or randomly generated before it sends the next STATUS message (i.e. if the polling initiation procedures suspect loopback, the send sequence number of the next STATUS ENQUIRY is incremented by this value. If the polling response procedures suspect loopback, the send sequence number of the STATUS response is incremented by this value). A bilateral agreement should be reached to ensure that the DTE and DCE do not use the same sequence number. If the next STATUS message received by the procedure opposite the one suspecting the loopback condition contains a send sequence number that matches the incremented send sequence count, the loopback condition is confirmed. The STATUS message with the matching send sequence number is discarded.

Once the loopback condition is confirmed, each STATUS message received that meets the loopback condition is discarded. This results in a service affecting condition until the loopback condition is cleared.

The DTE/DCE detects that the loopback has been cleared when it receives N392 consecutive status messages where the send sequence number of the received STATUS message does not match the send sequence count of the opposite procedures.

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Appendix V

Information on address

V.1 Main address and complementary address

A DTE address may include two components: a main address and a complementary address.

V.1.1 Main address

The main address corresponds to the part of the DTE address the network may interpret. It conforms either to formats described in Recommendations X.121 and X.301 or to formats described in Recommendation E.164.

V.1.2 Complementary address

A complementary address is an address information additional to the main address, which may be used, for instance, for routing purposes inside the DTE.

Some networks allow the DTE to include a complementary address. When a complementary address is permitted by the network, the DTE is not obliged to use this complementary address. The complementary address may be as long as possible in considering the maximum length of the information element that contains the DTE address (i.e. calling party number, called party number and connected number information elements).

When a complementary address is contained in an information element of a message transmitted by the network to the DTE, this complementary address is always passed transparently from the remote DTE: it means that the network never creates a complementary address from itself.

When the type of number contained in an information element received by the DCE is set to “complementary address without main address”, the DCE shall insert the main address before the complementary address to obtain a complete DTE address to be sent to the remote DTE.

When a complementary address is invoked in the following subclauses, it is supposed that the network supports the use of complementary addresses.

V.2 Addresses in SETUP message

Table V.1 describes the possible types of address for calling party number and called party number information elements in SETUP messages.

TABLE V.1/X.36

Type of address in SETUP message

Information element	Calling DTE interface	Called DTE interface
Calling party number	All defined values	All defined values except “complementary address without main address”
Called party number	All defined values except “complementary address without main address”	All defined values

V.3 Addresses in CONNECT message

Table V.2 describes the possible types of address for connected number information element in CONNECT message.

TABLE V.2/X.36

Type of address in CONNECT message

Information element	Calling DTE interface	Called DTE interface
Connected number	All defined values except “complementary address without main address”	All defined values

V.4 Addresses processing by the network in SETUP message

Table V.3 describes addresses processing by the network in SETUP message.

TABLE V.3/X.36

Addresses processing in SETUP message

Information element	Calling DTE interface	Called DTE interface
Called party number	Called DTE address must be present: main address possibly followed by a complementary address	Called DTE address may be present. When present it can be either a main address, the main address plus a complementary address or the complementary address without the main address.
Calling party number	Calling DTE address may be present. When present it can be either a main address possibly followed by a complementary address or a complementary address without the main address.	Calling DTE address must be present: main address possibly followed by a complementary address

V.5 Addresses processing by the network in CONNECT message

Table V.4 describes addresses processing by the network in CONNECT message.

TABLE V.4/X.36

Address processing in CONNECT message

Information element	Called DTE interface	Calling DTE interface
Connected number	Connected number may be present. When present it can be either a main address possibly followed by a complementary address or a complementary address without the main address.	Connected number may be present if it differs from the called party number presented in the SETUP message by the DCE at the called interface. When present the connected number must be a main address possibly followed by a complementary address.

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Appendix VI

Identification of frame relay networks using E.164 numbering plan

VI.1 Introduction

For those public frame relay networks numbered under the E.164 numbering plan, the International identifier will consist of the E.164 Country Code followed by a network identifier code. The maximum length of the International identifier is 8-octets code according to Recommendation T.50. Only numeric values (0-9) shall be used.

Whilst the assignment of these network identification codes is a national matter, regular publication of such information is required to be made available to both users and operators of public frame relay networks. Accordingly, this appendix outlines the procedure for the assignment by a national authority, and notification to the ITU-T of the allocated network identification codes, in order that this information can be maintained in a central register and be published on a regular basis.

VI.2 Assignment and notification process

The assignment of network identification codes to frame relay networks numbered under the E.164 numbering plan, in order to create an International identifier, is a purely national matter and will be made by a national authority in accordance with national laws and regulations or agreed national arrangements. The allocating authority will notify the ITU TSB of any new or revised assignments. Assignments of frame relay network identification codes will be published in the ITU Operational Bulletin. A recapitulatory list is published annually in the Operational Bulletin.

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