ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

STANDARD ECMA-106

LAYER 3 PROTOCOL FOR SIGNALLING OVER THE D-CHANNEL OF THE S-INTERFACES BETWEEN DATA PROCESSING EQUIPMENT AND PRIVATE CIRCUIT SWITCHING NETWORKS

September 1985

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F O R E W O R D

Due to particular conditions in the ECMA Headquarters during Summer 1985, this ECMA Standard is not presented in all respects according to the usual editing rules of the ECMA Secretariat. This should be considered exceptional. Future editions of this Standard will be presented in the usual layout.

BRIEF HISTORY

This Standard ECMA-106 is one of a series of standards for the connection of Data Processing Equipment to Private Circuit Switching Network interfaces.

It uses the ISDN concepts as developed by CCITT and it is also within the framework of standards for open systems interconnection as defined by ISO 7498 and within the Technical Report ECMA TR/24. It is based on the practical experience of ECMA member companies and the results of their active and continuous participation in the work of ISO, CCITT and various national standardization bodies in Europe and in the USA.

The Standard ECMA-106 standardizes the Layer 3 protocol for signalling at the S reference point at DPE to PCSN interfaces (also called S interfaces in this document). Where appropriate, assumptions of the interface as presented by the Private Circuit Switching Network are also indicated.

It represents a pragmatic and widely based consensus.

Adopted by the General Assembly of ECMA as Standard ECMA-106 on June 13, 1985.

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SCOPE

SECTION 1

This Standard ECMA-106 describes the signalling procedures and messages used at the interface between a Data Processing Equipment (DPE) and a Private Circuit Switching Network (PCSN).

The procedures and messages are part of the Layer 3 protocol which provides the means to establish, maintain and terminate Circuit Switched and Signalling connections across an interface between DPE and PCSN. It makes use of the definition and terminology concepts of the ISDN protocol reference model given in CCITT Recommendation I.320 and it is based on CCITT recommendation I.450 and I.451. These procedures are defined in terms of messages exchanged over the D-channel of the basic and primary rate access interfaces as defined in CCITT Recommendation I.412.

To the extent possible, this standard is a fully compatible subset of CCITT Recommendation I.451/Q.931. The subset forms the protocol specification necessary to allow early implementation of ISDN interfaces between Data Processing Equipment and Private Circuit Switching Networks. Minor enhancements to the CCITT Recommendations have been made in order to provide capabilities considered essential to the data processing environment. In addition, portions of CCITT Recommendation I.451 considered essential for implementation (e.g. timer values) which have been left for further study, have been specified in this Standard.

The procedures described in this Standard are for the control of circuit-switched connections, and user-to-user signalling. The application of the procedures for the transfer of other message-based information (telemetry, etc.) via the D-channel is beyond the scope of this Document.

REFERENCES

SECTION 2

CCITT Recommendations

E.120	Instructions for users of the International Telephone Service
E.163	Numbering plan for the International Telephone Service
E.164/I.331	The numbering plan for the IDSN era.
E.211	Numbering and Dialling Procedures for VHF/UHF and Maritime Mobile-Satellite Telephone Services
E.212	Identification plan for land mobile stations
E.213	Telephone numbering plan for land mobile stations in public land mobile networks (PLMN)
F.69	International Numbering Plan for Public Telex Networks
G.711	Pulse code modulation (PCM) of voice frequencies
G.722	Interconnection of digital paths using different techniques
I.320	ISDN Protocol Reference Model.
I.340	ISDN Connection types
I.412	ISDN user-network interfaces - Channel structures and access capabilities
I.440/Q.920	ISDN user-network interface Data Link Layer - general aspects
I.441/Q.921	ISDN user-network interface Data Link Layer specification
I.450/Q.930	ISDN user-network interface layer 3 - General aspects
I.451/Q.931	ISDN user-network interface layer 3 - Specification
I.460	Rate adaption, Multiplexing, and support of existing Interfaces.
I.461	Support of X.21 and X.21bis based DTE by an ISDN
I.463	Support of DTE with V-series type interfaces by an ISDN
I.464	Rate adaption, multiplexing and support of existing interfaces for restricted 64 kbits/s transfer capability
Q.710	Use of Signalling System No. 7 for PABX application
Q.764	ISDN user part - Signalling procedures - Signalling System No. 7

References

V. 3	International Alphabet 5 characterset
X. 21	Interface between Data Terminal Equipment (DTE) and Data Circuit Terminating Equipment (DCE) for Synchronous Operation on Public Data Networks
X. 25	Interface between data terminal equipment (DTE) and data circuit terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit
X. 31/I. 462	Support of packet-mode terminal equipments on an ISDN
X. 121	International Numbering Plan for Public Data Networks
X. 300	General principles and arrangements for interworking between public data networks, and between public data networks and other public networks

TERMINOLOGY

SECTION 3

A basic vocabulary of terms can be found in CCITT Recommendation I. 112. In addition, the following definitions apply in this Standard:

B-Channel
The B-channel is a 64 kbit/s access channel with bit and octet timing. It is used to carry user data in both directions of transmission between DPEs connected over a PCSN.

D-Channel
The D-channel is a 16 kbit/s or 64 kbit/s access channel. It is used to carry signalling and other information in both directions of transmission between a DPE and the PCSN.

Data Processing Equipment (DPE)
Specific type of terminal equipment, exclusively or mainly used to process data (in contrast to a voice-only terminal).

Layer Service
This term is defined in the ISO Reference Model on Open Systems Interconnections (ISO IS 7498).

Private Circuit Switching Network (PCSN)
A PCSN is a circuit switching network with fully digital transmission capabilities operated over a private domain and bounded by S interfaces.

S_0 Interface
The S_0 interface is the basic access interface at the S reference point (see CCITT Recommendation I. 411) operating at a physical bit rate of 192 kbit/s. It provides access to two B-channels and one D-channel (2B+D). The S_0 interface forms one of the user access points to a PCSN.

S_2 Interface
The S_2 interface is primary rate access interface at the S reference point (see CCITT Recommendation I. 411) operating at a physical bit rate of 2048 kbit/s. It provides access to 30 B-channels and one D-channel (30B+D). The S_2 interface forms one the user access points to s PCSN.

Specification and Description Language (SDL)
The specification and description language according to CCITT Recommendations Z. 101...Z. 104.

Terminal Equipment (TE)
A general term to designate any terminal (voice or data processing or combination of both) connected to a PCSN at the S_0 or at the S_2 interface.

LAYER 3 GENERAL DESCRIPTION

SECTION 4

Layer 3 provides to the user the functions associated with the establishment, operation and disestablishment of a connection through the PCSN and, possibly, via the PCSN to other networks. This protocol has been defined to be symmetrical, when asymmetric situations occur, they are solved through administrative procedures. This allows the protocol to be used for direct DPE to DPE interconnection.

4.1 Data Link Layer Services

Layer 3 utilizes services provided by the Data Link Layer as defined in Standard ECMA-105. These services do not appear to the user. They are summarized below:

- Error-protected transmission of Layer 3 messages.
- Notification of unrecoverable Data Link errors.
- Notification of Data Link Layer failures.
- Recovery from certain error conditions.
- Indication of Data Link Layer status.
- Acknowledged and unacknowledged transfer of Layer 3 messages.

4.2 Structure

There are three categories of functions performed at Layer 3.

- Functions which directly control the connection establishment/disestablishment. (Support of sending, permanent circuits and call rearrangement are beyond the scope of this document.)
- Transport of messages in additional to the Data Link Layer functions. (e.g.: user-to-user information).

4.3 Layer 3 Functions

The Layer 3 protocol described in this Standard is designed to affect the establishment and control of circuit-switched connections.

Functions performed by Layer 3 include the following:

a) Processing of primitives for communicating with the Data Link Layer. (see ECMA-105)

b) Generating and interpretation of Layer 3 messages for peer-level communication.

c) Protocol handling (e.g.: timers, error detection & recovery).

d) Administration of resources (e.g. B-channels, call-references)

e) Checking to ensure that services provided are consistent with user requirements (e.g. compatibility information, addresses)

f) Support of peer-to-peer communications. (e.g.: user-to-user messages transport, segmentation, flow control)

CALL CONTROL PROCEDURES

SECTION 5

The procedures for call control, are given in terms of message sequences which are transferred across the DPE-PCSN interface and of the actions that take place at the DPE side and the PCSN side of the interface. SDL diagrams of the procedures are contained in Appendix B. These diagrams do not show all details, they show only some of the messages possible at each state, generally those messages, most likely to occur at that state. Timers and their operations are not always shown explicitly. Internal requests from the PCSN and the DPE sides are shown as far as they are necessary for comprehension.

State Transition Tables can be found in Appendix C.

When there is ambiguity in the narrative text, the diagrams or tables should be used to solve the conflict. However when the text and the diagrams are in disagreement, the text should be used as the prime source.

The call states referred to in this section cover the states perceived by the PCSN and the DPE as a consequence of receiving or sending a message. A description of the call states is contained in 6 of this Standard.

Since symmetrical procedures are used as far as possible for initiating and clearing calls, the PCSN and DPE are usually referred to as systems. When the procedures are not symmetrical, the terms originating DPE and terminating DPE will be used to indicate the direction of the described procedure.

Messages in this standard contain only functional information elements. However Keypad and Display information elements have been included to provide a mechanism for the implementation of facilities which are outside the scope of this Standard. The use of these information elements is not specified.

5.1 Rules for message processing

The following rules are listed in order of precedence:

a) When a message is received that is less than three octets long, that message shall be ignored;

b) When a message is received with a protocol discriminator not in accordance with 7.2, that message shall be ignored;

c) If a message is received which is missing one or more mandatory information elements, no action shall be taken on the message and no state change should occur. When this occurs, a STATUS message shall be returned with the cause "mandatory information element is missing".

d) When a system receives a message containing optional information elements that it does not know to how act upon, it shall act on the message and those information elements that it can action. Furthermore, it may return a STATUS message containing one cause information element for each of the unimplemented information elements received. In that case, each cause information element shall contain the cause "information element not existent or not implemented" and the diagnostic field shall contain the unimplemented information element that was received, in its entirety.

5.2 Call establishment

5.2.1 Call request

5.2.1.1 Call Reference Selection

The presence of a Call Request resolve in the assignment of a Call Reference Value according to the procedure in 8.3. The purpose of the Call Reference is to identify the call at the local interface to which the particular message applies. The Call Reference does not have end-to-end significance across the PCSN.

5.2.1.2 Call information sending

a) Point-to-point procedure

Note :

This includes the case when the originating system is one of the DPEs of a multipoint configuration.

Before these procedures are invoked, a reliable data link connection must be established between the PCSN and DPE. The data link services as described in ECMA-105 are assumed.

A system initiates call establishment by transferring a SETUP message across the system interface and starting timer T303. The SETUP message will contain all the information required by the terminating system to process the call including the Call Reference. Prior to sending the SETUP message for a given call, the call is considered to be in a `Null(s0)` state. Following the transmission of the SETUP message, the call shall be considered by the originating system to be in the `Call init(s1)` state.

If the terminating system is not able to answer with a call confirmation (see 5.2.3) within the timeframe given by T303, a CALL PROCeeding message is sent to the originating system to acknowledge that the call is being processed. The CALL PROCeeding message contains the B-channel allocated to the call and to which the originating system must be attached. Receipt of the CALL PROCeeding message by the originating system causes timer T303 to be canceled and timer T310 to be started. At this point, the call at the originating system is in the `Outgoing call proceeding(s3)` state and at the terminating system the call is in the `Incoming call proceeding(s9)` state.

If the originating system has not received any response to the SETUP message when timer T303 expires and counter N303 does not indicate that the relevant number of retransmissions already have beeen executed, the SETUP message will be retransmitted, timer T303 restarted and the retry counter incremented. If the SETUP is retransmitted and no response is received after N303 retries, then the call request is terminated by clearing the call, according to 5.3.1.3 (in this case by using procedure P3).

If following the receipt of a SETUP message, the terminating system determines that the call information received from the originating system is invalid (e.g., invalid address) or that access to any services and facilities requested is not authorized or are not presently available, then the terminating system shall initiate clearing by sending a RELease COMplete message to the originating system (according to

procedure P1 in 5.3.1.1). Receipt of a RELease COMplete message will also cancel timer T303 at the originating system.

b) Point to multi-point procedure

This procedure assumes that a reliable data link connection as described in ECMA-105 may not yet be established when the first Layer 3 message (a SETUP message) is transferred across the interface.

The originating system (PCSN) initiates call establishment by sending a SETUP message using the broadcast capability of the data link layer. However, the answer to the SETUP message sent from the terminating system(s) must make use of a reliable data link connection.

The timer T303 will be cancelled and the retransmission mechanism inhibited on receipt of a message indicating a suitable terminating system for the offered call. Timer T303 is not cancelled on the receipt of negative responses (e.g RELease COMplete).

The content of messages, their sequence and call states involved are otherwise the same as described in a) above.

5.2.1.3 Channel selection

In the SETUP message, the originating system will indicate one of the following:

a) exclusive option (i.e. preferred channel with no acceptable alternative);

b) a preferred channel, any alternative is acceptable;

c) any channel is acceptable.

If no indication is included, alternative (c) is assumed.

In cases (a) and (b), if the preferred channel is available, the terminating system reserves it for the call.

In case (b), if the terminating system cannot grant the specified channel, it reserves any other channel on the interface.

In case (c), the terminating system reserves any available channel on the interface.

The reserved B-channel is indicated in the first message returned by the terminating system in response to a SETUP message; it can be either a CALL PROCeeding, ALERTing or CONNect message.

In case (a), if the specified channel is not available, and in case (b) and (c), if no channel is available, the call request is terminated by clearing the call according to 5.3.1.1 (in this case using Procedure P1).

Note :

On the S_0 interface, the PCSN should use the exclusive option by default.

5.2.1.4 Channel Selection Conflict

The possibility exists that both systems will simultaneously transfer a SETUP message with the same preferred or exclusive B-channel specified. To avoid this situation, one system will only use the exclusive option and the other system will use one of the two remaining options. When only one channel is available and both systems simultaneously request that channel for a call, the system with the exclusive channel capability will clear the other system's call request by transmitting a RELease COMplete message with the appropriate call reference indicated. The clearing cause will be "no channel available." The selection of the system that will have the exclusive option will be done by administration procedures when the PCSN-DPE interface is initialized.

B-channel selection collision occurs when both sides of the interface simultaneously use option (a) or (b) to identify the B-channel to be assigned to a call. To avoid collision, it is necessary to limit the options that one side of the interface can use in identifying a B-channel. Accordingly, the following is the recommended channel selection procedure;

1. One side of the interface will always use option (a), namely exclusive channel identification.

2. The other side of the interface can use options (b) or (c) only. That is, the B-channel can be identified as preferred with any alternative acceptable, or any channel is acceptable.

3. When only one B-channel remains and both sides of the interface simultaneously transfer a SETUP message, the side of the interface with the exclusive option shall be awarded the B-channel.

4. The determination of which side of the interface will have the right to use the exclusive option is done before the interface is activated for the first time.

If only one B-channel is available, the DPE shall generally give preference to the PCSN for call establishment. However, some DPEs may have limitations on which B-channel can be used for different bearer capabilities. In such cases it is desirable to let the DPE have the exclusive option. Should collision occur, the PCSN would clear the DPE initiated call according to 5.3.1.1 (in this case using Procedure P1). The clearing cause will be "no channel available". The DPE will follow the procedure discussed in 5.2.1.2 for responding to the PCSN's request for a preferred or exclusive B-channel.

Note :

A description of possible channel management procedures is given for tutorial purposes in Appendix D.

5.2.2 Call confirmation

If access to the requested service and facilities is authorized and available, the terminating system transfers an ALERTing message across the system interface. At this time, the call enters the `Call delivered(s4)` state at the originating system and the `Call received(s7)` state at the terminating system.

The terminating system may also choose to send a CONNect message without having sent an ALERTing message. The call then enters the `Connect request(s8)` state.

When a CONNect or ALERTing message is received after a CALL PROCeeding message, timer T310 is cancelled. If no CALL PROCeeding message has beeen received on the receipt of an ALERTing or CONNect message (see 5.2.1.1), timer T303 will be cancelled and timer T310 will not be started.

If the originating system does not receive a CALL PROCeeding, ALERTing, CONNect, or RELease COMplete message (see procedure P1 in 5.3.1.1) prior to the last expiration of timer T303 or ALERting, CONNect or DISConnect message (see procedure P3 in 5.3.1.3) prior to expiration of timer T310, it initiates clearing procedures as defined in 5.3.1.3. The clearing cause sent to the terminating system is "no user responding".

5.2.3 Call Acceptance

A terminating system indicates acceptance of the incoming call by transferring a CONNect message across the system interface toward the originating system. The call at the terminating system then enters the `Connect request(s8)` state, and timer T30Y is started.

If the terminating system does not receive a CONNect ACKnowledge message prior to the expiration of timer T30Y, it sends a CONNect message and increments a retry counter. If the counter exceeds the maximum retry count N30Y the terminating system sends a DISConnect message to initiate call clearing as described in 5.3.1.3.

5.2.4 Active indication

On receipt of a CONNect message, the originating system first completes the path to the selected channel, then sends a CONNect ACKnowledge message to the terminating system, and places the call in the `Active(s10)` state. When the terminating system has received the CONNect ACKnowledge message, the call at this side of the system interface moves from the `Connect request(s8)` state to the `Active(s10)` state, and timer T30Y is stopped.

For multipoint configuration, the CONNect ACKnowledge message is sent to the DPE selected for the call and a RELease message (see 5.3.1.2) to all other DPEs at the interface which had sent an ALERTing or CONNect message in response to a SETUP message.

5.2.5 Call Setup flow diagrams

Figure 5.1 shows the sequence of messages for a successful call setup. The sequence of messages for an unsuccessful call attempt when destination address is busy (i.e., user busy) and queuing is not permitted at the terminating system is shown in Figure 5.2.

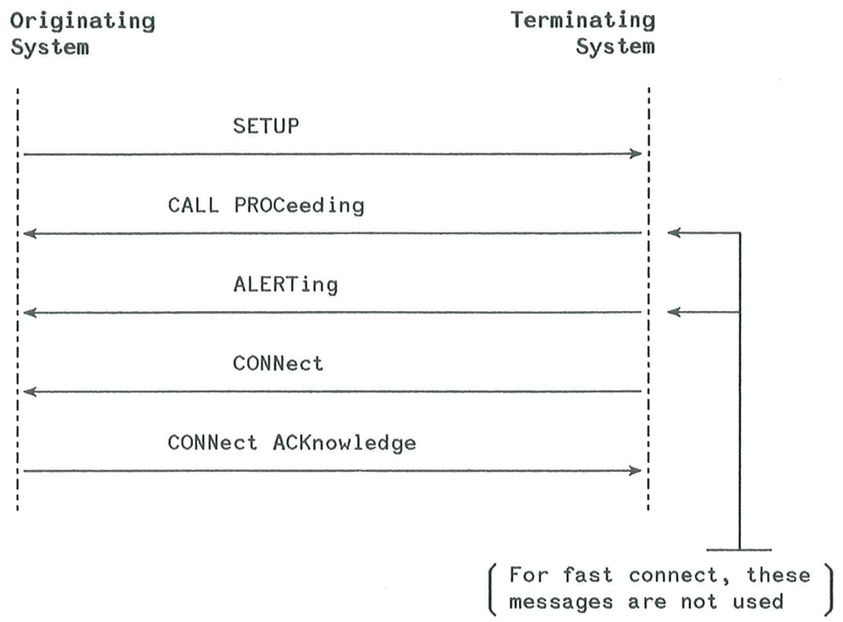


Figure 5.1 - Successful Call Setup

5.2.6 Start of user data transfer on the Bearer channel

The purpose of this section is to indicate when PCSN and DPE connection to the B-channel should take place and when the data transfer phase on the B-channel can begin.

5.2.6.1 Connection to the B-channel

For outgoing calls, the PCSN shall connect to the allocated B-channel when transmitting the CALL PROCeeding message to the DPE. Upon receipt of the CALL PROCeeding message, the DPE shall connect to the allocated B-channel.

For incoming calls on a basic access, the DPE shall connect to the selected B-channel only after receipt of the CONNect ACKnowledge message. However, for basic access configuration which are known to be point-to-point, B-channel connection may take place as soon as channel negotiation has been completed.

For primary rate interfaces, the DPE may connect to the B-channel as soon as channel negotiation has been completed.

The PCSN connects the B-channel on incoming calls upon receipt of the first CONNect message.

Note :

Inband tones may be received due to interworking with the existing networks. Whether they occur or not depends on factors external to the S interface. A possible procedure to cater for the alternatives envisaged would be to :

- *Connect the B-channel on the receipt of the CALL PROCeeding message.*

- *Disconnect the channel if an ALERTing message is received, as this indicates that inband tones are not used.*

- *Connect the B-channel (if not already connected) on the receipt of the CONNect message.*

5.2.6.2 Data Transfer Phase

On outgoing calls, Data Transfer phase commences on receipt of the CONNect message.

On incoming calls, Data Transfer phase commences on receipt of the CONNect ACKnowledge message.

5.3 Call Disestablishment

5.3.1 Call Clearing Procedures

Three procedures for clearing a call are possible: P1 to P3.

- P1 uses only a RELease COMplete message
- P2 uses a RELease message acknowledged by a RELease COMplete message
- P3 uses the following sequence of messages DISConnect, RELease and RELease COMplete.

Procedure P1 should be used in response to a SETUP message to refuse the call.

Procedure P2 should be used for non selected DPE clearing (see 5.2.5) and clearing of temporary signalling connection (see 5.5.3).

Procedure P3 should be used in all other cases.

5.3.1.1 Clearing Procedure 1 (P1)

If the terminating system cannot complete the call requested in the SETUP message for any reasons, it clears the call with RELease COMplete message as shown in Figure 5.2. The RELease COMplete message will contain the appropriate clearing cause (e.g.: no channel available, ...).

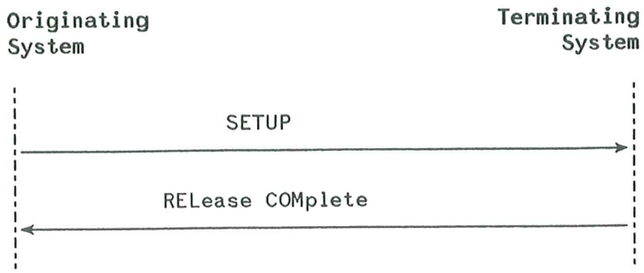


Figure 5.2 - Call Clearing Procedure 1 (P1)

5.3.1.2 Clearing Procedure 2 (P2)

For incoming calls on a multipoint configuration, more than one terminating system may respond to the SETUP message and declare itself suitable for the offered call. In addition to sending the CONNect ACKnowledge message to the terminating system selected for the call, a RELease message as shown in Figure 5.3, will be sent to each of the non selected DPEs. The complete call setup sequence for two DPEs in a multipoint configuration is shown in Figure 5.4, where DPE1 is cleared and DPE2 is accepted.

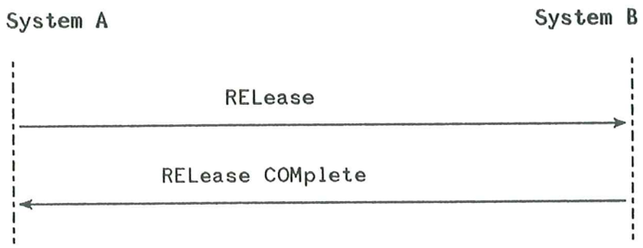


Figure 5.3 - Call Clearing Procedure 2 (P2)

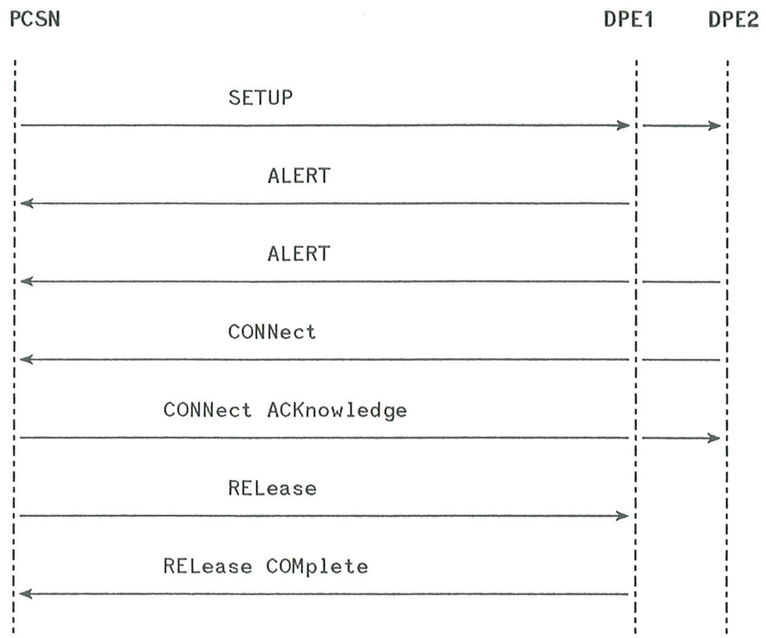


Figure 5.4 - Call setup sequence in a multipoint configuration

For the use of procedure P2 to clear a temporary signalling connection, see 5.5.3.

When RELease is sent, timer T308 is started and the call enters the `Release request(s19)` state, see 5.3.1.3.4.

5.3.1.3 Clearing Procedure 3 (P3)

5.3.1.3.1 Normal case. At anytime, other than during those conditions listed in 5.3.1.1 and 5.3.1.2, either system may initiate call clearing using clearing procedure 3 (P3). For the purposes of clarity, the two systems will be referred to as A and B, where A initiates the clearing. P3 consists of system A sending system B a DISConnect message, starting timer T305 and the call entering the `Disconnect request(s11)` state. When the DISConnect message is received by system B, it sends a RELease message back to system A, starts timer T308, puts the call in the `Release request(s19)` state and then follows the procedure described in 5.3.1.3.4. When that RELease message is received by system A, it resets timer T305, sends the RELease COMplete message back to system B and the call enters the `Null(s0)` state. This is illustrated in Figure 5.5.

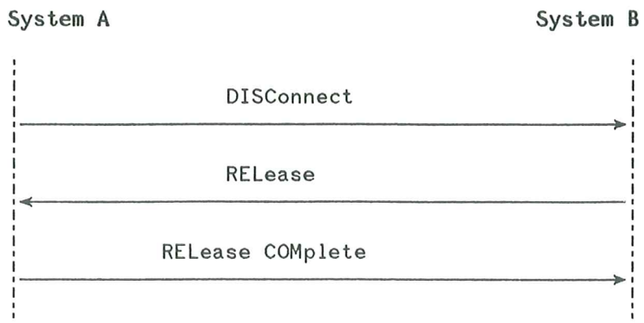


Figure 5.5 - Call Clearing Procedure 3(P3)

5.3.1.3.2 Expiry of Timer in the Disconnect request(s11) state. If a call in system A is in the Disconnect request(s11) state and the system does not receive the RELease message from system B, Timer T305 will expire. In this case, system A will send the RELease message to system B, start timer T308 and put the call in the Release request(s19) state. For description of this state see 5.3.1.3.4.

5.3.1.3.3 Disconnect Collision cases. Disconnect collision occurs when both systems simultaneously send a DISConnect message. As a result, each system will receive the DISConnect message while the call is in the Disconnect request(s11) state. Both systems should then send a RELease message, start timer T308 and put the call in the Release request(s19) state. For description of the procedure in this state. see 5.3.1.3.4.

5.3.1.3.4 Release request(s19) state. A call is in the Release request(s19) state when the system has sent a RELease message and started timer T308. Normally, RELease COMplete message is expected and this cancels timer T308 and puts the call in the Null(s0) state. If, however, RELease COMplete message does not come and timer T308 expires, the system should retry by sending an other RELease message and restarting timer T308. If a RELease COMplete message is still not returned and timer T308 expires a second time, or, if a RELease message is received at any time (i.e.: release collision) then a RELease COMplete message should be sent, timer T308 cancelled (if running) and the call put in the Null(s0) state.

5.3.2 End of user data transfer on the Bearer channel

5.3.2.1 End of data transfer phase

The data transfer will be terminated upon the sending or receiving of any clearing messages.

5.3.2.2 Release of the B-channel

If the B-channel is connected, it will be disconnected by the first clearing message sent or received. However the B-channel will remain assigned and not yet be free for further use until the call is put into the Null(s0) state.

5.3.3 Release of Call Reference

The Call Reference is released and available for re-use when the call enters the Null(s0) state.

5.4 Handling of Error Conditions

a) Whenever a message is received, at either side of the interface, specifying a call reference relating to a call which is considered to be in the Active(s10) state, but for which a response is not prescribed by the procedures in 5.2 and 5.3, a STATUS message is returned indicating the call state of the receiver. The sending or receipt of a STATUS message in such a situation will not directly affect the call state at either system . The system having received a STATUS message may following analysis of the message contents, take appropriate action (e.g. by returning a DISConnect message in response to the STATUS message). In particular, if the call state indicated in the STATUS message is at variance with the call state perceived by the side of the interface receiving the STATUS message, a DISConnect message should be sent.

b) If either system receives a DISConnect message specifying a call reference which it does not recognize as relating to an active call or a call establishment in progress, it sends a RELease message, specifying the call reference in the received message.

c) If either system receives a RELease message specifying a call reference which it does not recognize as relating to an active call or a call in progress, a RELease COMplete message is returned specifying the call reference in the received message.

d) If either system receives a RELease COMplete message specifying a call reference which it does not recognize as relating to an active call or a call in progress, no action should be taken.

e) Whenever either system receives any message except SETUP, RELease, RELease COMplete, or DISConnect specifying a call reference which it does not recognize as relating to an active call or a call establishment in progress, it initiates clearing according to the procedures in 5.3.1.3, specifying the call reference in the received message.

f) If the Layer 3 is notified by the Data Link layer entity that the underlying data link is disconnected, it should *not* immediately clear the calls supported by the data link but should attempt to re-establish a data link connection. Messages in transit during the Data Link Layer failure may be lost or duplicated during recovery. Calls which were stable should not be lost if the Data Link Layer can be reconnected within T309. If T309 expires before the Data Link is re-established, all calls supported by that Data Link should be cleared. When the Data Link is re-established, for each call reference that is assigned, a STATUS message should be sent across the interface (see (a) above).

5.5 Procedures for user-user signalling

5.5.1 General

User-to-user signalling provides a means of communication between two customers by using as a basis the layer 3 protocol.

User-to-user signalling is used to exchange information between two users to provide, for example, facilities that are not described in this Standard. User-to-user signalling is subject to flow control.

Two possibilities of user-to-user signalling may be provided:

1) user-to-user signalling in association with a circuit-switched connection on the B-channel,

2) user-to-user signalling (not associated with a circuit-switched connection) via an end-to-end temporary signalling connection.

5.5.2 Associated with a Bearer channel

5.5.2.1 Call establishment

A user-user information information element of variable length as specified in 8.5.17 may be included in the SETUP message transferred across the DPE-PCSN interface at the originating side as described in 5.2.1. The content of this information element is transferred across the PCSN and delivered in the same information element in the SETUP message transferred across the PCSN-DPE interface at the terminating side as described in 5.2.2.

A user-user information information element with the same characteristics may be included in the ALERTing and/or CONNect messages transferred across the DPE-PCSN interface at the terminating side as described in 5.2.2, 5.2.3 and 5.2.4. The content of this information element is transferred in the PCSN and delivered in the corresponding message(s) transferred across the DPE-PCSN interface at the originating side as described in 5.2.1.

5.5.2.2 Transfer of user information messages

Once the call is established, i.e.: in the `Active(s10)` state , both the involved DPE may exchange information by transferring USER INFOrmation messages across the DPE-PCSN interface unless the PCSN or interworking network does not support this facility.

The USER INFOrmation message includes as information elements, the call reference, the user-user information elements as defined in 8.5.17 and the more data indication if required. The more data indication is set by the originating DPE to indicate to the terminating DPE that another USER INFOrmation message will follow, containing information belonging to the same block. The use of the more data indication is not supervised by the network.

USER INFOrmation messages received by the terminating system in any call state other than the `Active(s10)` state are discarded and the originating system is notified by a STATUS message with a cause "user information discarded locally".

USER INFOrmation messages do not change the state of a call.

5.5.2.3 Flow control

The transfer of USER INFOrmation messages may be flow controlled, by means of a CONgestion CONtrol message containing a Congestion Level information element. Two indications of Congestion Level are specified: *receive not ready* and *receive ready*. On receipt of the former, the DPE or PCSN should suspend sending USER INFOrmation messages; on receipt of the latter, sending may restart. After having sent a *receive not ready* indication, the PCSN may discard USER INFOrmation messages which are subsequently received. The PCSN will send a CONgestion CONtrol message with a *receive not ready* indication whenever a USER INFOrmation message is locally discarded. The CONgestion CONtrol message shall also include a cause "user information discarded locally". After receiving a *receive not ready* indication from the DPE the PCSN shall transmit a *receive not ready* indication to the terminating DPE. It should be recognized that USER INFOrmation messages generated by the terminating DPE prior to receipt of the *receive not ready* indication may be lost.

5.5.2.4 Call clearing

A user-user information information element with the characteristics described above may be included in the DISConnect and RELease messages. The information contained in such an information element is transferred to the terminating DPE in the corresponding clearing message. Such a transfer is only performed if the information is received at the PCSN interface to terminating DPE before sending a clearing message to that DPE; otherwise, the information is discarded.

5.5.3 Associated with a Temporary signalling connection

5.5.3.1 General characteristics

This feature allows the users to communicate by means of user-user signalling without setting up a circuit-switched connection. A temporary signalling connection is set up and cleared in a similar way to the control of a circuit-switched connection, as detailed in the following.

5.5.3.2 Call establishment

Procedures for call establishment are as described in 5.2 with the following modifications.

On call request, the SETUP message sent by the originating DPE will indicate CCITT Recommendation Q.931 in the bearer capability information element (see 8.5.5). The channel identification information element will indicate *exclusive; only the indicated channel is acceptable, the channel identified is the D-channel* and *no B-channel.*

Procedures as described in 5.2 apply for the inclusion of the user-user information information element in call establishment messages and for the handling of ALERTing and CONNect messages.

5.5.3.3 Transfer of user information messages

The procedures described in 5.5.2.2 apply, where the call reference applies to the signalling connection.

5.5.3.4 Flow control

The procedure described in 5.5.2.3 apply.

5.5.3.5 Call clearing

The clearing of a temporary signalling connection will be initiated by the DPE or the PCSN by sending a RELease message as described in 5.3.1.2 (Procedure P2). In addition, a user-user information information element having the characteristics described in 8.5.17 may be included in the RELease message sent by the clearing DPE to the other DPE before the signalling connection is cleared.

CALL STATES

SECTION 6

This section provides the definition for states that individual calls may have, and provides overview State Transition diagrams for the originating and terminating system in a call. These definitions do not apply to the state of the interface itself, any attached equipment, the signalling channel or the call reference. They are call states. Since several calls may exist simultaneously at a PCSN-TE interface, and each call may be in a different state, the state of the interface itself cannot be unambiguously defined. State Transition diagrams can be found in Appendix C. Timer initialization and actions on time out are to be found in 9.

The following definitions apply to states that may exist for a call with respect to a particular call reference. Note that all states do not apply to both outgoing and incoming calls.

6.1 Null (s0)

No call exists.

6.2 Call init (s1)

This call state exists for an outgoing call, as a result of user action requesting call establishment.

6.3 Outgoing call proceeding (s3)

This state exists for an outgoing call when the terminating system has acknowledged receipt of the information required for the call establishment and channel negotiation has been terminated.

6.4 Call delivered (s4)

This state exists for an outgoing call, when the terminating system has completed processing the call to the point of passing alerting across the system interface.

6.5 Call received (s7)

This state exists for an incoming call when a response/answer from the terminating system is awaited while alerting.

6.6 Connect request (s8)

This state exists for an incoming call while awaiting receipt from the originating system of a connect acknowledgement.

6.7 Incoming call proceeding (s9)

This state exists for an incoming call when the terminating system has acknowledged receipt of the information required for the call to proceed.

6.8 Active (s10)

This state exists when a call is in the end-to-end communication mode.

6.9 Disconnect request (s11)

This state exists in response to a request to disconnect a call, prior to acknowledgement by the other system.

6.10 Release request (s19)

This state exists in response to a release request, prior to acknowledgement by the other system.

MESSAGE FUNCTIONAL DEFINITIONS

SECTION 7

7.1 Overview

The message functional definitions are listed in alphabetical order. These messages are transported on a data link defined by the Data Link Layer protocol as described in the Standard ECMA-XX.

Since either the PCSN or DPE can initiate and clear calls, and symmetrical procedures are being implemented, the PCSN and DPE will be generically referred to as systems. The system that initiates the call by sending a SETUP message on the signalling channel is called the originating system. The system that receives a SETUP message on the signalling channel is called the terminating system. Each definition includes:

a) a brief description of the message direction and use; for call control messages the direction in which the message may be sent will be shown as (1) originating system to terminating system (OS → TS), (2) terminating system to originating system (TS → OS) or (3) both; where appropriate, additional information on how the message may be applied is shown in italics.

b) a figure listing the information elements contained in the message. For each information element, the figure indicates:

- the section of this standard describing the information element;
- whether its inclusion is mandatory ('M') or optional ('O');
- its (minimum/maximum) length in octets.

c) further explanatory notes, as necessary.

The information elements are listed in order of appearance in the message. The relative order of information elements is the same for all message types.

Mandatory implies that the element must be present in the message otherwise the message is discarded and a STATUS message is returned to the source of the invalid message.

Optional means that the element may or may not be present in the message.

7.2 Messages for circuit-mode connections

Figure 7.2 summarizes the messages and their contents. Those information elements which are not applicable to a message are designated with a "-", those that are mandatory are designated with a "M" and those that are optional are designated with a "O". The column labelled "Reference" indicates the section of this Standard where the information element is defined. The column labeled "Length" indicates the minimum and maximum length of the information element.

Figure 7.1 gives a functional overview of the messages.

Call establishment messages:

ALERTing
CALL PROCeeding
CONNect
CONNect ACKnowledge
SETUP

Call information phase messages:

USER INFOrmation

Call disestablishment messages:

DISConnect
RELease
RELease COMplete

Miscellaneous messages:

CONgestion CONtrol
INFOrmation
STATUS

Figure 7.1 - Messages for circuit-mode connection

Message name / Information elements	ALERT	CALL PROC	CONN	CONN ACK	DISC	INFO	REL	REL COM	SETUP	STATUS	USER INFO	Reference	Length
Protocol disc.	M	M	M	M	M	M	M	M	M	M	M	8.2	1
Call reference	M	M	M	M	M	M	M	M	M	M	M	8.3	1-3
Message type	M	M	M	M	M	M	M	M	M	M	M	8.4	1
Bearer capability	-	-	-	-	-	-	-	-	M	-	-	8.5.5	4-9
Congestion level	-	-	M	-	-	-	-	-	-	-	-	8.5.9	1
Cause	O	O	M	O	-	M	-	M	M	-	M	-	8.5.7	4-37
Connected address	-	-	-	O	-	-	-	-	-	-	-	-	8.5.10	4-27
Call state	-	-	-	-	-	-	-	-	-	-	M	-	8.5.6	3
Channel id.	O	M	-	O	-	-	-	-	-	M	-	-	8.5.8	3-5
More data	-	-	-	-	-	-	-	-	-	-	-	O	8.5.15	1
Origination add.	-	-	-	-	-	-	-	-	-	O	-	-	8.5.16	4-27
Destination add.	-	-	-	-	-	-	-	-	-	O	-	-	8.5.11	4-27
Low Layer Comp.	-	-	-	-	-	-	-	-	-	O	-	-	8.5.14	4-13
User-User inf.	O	-	-	O	-	O	-	O	-	O	-	M	8.5.17	Note
Keypad	Outside the scope of this standard												8.5.13	3-34
Display	Outside the scope of this standard												8.5.12	3-34
Subsection of 7.2 for Message def.	1	2	3	4	5	6	7	8	9	10	11	12		

Figure 7.2 - Messages and Their Information Elements

NOTE - *4 - 130 or 4 - 34 depending of the use (see 8.5.17).*

7.2.1 ALERTing

This message is sent by the terminating system to the originating system, to indicate that alerting has been initiated at the terminating system. *The ALERTing message is functionally equivalent to the audible ring back in telephony applications.*

Message type: ALERTing
Direction: TS → OS

Information elements	Reference	Type	Length
Protocol discriminator	8.2	M	1
Call reference	8.3	M	1 - 3
Message type	8.4	M	1
Cause	8.5.7	O	4 - 37
Channel identification	8.5.8	O	3 - 5
Display	8.5.12	O	3 - 34
User-user information (Note)	8.5.17	O	4 - 34

Figure 7.3 - ALERTing Message Content

NOTE - *User-user information may be included for outgoing call and when an incoming call was offered with the point-to-point procedure.*

7.2.2 CALL PROCeeding

This message is sent by the terminating system to the originating system to indicate that requested call establishment has been initiated, and no more call establishment information will be accepted. *In addition, this message completes the channel negotiation by indicating the channel to be allocated to the call in the "Channel identification" information element.*

Message type: CALL PROCeeding
Direction: TS → OS

Information elements	Reference	Type	Length
Protocol discriminator	8.2	M	1
Call reference	8.3	M	1 - 3
Message type	8.4	M	1
Cause	8.5.7	O	4 - 37
Channel identification	8.5.8	M	3 - 5
Display	8.5.12	O	3 - 34

Figure 7.4 - CALL PROCeeding Message Content

7.2.3 CONgestion CONtrol

This message is sent by either system to indicate the establishment or termination of flow control on the transmission of USER INFOrmation messages.

Message type: CONgestion CONtrol
Direction: Both

Information elements	Reference	Type	Length
Protocol discriminator	8.2	M	1
Call reference	8.3	M	1 - 3
Message type	8.4	M	1
Congestion level	8.5.9	M	1
Cause	8.5.7	M	4 - 37

Figure 7.5 - CONgestion CONtrol Message Content

7.2.4 CONNect

This message is sent by the terminating system to the originating system to indicate call acceptance by the terminating system. *The channel assigned to the call should not be used by the terminating system until a CONNect ACKnowledge is returned by the originating system.* (see. 5.2.4)

Message type: CONNect
Direction: TS → OS

Information elements	Reference	Type	Length
Protocol discriminator	8.2	M	1
Call reference	8.3	M	1 - 3
Message type	8.4	M	1
Cause	8.5.7	O	4 - 37
Connected address	8.5.10	O	4 - 27
Channel identification	8.5.8	O	3 - 5
Display	8.5.12	O	3 - 34
User-user information	8.5.17	O	4 - 34

Figure 7.6 - CONNect Message Content

7.2.5 CONNect ACKnowledge

This message is sent by the originating system to the terminating system. *It indicates that the originating system has received the CONNect message and has completed the circuit switched path to the channel previously assigned.*

Message type: CONNect ACKnowledge
Direction: OS → TS

Information elements	Reference	Type	Length
Protocol discriminator	8.2	M	1
Call reference	8.3	M	1 - 3
Message type	8.4	M	1
Display	8.5.12	O	3 - 34

Figure 7.7 - CONNect ACKnowledge Message Content

7.2.6 DISConnect

This message may be sent by either system as an invitation to release the channel (if any) and call reference. The channel (if any) and call reference are still retained at this time by the system that sends the message. *The system sending a DISConnect message will normally receive a RELease message as an acknowledgement of the request to terminate the call.*

Message type: DISConnect
Direction: Both

Information elements	Reference	Type	Length
Protocol discriminator	8.2	M	1
Call reference	8.3	M	1 - 3
Message type	8.4	M	1
Cause	8.5.7	M	4 - 37
Display	8.5.12	O	3 - 34
User-user information	8.5.17	O	4 - 34

Figure 7.8 - DISConnect Message Content

7.2.7 INFOrmation

This message is sent by either system to provide additional information. INFOrmation messages for call control may be sent by a system as long as an acknowledged call reference exists.

Message type: INFOrmation
Direction: Both

Information elements	Reference	Type	Length
Protocol discriminator	8.2	M	1
Call reference	8.3	M	1 - 3
Message type	8.4	M	1
Display	8.5.12	O	3 - 34
Keypad	8.5.13	O	3 - 34

Figure 7.9 - INFOrmation Message Content

7.2.8 RELease

This message is sent from either system to indicate that the system sending the message has disconnected the channel and intends to release the call reference. *The system receiving the message should release the channel and call reference and abort any call in the process of being setup. The message is usually sent in response to a DISConnect message.*

Message type: RELease
Direction: Both

Information elements	Reference	Type	Length
Protocol discriminator	8.2	M	1
Call reference	8.3	M	1 - 3
Message type	8.4	M	1
Cause	8.5.7	M	4 - 37
Display	8.5.12	O	3 - 34
User-user information	8.5.17	O	4 - 34

Figure 7.10 - RELease Message Content

7.2.9 RELease COMplete

This message is sent from either system to indicate that the system sending the message has released the channel (if any) and call reference, the channel is available for re-use, and the receiving system shall release the call reference. *This message is the normal response to the RELease message, but it can also be used to reject a setup request (see 5.2.1).*

Message type: RELease COMplete
Direction: Both

Information elements	Reference	Type	Length
Protocol discriminator	8.2	M	1
Call reference	8.3	M	1 - 3
Message type	8.4	M	1
Cause	8.5.7	M	4 - 37
Display	8.5.12	O	3 - 34

Figure 7.11 - RELease COMplete Message Content

7.2.10 SETUP

This message is sent from the originating system to the terminating system to request call establishment. *The system initiating the call assigns the call reference (see 8.3) which will identify future messages relating to this call.*

Message type: SETUP
Direction: OS → TS

Information elements	Reference	Type	Length
Protocol discriminator	8.2	M	1
Call reference	8.3	M	1 - 3
Message type	8.4	M	1
Bearer capability (Note 1)	8.5.5	M	4 - 9
Channel identification	8.5.8	M	3 - 5
Display	8.5.12	O	3 - 34
Keypad	8.5.13	O	3 - 34
Origination address (Note 2)	8.5.16	O	4 - 27
Destination address (Note 3)	8.5.11	O	4 - 27
Low layer compatibility (Note 1)	8.5.14	O	4 - 13
User-user information	8.5.17	O	4 - 34

Figure 7.12 - SETUP Message Content

NOTE 1 - *The bearer capability and low layer compatibility information elements may be used to describe a CCITT telecommunication service, if appropriate.*

NOTE 2 - *This element is optional because it may not be known. Whenever it is known it should be provided.*

NOTE 3 - *This element will normally be required in the SETUP message from the DPE which initiates the call, except by agreement with the PCSN.*

7.2.11 STATUS

This message may be sent from either system at any time during a call when an unexpected message is received or to report other conditions of the call.

Message type: STATUS
Direction: Both

Information elements	Reference	Type	Length
Protocol discriminator	8.2	M	1
Call reference	8.3	M	1 - 3
Message type	8.4	M	1
Cause	8.5.7	M	4 - 37
Call state	8.5.6	M	3

Figure 7.13 - STATUS Message Content

7.2.12 USER INFOrmation

This message is sent by either system to transmit information from one DPE to the other. *The transfer of USER INFOrmation message across the interface may be performed only when a call is in the ACTIVE state.*

Message type: USER INFOrmation
Direction: Both

Information elements	Reference	Type	Length
Protocol discriminator	8.2	M	1
Call reference	8.3	M	1 - 3
Message type	8.4	M	1
More data indication	8.5.15	O	1
User-user information	8.5.17	M	4 - (Note 1)

Figure 7.14 - USER INFOrmation Message Content

NOTE 1 - *It could be 4 - 34 or 4 - 130 depending on the use of user-to-user information (see 8.5.15).*

7.3 Messages for other types of connections

7.3.1 Temporary user-to-user signalling

The following messages defined in section 7.2 are used for temporary user-to-user signalling connections:

a) ALERTing
b) CALL PROCeeding
c) CONgestion CONtrol
d) CONNect
e) CONNect ACKnowledge
f) DISConnect
g) RELease
h) RELease COMplete
i) SETUP
j) STATUS
k) USER INFOrmation

MESSAGE STRUCTURE

SECTION 8

The figures and text in this section describe message contents. Within each octet, the bit designated "bit one" is transmitted first, followed by bits 2,3,4, etc. Similarily, the octet shown at the top of each figure is sent first.

8.1 Overview

Whithin this protocol, every message consists of the following parts:

a) protocol discriminator;
b) call reference;
c) message type;
d) mandatory information elements, as required;
e) additional information elements, when required.

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

This organisation is illustrated in the example shown in Figure 8.1.

A particular message may contain more information than a particular system needs or can understand. All systems should be able to ignore any extra information, which is not required for the proper operation of that equipment. For example, a system may ignore the originating address if that address is of no interest to the system when a SETUP is received.

The length fields for call reference and the information elements are binary coded, where the least significant digit is coded in bit number one.

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

A particular information element may be present, but empty. For example, it is allowed to send a destination address information element which is of zero length. This should be interpreted by the receiver as equivalent to that information element being absent. Similarily, an absent information element should be interpreted by the receiver as equivalent to that information element being empty.

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

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

Those code values not specified for a given field are *Reserved*.

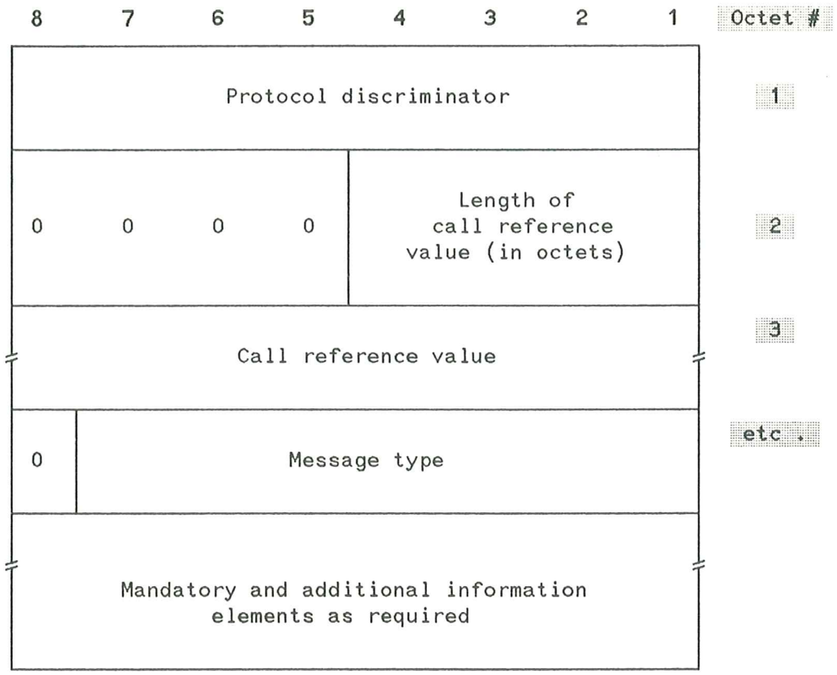


Figure 8.1 – General Message Organization Example

8.2 Protocol discriminator

The purpose of the protocol discriminator is to distinguish messages for PCSN-DPE call control from those Open System Interconnection (OSI) network layer protocol units which are coded to other standards.

The protocol discriminator is the first part of every message. The protocol discrimator is coded according to Figure 8.2.

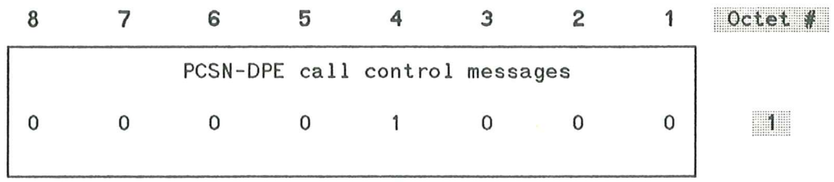


Figure 8.2 – Protocol Discriminator

8.3 Call reference

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

The call reference is the second part of every message. The call reference information element may be one to three octets long and is coded as shown in Figure 8.3.

Provisionally, the default maximum length of the call reference for a basic PCSN-DPE interface is one octet long, and the default maximum length of the call reference for a primary rate multiplex PCSN-DPE interface is two octets long. The term *default* shall be interpreted as in 8.1.

The call reference information element comprises two fields: the call reference value and the call reference flag.

Call reference values are assigned by the originating system for a call. These values are unique to the originating system only within a particular D-channel Data Link connection. The call reference value is assigned at the beginning of a call and remains fixed for the lifetime of a call. After a call ends, the associated call reference value may be reassigned to a later call. Two identical call reference values on the same D-channel Data Link connection may be used when each value pertains to a call originated at opposite ends of the link.

The call reference flag, which appears in octet 2 only, can take on the values of ZERO or ONE. The call reference flag is used to identify which end of the layer two logical link originated a call. The originating system always sets the call reference flag to ZERO. The terminating system always sets the call reference flag to ONE.

Note :

The dummy call reference is one octet long and is coded "0000 0000". The dummy call reference may be used for certain STATUS messages.

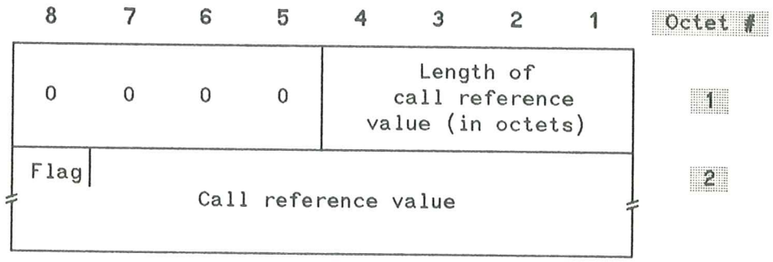
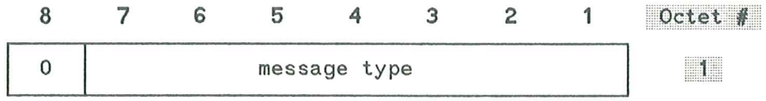


Figure 8.3 – Call Reference Information Element

8.4 Message type

The purpose of the message type is to identify the function of the message being sent. The message type is the third part of every message. The message type is coded as shown in Figure 8.4.

Bit 8 is reserved for possible future use as an extension bit.



Bits: 8 7 6 5 4 3 2 1 *Message type (octet # 1)*

0 0 0 - - - - -	Call establishment messages
0 0 0 0 1	ALERTing
0 0 0 1 0	CALL PROCeeding
0 0 1 1 1	CONNect
0 1 1 1 1	CONNect ACKnowledge
0 0 1 0 1	SETUP
0 0 1 - - - - -	Call information phase messages
0 0 0 0 0	USER INFOrmation
0 1 0 - - - - -	Call disestablishment messages
0 0 1 0 1	DISConnect
0 1 1 0 1	RELease
1 1 0 1 0	RELease COMplete
0 1 1 - - - - -	Miscellaneous messages
1 1 0 0 1	CONgestion CONtrol
1 1 0 1 1	INFOrmation
1 1 1 0 1	STATUS

Figure 8.4 – Message type information elements

8.5 Other information elements

8.5.1 Coding rules

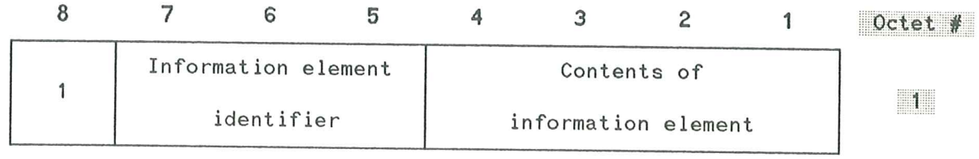
8.5.1.1 Information elements

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

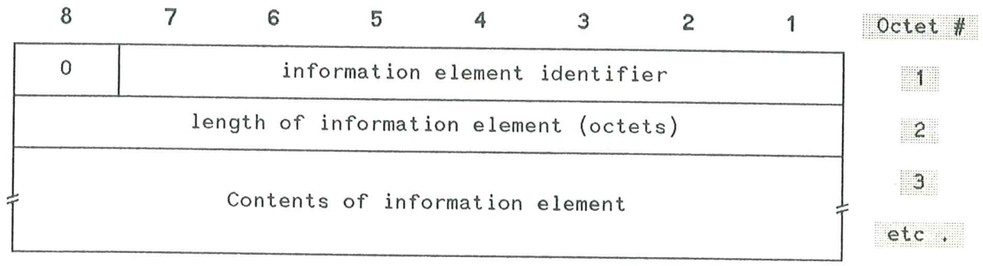
Two categories of information elements are defined:

a) single octet information elements, where bit 8 is set to 1 (see Figure 8.5-a);
b) variable length information elements, where bit 8 of octet 1 is set to 0 (see Figure 8.5-b).

The coding of the bits of the information element identifiers is summarized in Figure 8.6.



(a) Single octet information element format



(b) Variable length information element format

Figure 8.5 – Formats of Information Elements

Bits: 8 7 6 5 4 3 2 1	*Information element identifier (octet # 1)*
1 - - - - - - -	Single octet information elements
0 0 0 - - - -	reserved
0 0 1 - - - -	shift
0 1 0 0 0 0 0	more data
0 1 1 - - - -	congestion level
0 - - - - - - -	Variable length information element
0 0 0 0 1 0 0	bearer capability
0 0 0 1 0 0 0	cause
0 0 0 1 1 0 0	connected address
0 0 1 0 1 0 0	call state
0 0 1 1 0 0 0	channel identification
0 1 0 1 0 0 0	display
0 1 0 1 1 0 0	keypad
1 1 0 1 1 0 0	origination address
1 1 1 0 0 0 0	destination address
1 1 1 1 1 0 0	low layer compatibility
1 1 1 1 1 1 0	user-user information

Figure 8.6 - Information Element identifier

The descriptions of the information elements are organized in alphabetical order. However, there is a particular order of appearance for most information elements in a message. This order is defined in 7.2 which contains the message definitions (see also figure 7.1). The code values of the information element identifier for the variable length formats are assigned in ascending numerical order, according to the actual order of appearance of each information element in a message. This allows the receiving equipment to detect the presence or absence of a particular information element without scanning through an entire message.

Information elements using the single octet information element identifier may appear at any point in the message.

Where the description of information elements in this section contains spare bits, these bits are indicated as being coded to ZERO. In order to allow compatibility with future implementation, messages should not be rejected simply because a spare bit is set to ONE.

The second octet of the variable length information element indicates the total length of the contents of that information element. It is the binary coding of the number of octets of the contents with bit ONE as the least significant bit (2°).

8.5.1.2 Extension of an information element field

For a variable length field that spans more than one octet in an information element, an extension mechanism using bit 8 of every octet of the composite field will be employed. Every octet but the last one will be flagged with bit 8 set to ZERO (indicating that the information continues in the next octet). The last octet of the field is flagged with bit 8 set to ONE (see example in Figure 8.7).

8	7	6	5	4	3	2	1	Octet #
0								n
0								n+1
0								n+2
1								n+3

Figure 8.7 - Example of extension bit utilization

8.5.1.3 Repetition of a field in an information element

A given field may be repeated to provide the same type of information for different parts of an information element (example : bearer capability, low layer compatibility).

Note :

Each field must make use of the extension mechanism such as described in 8.5.1.2.

8.5.2 Extensions of Codesets

There are 136 possible information element identifier values using the formatting rules described in 8.5.1: 8 from the single octet information element format and 128 from the variable length information element format.

One value in the single octet format is specified for shift operations described below. One other value in both the single octet and variable format is reserved. This leaves 133 information element identifier values available for assignment.

It is possible to expand this structure to eight codesets, each having 133 information element identifier values. One common value in the single octet format is employed in each codeset to facilitate shifting from one codeset to another. The contents of this shift item identifies the codeset to be used for the next information element or elements. The codeset in use at any given time is referred to as the "active codeset". By convention, codeset 0 is the initially active codeset.

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

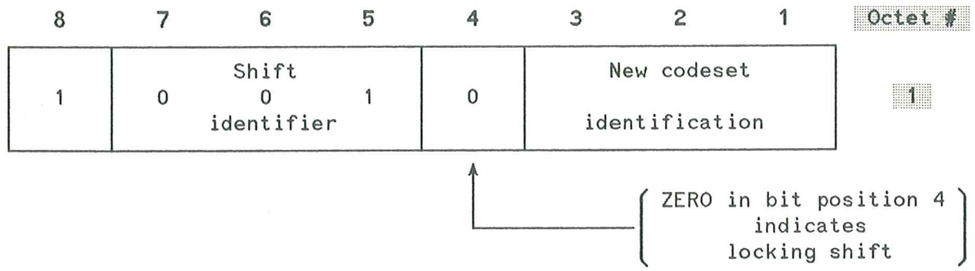
Codeset 7 is available for user-specific information elements, as it has been reserved for that purpose.

8.5.3 Locking shift procedure

The locking shift procedure employs an information element to indicate the new active codeset. The specified codeset remains active until another locking shift information element is encountered which specifies the use of another codeset. For example, codeset 0 is active at the start of message content analysis. If a locking shift to codeset 7 is encountered, the next information elements will be interpreted according to the information element identifiers assigned in codeset 7, until another shift information element is encountered.

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

The locking shift information element uses the single octet information element format and coding shown in Figure 8.8.



Bits: 3 2 1 *Codeset identification (octet # 1)*

0 0 0	codeset 0: PCSN-DPE information elements (initially active)
1 1 1	codeset 7: user-specific information element

Figure 8.8 - Locking Shift Element

8.5.4 Non-locking shift procedure

The non-locking shift procedure provides a temporary shift to the specified codeset. The non-locking shift procedure uses a single octet information element to indicate the codeset to be used to interpret the next single following information element. After the interpretation of the next single information element, the active codeset is again used for interpreting any following information elements. For example, codeset 0 is active at the beginning of message content analysis. If a non-locking shift to codeset 7 is encountered *only* the next information element is interpreted according to the information element identifiers assigned in codeset 7. After this information element is interpreted, codeset 0 will again be used to interpret the following information elements.

The non-locking shift information element uses the single octet information element format and coding shown in Figure 8.9.

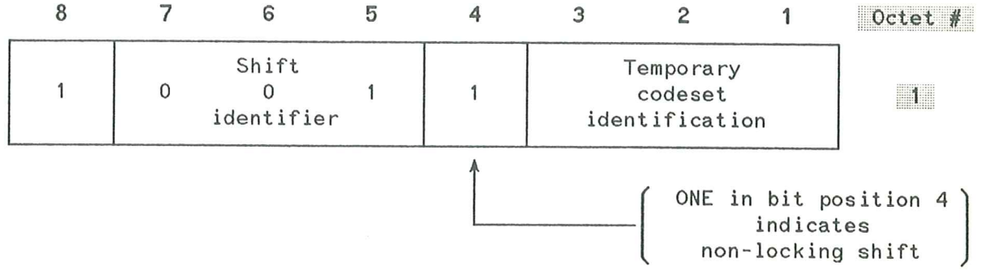


Figure 8.9 - Non-locking Shift Element

Note :

The codeset identification is coded as shown in Figure 8.8.

8.5.5 Bearer capability

The purpose of the bearer capability information element is to indicate the requested bearer capability to be provided by the channel to be assigned to the call.

The bearer capability information element is coded as shown in Figure 8.10. The interface will recognize only the coding of bearer capability shown in Figure 8.10.

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

8	7	6	5	4	3	2	1	Octet #
0	Bearer capability identification 0 0 0 0 1 0 0 information element identifier							1
Length of the Bearer capability information								2
1	Coding standard	Informations transfer capability						3
Ext	Transfer mode	Information transfer rate						4
Ext 0/1	Structure 0 0 0			Configuration		Establishment		4a *(Note 1)*
1	Symmetry	Information transfer rate (destination → origination)						4b *(Note 2)*
0/1 Ext	Multiplier or Layer identification	Bearer capability multiplier Protocol identification						5 *(Note 3)* etc.

NOTE 1 – *This octet may be omitted unless 4b is present*

NOTE 2 – *This octet may be omitted; if present, octet 4a shall also be present.*

NOTE 3 – *This field may be repeated to describe the use of each layer.*

Figure 8.10 – Bearer capability Information Element

Bit: 8 *Extension bit (octet # 4, 4a and 5)*

0	description is extended through next octet
1	last octet of the description

Bits: 7 6 *Coding standard (octet # 3)*

0 0	conforming to CCITT Recommendation Q.931

Bits: 5 4 3 2 1 *Information transfer capability (octet # 3)*

0 1 0 0 0	unrestricted digital information
0 1 0 0 1	restricted digital information

Bits: 7 6 *Transfer mode (octet # 4)*

0 0	circuit mode

Bits: 5 4 3 2 1 *Information transfer rate (octet # 4 and 4b)*

1 0 0 0 0	64 kbit/s

NOTE – *When octet 4b is omitted, the bearer capability is duplex-symmetric at the information transfer rate specified in octet 4. When octet 4b is included, the information transfer rate in octet 4 refers to the origination → destination direction.*

Bits: 7 6 5 *Structure (octet # 4a)*

0 0 0	default (timed at 8 kHz integrity)

Bits: 4 3 *Configuration (octet # 4a)*

0 0	point-to-point
1 0	multipoint

NOTE – *If octet 4a is omitted, the configuration is assumed to be point-to-point.*

Bits: 2 1 *Establishment (octet # 4a)*

0 0	demand

NOTE – *If octet 4a is omitted, the method of establishment is assumed to be "demand".*

Bits: 7 6 *Symmetry (octet # 4b)*

0 0	bidirectional symmetric
0 1	bidirectional asymmetric
1 0	unidirectional (origination → destination)
1 1	unidirectional (destination → origination)

Bits: 7 6 *Layer and protocol identification (octet # 5.0)*

0 0	bearer capability multiplier: bits 5-1 represent then number (binary encoding) of instances of bearer capability requested, e.g. "00010" means two instances of the described bearer capability are requested.

NOTE – *Octets 5.n may or may not be present.*

Bits: 7 6 5 4 3 2 1 *Layer 1 protocol identification (octet # 5.1)*

0 1 0 0 0 0 0	Recommendation I.412; no additional layer 1 protocol specified ofr this bearer capability
0 1 0 0 0 0 1	Rate adaption : the extension bit in this octet is set to "0" and an additional octet is coded (5.1a)
0 1 0 0 0 1 0	Recommendation G.711 u-law speech
0 1 0 0 0 1 1	Recommendation G.711 a-law speech
0 1 0 0 1 0 0	Recommendation G.721 32 kbit/s ADPCM and Recommendation I.460

Bits: 5 4 3 2 1 *Layer 1 protocol identification (octet # 5.1a)*

0 0 0 0 0	undefined
0 0 0 0 1	0.6 kbit/s CCITT Recommendations X.1 and I.461
0 0 0 1 0	1.2 kbit/s Recommendations X.1 and I.461
0 0 0 1 1	2.4 kbit/s Recommendations X.1 and I.461
0 0 1 0 0	3.6 kbit/s Recommendations V.6 and I.463
0 0 1 0 1	4.8 kbit/s Recommendations X.1 and I.461
0 0 1 1 0	7.2 kbit/s Recommendations V.6 and I.463
0 0 1 1 1	8 kbit/s Recommendations I.460
0 1 0 0 0	9.6 kbit/s Recommendations X.1 and I.461
0 1 0 0 1	14.4 kbit/s Recommendations V.6 and I.463
0 1 0 1 0	16 kbit/s Recommendations I.460
0 1 0 1 1	19.2 kbit/s Recommendations I.463
0 1 1 0 0	32 kbit/s Recommendations I.460
0 1 1 1 0	48 kbit/s Recommendations X.1 and I.461
0 1 1 1 1	56 kbit/s Recommendations I.463

8	7	6	5	4	3	2	1
1	0	0	rate identification				
	spare						

Bits: 7 6 5 4 3 2 1 *Layer 2 protocol identification (octet # 5.2)*

1 0 0 0 0 0 0	undefined
1 0 0 0 0 1 0	CCITT Recommendations I.441/Q.921
1 0 0 0 1 0 0	CCITT Recommendation Q.710
1 0 0 0 1 1 0	CCITT Recommendation X.25 link level

Bits: 7 6 5 4 3 2 1 *Layer 3 protocol identification (octet # 5.3)*

1 1 0 0 0 0 0	undefined
1 1 0 0 0 1 0	CCITT Recommendations I.451/Q.931
1 1 0 0 1 1 0	CCITT Recommendation X.25 packet level

NOTE – *If any of the octets 5.1, 5.2 or 5.3 are omitted, the respective layer protocol is undefined.*

Examples of use of octet 5 :

Circuit switching with 9.6 kbit/s

octet — *octets 5.0, 5.2, 5.3 omitted*

	8 7 6 5 4 3 2 1	
5.1	0 0 1 0 0 0 0 1	layer 1 : rate adaption
5.1a	1 0 0 0 1 0 0 0	9.6 kbit/s

X.25 link and packet level 4.8 kbit/s

octet — *octet 5.0 omitted*

	8 7 6 5 4 3 2 1	
5.1	0 0 1 0 0 0 0 1	rate adaption
5.1a	1 0 0 0 0 1 0 1	4.8 kbit/s
5.2	1 1 0 0 0 1 1 0	Layer 2 : X.25 link layer
5.3	1 1 1 0 0 1 1 0	Layer 3 : X.25 packet layer

8.5.6 Call state

The purpose of the call state information element is to describe the current status of a call at a particular system. A description of each of the system states can be found in Section 6 of this Standard. The call state information element is coded as shown in Figure 8.11.

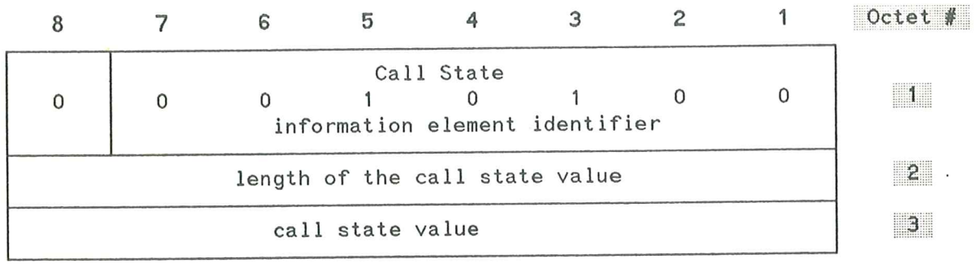


Figure 8.11 – Call State Information Element

State Number	binary code	System state
0	0 0 0 0 0 0 0 0	null
1	0 0 0 0 0 0 0 1	call init
3	0 0 0 0 0 0 1 1	outgoing call proceeding
4	0 0 0 0 0 1 0 0	call delivered
7	0 0 0 0 0 1 1 1	call received
8	0 0 0 0 1 0 0 0	connect request
9	0 0 0 0 1 0 0 1	incoming call proceeding
10	0 0 0 0 1 0 1 0	active
11	0 0 0 0 1 0 1 1	disconnect request
19	0 0 0 1 0 0 1 1	release request

8.5.7 Cause

The purpose of the cause information element is to describe the reason for generating certain messages, to provide diagnostic information in the event of procedural errors and to indicate the location of the cause originator.

The cause information element is coded as shown in Figure 8.12. Diagnostic information is not available for every cause. When available the coding of the diagnotic(s) is the same as for the corresponding information elements in section 8. The coding for other diagnostics has not yet been specified; in these cases, no diagnostic should be returned.

The cause information element and diagnostic may be repeated in a message, e.g.: to report multiple errors associated with a single call. However the number of cause information elements will be limited by the maximum message length allowed.

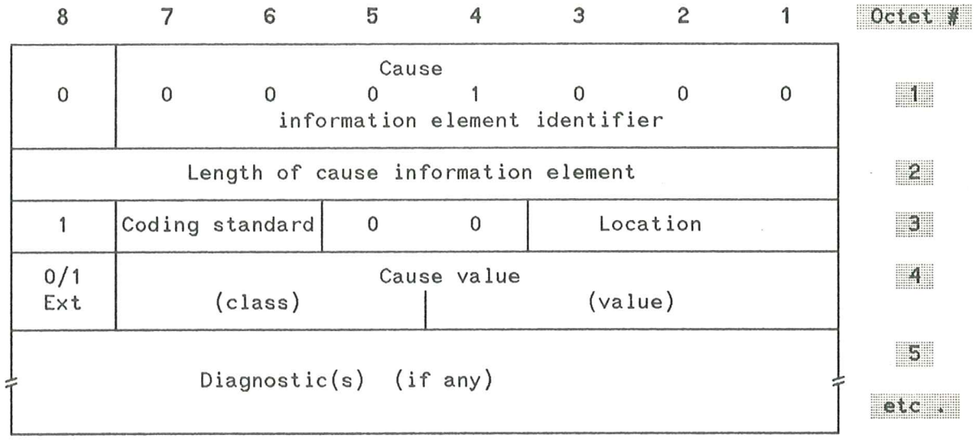


Figure 8.12 – Cause Information Element

Bits: 7 6	*Coding standard (octet # 3)*
0 0	CCITT-standard

Bits: 3 2 1	*Location (octet # 3)*
0 0 0	DPE
0 0 1	PCSN
0 1 0	local network
0 1 1	transit network
1 0 0	remote local network
1 0 1	remote PCSN

Cause value (octet # 4)

The cause value is divided in two fields, a class (bits 5 through 7) and a value within the class (bits 1 through 4).

The class indicates the general nature of the event:

Class (0 0 1)	normal event
Class (0 1 0)	network resources temporarily not avaible
Class (0 1 1)	service or option not available
Class (1 0 0)	service or option not implemented
Class (1 0 1)	invalid message (e.g. parameter out of range...)
Class (1 1 0)	protocol error (e.g. unknown message...)
Class (1 1 1)	interworking

and the value 1 1 1 1 indicate unspecified within the class.

Cause class 7 6 5	Cause value 4 3 2 1	number	Cause description	Diagnostics description
0 0 1	0 0 0 0	16	normal clearing	-
0 0 1	0 0 0 1	17	user busy	destination address
0 0 1	0 0 1 0	18	no user responding	destination address
0 0 1	0 0 1 1	19	this call waiting at destination	destination address
0 0 1	0 1 0 0	20	circuit operational	circuit identification
0 0 1	0 1 0 1	21	call rejected	user supplied diagnostic
0 0 1	0 1 1 0	22	number changed	destination address, new destination address
0 0 1	0 1 1 1	23	reverve charging rejected	destination address
0 0 1	1 0 0 0	24	call suspended	suspending address
0 0 1	1 0 0 1	25	call resumed	resuming address
0 0 1	1 0 1 0	26	destination address invalid	destination address
0 0 1	1 1 1 1	31	normal unspecified	-
0 1 0	0 0 0 1	33	circuit out of order	circuit identification
0 1 0	0 0 1 0	34	no channel available	-
0 1 0	0 0 1 1	35	destination not obtainable	destination address
0 1 0	0 1 0 0	36	out of order	destination address
0 1 0	0 1 0 1	37	degraded service (e.g., excessive error rate)	-
0 1 0	0 1 1 0	38	network out of order	transit network identification
0 1 0	0 1 1 1	39	transit delay range cannot be achieved	minimum available
0 1 0	1 0 0 0	40	throughput range cannot be achieved	maximum available
0 1 0	1 0 0 1	41	network failure	destination address
0 1 0	1 0 1 0	42	network congestion	network identification
0 1 0	1 0 1 1	43	user information discarded	copy of first 32 octets of user-user information element
0 1 0	1 1 1 1	47	network resource temporarily not available, unspecified	-
0 1 1	0 0 0 1	49	overlap sending not allowed	network identification facility
0 1 1	0 0 1 0	50	requested facility not subscribed	network identification facility
0 1 1	0 0 1 1	51	reverse charging not allowed	-
0 1 1	0 1 0 0	52	outgoing calls barred	-
0 1 1	0 1 0 1	53	outgoing calls barred within CUG	CUG identification
0 1 1	0 1 1 0	54	incoming call barred	destination address; optional user specified information
0 1 1	0 1 1 1	55	incoming call barred within CUG	CUG identification, destination address
0 1 1	1 0 0 0	56	call waiting not subscribed	destination address
0 1 1	1 1 1 1	63	service or option not available, unspecified	-
1 0 0	0 0 0 1	65	bearer service not implemented	service type
1 0 0	0 0 1 0	66	channel type not implemented	channel type
1 0 0	0 1 0 1	69	requested facility not implemented	network identify, facility
1 0 0	0 1 1 0	70	only restricted digital information bearer capability is available	-
1 0 0	1 1 1 1	79	service or option not implemented, unspecified	-
1 0 1	0 0 0 1	81	invalid call reference value	call reference value
1 0 1	0 0 1 0	82	identified channel does not exist	channel identification
1 0 1	0 0 1 1	83	call identity does not exist	call identity
1 0 1	0 1 0 0	84	call identity in use	call identity
1 0 1	0 1 0 1	85	invalid digit value for number	address information element
1 0 1	0 1 1 0	86	non-existent closed-user group	CUG number
1 0 1	0 1 1 1	87	destination address not member of CUG	destination address, CUG number
1 0 1	1 0 0 0	88	incompatible destination	destination address, incompatible parameter
1 0 1	1 0 0 1	89	non-existent abbreviated address entry	copy of address element
1 0 1	1 0 1 0	90	destination address missing, and direct call not subscribed	-
1 0 1	1 0 1 1	91	transit network does not exist	transit network identification
1 0 1	1 1 0 0	92	invalid facility parameter	network identification, facility
1 0 1	1 1 0 1	93	mandatory information element is missing	information element identifier
1 0 1	1 1 1 1	95	invalid message, unspecified	-
1 1 0	0 0 0 1	97	message type non-existent or not implemented	message type
1 1 0	0 0 1 0	98	message not compatible with call state	message type
1 1 0	0 0 1 1	99	information element non-existent or not implemented	information element
1 1 0	0 1 0 0	100	invalid information element contents	information element
1 1 0	0 1 0 1	101	information element identifier in a message notin ascending order	information element
1 1 0	1 1 1 1	111	protocol error, unspecified	-
1 1 1	1 1 1 1	127	interworking, unspecified	-

8.5.8 Channel Identification

The purpose of the channel identification information element is to identify a channel within the interface controlled by these signalling procedures.

The channel identification information element is coded as shown in Figure 8.13. The channel identification information element may be repeated in a message; e.g.: to list several acceptable channels during channel negotiation. Example of coding of the channel identification information element are shown in Figure 8.14.

8	7	6	5	4	3	2	1	Octet #
0	Channel identification 0 0 1 1 0 0 0 information element identifier							1
length of channel identification								2
1	Int. id.	Int. type	0 spare	Pref./ /Excl.	D-chan. ind.	Channel selection		3
0	Coding standard		#/ /Map	Channel type / /Map element type				4 *(Note)*
1	(Channel #)							5 *(Note)*

NOTE – *When the "interface type" field in octet 3 indicates "basic interface" octets 4 and 5 are functionally replaced by the "channel selection" field in octet 3, and thus omitted.*

Figure 8.13 – Channel Identification Information Element

Bit: 7 *Interface identifier present (octet # 3)*

0 interface implicitly identified

NOTE – *The interface which includes the signalling channel carrying this information element is indicated.*

Bit: 6 *Interface type (octet # 3)*

0 PCSN-DPE Basic interface
1 PCSN-DPE Primary Rate interface

Bit: 4 *Preferred / Exclusive (octet # 3)*

0 indicated channel is preferred
1 exclusive; only the indicated channel is acceptable

Bit: 3 *D-channel indicator (octet # 3)*

0 the channel identified is *not* the D-channel
1 the channel identified is the D-channel

Bits: 2 1 *Information channel selection (octet # 3)*

	Basic Access interface	Primary Rate interface
0 0	no channel	no channel
0 1	B1 channel	as indicated below in following octets
1 0	B2 channel	reserved
1 1	any channel	any channel

Bits: 7 6 *Coding standard (octet # 4)*

0 0 PCSN-DPE

Bit: 5 *# / Map (octet # 4)*

0 channel is indicated by the number (#) in the following octet

Bits: 4 3 2 1 *Channel type / Map element type (octet # 4)*

0 0 1 1 B-channel units

Bits: 7 6 5 4 3 2 1 *Channel # (octet # 5)*

- - - - - - - binary number assigned to the channel

8	7	6	5	4	3	2	1	Octet #
0	Channel identification 0 0 1 1 0 0 0 information element identifier							1
0	0 0 0 0 0 0 1 1 length							2
1	0 Int. id.	1 Int. type	0 spare	1 Excl.	0 D-chan. ind.	0 1 Channel selection		3
0	0 0 (ECMA-106)		0 #	0 0 1 1 (B-channel units)				4
1	0 0 0 1 1 0 0 (Channel # 12)							5

(i) - Primary rate access: Exclusive channel selection (B12)

8	7	6	5	4	3	2	1	Octet #
0	Channel identification 0 0 1 1 0 0 0 information element identifier							1
0	0 0 0 0 0 0 1 1 length							2
1	0 Int. id.	1 Int. type	0 spare	0 Pref.	0 D-chan. ind.	0 1 Channel selection		3
0	0 0 (ECMA-106)		0 #	0 0 1 1 (B-channel units)				4
1	0 0 0 1 0 1 1 (Channel # 11)							5

(ii) - Primary rate access: Preferred channel selection (B11)

8	7	6	5	4	3	2	1	Octet #
0	Channel identification 0 0 1 1 0 0 0 information element identifier							1
0	0 0 0 0 0 0 0 1 length							2
1	0 Int. id.	1 Int. type	0 spare	0 Pref.	0 D-chan. ind.	1 1 Channel selection		3

(iii) - Primary rate access: Any channel selection (any B)

8	7	6	5	4	3	2	1	Octet #
0	Channel identification 0 0 1 1 0 0 0 information element identifier							1
0	0 0 0 0 0 0 0 1 length							2
1	0 Int. id.	0 Int. type	0 spare	1 Excl.	0 D-chan. ind.	1 0 Channel selection		3

(iv) - Basic access: Exclusive channel selection (B2)

8	7	6	5	4	3	2	1	Octet #
0	Channel identification 0 0 1 1 0 0 0 information element identifier							1
0	0 0 0 0 0 0 0 1 length							2
1	0 Int. id.	0 Int. type	0 spare	0 Pref.	0 D-chan. ind.	1 1 Channel selection		3

(v) - Basic access: Any channel selection (any B)

Figure 8.14 - Examples of Channel Identification Information Element

8.5.9 Congestion level

The purpose of the congestion level information element is to describe the congestion status of the call. It is a single octet information element coded as shown in Figure 8.15.

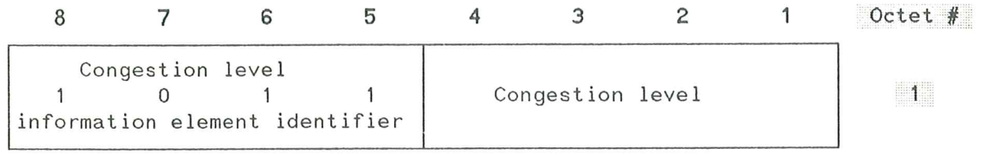


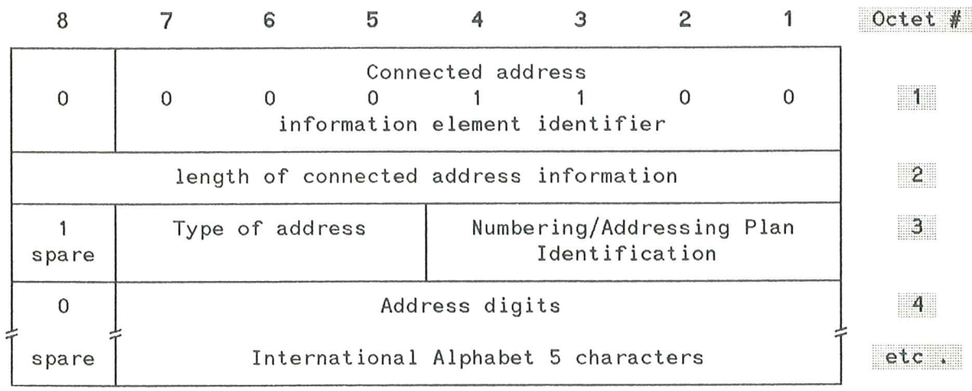
Figure 8.15 – Congestion Level Information Element

Bits: 4 3 2 1	*Congestion level (octet # 1)*
0 0 0 0	receiver ready
1 1 1 1	receiver not ready

8.5.10 Connected address

The purpose of the connected address information element is to indicate which address is connected to a call. The connected address(es) may be different from the origination or destination address(es) because of changes during the lifetime of the call.

The connected address information element is coded as shown in Figure 8.16. The connected address may be repeated in a message, e.g.: for a multipoint call. The coding of the fields in octet 3 and 4 are shown in Figure 8.17.



NOTE – *The address digit in octet 4 precedes the digit in octet 5, etc. The address digit which would be dialed first is located in octet 4.*

Figure 8.16 – Connected Address Information Element

Bits: 7 6 5	*Type of address (octet # 3)*
0 0 0	unknown
0 0 1	international number
0 1 0	national number
0 1 1	network-specific number
1 0 0	local (directory) number
1 0 1	subaddress
1 1 0	abbreviated address

NOTE – *For the definition of "number", "subaddress" and "address", see Rec. I.330.*

NOTE – *The subaddress, if conveyed, shall be provided as a separate specific address element, that immediately follows the address information element conveying the asociated number information.*

Bits: 4 3 2 1	*Numbering/Addressing Plan Identification (octet # 3)*
0 0 0 0	unknown
0 0 0 1	ISDN numbering plan (Rec. E.164)
0 0 1 0	Telephony numbering plan (Rec. E.163)
0 0 1 1	Data numbering plan (Rec. X.121)
0 1 0 0	Telex numbering plan (Rec. F.69)
0 1 0 1	Maritime mobile numbering plan (Rec. E.120 and E.211)
0 1 1 0	Land mobile numbering plan (Rec. E.212 and E.213)

Bits: 7 6 5 4 3 2 1	*Address digits (octets # 4 etc.)*
	Value
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
0 1 0 1 0 1 0	*
0 1 0 0 0 1 1	#
1 1 0 0 0 0 1	a
1 1 0 0 0 1 0	b
1 1 0 0 0 1 1	c
1 1 0 0 1 0 0	d

Figure 8.17 – Coding of fields in Address Information Element

8.5.11 Destination address

The purpose of the destination address information element is to identify one destination of a call.

The destination address information element is coded as shown in Figure 8.18 The destination address information element may be repeated in a message : e.g.: for a multipoint call. The coding of the fields in octet 3 and 4 are shown in Figure 8.17.

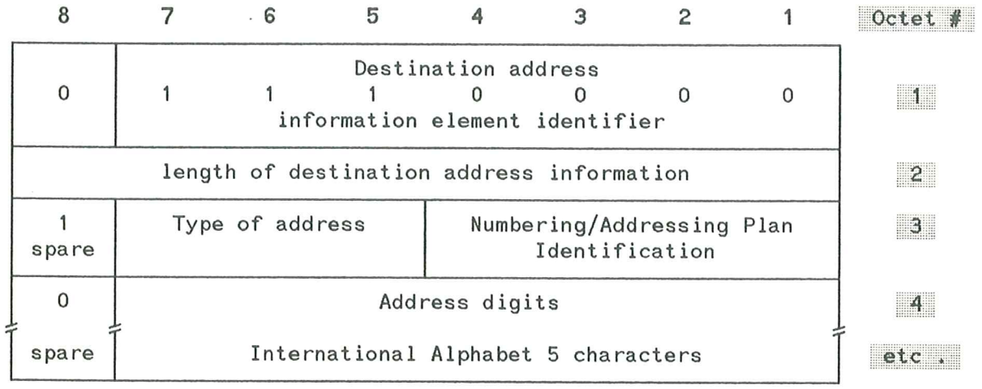


Figure 8.18 - Destination Address Information Element

8.5.12 Display

The purpose of the display information element is to supply unspecified information. The information contained in this element is coded in IA5 characters.

The display information element is coded as shown in Figure 8.19.

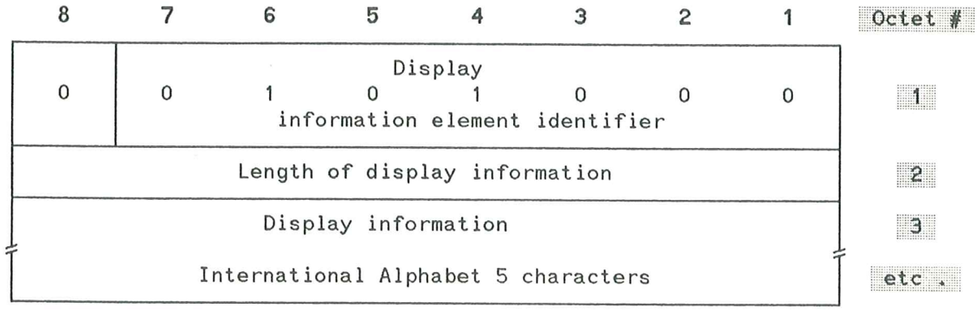


Figure 8.19 - Display Information Element

8.5.13 Keypad

The purpose of the keypad information element is to convey IA5 characters e.g.: entered by means of a **ter**minal keypad.

The keypad information element is coded as shown in Figure 8.20.

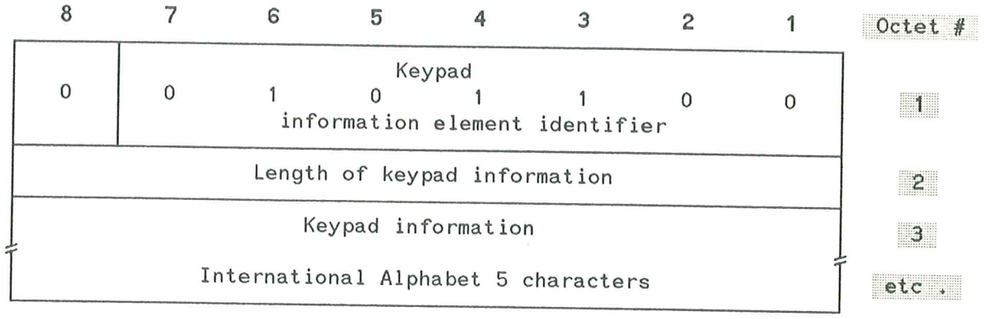
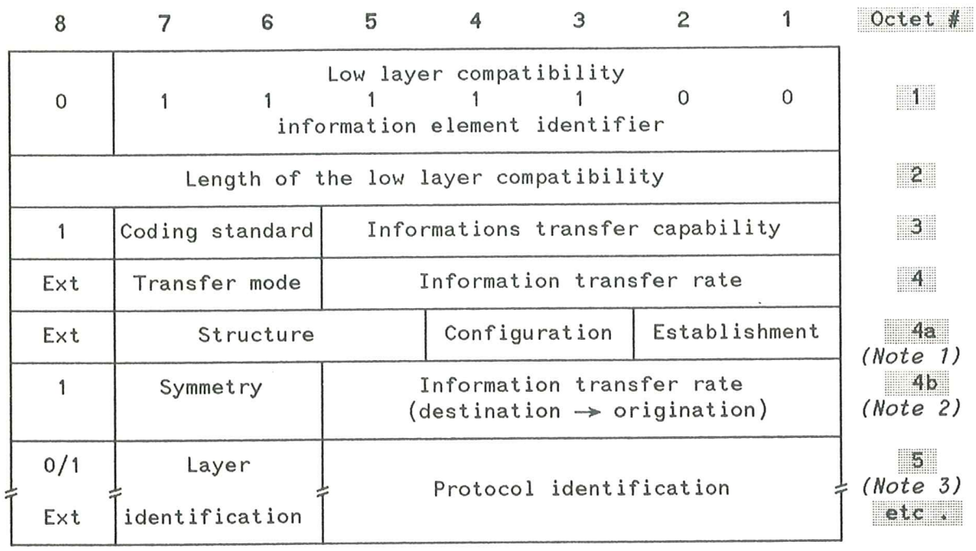


Figure 8.20 - Keypad Information Element

8.5.14 Low layer compatibility

The purpose of this information element is to provide a means to carry end to end the information required for compatibility checking. It will be transparently conveyed by the PCSN and will allow in particular the originating end to describe the way it intends to use the B channel.

The low layer compatibility information element can be duplicated when each direction of transmission has different characteristics. It is coded as shown in Fig 8.21.



NOTE 1 – *This octet may be omitted unless 4b is present*

NOTE 2 – *This octet may be omitted; if present, octet 4a shall also be present*

NOTE 3 – *This set of octets may be repeated to describe the use of each layer.*

Figure 8.21 – Low layer compatibility Information Element

Bit: 8 *Extension bit (octet # 4, 4a and 5)*

0	description is extended through next octet
1	last octet of the description

Bits: 7 6 *Coding standard (octet # 3)*

0 0	conforming to CCITT Recommendation Q.931
0 1	reserved for other international standards
1 0	national standard
1 1	standard specific to identified location

Bits: 5 4 3 2 1 *Information transfer capability (octet # 3)*

0 1 0 0 0	unrestricted digital information
0 1 0 0 1	restricted digital information

Bits: 7 6 *Transfer mode (octet # 4)*

0 0	circuit mode

Bits: 5 4 3 2 1 *Information transfer rate (octet # 4 and 4b)*

1 0 0 0 0	64 kbit/s

NOTE – *When octet 4b is omitted, the low layer compatibility is duplex-symmetric at the information transfer rate specified in octet 4. When octet 4b is included, the information transfer rate in octet 4 refers to the origination → destination direction.*

Bits: 7 6 5 *Structure (octet # 4a)*

0 0 0	default (timed at 8 kHz integrity)

Bits: 4 3 *Configuration (octet # 4a)*

0 0	point-to-point
1 0	multipoint

NOTE – *If octet 4a is omitted, the configuration is assumed to be point-to-point.*

Bits: 2 1 *Establishment (octet # 4a)*

0 0	demand

NOTE – *If octet 4a is omitted, the method of establishment is assumed to be "demand".*

Bits: 7 6 *Symmetry (octet # 4b)*

0 0	bidirectional symmetric
0 1	bidirectional asymmetric
1 0	unidirectional (origination → destination)
1 1	unidirectional (destination → origination)

NOTE – *If octet 4b is omitted, bidirectional-symmetric is assumed.*

Bits: 7 6 5 4 3 2 1 *Layer 1 Protocol identification (octet # 5.1)*

0 1 0 0 0 0 0	undefined
0 1 0 0 0 0 1	CCITT Rate adaption as specified in Q.931 (only bits 5-1 of octet 5.1a are used)
0 1 0 0 0 1 0	Recommendation G.711 μ-law
0 1 0 0 0 1 1	Recommendation G.711 A-law
0 1 0 0 1 0 0	Recommandation G.722
0 1 0 0 1 1 1	ECMA rate adaptation as specified in Standard ECMA-102 (this implies the use of octets 5.1a, 5.1b and optionally 5.1c)

Bits: 7 *Synchronous/Asynchronous (octet # 5.1a)*

0	synchronous
1	asynchronous

Bits: 6 *Negotiation (octet # 5.1a)*

0	negotiation not used
1	negotiation is used

Bits: 5 4 3 2 1 *User rate (octet # 5.1a)*

0 0 0 0 0	undefined
0 0 0 0 1	0.6 kbit/s CCITT Recommendations X.1 and I.461
0 0 0 1 0	1.2 kbit/s CCITT Recommendations X.1 and I.461
0 0 0 1 1	2.4 kbit/s CCITT Recommendations X.1 and I.461
0 0 1 0 0	3.6 kbit/s CCITT Recommendations V.6 and I.463
0 0 1 0 1	4.8 kbit/s CCITT Recommendations X.1 and I.461
0 0 1 1 0	7.2 kbit/s CCITT Recommendations V.6 and I.463
0 0 1 1 1	8 kbit/s CCITT Recommendation I.460
0 1 0 0 0	9.6 kbit/s CCITT Recommendations X.1 and I.461
0 1 0 0 1	14.4 kbit/s CCITT Recommendations V.6 and I.463
0 1 0 1 0	16 kbit/s CCITT Recommendation I.460
0 1 0 1 1	19.2 kbit/s CCITT Recommendation I.463
0 1 1 0 0	32 kbit/s CCITT Recommendation I.460
0 1 1 1 0	48 kbit/s CCITT Recommendations X.1 and I.461
0 1 1 1 1	56 kbit/s CCITT Recommendations I.464
1 1 0 0 1	0.050 kbits/s
1 1 0 1 0	0.075 kbits/s
1 1 0 1 1	0.110 kbits/s
1 1 1 0 0	0.150 kbits/s
1 1 1 0 1	0.200 kbits/s
1 1 1 1 0	0.300 kbits/s
1 1 1 1 1	12 kbits/s

Bits: 7 6 *Intermediate rate (octet # 5.1b)*

0 0	not used
0 1	8 kbits/s
1 0	16 kbits/s
1 1	32 kbits/s

Bit: 5 *Network Independent Clock on transmission (octet # 5.1b)*

0	does not require to send data with NIC
1	requires to send data with NIC

Bit: 4 *Network Independent Clock on reception (octet # 5.1b)*

0	cannot accept data with NIC
1	can accept data with NIC

Bits: 7 6 *Number of stop bits (octet # 5.1c)*

0 0	not used
0 1	1
1 0	1.5
1 1	2

Bits: 5 4 *Number of data bits including parity bit if present(octet # 5.1c)*

0 0	not used
0 1	5 bits
1 0	7 bits
1 1	8 bits

Bits: 3 2 1 *Parity information (octet # 5.1c)*

0 0 0	odd
0 1 0	even
0 1 1	none
1 0 0	forced to 0
1 0 1	forced to 1

NOTE – *octet 5.1c may be omitted in case of synchronous.*

Bits: 7 6 5 4 3 2 1 *Layer 2 protocol identification (octet # 5.2)*

1 0 0 0 0 0 0	undefined
1 0 0 0 0 0 0	CCITT Recommendation I.441/Q.921
1 0 0 0 1 0 0	CCITT Recommendation Q.710
1 0 0 0 1 1 0	CCITT Recommendation X.25 link level

Bits: 7 6 5 4 3 2 1 *Layer 3 protocol identification (octet # 5.3)*

1 1 0 0 0 0 0	undefined
1 1 0 0 0 1 0	CCITT Recommendation I.451/Q.931
1 1 0 0 1 1 0	CCITT Recommendation X.25 packet level

NOTE – *If any of the octets 5.1, 5.2 or 5.3 is omitted the respective information low layer protocol is undefined.*

Examples of use of octet 5 :

Circuit switching with 9.6 kbit/s synchronous

octet	8	7	6	5	4	3	2	1	
5.1	0	0	1	0	0	0	0	1	Layer 1 : CCITT rate adaption
5.1a	1	0	0	0	1	0	0	0	user rate 9.6 kbit/s

Circuit switching with ECMA rate adaption, asynchronous 4.8 kbit/s /stopbit, 7 data bits + even parity bit

octet	8	7	6	5	4	3	2	1	
5.1	0	0	1	0	0	1	1	1	Layer 1 : ECMA rate adaption
5.1a	0	1	0	0	0	1	0	1	asynchronous 4.8 kbit/s
5.1b	0	0	1	0	0	0	0	0	8 kbit/s intermediate rate, Network independent clock not used
5.1c	1	0	1	1	1	0	1	0	1 stop, 8 data bits (including even parity bit)

Circuit switching with ECMA rate adaption, synchronous 12 kbit/s

octet	8	7	6	5	4	3	2	1	
5.1	0	0	1	0	0	1	1	1	Layer 1 : ECMA rate adaption
5.1a	0	0	0	1	1	1	1	1	synchronous 12 kbit/s
5.1b	1	1	0	0	0	0	0	0	16 kbit/s intermediate rate, Network independent clock not used

8.5.15 More data

The more data information element is a continuation indicator sent by one system to another system in a USER INFOrmation message. It is a single octet information element coded as shown in Figure 8.22.

The use of the more data information element is not supervised by the network.

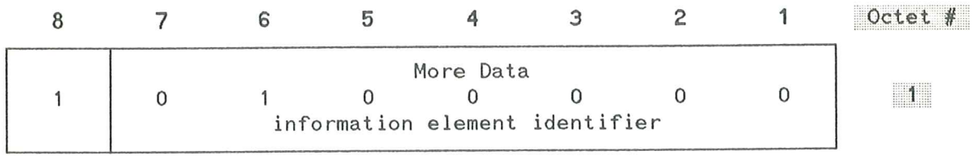


Figure 8.22 – More Data Information Element

8.5.16 Origination address

The purpose of the origination address information element is to identify the origin of a call.

The origination address information element is coded as shown in Figure 8.23. The coding of the fields in octet 3 and 4 are shown in Figure 8.17.

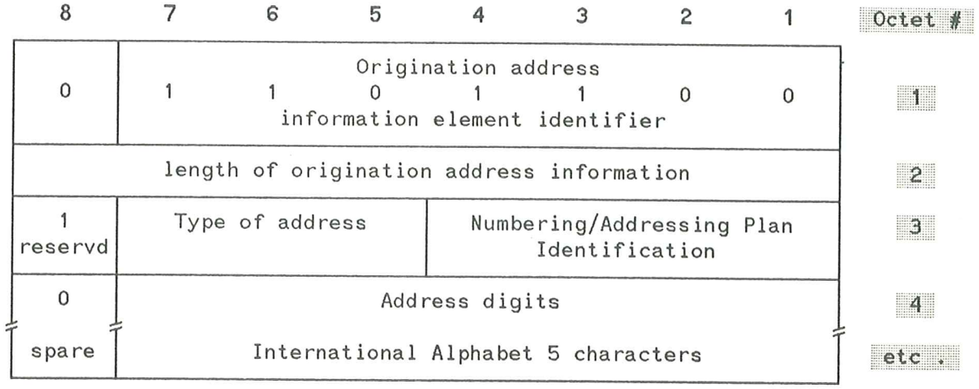


Figure 8.23 – Origination Address Information Element

8.5.17 User-user information

The purpose of the user-user information element is to convey information between systems. This information is not interpreted by intermediate systems, but rather is carried transparently and delivered to the end system.

The user-user information element is coded as shown in Figure 8.24. There are no restrictions on the content of the user information field. The first octet of the user information field will be used as a discriminator to indicate the structure of the protocol used in the rest of the user information field. The following values will be used :

1xxx xxxx	unstructured, reserved for proprietary use
0xxx xxxx	user information discriminator

In USER INFOrmation messages sent in association with a circuit-mode connection, the user information field contained inside this information element has a maximum size of 31 or 127 octets. For USER INFOrmation messages sent in a temporary or user-user signalling connection, the user information field contained inside this information element has a maximum size equal to the maximum size of messages defined in Section 7 (excluding USER INFOrmation).

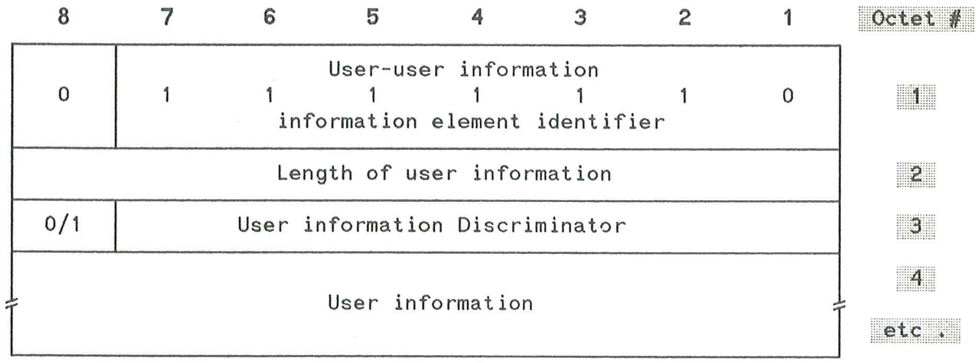


Figure 8.24 - User-user Information Element

LIST OF SYSTEM PARAMETERS

SECTION 9

9.1 Timers

Note :

Tx = N200 x T200
N200 and T200 are defined in ECMA-105.

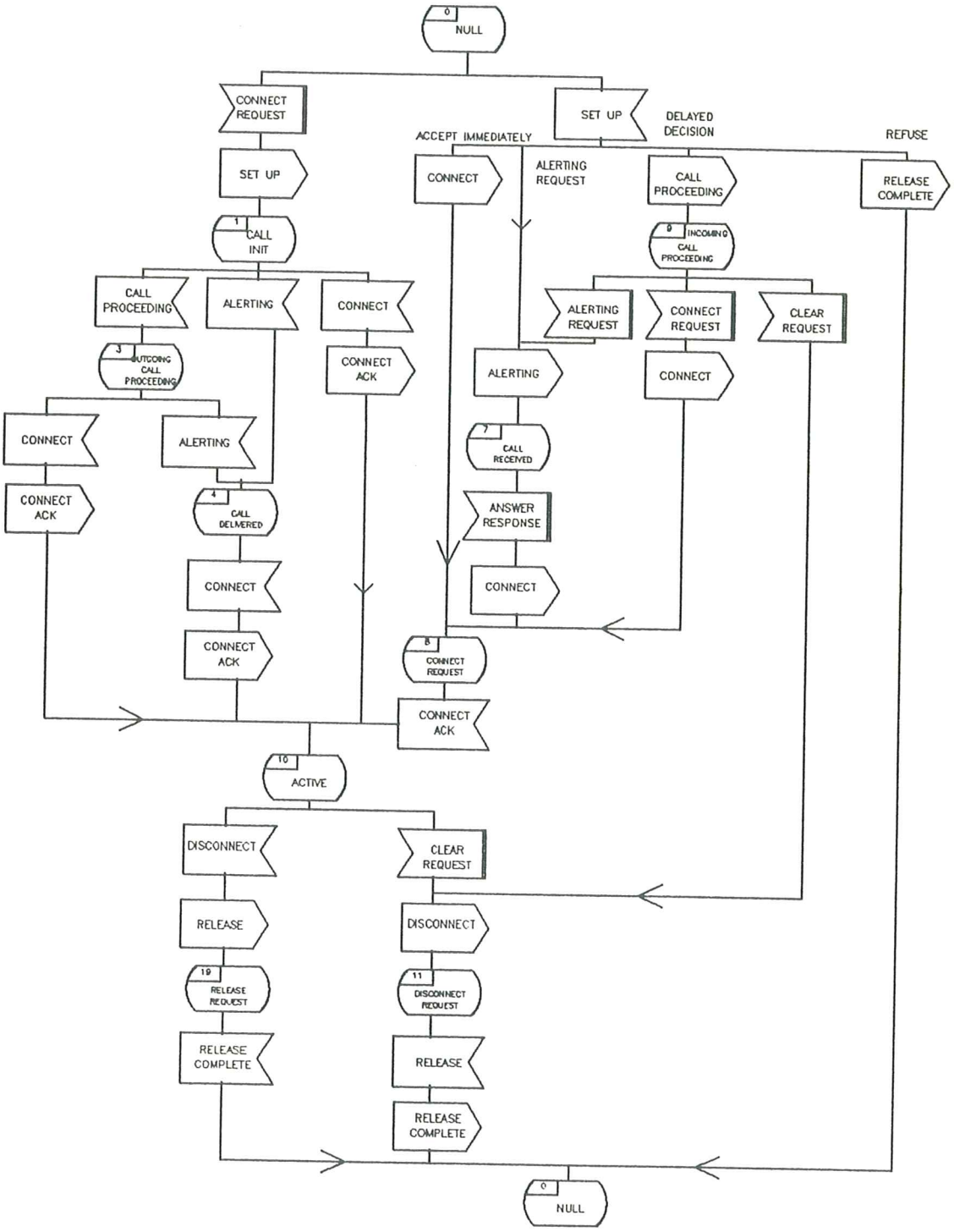
Timer Number	Time-Out Value (sec.)	State of Call	Normally Terminated When	Action to be Taken First Time Timer Expires	Action to be Taken Second Time Timer Expires
T303	10	s1	Originating system receives RELease COMplete, CALL PROCeeding, ALERTing CONNect message	Timer may be reinitialized. –If reinitialized, SETUP message retransmitted –If not reinitialized, DISCONNect message sent, timer T305 initialized and call enters state s11	DISCONNect message sent, timer T305 initialized, call enters state s11
T305	1+Tx	s11	System receives DISConnect or RELease message	Timer not reinitialized. RELease message sent, timer T308 initialized and call enters state s19	–
T308	1+Tx	s19	System receives RELease COMplete message	Retransmits RELease and reinitialize, T308 timer	Timer not reinitialized. RELease COMplete message sent and call enters state s0
T309	90	all states	Data Link Layer is reconnected	Timer is not reinitialized Calls are cleared	–
T310	10	s3	Originating system receives ALERTing or CONNect message	Timer not reinitialized. DISConnect message sent, and call enters state s11	–
T30Y	3	s8	CONNect. ACKnowledgement received	Returned CONNect and increment counter reinitialize timer T30Y	same as T303

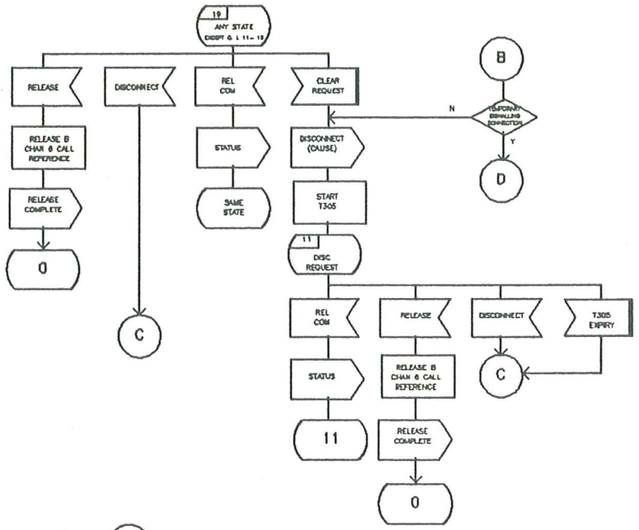
9.2 Retry Counters

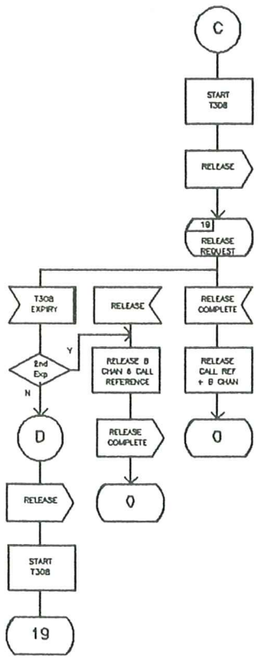
retry counter	value
N303	2
N30Y	2

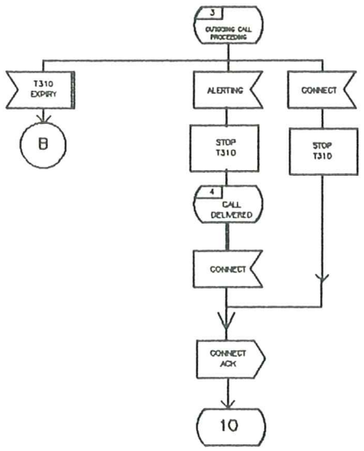
SDL DIAGRAMS OVERVIEW

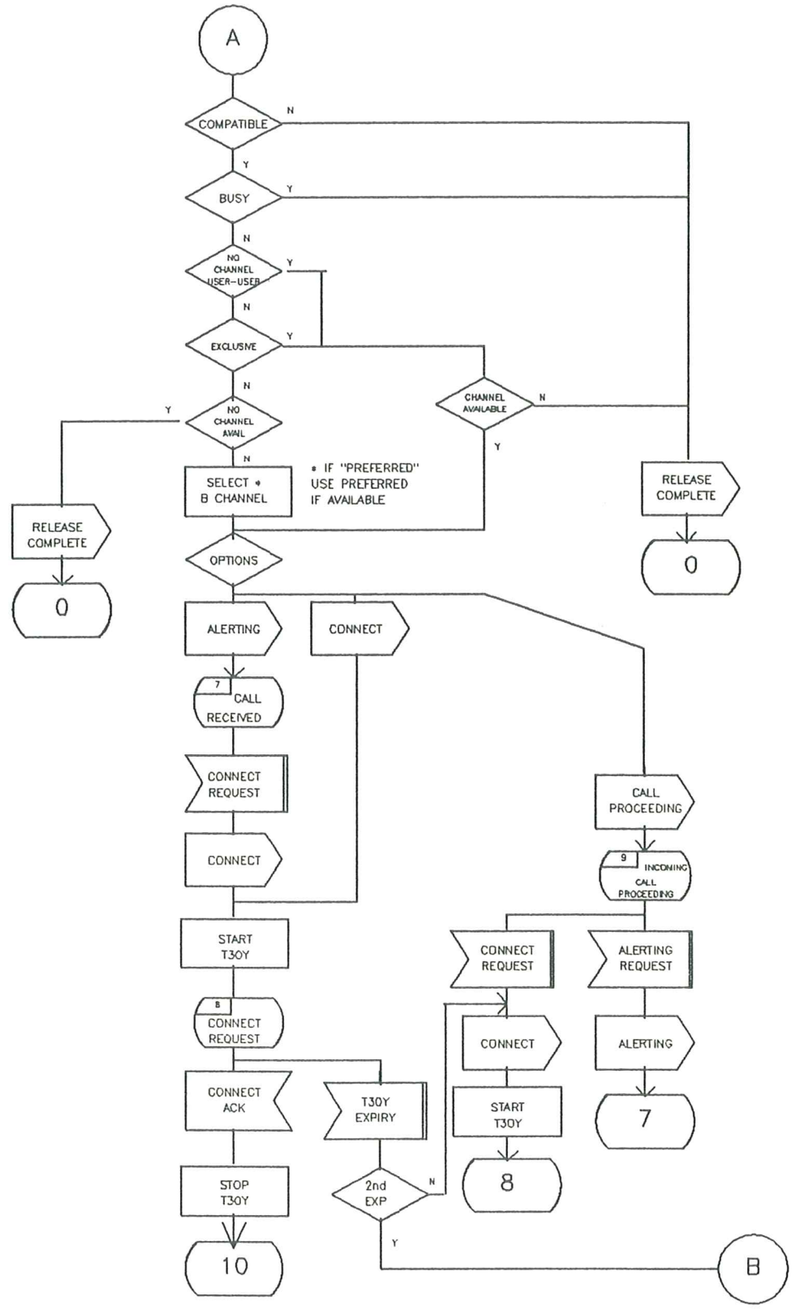
APPENDIX
A




19
ANY STATE
EXCEPT 0, 1, 11, 19
RELEASE
DISCONNECT
REL COM
CLEAR REQUEST
RELEASE B CHAN & CALL REFERENCE
RELEASE COMPLETE
0
STATUS
SAME STATE
DISCONNECT (CAUSE)
START T305
11
DISC REQUEST
REL COM
RELEASE
DISCONNECT
T305 EXPIRY
STATUS
RELEASE B CHAN & CALL REFERENCE
RELEASE COMPLETE
0
11
C
B
SUPPORT SIGNALLING CONNECTION
N
Y
D

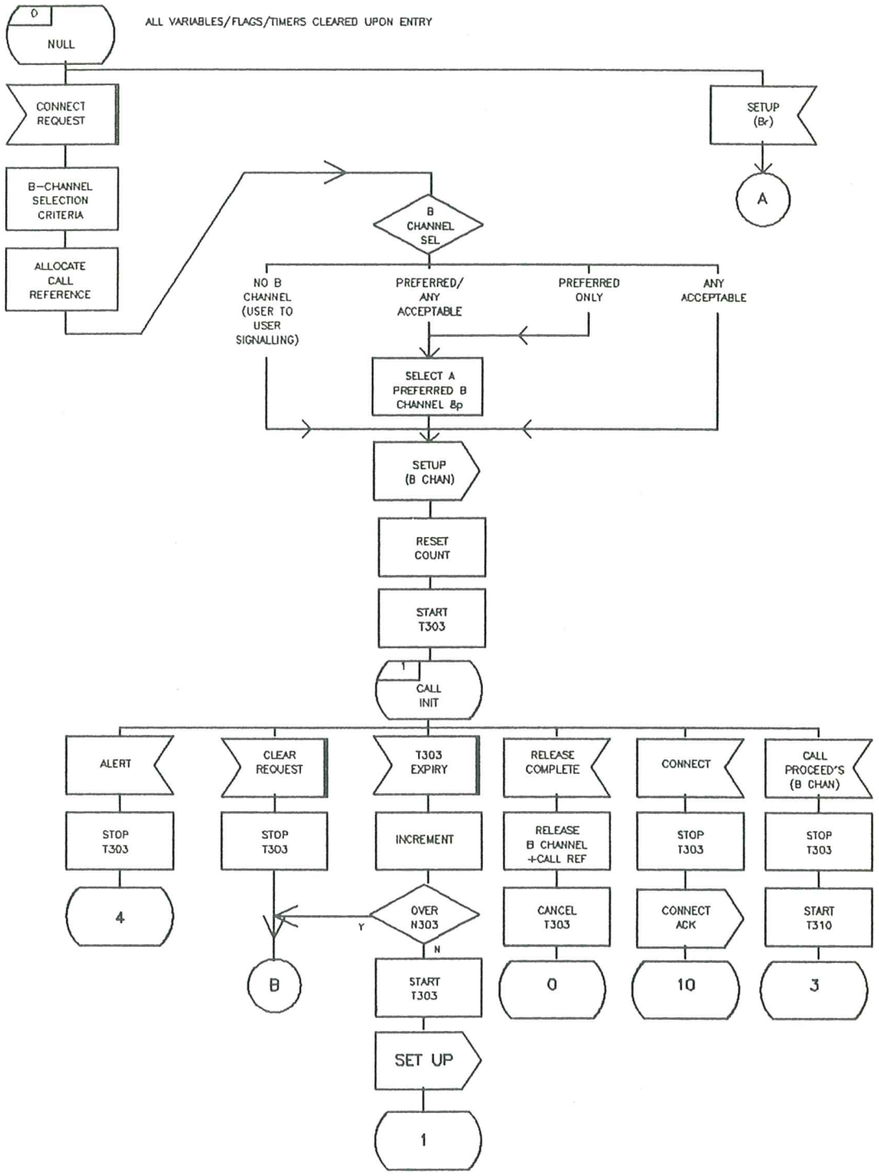

C
START T308
RELEASE
19
RELEASE REQUEST
T308 EXPIRY
RELEASE
RELEASE COMPLETE
End Exp
Y
N
RELEASE B CHAN & CALL REFERENCE
RELEASE CALL REF + B CHAN
RELEASE COMPLETE
0
D
RELEASE
START T308
19


3
OUTGOING CALL PROCEEDING
T310 EXPIRY
B
ALERTING
CONNECT
STOP T310
STOP T310
4
CALL DELIVERED
CONNECT
CONNECT ACK
10


A
COMPATIBLE
N
Y
BUSY
Y
N
NO CHANNEL USER-USER
Y
N
EXCLUSIVE
Y
N
NO CHANNEL AVAIL
Y
N
CHANNEL AVAILABLE
N
Y
* IF "PREFERRED" USE PREFERRED IF AVAILABLE
SELECT * B CHANNEL
RELEASE COMPLETE
0
RELEASE COMPLETE
0
OPTIONS
ALERTING
CONNECT
7
CALL RECEIVED
CONNECT REQUEST
CONNECT
START T30Y
8
CONNECT ACK
STOP T30Y
10
T30Y EXPIRY
2nd EXP
N
Y
CONNECT REQUEST
CONNECT
START T30Y
8
CALL PROCEEDING
9
INCOMING CALL PROCEEDING
CONNECT REQUEST
ALERTING REQUEST
CONNECT
ALERTING
7
B

SDL DETAILED

APPENDIX
B



STATE TRANSITION TABLES

APPENDIX C

State transition tables for the originating and terminating systems are shown in this Appendix. For each system, two types of events may be received: External and Internal.

External events are message events that cross the system interface. Internal events are actions initiated by a system on his own side of the interface. For example in order to initiate a call, a system must request a connection. This decision will cause a SETUP message to be generated and move the call state from `Null state (s0)` to `Call init state (s1)`. For clarity in the table, internal events are shown in lower case and external events are shown as defined in section 7.

Actions to be taken as a result of receiving an *event* for a given *call state* are represented by a pair of entries in the tables. The upper entry indicates the message to be returned across the system interface. The lower entry indicates the new state that the call will be entered.

When no message is to be sent in response to an external event, this action is indicated by a"--".

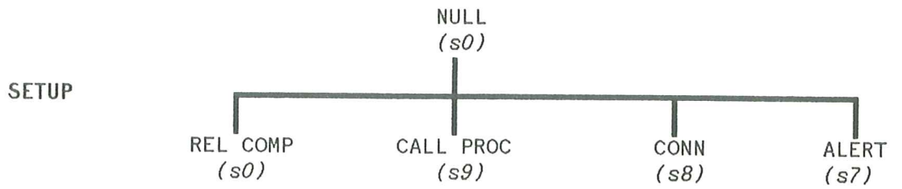
The following notes cover situations that may be repeated in the state transition diagrams or permit more than one response to an external event.

The entry "*" in the transition tables represent the sending of a STATUS message when an unexpected message or a message out of sequence is received. The current state is maintained.

Whenever an event should not occur this is indicated by "/".

NOTE 1 – *If the call state in the STATUS message is at variance with the call state perceived by the system receiving the STATUS message, then the call is immediately cleared by the system with a DISConnect message: If a call state in the STATUS message is not at variance with the call state perceived by the system receiving a STATUS message no action is taken. The current state is maintained.*

NOTE 2 – *The following transitions are allowed for incoming calls only from the Null stat, upon receiving a SETUP message:*



Event received	Current state: Null s0	Call init s1	Outgoing Call proc s3	Call deliv. s4	Active s10	Discon. request s11	Release request s19
ALERTing	DISC s11	-- s4	-- s4	*	*	*	*
CALL PROC	DISC s11	-- s3	*	*	*	*	*
CONNect	DISC s11	CONN ACK s10	CONN ACK s10	CONN ACK s10	*	*	*
CONNect ACK	DISC s11	*	*	*	*	*	*
DISConnect	REL s19	REL s19	REL s19	REL s19	REL s19	REL s19	*
RELease	REL COM s0	REL COM s0	REL COM s0	REL COM s0	REL COM s0	REL COM s0	REL COM s0
RELease COM	-- s0	-- s0	*	*	*	*	-- s0
SETUP	note 2	*	*	*	*	*	*
STATUS	note 1	note 1	note 1	note 1	note 1	note 1	note 1
Call request	SETUP s1	/	/	/	/	/	/
Clear request	/	DISC s11	DISC s11	DISC s11	DISC s11	/	-- s0

Figure C.1 – State Transition Table for outgoing calls

Event received	Null s0	Call receiv. s7	Connect request s8	Incom Call proc s9	Active s10	Discon. req. s11	Release request s19
ALERTing	DISC s11	*	*	*	*	*	*
CALL PROC	DISC s11	*	*	*	*	*	*
CONNect	DISC s11	*	*	*	*	*	*
CONNect ACK	DISC s11	*	-- s10	*	*	*	*
DISConnect	REL s19	REL s19	REL s19	REL s19	REL s19	REL s19	*
RELease	REL COM s0	REL COM s0	REL COM s0	REL COM s0	REL COM s0	REL COM s0	REL COM s0
RELease COM	-- s0	*	*	*	*	*	-- s0
SETUP	note 2	*	*	*	*	*	*
STATUS	note 1	note 1	note 1	note 1	note 1	note 1	note 1
connect request	/	CONN s8	/	CONN s8	/	/	/
clear request	/	DISC s11	DISC s11	DISC s11	DISC s11	/	-- s0
alerting request	/	/	/	ALERT s7	/	/	/

Figure C.2 – State Transition Table for incoming calls

B-CHANNEL MANAGEMENT

APPENDIX D

In order to avoid conflicts, both channel assignment and release are subject to an agreement from the other side; five channel states are defined, and managed at each side of the interface :

- free (F) : channel is free for allocation
- reserved (R) : the channel has been selected locally and is proposed to the other side
- allocated (A) : both sides have reached an agreement on channel selection
- connected (C) : the channel may transmit information
- disconnected (D) : the channel is no longer allocated to the call for this side of the interface, but cannot be used for another call until the other side indicates disconnection.

1 - making a proposal
2 - proposal refused
3 - own proposal accepted
4 - other end's proposal accepted
5/7 - disconnected
6 - connection
8 - release

The corresponding state transitions appear on the following diagram.

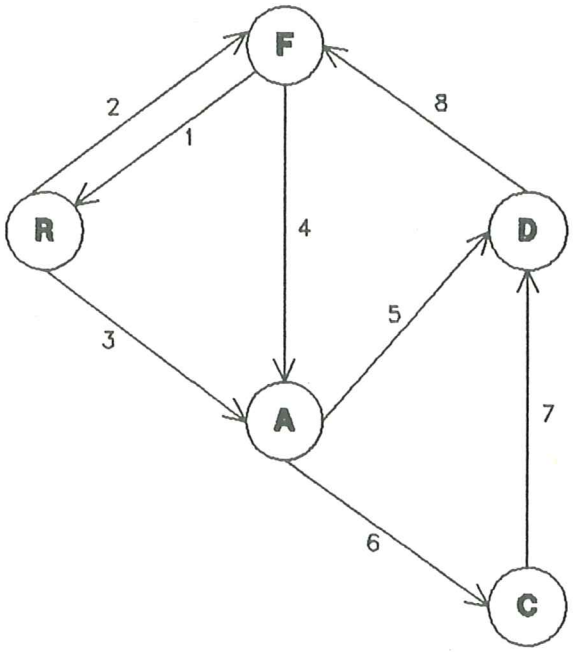


Figure D.1 - B-Channel Management state transition diagram

EXAMPLES

APPENDIX
E

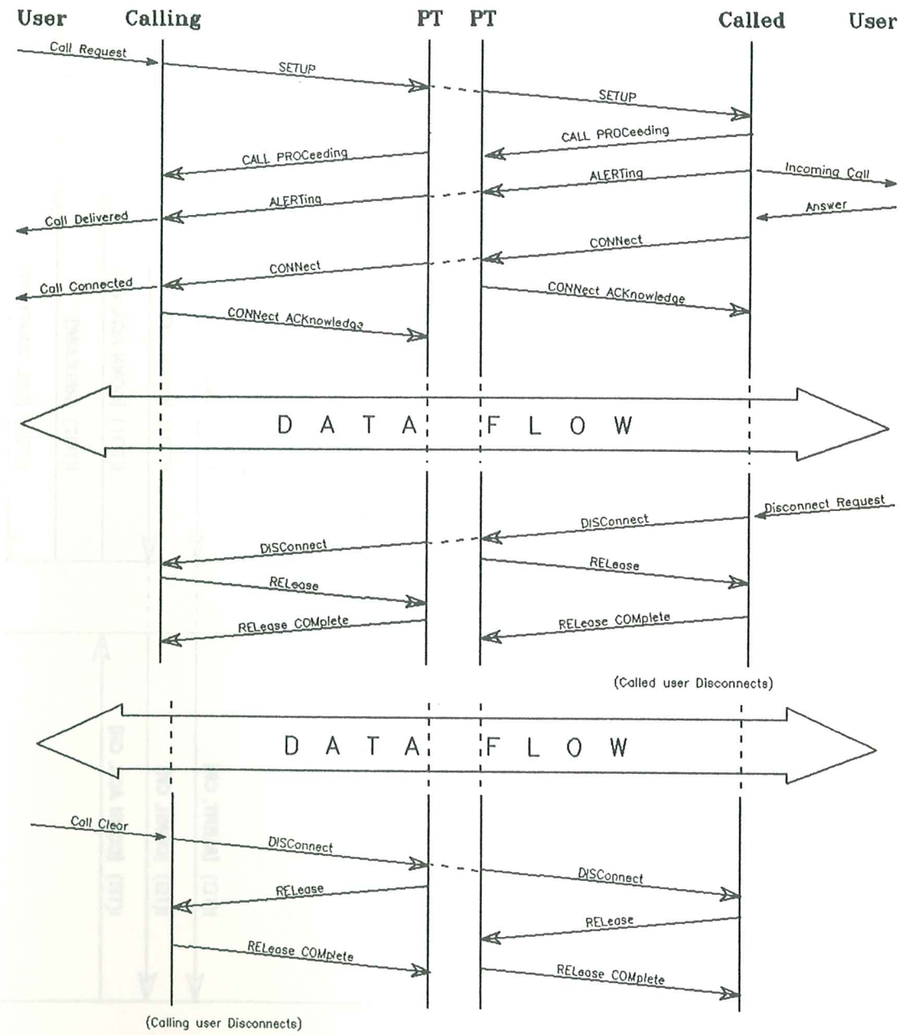


Figure E.1 – Call establishement and distablishement

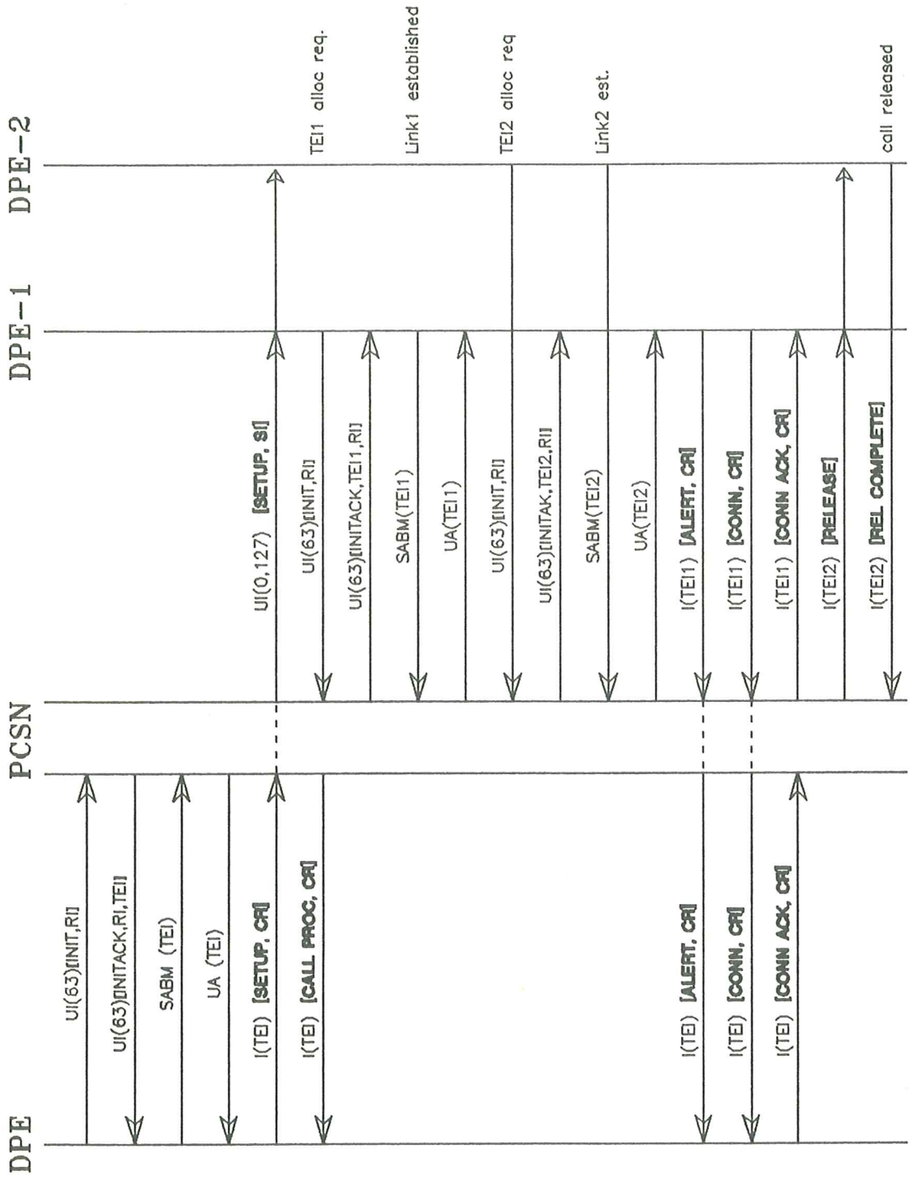


Figure E.2 – Incoming Call on a multipoint configuration

Level 2 frames: I(TEI), SABM(TEI), UA(TEI)
UI(SAPI)[INIT,x] ID request
UI(SAPI)[INITAK,x] ID assigned

Level 2 address: TEI (terminal endpoint identifier)
Global (broadcast):127
SAPI:63=Management, 0=Signalling

Level 3 messages: SETUP
ALERT : ALERTing
CALL PROC : CALL PROCeeding
CONN : CONNect CONNACK : CONNect ACKnowledge
RELease and RELease COMplete

ABREVIATIONS USED

APPENDIX F

Abbreviations	Meaning
ACK	ACKnowledge
ALERT	ALERTing
CALL PROC	CALL PROCeeding
CR	Call Reference
CONN	CONNect
CONNACK	CONNect ACKnowledge
CUG	Closed User Group
DISC.	DISConnect
DPE	Data Processing Equipment
IA5	International Alphabet No 5
ID/id	IDentification
INIT	INITiate
Int	Interface
ISDN	Integrated Services Digital Network
M	Mandatory
max.	maximum
min.	minimum
O	Optional
O.S..	Origination System
OSI	Open System Interconnection
PCSN	Private Circuit Switching Network
RI	Reference Indicator
REL	RELease
RELCOM	RELease COMplete
SABM	Set Asynchronous Balanced Mode
SAPI	Service Acces Point Identifier
SDL	Specification and Description Language
TE	Terminal Equipment
TEI	Terminal Endpoint Identifier
TS	Terminating System
UA	Unnumbered ACKnowledgement
UI	Unnumbered Information
DCE	Data Circuit terminating Equipment
DTE	Data Terminal Equipment
NIC	Network Independent C