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Contents

Foreword

This European Telecommunication Standard (ETS) has been produced by the Signalling Protocols & Switching (SPS) Technical Committee of the European Telecommunications Standards Institute (ETSI).

Introduction

This standard was drafted on the basis of CCITT Recommendation X.31 [15], incorporating also enhancements made to that document during early years of the study period 1988-1992.

As a consequence this document:

(a) incorporates service aspects useful to understand the context of this standard;

(b) does not necessarily fully align with the available stage 1 description, which is still under preparation. Therefore, several stage 1 aspects may not be covered here or are covered in a different manner;

(c) is not based on a stage 2 description as there was no stage 2 draft ETS available;

(d) does not necessarily seek alignment with draft ETS 300 099 [25] since it introduces limitations when the Packet Handler (PH) is remotely located;

(e) includes a description of terminal adaptor functions which are required to support a CCITT Recommendation X.25 [14] DTE (Data Terminal Equipment) which is normally outside the scope of any comparable stage 3 access protocol specification.

In producing this draft standard, the following considerations have been taken into account:

(a) DTEs conforming to CCITT Recommendation X.25 [14] shall be used, at least during the evolution of Integrated Services Digital Networks (ISDN) and possibly thereafter, in conjunction with Packet Mode Bearer Services (PMBS) provided on an ISDN or via an ISDN using circuit switched bearer service to Packet Switched Public Data Networks (PSPDNs);

(b) the packet mode TE1s conforming to ETS 300 012 [23] and ETS 300 011 [22] at reference points S and T shall be used in conjunction with PMBS provided by an ISDN or via an ISDN using circuit switched bearer service to PSPDNs;

(c) the functions and protocol defined by this draft ETS shall allow the provision of the network service defined in CCITT Recommendation X.213 [18];

(d) the interworking function between an ISDN and a PSPDN is defined in CCITT Recommendation X.325 [21];

(e) the demand access to PSPDNs is defined in CCITT Recommendation X.32 [16];

(f) the dedicated access to PSPDNs is defined in CCITT Recommendation X.25 [14].

Normative references

This ETS incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] CCITT Recommendation E.163 (1988): "Numbering plan for the international telephone service".

[2] CCITT Recommendation E.164 (1988): "Numbering plan for the ISDN era".

[3] CCITT Recommendation E.166 (1988): "Numbering plan interworking in the ISDN era".

[4] CCITT Recommendation I.130 (1988): "Method for the characterisation of telecommunication services supported by an ISDN and network capabilities of an ISDN".

[5] CCITT Recommendation I.330 (1988): "ISDN Numbering and addressing principles".

[6] CCITT Recommendation I.411 (1988): "ISDN user-network interfaces - Reference configurations".

[7] CCITT Recommendation I.430 (1988): "Basic user-network interface - Layer 1 specification".

[8] CCITT Recommendation Q.931 (1988): "ISDN user-network interface layer 3 specification for basic call control".

[9] CCITT Recommendation V.25 *bis* (1988): "Automatic calling and/or answering equipment on the General Switched Telephone Network (GSTN) using the 100-series interchange circuits".

[10] CCITT Recommendation X.1 (1988): "International user classes of service in public data networks and Integrated Services Digital Networks (ISDNs)".

[11] CCITT Recommendation X.10 (1988): "Categories of access for Data Terminal Equipment (DTE) to public data transmission services".

[12] CCITT Recommendation X.21 (1988): "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for synchronous operation on public data networks".

[13] CCITT Recommendation X.21 *bis* (1988): "Use on public data networks of Data Terminal Equipment (DTE) which is designed for interfacing to synchronous V-series modems".

[14] CCITT Recommendation X.25 (1988): "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".

[15] CCITT Recommendation X.31 (1988): "Support of packet mode terminal equipment by an ISDN".

[16] CCITT Recommendation X.32 (1988): "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and accessing a packet switched public data network through a public switched telephone network or an integrated services digital network or a circuit switched public data network".

[17] CCITT Recommendation X.121 (1988): "International numbering plan for public data networks".

[18] CCITT Recommendation X.213 (1988): "Networks service definition for open systems interconnection for CCITT applications".

[19] CCITT Recommendation X.300 (1988): "General principles for interworking between public networks, and between public networks and other networks for the provision of data transmission services".

[20] CCITT Recommendation X.320 (1988): "General arrangements for interworking between Integrated Services Digital Networks (ISDNs) for the provision of data transmission services".

[21] CCITT Recommendation X.325 (1988): "General arrangements for interworking between Packet Switched Public Data Networks (PSPDNs) and Integrated Services Digital Networks (ISDNs) for the provision of data transmission services".

[22] ETS 300 011: "Integrated Services Digital Network (ISDN); Primary rate user-network interface Layer 1 specification and test principles".

[23] ETS 300 012: "Integrated Services Digital Network (ISDN); Basic user-network interface Layer 1 specification and test principles".

[24] ETS 300 058 (1991): "Integrated Services Digital Network (ISDN); Call Waiting (CW) supplementary service Digital Subscriber Signalling System No. one (DSS1) protocol".

[25] ETS 300 099: "Integrated Services Digital Network (ISDN); Specification of the Packet Handler Access Point Interface (PHI)".

[26] ETS 300 102-1 (1990): "Integrated Services Digital Network (ISDN); User-network interface layer 3 Specifications for basic call control".

[27] ETS 300 103 (1990): "Integrated Services Digital Network (ISDN); Support of X.21, X.21 *bis* and X.20 *bis* based Data Terminal Equipments (DTEs) by an ISDN Synchronous and asynchronous terminal adaption functions".

[28] ETS 300 125 (1991): "Integrated Services Digital Network (ISDN); User-network interface data link layer specifications Application of CCITT Recommendations Q.920/I.440 and Q.921/I.441".

1 Scope

This stage three standard defines user-network signalling requirements to support:

a) the application of the ISDN circuit mode 8 kHz structured 64 kbit/s unrestricted bearer service category for access to a Packet Switched Public Data Network (PSPDN);

b) the ISDN packet mode bearer services (both B and D channels);

for the pan-European Integrated Services Digital Network (ISDN) as provided by European public telecommunications operators at the T reference point or coincident S and T reference point (as defined in CCITT Recommendation I.411 [6], by means of the Digital Subscriber Signalling System number one (DSS1). Stage three identifies the protocols and switching functions required to support telecommunication services (see CCITT Recommendation I.130 [4]).

In order to aid the understanding and the interpretation of the signalling and protocol requirements and specifications, this standard also includes:

- reference configurations aiming at providing guidance on the allocation of functionality in an ISDN supporting the above services;

- a summary of the service aspects that may be expected from an ISDN conforming to this standard.

This standard also specifies the mapping from the coincident S and T reference point to the R reference point, using a terminal adaptor to support existing X.25 DTE's.

This standard has been written to support cases a) and b) at the coincident S and T reference point. In addition the access protocol provides the capability to support cases a) and b) also at the T reference point where the services are offered to the user via a private ISDN.

The mapping to an S reference point or R reference point via a private ISDN (e.g. combining NT2 and TA functional groupings) is not specified, although such a configuration is not precluded.

The ISDN packet-mode bearer services (PMBS) provide the unrestricted transfer (without alteration) of user information in a packetised manner over a virtual circuit within the B and D channels at coincident S and T reference point.

The ISDN circuit-mode 64 kbit/s unrestricted 8 kHz structured bearer services provide unrestricted information transfer between coincident S and T reference points (see CCITT Recommendation I.411 [6]).

This standard is applicable to user and network equipment supporting case a or case b, to be attached at either side of a T reference point or coincident S and T reference points.

2 General service aspects

Two main services for packet switched data transmission are defined for packet-mode terminals connected to the ISDN, namely:

- Case A: access to a PSPDN (PSPDN services);

- Case B: use of an ISDN virtual circuit service.

In Case A an ISDN transparent circuit connection, either permanent (i.e., non-switched) or demand (i.e., switched), is used. The corresponding ISDN bearer service is a 64 kbit/s service. The service available to the user is that of the PSPDN described in CCITT Recommendation X.25 [14] (permanent access) and CCITT Recommendation X.32 [16] (demand access), as well as in other CCITT X-Series Recommendations (e.g., X.2, X.121).

In Case B an ISDN virtual circuit service is used.

In Case A only B-channel can be used to access the packet switched service at the user-network interface, while in Case B both B-and D-channels can be used. The detailed service aspects for both cases are described in Clause 3.

This ETS covers the following procedures at the coincident S and T reference point:

- B- and D- channel access on both basic and primary rate interfaces;

- CCITT Recommendation X.25 [14] LAPB procedures on the B-channel and ETS 300 125 [28] LAPD procedures on the D-channel.

  CCITT Recommendation X.25 [14] LAP procedures are not considered here;

- CCITT Recommendation X.25 [14] packet layer procedures on both B- and D-channels.

In addition, this ETS defines the use of ETS 300 125 [28] and ETS 300 102-1 [26] procedures, when appropriate for the establishment and release of a physical path through the ISDN.

3 Reference configurations

The configurations given below are the basis on which the support of CCITT Recommendation X.25 [14] DTEs and TE1s by the ISDN should be standardised. Interworking considerations are defined in Clause 6.

These configurations are also the basis on which the support of packet mode TEs by an ISDN has been standardised, since an X.25 DTE and its Terminal Adaptor (TA) is always equivalent to a packet mode TE1 at the S/T interface. Therefore, every reference in this ETS to the combination of an X.25 DTE and its TA should always be considered as being applicable to a packet mode TE1. However, some TE1s may have more capability than that available from an X.25 DTE and its TA.

Multiple X.25 DTE + TAs or TE1s, or a combination thereof, may be supported at the customer premises. Multiple X.25 DTEs may be multiplexed at layer 3 by an NT2 onto a single B-channel. Multiple TAs or TE1s are able to use the B-channel, one at a time, on a per-call basis.

This ETS only applies to packet mode operation carried out independently on a single ISDN network connection type (i.e, involving either a B- or a D-channel).

In addition, Annex D shows the reference configurations and an example of incoming call offering where an NT2 acting as a Frame Handler is present at the user access.

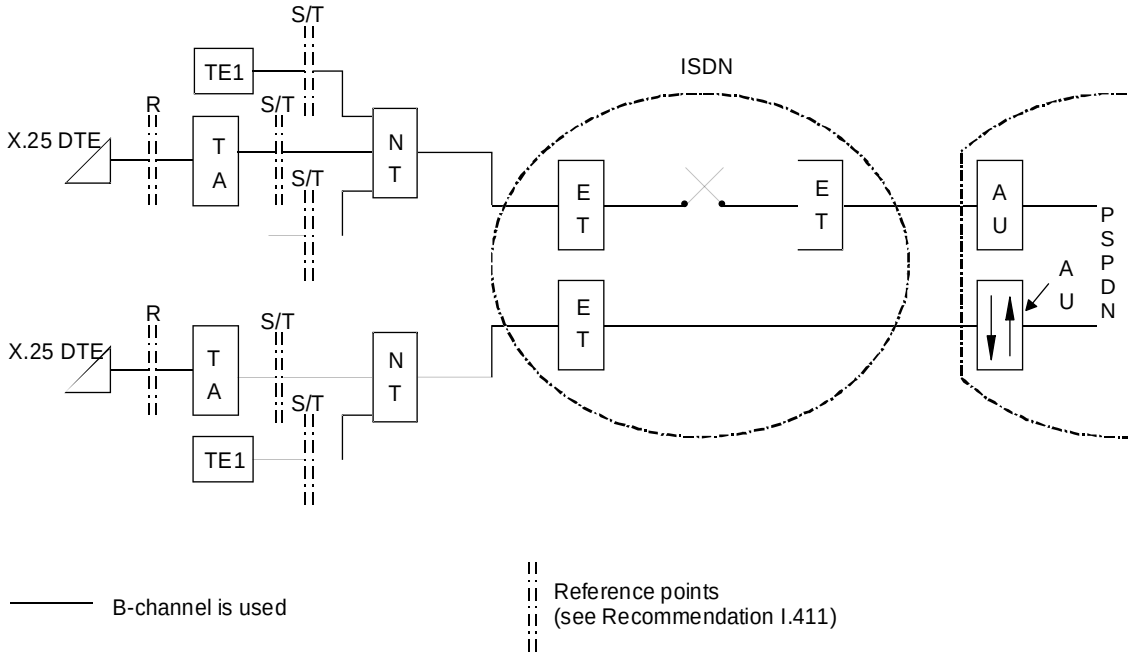
3.1 Configuration when accessing PSPDN services (Case A)

This configuration (see figure 1) refers to the service of Case A, thus implying a transparent handling of packet calls through an ISDN. Only access via the B-channels is possible. In this context, the only support that an ISDN gives to packet calls is a physical 64 kbit/s circuit-mode semi-permanent or demand transparent network connection type between the appropriate PSPDN port and the X.25 DTE+TA or TE1 at the customer premises.

In the case of semi-permanent access, the X.25 DTE+TA or TE1 is connected to the corresponding ISDN port at the PSPDN (AU). The TA, when present, performs only the necessary physical channel rate adaption between the user at the R reference point and the 64 kbit/s B-channel rate. ETS 300 102-1 [26] messages are not used in this case.

In the case of demand access to PSPDNs, which is illustrated in the upper portion of figure 1, the X.25 DTE+TA or TE1 is connected to an ISDN port at the PSPDN (AU). The AU is also able to set up 64 kbit/s physical channels through the ISDN.

In this type of connection, originating calls will be set up over the B-channel towards the PSPDN port using the ISDN signalling procedure prior to starting CCITT Recommendation X.25 [14] layer 2 and layer 3 functions. This can be done by exploiting either hot-line (e.g., direct call) or complete selection methods. Moreover, the TA, when present, performs user rate adaption to 64 kbit/s. Depending on the data rate adaption technique employed, a complementary function may be needed at the AU of the PSPDN (see clause 8 on TA rate adaption).



Keys:

S/T = Coincident S and T reference point
AU = ISDN access unit ports
TA = Terminal adaptor
NT = Network termination
ET = Exchange termination
TE1 = Terminal equipment 1

NOTE 1: This figure is only an example of many possible configurations and is included as an aid to the text describing the various interface functions

NOTE 2: See CCITT Recommendation X.325 [21] for interworking guidelines

Figure 1: Configuration when accessing PSPDN services

In the complete selection case, two separate numbers are used for outgoing access to the PSPDN:

- the ISDN number of the access port of the PSPDN, indicated in the ETS 300 102-1 [26] SETUP message;

- the address of the called DTE indicated in the CCITT Recommendation X.25 [14] call request packet.

The corresponding service requested in ETS 300 102-1 [26] SETUP message is ISDN circuit-mode bearer service.

For calls originated by the PSPDN, the same considerations as above apply. In fact, with reference to figure 1, the ISDN port of the PSPDN includes both rate adaption (if required) and path setting-up functions.

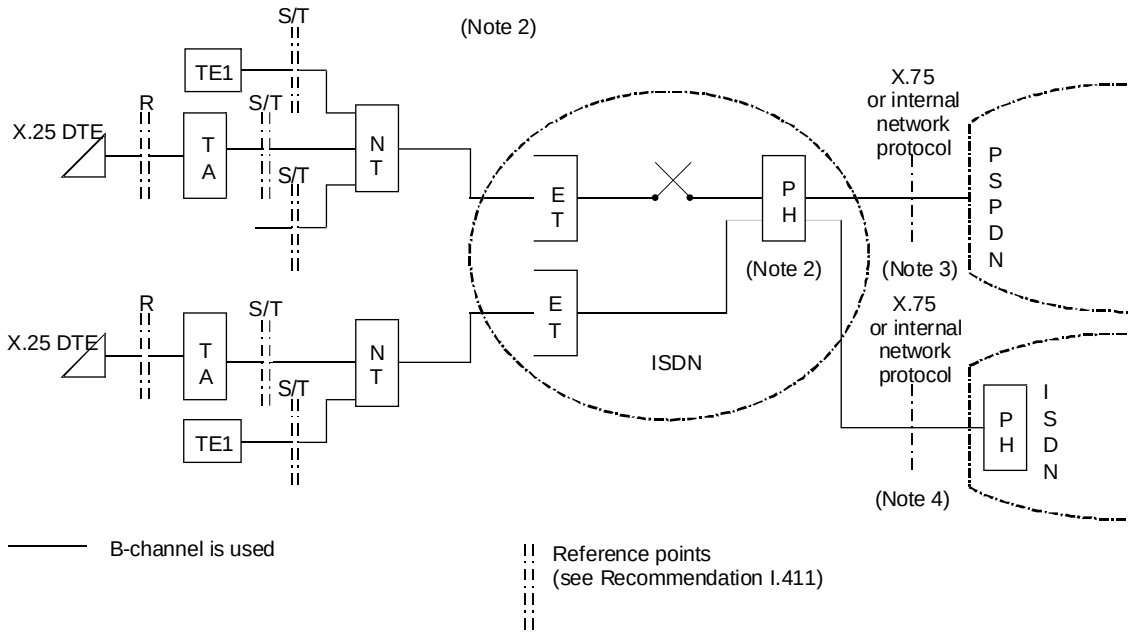
When needed, DTE identification may be provided to the PSPDN by using the call establishment signalling protocols in ETS 300 102-1 [26]. Furthermore, DCE identification may be provided to the DTE, when needed, by using the same protocols.

For the demand access case, layer 2 and layer 3 operation in the B-channel as well as service definitions are given in CCITT Recommendation X.32 [16].

Some PSPDNs may operate the additional DTE identification procedures defined in CCITT Recommendation X.32 [16] to supplement the ISDN provided information in Case A.

3.2 Configuration for the ISDN virtual circuit service (Case B)

This configuration refers to the case where a packet handling (PH) function is provided within the ISDN. The configuration in figure 2 relates to the case of CCITT Recommendation X.25 [14] link and packet layer procedures conveyed through the B-channel. In this case, the packet call is routed, within an ISDN, to some PH function where the complete processing of the CCITT Recommendation X.25 [14] call can be carried out.



Keys:

S/T = Coincident S and T reference point
TA = Terminal adaptor
NT = Network termination 1
ET = Exchange termination
TE1 = Terminal equipment 1
PH = Packet handling function

NOTE 1: This figure is only an example of many possible configurations and is included as an aid to the text describing the various interface functions.

NOTE 2: In some implementations the PH functions logically belonging to the ISDN may reside physically in a node of the PSPDN. The service provided is still the ISDN virtual circuit service.

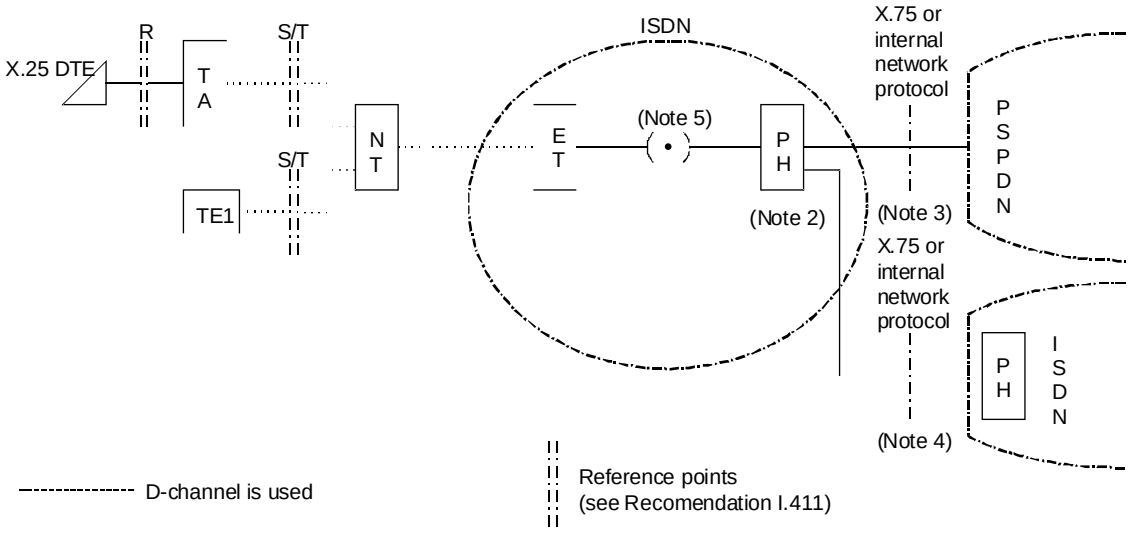
NOTE 3: See CCITT Recommendation X.325 [21].

NOTE 4: See CCITT Recommendation X.320 [20].

Figure 2: Configuration for the ISDN virtual circuit service (access via B-channel)

The PH function may be accessed in various ways depending on the related ISDN implementation alternatives. In any case a B-channel connection is set up to/from a PH port supporting the necessary processing for B-channel packet calls, standard CCITT Recommendation X.25 [14] functions for layer 2 and layer 3 as well as possible path setting-up functions for layer 1 and possible rate adaption.

The configuration in figure 3 refers to the case of CCITT Recommendation X.25 [14] packet layer procedures conveyed through the D-channel. In this case a number of DTEs can operate simultaneously through a D-channel by using connection identifier discrimination at layer 2. The accessed port of PH is still able to support CCITT Recommendation X.25 [14] packet layer procedures.



Keys:

S/T = Coincident S and T reference point
TA = Terminal adaptor
NT = Network termination 1
ET = Exchange termination
TE1 = Terminal equipment 1
PH = Packet handling function

NOTE 1: This figure is only an example of many possible configurations and is included as an aid to the text describing the various interface functions.

NOTE 2: In some implementations the PH functions logically belonging to the ISDN may reside physically in a node of the PSPDN. The service provided is still the ISDN virtual circuit service.

NOTE 3: See CCITT Recommendation X.325 [21].

NOTE 4: See CCITT Recommendation X.320 [20].

NOTE 5: This connection is either on demand or semi-permanent, but has no relevance with the user-network procedures. Only internal procedures between the ET and the PH are required.

Figure 3: Configuration for the ISDN virtual circuit service (access via D-channel)

It is also important to note that the procedures for accessing a PSDTS through an ISDN user-network interface over a B- or D-channel are independent of where the service provider chooses to locate packet handling functions, i.e.:

- in a remote exchange or packet switching module in an ISDN;
- in the local exchange.

However, the procedures for packet access through the B- channel or the D-channel are different (see Clause 7).

In both cases of B- and D-channel accesses, in the service of Case B, the address of the called DTE is contained in the CCITT Recommendation X.25 [14] call request packet. The establishment of the physical connection from the TA/TE1 to the packet handling functions is done on the basis of the requested bearer service (ISDN virtual circuit service), therefore, the user does not provide any called party number or called party subaddress information in the ETS 300 102-1 [26] procedures.

4 Service aspects

4.1 Access to PSPDN services (Case A)

Interworking considerations are defined in Clause 6.

4.1.1 Service characteristics

In this case, the ISDN offers a 64 kbit/s circuit-switched or semi-permanent transparent network connection type between the TA/TE1 and the PSPDN port (AU). In the switched access case the AU must be selected by the called address in the D-channel signalling protocol when the TA/TE1 sets up the circuit-switched connection to the AU, In the non-switched access case, ETS 300 102-1 [26] call control messages are not used.

Since the packet switched service provider is a PSPDN, some DTEs are PSPDN terminals; they are handled by the PSPDN. Other DTEs may access the PSPDN without being subscribed to the PSPDN permanently.

In the first case, the same services as PSPDN services are maintained, including facilities, Quality of Service (QoS) characteristics and DTE-DCE interfaces. In the case where a DTE is not subscribed to the PSPDN, it will be provided with a limited set of PSPDN facilities (see CCITT Recommendation X.32 [16])

Every DTE will be associated with one or more ISDN (CCITT Recommendation E.164 [2]) numbers. In addition, a DTE may be associated with one or more X.121 numbers assigned by the PSPDN(s) associated by the DTE. The method for CCITT Recommendation X.25 [14] packets to convey numbers from the ISDN numbering plan and the relationship with X.121 are described in CCITT Recommendation E.166 [3].

4.1.2 User access capabilities

In this case DTEs belonging to user classes 8 to 11, 13 and 30 of CCITT Recommendation X.1 [10] (categories of access Q1 to Q5 of CCITT Recommendation X.10 [11]) can be supported with no restrictions on the use of CCITT Recommendation X.25 [14]. The rate adaption mechanism for user classes of service 8 to 11 (categories of access Q1 to Q4) as well as the TA functionalities are described in Clause 8.

4.1.3 Basic rules

Packet data communications, when using a switched B-channel, will be established by separating the establishment phase of the B-channel and the control phase of the virtual circuits using the CCITT Recommendation X.25 [14] protocol (link layer and packet layer).

In general ISDN has no knowledge of the customer's terminal equipment or configuration. The incoming B-channel connection establishment will have to employ the D-channel signalling procedure (see ETS 300 102-1 [26]).

4.1.4 Notification classes

There is one class in terms of ETS 300 102-1 [26] procedures to notify the user of incoming calls. In addition there is a notification class which does not use ETS 300 102-2 procedures. These two classes may be provided on a subscription basis. Networks shall provide one or more of these classes. These classes are defined in subclauses 4.2.3.1 and 4.2.3.2 with the following exceptions:

- the terms used in subclause 4.2.3.1 apply by replacing "PH" with "AU";
- only the B-channel access will be used in this case;
- mapping of information in the conditional case is restricted to the information elements available for end-to-end transfer of information.

4.2 Access to the ISDN virtual circuit service (Case B)

Interworking considerations are defined in Clause 6.

4.2.1 Service characteristics

The virtual circuit service provided within the ISDN is aligned with what is described in the CCITT X-Series Recommendations (e.g., in terms of facilities, quality of service, etc.).

The service and facilities provided as well as the quality of service characteristics are those of the ISDN. Existing features of the CCITT X-series Recommendation may be enhanced and additional features may also be developed taking into account the new ISDN customer capabilities. A number from the ISDN numbering plan will be associated with one or more TA/TE1 (see CCITT Recommendation E.164 [2]).

4.2.2 User access capabilities

In this case both B- and D-channels can be used for accessing the ISDN virtual circuit service.

4.2.2.1 Access through the B-Channel

4.2.2.1.1 Service limitations

In this case DTEs belonging to user classes of service 8 to 11, 13 and 30 of CCITT Recommendation X.1 [10] (categories of access T1 to T5 and Y1 to Y5 of CCITT Recommendation X.10 [11]) can be supported with no restrictions on the use of CCITT Recommendation X.25 [14]. The rate adaption mechanisms for user classes 8 to 11 (access categories T1 to T4 and Y1 to Y4) as well as the TA functionalities are described in Clause 8.

4.2.2.1.2 Basic rules

Packet data communications, when using a switched B-channel, will be established by separating the establishment phase of the B-channel and the control phase of the virtual circuits using the CCITT Recommendation X.25 [14] protocol (link layer and packet layer).

In general an ISDN has no knowledge of the customer's terminal equipment or configuration. In the demand access case the incoming B-channel connection establishment will have to employ the signalling procedures of Clause 7.

4.2.2.2 Access through the D-Channel

4.2.2.2.1 Service limitations

In this case DTEs belonging to user classes of service 8 to 10 of CCITT Recommendation X.1 [10] (categories of service U1 to U4 of CCITT Recommendation X.10 [11]) and except on basic access user class of service 11 of CCITT Recommendation X.1 [10] (categories of access U5 of CCITT Recommendation X.10 [11]) can be supported subject to the limitation imposed by LAPD as regards the maximum I-field length of the information frames (parameter N201 as defined in ETS 300 125 [28]). In any case, the maximum number of octets in the information field of each frame transferred on the D-channel shall be 260 octets.

4.2.2.2.2 Basic rules

The following principles must always be respected in order to offer the access to the PSDTS as it is defined in the CCITT X-Series Recommendations, particularly CCITT Recommendation X.25 [14].

A single SAPI=16 LAPD link, as viewed by both the network and the user, must support multiplexing of logical channels at layer 3. Additionally, because the user may have a multipoint access, and because a single TA or TE1 is allowed to operate with more than one TE1, the network must support the presence of multiple SAPI=16 LAPD logical links simultaneously operating at layer 2. This results in the requirement that the network be able to support simultaneous layer 2 and layer 3 multiplexing for D-channel packet mode connections.

All CCITT Recommendation X.25 [14] packets, including *call request* and *incoming call* packets, must be transported to and from the TE in numbered information frames (I-frames) in a SAPI=16 LAPD link.

An *incoming call* packet will be transmitted to a TE only after the public networks check at least the following:

- compatibility of user facilities contained in the *incoming call* packet with the called subscriber profile when present;

- availability of the logical channel, either two-way or incoming, on which the *incoming call* packet is sent.

4.2.3 Notification classes for incoming calls

There are three classes in terms of ETS 300 102-1 [26] procedures to notify the user of incoming calls. These classes may be provided on a subscription basis. Networks shall provide one or more of these classes.

4.2.3.1 No notification class

The network shall allocate incoming calls to a channel (B/D) using a network implemented algorithm. No ETS 300 102-1 [26] procedures are used to notify the user of incoming calls. Two subclasses are recognised:

- Semi-permanent (nailed-up) connections to the PH. An *incoming call* packet will be directly delivered over the semi-permanent connection;

- User initiated demand connections (at the called side). The user is responsible for initiating connections to the PH using ETS 300 102-1 [26] procedures. If the user has not initiated connections to the PH, the network shall clear incoming calls.

4.2.3.2 Conditional notification class

ETS 300 102-1 [26] procedures are only used by the network to activate a channel for delivery of an incoming call when there is no available channel in the active state. Subsequent incoming calls to the same ISDN number will be delivered over this channel without using ETS 300 102-1 [26] procedures.

NOTE: This conditional notification class applies to both the B- and the D-channel incoming call offerings.

In this case the network shall allocate incoming calls to a channel (D/B) using a network implemented algorithm.

Some networks may have the ability to maintain information related to the state of the user's packet access channel. The network may apply an algorithm to determine that no additional calls should be added to the active packet access channel. The network may then reject the call immediately or use ETS 300 102-1 [26] procedures in an attempt to activate another channel for the purpose of delivering additional calls.

Some networks may also, on a user's profile basis, compare the subaddress and use call offering procedure (see subclause 7.2.2.3) only when the ISDN address differs from the ISDN address of the terminal with the active packet access channel.

4.2.3.3 Unconditional notification class

This class is not supported by this ETS.

4.2.3.4 Information mapping from the CCITT Recommendation X.25 incoming call packet to the ETS 300 102-1 message

In case of the conditional notification class, the information present in the CCITT Recommendation X.25 [14] *incoming call* packet should be mapped into the ETS 300 102-1 [26] SETUP message as indicated in table 1.

Table 1: Information mapping requirements for notification classes

Notification class	Information mapping	
Conditional Notification	Called DTE address	M
	Called DTE subaddress	M
	Any others	O

Key: M Mandatory
O Optional

4.3 Compatibility checking

This subclause is relevant for both Case A and Case B services.

Information subject to compatibility checking in the networks(s), in the terminal systems, or in both the network(s) and the terminal systems when establishing a communication between two systems can be divided into two basic capabilities.

- the transmission capability may include ISDN network connection types and bearer service identification information in relation to layers 1 to 3 in the terminals;

- the communication capability involves higher layer functions for standardised applications in relation to telecommunication services. Other information, which is passed transparently between the terminal systems, may also form part of the communication capability. The coding of the information elements for compatibility checking and their relation to the open systems interconnection (OSI) reference model is in ETS 300 102-1 [26] and CCITT Recommendation X.300 [19]. Communication capability checking at the ISDN network connection level is limited to those parameters conveyable by the CCITT Recommendation X.25 [14] packet layer protocols i.e, higher layer compatibility parameters cannot be passed from the calling user to the called user.

The network provides the transmission capability and furnishes the associated Bearer capability information element to the user in ETS 300 102-1 [26] SETUP message when the incoming call is notified to the user. This element and possibly others are used by the user equipment for compatibility checking purposes in ETS 300 102-1 [26] Annex B.

The network does not transmit any communication capability (i.e, the associated High layer compatibility information element) to the user since an CCITT Recommendation X.25 [14] packet layer protocol cannot transfer such an information element from the calling to the called user.

5 Addressing and routing aspects

5.1 Terminal interface selection

This subclause describes the information necessary to select a compatible TA/TE1 for the completion of an incoming call since users may operate several packet terminals in their multiservice arrangements.

For data transmission, it is envisaged that an ISDN would identify, by means of an ISDN address, a specific interface within the subscriber premises. The transmission capability information is used by the called TA/TE1 for compatibility checking purposes in accordance with Annex B of ETS 300 102-1 [26].

In general, an ISDN number identifies one or more ISDN user-network interfaces. However, some networks may allow an ISDN user-network interface to be allocated more than one ISDN number, thus allowing the identification of a given terminal within an ISDN user-network interface. Furthermore, a sub-address, derived from the CCITT Recommendation X.25 [14] address extension facility may be used to identify a specific terminal within a user installation.

5.2 Access to PSPDN services (Case A)

5.2.1 Channel type selection

Packet calls using this bearer service (i.e. circuit-mode) will always use the B-channel.

5.2.2 Addressing scheme for outgoing calls

ETS 300 102-1 [26] SETUP message, when used, contains the request for a circuit-mode bearer service. The SETUP message also contains the ISDN called party number and optionally the called party sub-address of the AU of the PSPDN.

The CCITT Recommendation X.25 [14] *call request* packet contains the address of the called terminal.

5.3 Access to the ISDN virtual circuit service (Case B)

5.3.1 Channel type selection

Two procedures are available regarding the manner in which channel type selection (i.e., selecting between the B- and D-channel type) can be performed:

a) the terminal which is to accept the call will indicate the channel type to be used;

b) the ISDN has information on which channel type will be used for the incoming call. The various sorts of information that the ISDN may use to determine the channel may include, but are not limited to:

i) subscription time agreements;

ii) occupancy level on established channels.

Channel negotiation procedures may be found in Clause 7.

5.3.2 Addressing scheme for outgoing calls

ETS 300 102-1 [26] SETUP message, when used, contains the request for the ISDN virtual circuit service. The SETUP message does not contain called party number or called party subaddress.

The CCITT Recommendation X.25 [14] *call request* packet contains the address of the called terminal.

6 Interworking with dedicated networks

6.1 Circuit-mode access to PSPDN services (Case A)

Interworking by port access (see CCITT Recommendation X.300 [19]) applies, i.e., the packet mode terminal accesses the PSPDN access port (AU) by use of a 64 kbit/s connection through the ISDN. The AU belongs to the PSPDN and is functionally equal to the interworking function (IWF) (see CCITT Recommendation X.325 [21]).

6.2 Access to PSPDNs via virtual circuit service (Case B)

Interworking by call control mapping (see CCITT Recommendation X.300 [19]) applies, i.e. interworking between the ISDN and PSPDN is effected using X.75 or a functionally equivalent internal network protocol. In some implementations, the PH functions logically belonging to the ISDN may reside physically in a node of the PSPDN (for example see ETS 300 099 [25]). The service provided is still the ISDN virtual circuit service. In any case, interworking between network providers is effected through use of X.75. See also CCITT Recommendation X.325 [21].

7 Packet communications at the S/T reference point

This Clause describes the information flows necessary to support packet communication over:

a) circuit mode (Case A) operation on B-channels;

and:

b) packet mode (Case B) operation on B- and D-channels of an ISDN access line.

The ISDN TA/TE1 presents a coincident S and T reference point towards the network and therefore the TA/TE1 implementation should embody the procedures described in ETS 300 125 [28] and ETS 300 102-1 [26] for B- and D-channel connection establishment and control.

For demand access connections, subclauses 7.1 through 7.4 apply. Example message flows for demand access connections are shown in Appendix III.

Two types of semi-permanent connections on B- and D-channels are covered in this Clause:

a) physical layer semi-permanently established between the terminal and the PH/AU, i.e., the I.430/I.431 physical layer remains activated and the physical path through the ISDN is connected semi-permanently;

and:

b) data link and physical layers semi-permanently established between the terminal and the PH/AU (In this type, the network shall keep the data link layer in the established state).

When a PVC is used, there must exist a type b) semi-permanent connection.

In semi-permanent connection type a), the procedures of subclause 7.3 are followed for call establishment and release.

In semi-permanent connection type b) only the procedures of subclause 7.3.2 are followed for call establishment and release.

When semi-permanent connection type b) is used for PVCs none of the following procedures apply.

Semi-permanent connections are established via a provisioning process without ETS 300 102-1 [26] procedures.

7.1 Outgoing access

If the user selects an already established channel for the outgoing virtual call, then the procedures described in subclause 7.3 apply. If the selected channel is not established to the AU/PH, then the procedures for activating a channel described in the following subclauses are to be used before establishing the virtual call using the procedures of subclause 7.3.

For outgoing data calls, the user first must decide whether circuit-switched (Case A) or packet switched services (Case B) are desired from the network. For outgoing circuit calls, the user follows the procedures of subclause 7.1.1. For outgoing packet calls, a user decides whether B-channel or D-channel is to be used for the packet call. If the user decides to use the B-channel, then the procedures described in subclause 7.1.2.1 are used. If the user decides to use the D-channel, then the procedures described in subclause 7.1.2.2. are used.

NOTE: Some networks may not support every type of access. In the case of B-channel access, the network will clear a request for unsupported services by sending a RELEASE COMPLETE message with cause #65, "*bearer service not implemented*". In the case of a request for D-channel access (an SABME with SAPI=16), on a network port which does not support the service, no response is required of the network.

7.1.1 Circuit-switched access to PSPDN services (Case A)

The B-channel connection between the user and the AU shall be controlled using the D-channel signalling procedure for call establishment described in subclause 5.1 of ETS 300 102-1 [26]. The specific B-channel to be used as a switched connection is selected using the channel selection procedures described in subclause 5.1.2 of ETS 300 102-1 [26] and summarised in table 2.

Table 2: User requested channel and network response.
Outgoing access to either an AU or PH

Channel indicated in the SETUP message user to network direction			Allowable network response network-user
Information channel selection (NOTE 3)	Preferred or Exclusive	D-channel indicator (NOTE 4)	
Bi	Exclusive	No	Bi
	Preferred	No	Bi,Bi'
Any	(Ignore)	No	Bi'
(Absent)			Bi'

Key:
Bi - the indicated (idle) B-channel
Bi' - any (other) idle B-channel

NOTE 1: All other encodings are invalid.

NOTE 2: All columns under the heading "Channel indicated in the SETUP message" indicate possible user coding of the Channel identification information element contained in the SETUP message sent by the user to the network requesting a connection to an AU or PH (see subclause 4.5.13 of ETS 300 102-1 [26]). The column under "Allowable network response" refers to the allowable responses by the network to the user.

NOTE 3: In the case of primary rate access (PRA) this field shall be "channel number".

NOTE 4: D-channel indicator shall be coded:

0 to indicate NO;
1 to indicate YES.

On the basis of the call set-up information (e.g. called party number identifying an AU, transit network selection, etc.) and/or a subscription time agreement, the network provides a connection to the appropriate AU. The bearer capability information element included in the SETUP message shall be coded with:

- information transfer capability set to "unrestricted digital information";
- transfer mode set to "circuit mode";
- information rate set to "64 kbit/s".

Bearer capability information element octets 4a and 4b shall not be included.

The user may also specify the layer 1 (e.g. rate adaption), layer 2 (i.e. LAPB), and layer 3 (i.e. CCITT Recommendation X.25 [14]) information transfer protocols in the Low layer compatibility information element or in the Bearer capability information element in the SETUP message (see also Annex L to ETS 300 102-1 [26] entitled "Low layer information coding principles").

7.1.2 Access to the ISDN virtual circuit service (Case B)

7.1.2.1 B-Channel

Demand access B-channel connections are controlled using the D-channel signalling procedures for call establishment described in subclause 5.1 of ETS 300 102-1 [26] using the messages defined in Annex B with the following exceptions:

- The procedures for overlap sending specified in subclause 5.1.3 of ETS 300 102-1 [26] do not apply;
- The procedures for call proceeding and overlap sending specified in subclause 5.1.5.2 of ETS 300 102-1 [26] do not apply;
- The procedures for notification of interworking at the origination interface specified in subclause 5.1.6 of ETS 300 102-1 [26] do not apply;
- The procedures for call confirmation indication specified in subclause 5.1.7 of ETS 300 102-1 [26] do not apply;
- The procedures for call connected specified in subclause 5.1.8 of ETS 300 102-1 [26] apply as follows:
  * Upon accepting the access connection, the network shall send a CONNECT message across the user-network interface to the calling user and enter the Active state;
  * This message indicates to the calling user that an access connection to the packet handler has been established;
  * On receipt of the CONNECT message, the calling user shall stop timer T310 (see ETS 300 102-1 [26]) may optionally send a CONNECT ACKNOWLEDGE message, and shall enter the Active state.
- The procedures for call rejection specified in subclause 5.1.9 of ETS 300 102-1 [26] apply as follows:
  * When unable to accept the access connection, the network shall initiate call clearing at the originating user-network interface as described in subclause 5.3 of ETS 300 102-1 [26].

- The procedures for transit network selection specified in subclause 5.1.10 of ETS 300 102-1 [26] do not apply.

The specific B-channel to be used as a demand connection is selected using the channel selection procedures described in subclause 5.1.2 of ETS 300 102-1 [26] and summarised in table 2.

For a demand connection to an ISDN PH, the Bearer capability information element included in the SETUP message shall be coded with:

- information transfer capability set to "unrestricted digital information";
- transfer mode set to "packet mode";
- information transfer rate set to 00000;
- user information layer 2 protocol set to "CCITT Recommendation X.25 [14], link layer";
- user information layer 3 protocol set to "CCITT Recommendation X.25 [14], packet layer".

Octets 4a, 4b and 5a, 5b, 5c, 5d shall not be included.

The demand access connection can then be used to support packet communications according to CCITT Recommendation X.25 [14] link layer and CCITT Recommendation X.25 [14] packet layer procedures as specified in subclause 7.3.

Some networks may require the Calling party number and Calling party subaddress information elements to be included in the SETUP message to select a specific user profile.

7.1.2.2 D-channel

The D-channel provides a connection which enables the ISDN user terminal to access a PH function within the ISDN by establishing a link layer connection (SAPI=16) to that function which can then be used to support packet communications according to CCITT Recommendation X.25 [14] layer 3 procedures as defined in subclause 7.3. The CCITT Recommendation X.25 [14] packet layer uses the acknowledged information transfer service (i.e., I-frames) provided by LAPD (see ETS 300 125 [28]). Consequently ETS 300 102-1 [26] procedures are not required to provide D-channel access.

A number of packet mode user equipments can operate simultaneously over the D-channel, each using a separate layer 2 data link identified by an appropriate data link connection endpoint identifier (see ETS 300 125 [28]) in frames transferred between the user and PH.

7.2 Incoming access

7.2.1 Access from PSPDN services (Case A)

The ISDN signals the establishment of the circuit-mode connection using the procedures described in subclause 5.2 of ETS 300 102-1 [26]. The virtual calls are signalled between the user and the AU using the procedures described in subclause 7.3.

7.2.1.1 General

The general procedures performed by the AU are those defined in CCITT Recommendation X.32 [16].

7.2.1.2 Channel negotiation

If the physical circuit desired by the AU does not exist between the terminal and the AU, the procedures for physical channel establishment described in the following subclauses apply.

The format of the SETUP message sent by the network to the user is in accordance with subclause 3.1 of ETS 300 102-1 [26].

The bearer capability information element included in SETUP message shall be coded with:

- information transfer capability set to "unrestricted digital information";
- transfer mode set to "circuit mode";
- information rate set to "64 kbit/s".

Bearer capability information element octets 4a and 4b shall not be included.

The AU may also specify the layer 1 (e.g. rate adaption), layer 2 (i.e. LAPB) and layer 3 (i.e. CCITT Recommendation X.25 [14]) information transfer protocols in the Low layer compatibility information element or in the Bearer capability information element in the SETUP message (see Annex L to ETS 300 102-1 [26] entitled "Low layer information coding principles")

The channel identification information element octets 4a and 4b shall be coded according to table 3.

Table 3: Network requested channel and user response.
Incoming access from an AU

Channel indicated in the SETUP message network to user direction			Allowable user response user-network	
Information Channel selection (NOTE 4)	Preferred or Exclusive	D-channel indicator (NOTE 5)		
Bi	Exclusive	No	Bi	
Bi	Preferred	No	Bi,Bi`	NOTE 1
Any	ignore	No	Bi'	NOTE 2
No channel	ignore	No	Bi',No B channel	NOTE 3

Key:
Bi - indicated (idle) B-channel
Bi' - any other idle B-channel (not permitted for broadcast call offering).

NOTE 1: This encoding is not used for broadcast call offering.

NOTE 2: All other encodings are invalid.

NOTE 3: See ETS 300 058 [24] (Call waiting) for allowable user response.

NOTE 4: In the case of primary rate access (PRA) this field shall be "channel number".

NOTE 5: D-channel indicator shall be coded:

0 to indicate NO;
1 to indicate YES.

The B-channel connection to the called user shall be established by the network using the signalling procedures described in subclause 5.2 of ETS 300 102-1 [26]. The call is offered by sending the SETUP message on a point-to-point data link or on the broadcast data link.

The user responds to the SETUP as specified in subclause 5.2 of ETS 300 102-1 [26].

7.2.2 Access from the ISDN virtual circuit service (Case B)

To offer an incoming call, the network must perform the following steps:

1) Channel selection - the physical channel/logical link to be used for the incoming call must be identified. The network may use customer profile information, network resources, etc., to choose the channel, or the procedures in Step 2 below;

2) Physical channel/logical link establishment - if the physical B-channel or the logical link of the D-channel have not been determined by Step 1, the network shall use the procedures in subclause 7.2.2.3. The network shall then proceed with Step 3, unless premature clearing occurs;

3) Virtual call establishment - the network establishes the virtual call using the procedures described in subclause 7.3.

In the configuration for the ISDN virtual circuit service, the choice of channel type to be used for the delivery of a new *incoming call* packet made by the network as described below.

1) A new *incoming call* packet may be indicated to the ISDN customer by a call offering procedure between the network and all user packet mode terminals (see subclauses 4.2.3.2 and 4.2.3.3);

2) An incoming virtual call directed to a terminal with an established connection to the PH may be offered directly to the terminal over the established access connection without the use of ETS 300 102-1 [26] call offering procedures (see subclauses 4.2.3.1 and 4.2.3.2).

7.2.2.1 B-Channel

When calls are to be offered on the B-channels without channel negotiation, the procedures described in subclause 5.2 of ETS 300 102-1 [26] using the messages of Annex B apply with the following exceptions:

- The procedures for overlap receiving specified in subclause 5.2.4. of ETS 300 102-1 [26] do not apply;

- The procedures for channel selection are specified in table 4;

- The procedures for receipt of CALL PROCEEDING and ALERTING specified in subclause 5.2.5.2 of ETS 300 102-1 [26] apply with the following exception:

  * The receipt of an ALERTING message shall not cause the network to send a corresponding ALERTING message to the calling user.

- The procedures for call failure specified in subclause 5.2.5.3 of ETS 300 102-1 [26] apply with the following note:

  * The network clears the incoming X.25 virtual call towards the calling X.25 DTE using the appropriate cause from table 6.

- The procedures for notification of interworking at the terminating interface specified in subclause 5.2.6 of ETS 300 102-1 [26] apply with the following exceptions:

  * The case of the call entering an ISDN environment during call establishment is not applicable;

  * In the case of a call leaving the ISDN environment within the called user's premises, no notification is sent to the calling party;

  * The case of in-band information/patterns is not applicable.

- The procedures for active indication specified in subclause 5.2.8 of ETS 300 102-1 [26] apply with the following exception:

  * The network shall not initiate procedures to send a CONNECT message towards the calling user.

- The procedures for user notification specified in subclause 5.2.10 of ETS 300 102-1 [26] do not apply.

Where an established B-channel connection is to be used, the *incoming call* packet will be delivered in accordance with subclause 7.3.

Where a new B-channel connection is to be established, the identity of the selected user will be associated with the Connection Endpoint Suffix (CES) from which the first CONNECT message has been received.

7.2.2.2 D-Channel

The D-channel provides a connection which enables the ISDN PH to access an ISDN user terminal or vice versa. This access is accomplished by establishing a link layer connection (SAPI=16) to the terminal or network which can then be used to support packet communications according to CCITT Recommendation X.25 [14] layer 3 procedures as defined in subclause 7.3.

The layer 2 procedures shall be in accordance with ETS 300 125 [28]. The D-channel provides semi-permanent connection for packet access since all layer 2 frames containing a packet mode SAPI (16) are routed automatically between the user and the PH function.

When an incoming call is offered to packet mode user equipment at the user interface, the channel selection procedures described in subclause 7.2.2.3 shall be used.

A number of packet mode terminals can operate simultaneously over the D-channel, each using a separate layer 2 link identified by an appropriate TEI (see ETS 300 125 [28]) in frames transferred between the terminal and the network.

7.2.2.3 Call offering

7.2.2.3.1 Channel selection through call offering

The call offering procedure is performed using the layer 3 messages of Annex B and the procedures of subclause 7.2.2.1. The call offering procedure is integrated into the circuit-switched call control procedures, signalled on the D-channel, with the channel selection being accomplished by means of the channel selection procedure if offered as a network option.

As described in Clause 5 of ETS 300 102-1 [26], the network selects the first user which responds to the call offering with a CONNECT message. When the selected user has requested that the X.25 call be set up over a new B-channel, the network will indicate that the channel is acceptable by returning a CONNECT ACKNOWLEDGE message to the user. If multiple terminals have responded positively to the SETUP message, the network shall clear each of the non-selected terminals with a RELEASE message containing cause #26, "*non-selected user clearing*".

When the selected user has requested that the X.25 call be set up over an established B-channel or the D-channel, the network shall respond to the CONNECT message with a RELEASE message containing cause #7, "*call awarded and being delivered in an established channel*". The network shall also return a RELEASE message containing cause #26, "*non-selected user clearing*" to any other positively responding terminals. The network will then deliver the X.25 call over the selected channel.

ETSI requirement: On the D-channel of a user access, for a given communication the same connection endpoint suffix (CES) value as the one used by the selected terminal during the signalling phase (SAPI s) shall be used for data transfer over the D-channel (using SAPI p).

NOTE: There is no time significance between the delivery of the RELEASE message and the *incoming call* packet, i.e., either may occur first.

If the channel indicated by the first positively responding user is not available, the network will use ETS 300 102-1 [26] call clearing procedures to clear the call with cause #6, "*channel unacceptable*". If the channel indicated in the SETUP message is not acceptable to the user, the user will clear the call with a RELEASE message containing cause #34, "*no circuit channel available*" or cause #44, "*requested circuit/channel not available*".

On the basis of a network option or subscription agreement, the network selects the access channel or access channel type (e.g., B or D) for a particular incoming packet call.

When the channel indication information element indicates Channel indication = No channel, Exclusive, and D-channel indication = Yes, then the bearer capability information element should be encoded as follows:

- Information transfer capability set to: Unrestricted digital information;
- Transfer mode set to: packet mode;
- Information rate set to: packet mode (00000);
- Layer 2 protocol set to: ETS 300 125;
- Layer 3 protocol set to: Recommendation X.25, packet layer.

In all other cases, the bearer capability information element should be encoded as follows:

- Information transfer capability set to: Unrestricted digital information;
- Transfer mode set to: packet mode;
- Information rate set to: packet mode (00000);
- Layer 2 protocol set to: Recommendation X.25, link layer;
- Layer 3 protocol set to: Recommendation X.25, packet layer.

If the terminal responds with D-channel indication set (see table 4), the Layer 2 protocol to be used is ETS 300 125 [28] (LAPD).

The channel selection procedure for incoming calls is independent of the type of channel selected at the calling end. In this respect, any combination of channel type used at each end is possible, provided the user rates and available bandwidth are compatible.

The channel selection principle to be used in the procedure is shown in table 4.

When the incoming SETUP message is sent on a broadcast data link with a channel identification information element which indicates an idle B-channel and "preferred", the called user is not permitted to respond with a different idle B-channel in the response. The option to respond with a different idle channel is restricted to point-to-point call offerings.

Networks providing packet mode call offering shall provide ETS 300 102-1 [26] signalling procedures for packet mode calls on SAPI=O.

The option by which, in CCITT Recommendation Q.931 [8] paragraph 6.2.2.3.1, the network may offer SAPI=16 broadcast call offering procedures for providing and supporting ETS 300 102-1 [26] signalling procedures is not recommended within this ETS.

Table 4: Network requested channel and user response incoming access for packet mode

Channel indicated in the SETUP message network to user direction (Note 2)			Allowable user response network-user
Information Channel selection (NOTE 3)	Preferred or Exclusive	D-channel indicator (NOTE 4)	
Bi	Exclusive	No	Bi
		Yes	Bi,D
Bi	Preferred	No	Bi,Bi',Bj
		Yes	Bi,Bi',Bj,D
No channel	Preferred	No	Bj
		Yes	Bj,D
	Exclusive	Yes	D

Key:

Bi - indicated (idle) B-channel
Bi' - any other idle B-channel (not permitted in response to broadcast call offering
Bj - an established B-channel under the user's control
D - the D-channel

NOTE 1: All other encodings are invalid

NOTE 2: Public networks conforming this ETS don't offer the negotiation between B- and D-channel. Network which do not support B-channel negotiation shall offer the incoming call by indicating either Bi Exclusive, No D-channel, or No channel Exclusive, D-channel, in the SETUP message.

NOTE 3: In the case of Primary Rate Access (PRA) this field shall be "channel number".

NOTE 4: D-channel indicator shall be coded:

0 to indicate NO;
1 to indicate YES.

7.2.2.3.2 Information element mapping

Some networks may choose to provide a service of mapping some or all of the information from the *incoming call* packet into the SETUP message (see subclause 4.2.1). table 5 shows the mapping of the X.25 incoming call elements to ETS 300 102-1 [26] information elements. The *incoming call* packet will still contain these fields when it is delivered. See subclause 4.2.3.4 for mapping requirements.

Table 5: Mapping of CCITT Recommendation X.25 information elements to corresponding ETS 300 102-1 SETUP message information elements in packet-mode incoming call (NOTE 1)

	Information elements in X.25 incoming call packet	Corresponding information element in ETS 3000 102-1 SETUP message
	Calling DTE address	Calling party number
	Called DTE address	Called party number
	User data (UD)	Not applicable
	D-bit	Not applicable
	Modulus	Not applicable
X.25 user facility	Flow control parameter negotiation	Not applicable
	Throughput class negotiation	Not applicable
	Fast select	Not applicable
	Reverse charging	Not applicable
	Closed user group selection	Not applicable
	Closed user group with outgoing access selection	Not applicable
	Bilateral closed user group	Not applicable
	Transit delay selection and indication	Not applicable
	Call redirection and deflection notification	Not applicable
DTE facility	Calling address extension	Calling party sub-address
	Called address extension	Called party sub-address
	End-to-end transit delay	Not applicable
	Minimum throughput class	Not applicable
	Expedited data negotiation	Not applicable

NOTE 1: Mapping is optional or required as indicated in subclause 4.2.3

NOTE 2: The network will map bits 8 and 7 of the first octet of the Called address extension facility parameter field in the X.25 incoming call packet to "Type of subaddress" field in octet 3 of Called party subaddress information element in ETS 300 102-1 [26] SETUP message, assuming that the X.25 incoming call packet is coded based on 1988 version of CCITT Recommendation X.25 [14]. Therefore, the called user should notice that the received "Type of subaddress" may not be correct when the X.25 incoming call packet is coded based on the 1984 version of CCITT Recommendation X.25.

7.2.2.3.3 Channel selection without call offering

Where the network and user have agreed beforehand, the network may route an incoming call to the called user over an established B-channel connection or D-channel link without the need for any signalling for channel selection.

7.3 Virtual call establishment and release

In all cases, once the physical B-channel or logical link in the D-channel has been selected and, if necessary, connected to the PH or AU, the virtual call is established according to the procedures below. Some networks may require some of the terminal identification procedures of CCITT Recommendation X.32 [16] as well.

7.3.1 Link layer establishment and release

Link layer (CCITT Recommendation X.25 [14] LAPB on the B-channel or ETS 300 125 [28] LAPD on the D-channel) establishment shall be initiated by:

- the calling terminal in the case of outgoing calls;
- the AU in the case of incoming calls in Case A;

  or

- the PH in the case of incoming calls in Case B.

Link layer release may be initiated by:

- the terminal;
- the AU in Case A;

  or

- the PH in Case B.

7.3.2 Packet layer virtual call SETUP and RELEASE

The packet layer procedures of CCITT Recommendation X.25 [14] will be used for layer 3 call set-up and release. The packet layer procedures will additionally be able to control and monitor the established or released state of the link layer.

In case B, the PH may (in ETSI networks) maintain a timer T320 (defined in ETS 300 102-1 [26]). T320 is started:

a) upon clearance of the last virtual call;

or:

b) upon transmission of a CONNECT message by the network in case of an outgoing B-channel access connection;

or:

c) upon transmission of a CONNECT ACKNOWLEDGE message by the network in case of an incoming B-channel access connection;

or:

d) upon establishment of the link layer for D-channel access connections.

T320 is cancelled upon:

a) establishment of the first (next) virtual call;

or:

b) receipt of a clearing message from the user;

or:

c) disconnection of the SAPI=16 link on the D-channel.

Upon expiry of T320, the PH will release the link layer and, in the case of B-channel access, initiate clearing of the B-channel.

CCITT Recommendation X.25 [14] logical channels are associated with their underlying logical link. Specifically, in case of the use of the B-channel for packet communication there is an association between the logical channels and the LAPB logical link below them. Thus the same logical channel number may be used simultaneously on each different B-channel.

7.4 Call clearing

7.4.1 B-Channel

The clearing of the switched connection shall be effected by using the D-channel signalling procedures for call clearing as specified in subclause 5.3 of ETS 300 102-1 [26]. For access to PSPDN services, no exceptions apply. For the ISDN virtual circuit service, the messages of Annex B are used, and the following exceptions apply:

- The terms defined in subclause 5.3.1 of ETS 300 102-1 [26] "Terminology" apply by replacing "circuit-switched ISDN connection" with "demand packet mode access connection";

- The exception condition (f) specified in subclause 5.3.2 of ETS 300 102-1 [26] does not apply;

- The procedures for clearing with tones and announcements provided in subclause 5.3.4.1 of ETS 300 102-1 [26] do not apply.

The B-channel may be cleared at any time by the user though, in general, it will be cleared following the clearing of the last virtual call over that B-channel. In the ISDN virtual circuit service, if the user clears the B-channel access connection using ETS 300 102-1 [26] clearing message while X.25 virtual calls still exist on the B-channel, the network shall clear the X.25 virtual call(s) with cause #17 "*remote procedure error*", and diagnostic #64, "*call setup, call clearing, or registration problem*".

In case B, if an ETS 300 102-1 [26] RESTART message relating to the particular B-channel or to the whole interface, is received by the PH during the X.25 data transfer phase, the X.25 virtual calls shall be treated as follows:

- For switched virtual circuits, an X.25 *clear indication* packet shall be sent with cause #9, "*out of order*" and diagnostic #0, "*no additional information*";

- For permanent virtual circuits, an X.25 "*reset*" packet shall be sent containing cause #9, "*out of order*" and diagnostic # 0, "*no additional information*".

At the expiration of timer T320, the network may disconnect the X.25 link layer and the access connection. B-channel clearing is as described in subclause 5.3 of ETS 300 102-1 [26] with the exception above, with cause #102, "*recovery on timer expiry*".

7.4.2 D-Channel

D-channel access connections are cleared using the disconnect procedures as defined in subclause 7.3.

7.4.3 Additional error handling information

When call failure occurs, or the X.25 virtual call is cleared prematurely, the rules of subclause 5.8 of ETS 300 102-1 [26] shall apply. In addition, the following rules for determining the appropriate cause to be used shall apply in order of decreasing priority:

1) If a ETS 300 102-1 [26] clearing message or RESTART message is received by the PH during the X.25 data transfer phase, subclause 7.4.1 applies;

2) If a call is rejected by the destination user using ETS 300 102-1 [26] messages, the X.25 virtual call shall be cleared using a *clear indication* packet and the appropriate cause from table 6;

3) If a condition exists that prevents the ETS 300 102-1 [26] SETUP message from being delivered at the user-network interface, the X.25 virtual call shall be cleared using a *clear indication* packet and a cause shall be selected appropriate to the condition. table 6 shall serve as a guide to selecting an appropriate cause, i.e., the X.25 mapping of the ETS 300 102-1 [26] cause describing the interface condition shall be used (e.g. see figure III..8 in Appendic III);

4) If the ETS 300 102-1 [26] SETUP message is sent across the user-network interface, but no response is received prior to the second expiry of timer T303 (defined in ETS 300 102-1 [26]), rule #3 applies;

5) If the ETS 300 102-1 [26] SETUP message is sent across the user-network interface, and a response is received from a user which results in the clearing of the call at the user-network interface, the X.25 virtual call shall be cleared using a *clear indication* packet containing the appropriate cause from table 6 relative to the cause received/sent in the 300 102-1 [26] clearing message;

6) If an X.25 *clear request* packet is received from the originating user prior to the delivery of the X.25 *incoming call* packet to the called user (premature clearing), the PH shall sent a *clear confirmation* packet to the calling user and the access connection shall be treated as follows:

- If the ETS 300 102-1 [26] SETUP message was associated with the unconditional notification class of service (see subclause 4.2.3), the access connection, when and if established, shall be cleared. The 300 102-1 [26] clearing message shall contain the appropriate cause as described in table 7.

- If the ETS 300 102-1 [26] SETUP message was associated with the conditional notification class of service (see subclause 4.2.3) and there exists at least one terminal which responds positively to the ETS 300 102-1 [26] SETUP message, then two options are allowed:

  a) the access connection is cleared as described for the Unconditional class of service;

  or:

  b) the access connection is established and timer T320 is started. Upon expiry of timer T320, the access connection is cleared with cause #102, "*recovery on timer expiry*" and diagnostic indicating timer T320.

7.4.4 Cause mappings

7.4.4.1 Access to/from PSPDN services (Case A)

The AU may choose to follows the procedures in subclause 7.4.4.2 when mapping between causes delivered by the ISDN or the PSPDN.

7.4.4.2 Access to/from the ISDN virtual circuit service (Case B)

There are several cases where it is necessary to map causes between ETS 300 102-1 [26] and CCITT Recommendation X.25 [14]. Networks shall use table 6 and table 7 to map the causes between ETS 300 102-1 [26] and CCITT Recommendation X.25 [14] messages. The figures in Appendix III describe some example situations.

7.5 Access collision

When the network offers a packet mode call at the interface simultaneously with the user requesting a packet mode call, the network shall give priority to the completion of the incoming call. If the user determines that accepting the incoming call would meet the needs of its own outgoing call request, the user may clear the call request and accept the incoming call.

Table 6: Mapping of ETS 300 102-1 cause fields to CCITT Recommendation X.25 cause fields

Item	ETS 300 102-1 Cause	Code	ETS 300 102-1 Diagnostic	X.25 Cause	Code	X.25 Diagnostic	Code
1	Unallocated (unassigned) number	1	Condition: unknown,transient permanent	Not obtainable	13	Invalid called address	67
2	No route to destination	3	Condition: unknown,transient permanent	Not obtainable	13	Invalid called address	67
3	Channel unacceptable	6	(none)	Remote procedure error	17	Call setup,call clearing or registration problem	64
4	Normal call clearing	16	Condition: unknown,transient permanent	DTE originated	0	No additional information	0
5	User busy	17	(none)	Number busy	1	No logical channel available	71
6	No user responding	18	(none)	Remote procedure error	17	Call setup,call clearing or registration problem	64
7	No answer from user (user aborted)	19	(none)	Remote procedure error	17	Call setup,call clearing of registration problem	64
8	Call rejected	21	Condition: unknown,transient permanent + user applied diagnostics	DTE originated	0	No additional information	0
9	Number changed	22	New destination address	Not abtainable	13	Invalid called address	67
10	Destination out or order	27	(none)	Out of order	9	No additional information	0
11	Invalid number format (incomplete number)	28	(none)	Local procedure error	19	Invalid called address	67
12	Normal unspecified	31	(none)	DTE originated	0	No additional information	0
13	No circuit/ channel available	34	(none)	Number busy	1	No logical channel available	71
14	Network out of order	38	(none)	Out of order	9	No additional information	0
15	Temporary failure	41	Network identity	Out of order	9	No additional information	0
16	Switching equipment congestion	42	Network identity	Network congestion	5	No additional information	0

Table 6 (continued): Mapping of ETS 300 102-1 cause fields to CCITT Recommendation X.25 cause fields

Item	ETS 300 102-1 Cause	Code	ETS 300 102-1 Diagnostic	X.25 Cause	Code	X.25 Diagnostic	Code
17	Requested circuit/channel available	44	(none)	Number busy	1	No logical channel available	71
18	Resources unavailable, unspecified	47	(none)	Network congestion	5	No additional information	0
19	Quality of service unavailable	49	Condition: unknown,transient permanent	Network congestion	5	No additional information	0
20	Bearer capability not authorised	57	Bearer capability information element identifier	Incompatible destination	33	No additional information	0
21	Bearer capability not presently available	58	Bearer capability information element identifier	Remote procedure error	17	Call setup,call clearing or registration problem	64
22	Service or option unavailable, unspecified	63	(none)	Remote procedure error	17	Call setup,call clearing or registration problem	64
23	Bearer service not implemented	65	Attribute numbers	Incompatible destination	33	No additional information	0
24	Channel type not implemented	66	Channel type	Remote procedure error	17	Call setup,call clearing or registration problem	64
25	Service or option not implemented, unspecified	79	(none)	Remote procedure error	17	Call setup,call clearing or registration problem	64
26	Invalid call reference value	81	(none)	Remote procedure error	17	Call setup,call clearing or registration problem	64
27	Identified channel does not exist	82	Channel identity	Remote procedure error	17	Call setup,call clearing or registration problem	64
28	Incompatible destination	88	Incompatible parameter	Incompatible destination	33	No additional information	0
29	Invalid message, unspecified	95	(none)	Remote procedure error	17	Call setup,call clearing or registration problem	64
30	Mandatory information element is missing	96	Information element identifier(s)	Remote procedure error	17	Call setup,call clearing or registration problem	64
31	Message type non-existent or not implemented	97	Message type	Remote procedure error	17	Call setup,call clearing or registration problem	64

Table 6 (concluded): Mapping of ETS 300 102-1 cause fields to CCITT Recommendation X.25 cause fields

Item	ETS 300 102-1 Cause	Code	ETS 300 102-1 Diagnostic	X.25 Cause	Code	X.25 Diagnostic	Code
32	Message not compatible with call state or message type non-existent or not implemented	98	Message type	Remote procedure error	17	Call setup,call clearing or registration problem	64
33	Information element non-existent or not implemented	99	Information element identifiers(s)	Remote procedure error	17	Call setup,call clearing or registration problem	64
34	Invalid information element contents	100	Information element identifier(s)	Remote procedure error	17	Call Setup,call clearing or registration problem	64
35	Message not compatible with call state	101	Message type	Remote procedure error	17	Call setup,call clearing or registration problem	64
36	Recovery on timer expiry	102	Timer number	Remote procedure error	17	Call setup,call clearing or registration problem	64
37	Protocol error unspecified	111	(none)	Remote procedure error	17	Call setup,call clearing or registration problem	64
38	Interworking, unspecified	127	(none)	Remote procedure error	17	Call setup,call clearing or registration problem	64

NOTE 1: When clearing occurs during the X.25 data transfer phase, the procedure described in subclause 7.4.1 should be used.

NOTE 2: When the ETS 300 102-1 [26] RESTART message is received during the X.25 data transfer phase, switched virtual circuits shall be cleared with a *clear indication* packet containing cause # 9, "*Out of order*", with diagnostic # 0, "*no additional information*". Permanent virtual circuits shall have an X.25 *reset packet* sent with the same cause and diagnostic.

Table 7: Mapping of CCITT Recommendation X.25 cause to ETS 300 102-1 cause for premature clearing of the incoming call

	X.25 cause in *clear indication* packet				ETS 300 102-1 error condition		
Item	X.25/X.96 cause	Code	Diagnostic	Code	ETS 300 102-1 cause	Code	Diagnostic
1	DTE originated	0	No additional information	0	Normal call clearing	16	(none)
		1XX	DTE specified	XX			
2	Network congestion	5	No additional information	0	Switching equipment congestion	42	(none)
3	Out of order	9	No additional information	0	Destination out of order	27	(none)
4	Remote procedure error	17	(Any allowed)		Protocol error, unspecified	111	(none)

NOTE: Instead of providing the above mapping of X.25 to ETS 300 102-1 [26], the PH, as a network option, may code the ETS 300 102-1 [26]. Cause information element to indicate "CCITT Coding Standard" in octet 3, "X.25" in octet 3a, and code octets 4 amd 5 according to CCITT Recommendation X.25 [14], coping the cause from the X.25 *clear indication* packet rather than mapping it to a ETS 300 102-1 [26] cause.

8 Terminal adaptor functionalities

8.1 General

Terminal Adaptor (TA) functions are needed to support the access of CCITT Recommendation X.25 [14] DTEs at the coincident S and T reference point (see figure 4).

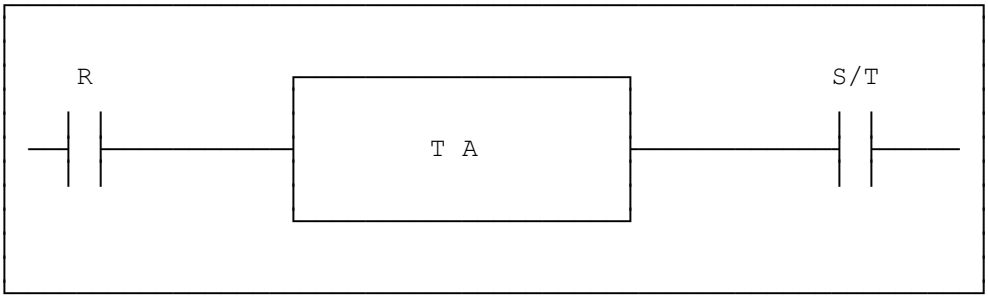


Figure 4

NOTE: A TA function supports only one CCITT Recommendation X.25 [14] DTE (simple or complex, e.g. LAN-gateway) at reference point R but more than one TA function may simultaneously share the D-channel, each TA using a separate LAPD link.

Main functionalities which are provided by the TA are the following:

- rate adaption;
- mapping of signalling information and procedures between the S/T and the R reference point;
- synchronisation;
- maintenance.

In the following, these main functionalities are described depending on the access types (B-channel and/or D-channel access), highlighting the differences between the two services defined in this ETS (Case A and Case B).

The procedures at the coincident S and T reference point are described in subclause 7.

8.2 Physical interfaces

The physical interfaces supported at the R reference point are those defined in CCITT Recommendation X.25 [14] paragraph 1, and CCITT Recommendation X.32 [16].

8.3 Access through the B-channel

8.3.1 General

This part defines the functionalities to be supported by the TA when the access through the B-channel is used. Both service Cases A and B are covered and differences, if any, are shown in the appropriate subparagraphs.

8.3.2 Rate adaption

Rate adaption can be performed according to one of the following two methods. The choice of the method is a network matter:

1) Packet mode of operation (Case B) and circuit mode of operation (case A) by using HDLC interframe flag stuffing.

   In this case, packet mode terminals operating at data signalling rates lower than 64 kbit/s at the R reference point can no longer be distinguished by the network from packet mode terminals operating at a data rate of 64 kbit/s at the R reference point.

   Therefore, the D-channel signalling procedures will indicate the data signalling rate of 64 kbit/s rather than the user data signalling rate at the R reference point. In addition, a throughput class may be indicated in the D-channel incoming call signalling procedures.

   It should be noted that the packet handling in the ISDN will be optimised for DTEs generating HDLC structured traffic at 64 kbit/s. In such an ISDN, flag stuffing is the preferred method for rate adaption.

   In order to avoid unnecessary retransmission on the B-channel, the TA implementation could have a buffer capacity which is related to the layer 2 window size and maximum frame length or may have flow control at layer 2.

2) Circuit mode of operation (Case A) by using the method indicated in ETS 300 103 [27] (for synchronous DTEs).

In this case, the D-channel signalling procedures shall indicate the data signalling rate being used by the DTE connected to the R reference point (this will be lower than 64 kbit/s).

NOTE: The use of the CCITT V series Recommendation methods for rate adaption is for further study.

8.3.3 Signalling

This part defines the functionalities to be supported by the TA to establish, maintain and release a B-channel connection to the PH/AU. These functionalities require a different degree of capabilities by the TA on the basis of the different implementation of CCITT Recommendation X.25 [14] procedures in the DTE. Two cases can be identified, namely:

Case 1: TA acts only on level 1;

Case 2: TA acts also on level 2 and/or 3.

The first case applies to CCITT Recommendation X.25 [14] DTEs which can disconnect at the physical level, when no VCs are in progress.

For CCITT Recommendation X.25 [14] DTEs which are not able to disconnect at the physical level or even require an active link, the consequence of the first case may be the automatic allocation of the B-channel immediately after power on. To avoid this situation with a permanently allocated B-channel, an alternative configuration is presented in Appendix I.

This subclause refers to signalling mapping of the first case.

8.3.3.1 Outgoing call

To provide a physical connection by means of a B-channel to the PH or PSPDN AU the TA shall provide:

- a method to indicate that the TA should start the B-channel establishment procedure at the coincident S and T reference point. The options available are described in subclause 8.3.3.1.1;

- a method to transfer address information to TA which is needed by the B-channel establishment procedure. The options available are described in subclause 8.3.3.1.2.

8.3.3.1.1 Conditions for initiating B-channel establishment

Two situations can be identified to categorise the conditions which may cause the TA to attempt to establish a B-channel connection.

a). (semi-) permanent B-channel

In this case, the B-channel is always available. No TA functionality is required to initiate the establishment of the B-channel connection.

b). B-channel establishment is initiated by actions at the R reference point (DTE/TA interface).

Two conditions are possible. See table 8.

b1. Hot-line access at the R reference point:

In case of hot-line access at the R reference point the detection of the following appropriate interface conditions shall cause the TA to establish the B-channel with the PH/PSPDN;

i. For CCITT Recommendation X.25 [14] level 1 interfaces - a transition from OFF to ON on the control lead (in case of X.21 leased circuit procedures) or circuit 108 (in case of X.21 *bis* or V - series interface procedures).

ii. For X.21 interface - direct call signal (C=ON):

The DTE will wait for I=ON before starting transmission.

iii. For the X.21 *bis* interface - direct call signal (108=ON):

The DTE will wait for 107=ON before starting transmission

iv. For the V.25 *bis* interface - direct call signal (108=ON):

The DTE will wait for 107=ON before starting transmission.

b2. Full circuit-switched selection access:

Full circuit-switched selection procedure (X.21, X.21 *bis* or V.25 *bis*) may be used at the DTE/TA interface to request the establishment of the B-channel connection to a PSPDN or PH. The TA will establish the B-channel connection to a PSPDN or PH. The TA will establish the B-channel in accordance with the procedures described in subclause 7. The address provided may be used to identify the PSPDN port and full CCITT Recommendation X.25 [14] procedures must be used following the establishment of the B-channel connection to identify the called packet mode DTE. Other method of selection may also be used;

In case of full circuit-switched selection, the following operating modes of CCITT Recommendations X.21 [12], X.21 *bis* [13] and V.25 *bis* [9] at the DTE/TA interface shall cause the TA to establish the B-channel with the PH/PSPDN.

i. For X.21 circuit-switched interfaces - X.21 call control phase.

ii. For X.21 *bis* circuit-switched interfaces - use of X.21 *bis* automatic address call facility.

iii. For V.25 *bis* circuit-switched interface - V.25 *bis* addressed call mode.

NOTE: The user may cause the TA to attempt to establish a B-channel connection by manual actions (e.g. by pressing a button) at the human/machine interface of the TA. Subsequently the TA may emulate the incoming call towards the DTE.

8.3.3.1.2 Options for transferring the ISDN address of the PSPDN port to the TA

Four options exist to handle address information of the PSPDN port at the TA:

a) (Semi-) permanent B-channel at the coincident S and T reference point:

In this case the TA has no need of address information, i.e. no functionality is required in the TA to obtain an address;

b) The address is conveyed across the R reference point:

In this case the circuit-switched procedures described in subclause 8.3.3.1.1 b2 are required;

c) The address is conveyed across the human/machine interface of the TA:

Manual procedures are used (e.g. by means of a keypad) at the human/machine interface of the TA. The address may be input each time the B-channel is requested. Alternatively the address may be stored at the TA (e.g., in the case of hot line operation at the R reference point);

d) The address is downloaded by the network via the coincident S and T reference point:

The need for this option is for further study.

NOTE: The address information may be for example a full ISDN address and abbreviated ISDN address, which is used by hot-line access procedures at the coincident S and T reference point, or an abbreviated address which is interpreted by the TA and expanded to an (abbreviated) ISDN address using pre-recorded information in the TA.

8.3.3.1.3 Mapping of procedures

The list of supported combinations and the appropriate procedures are given in table 9.

Following the establishment of the connection, the TA should place the R reference point in the appropriate condition for data transfer at layer 1.

Table 8: DTE/TA Layer 1 specifications and procedures to initiate B-channel establishment

Condition	DTE/TA layer 1 specification		Events at the R reference point	Procedure according to:
Hot-line access	X.25	X.21 leased circuit	DTE sets C = ON	X.25 clause 1.1
		X.21 bis	DTE sets circuit 108 = ON	X.25 clause 1.2
		V-Series interfaces	DTE sets circuit 108 = ON	X.25 clause 1.3
	X.21 circuit-switched		DTE signals direct call	X.21 clause 4.4
	X.21 bis direct call		DTE signals direct call	X.21 subclause 2.3.1
	V.25 bis direct call		DTE uses direct call mode	V.25 bis clause 5
Full circuit-switched access	X.21 addressed call		DTE enters call control phase	X.21 clause 4
	X.21 bis addressed call		DTE performs automic address call	X.21 bis subclause 2.3.2 iii)
	V.25 bis addressed call		DTE uses address call mode	V.25 bis clause 4

Table 9: TA functionality to control B-channel establishment

	TA functions		Description of procedures
	Conditions for initiation of B-channel establishment (subclause 7.3.3.1.1)	Transfer of address information to the TA subclause 7.3.3.1.2)	
1	Condition a	Option a	(Semi-) permanent B-channel. No signalling functions for layer 1 are needed in the TA.
2	Condition b1 i	Option c	The DTE sets C = ON or circuit 108 = ON. When C (or circuit 108) becomes ON, and the manual selection has been made at the TA, the TA then initiates, using the D-channel procedures, the establishment of an ISDN B-channel to provide a connection to the PSPDN. When the B-channel is completely established at the S/T reference point, the TA sets 1 = ON (or circuit 107 = ON).
3	Any of conditions b1 ii,iii,iv See note in subclause 7.3.3.1.1	Option c Option c	When the manual selection has been made at the TA, the TA may emulate an incoming call at the R reference point in the DCE waiting state at layer 1 and the initiates, using D-channel procedures, the establishment of an ISDN B-channel to provide a connection to the PSPDN. When the B-channel is completely established at the S/T reference point, the TA signals ready for the data at the R reference point.
4	Any of condition b2	Option b	When the DTE has requested the layer 1 connection and provided address information to the TA, the TA initiates, using the D-channel procedures, the establishment of ISDN B-channel. When the B-channel is completely established at the S/T reference point, the TA signals ready for data, using the appropriate procedure at the R reference point.
5	Condition b1	Option a	In this case, hot-line access is applied at the R reference point as well as the S/T reference point. No address information is therefore required by the TA. When the DTE presents the call request, the TA attempts to establish a B-channel. When the B-channel is completely set-up, the TA signals ready for data at the R reference point.

8.3.3.1.4 Mapping of the ETS 300 102-1 messages

The procedures between the TA and the network are the same as described in Clause 7. The choice of the requested service will be made by the appropriate coding of the bearer capability.

In Case A the ISDN address of the PSPDN port will be introduced as the destination in the ETS 300 102-1 [26] message while in Case B no called party number or called party subaddress is contained in the call setup request message.

8.3.3.1.5 CCITT Recommendation X.25 procedures

In the data transfer phase, the TA may be transparent to layer 2 and layer 3 of CCITT Recommendation X.25 [14] procedures. However, some realisations of CCITT Recommendation X.25 [14] terminals may require full or partial termination of layer 2 within the TA to accommodate existing LAPB establishment procedures (see Appendices I and IV).

8.3.3.2 Incoming call

8.3.3.2.1 ETS 300 102-1 call offering

The incoming call, in both Cases A and B, is first offered using ETS 300 102-1 [26] procedures for setting up the B-channel connection.

8.3.3.2.2 Actions at the R reference point

The TA shall not accept an incoming call from the network unless the R reference point is in one of the following states:

- the ready state for an R reference point conforming to X.21 circuit-switched procedures;
- the ready or send data state for an R reference point conforming to X.21 leased circuit procedures;
- circuits 125 and 108 ON with 107 OFF for an R reference point conforming to X.21 *bis* procedures.

If the R reference point is in, or can be placed in, the appropriate state defined above, the TA shall respond to the SETUP message (when compatibility checking has been successful) by returning a CONNECT message in accordance with the procedures of clause 7 and shall then wait for either a CONNECT ACKNOWLEDGE or RELEASE signalling message from the network (the TA may also reject the SETUP message by responding with a RELEASE COMPLETE message).

NOTE: ETS 300 102-1 [26] does not oblige the TA to return an ALERTING message prior to the return of a CONNECT.

If the R reference point is not and can not be placed in the appropriate states defined above, then the TA shall respond to the SETUP message in accordance with the negative response to the incoming call procedures defined in Clause 7.

The receipt of a CONNECT ACKNOWLEDGE message causes the TA to initiate the appropriate procedures described in ETS 300 103 [27] leading to the placing of the R reference point into the appropriate condition for data transfer, and to begin transmission of information in the B-channel.

The DTE/TA interface shall not be placed in the data transfer state before the B-channel is completely set up at the S/T reference point (see subclause 8.3.4).

8.3.3.2.3 CCITT Recommendation X.25 procedures

In the data transfer phase, the TA may be transparent to layer 2 and layer 3 of the CCITT Recommendation X.25 [14] procedures. However, some realisations of CCITT Recommendation X.25 [14] terminals may require full or partial termination of layer 2 within the TA to accommodate existing LAPB establishment procedures (see Appendix I).

8.3.3.3 Call clearing

To initiate the clearing of the B-channel it is necessary to detect the clearing of the last virtual call on the B-channel. Three parties can detect the clearing of the B-channel.

1) the DTE; initiating clearing via the R reference point;
2) the network (PH or AU); initiating clearing via the coincident S and T reference point;

3) the user; initiating clearing manually via the human/machine interface.

Before clearing of the B-channel is initiated, the layer 2 connection between the network and the DTE should be cleared.

8.3.3.3.1 Initiation of call clearing by the DTE

The conditions of the R reference point which cause the TA to attempt to disconnect the B-channel connection are;

- for X.21 circuit-switched interface - DTE clear request signal;
- for X.21 leased circuit interface - a transition from ON to OFF on the control lead;
- for X.21 *bis* interface - DTE clear request signal (circuit 108 from ON to OFF).

When one of these conditions occur, the TA will disconnect the internal rate adapting connection between the R and the coincident S and T reference point (see subclause 8.3.2) and will try to disconnect the B-channel applying the procedures of subclause 7.4.

8.3.3.3.2 Initiation of call clearing by the network

For the clearing of the B-channel the network applies the procedures of subclause 7.4. The receipt of a DISCONNECT or RELEASE message shall cause the TA to disconnect the internal rate adapting connection between the R and the S/T reference point and to take on the R reference point the appropriate action as described below:

- for X.21 circuit-switched interface - signal a DCE clear indication;
- for X.21 leased circuit interface - signal a DCE ready condition;
- for X.21 *bis* interface - set circuit 107 OFF.

See ETS 300 103 [27] for further details.

NOTE: RELEASE may be a common response to a CONNECT message in the case where more than one packet mode terminal is present at the customer premises and the incoming call has been globally offered using the point to multipoint procedures of ETS 300 125 [28].

8.3.3.3.3 Initiation of call clearing by the user

After the manual notification of the clearing of the last virtual call by the user, the TA disconnects the internal connection between the R and S/T reference point and applies the procedures of subclause 7.4 for the clearing of the B-channel. On the R reference point it takes the appropriate action as described below;

- for X.21 circuit-switched interface - signal a DCE clear indication;
- for X.21 leased circuit interface - signal a DCE ready condition;
- for X.21 *bis* interface - set circuit 107 OFF.

See ETS 300 103 [27] for further details.

8.3.4 Synchronisation

The TA should effect synchronisation between the D-channel activities (ETS 300 102-1 [26]) and the B-channel activities (CCITT Recommendation X.25 [14]).

Synchronisation between TA and PH/AU is provided by the exchange of synchronisation pattern. Continuous flag transmission shall be used when flag stuffing rate adaption is used. For class 30, synchronisation will be between the DTE and the PH/AU. The ETS 300 103 [27] scheme will be used when the ETS 300 103 [27] rate adaption is used.

8.4 Access through the D-Channel

8.4.1 General

This part defines the functionalities to be supported by a TA when access through a D-channel is used. This applies only to Case B (access to the ISDN virtual circuit service).

8.4.2 LAPB-LAPD mapping

The rate adaption is inherent to the contention mechanism for accessing the D-channel. In particular, the contiguous flag transmission perceived at the R reference point shall not be repeated at the S/T reference point.

8.4.2.1 Mapping by full link layer termination

Figure 5 shows the mapping architecture between the LAPB link at the R and the LAPD logical link at the S/T reference point, based on full termination of both link layer protocols in the TA. This figure is intended to describe the functionality to be provided by the TA. However, this figure should not constrain any specific implementation.

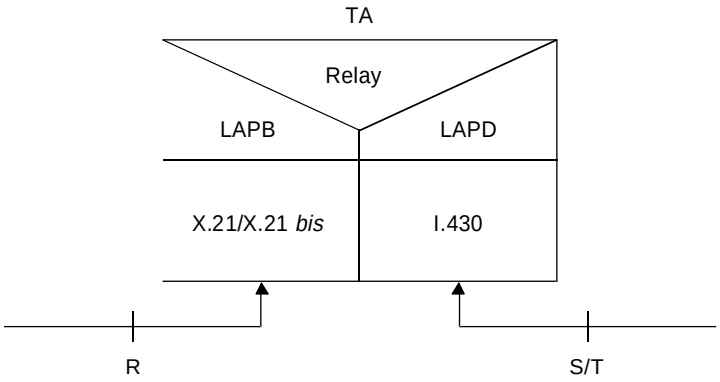


Figure 5: Architecture of the mapping function

The supervisory and unnumbered frames of the LAPB and LAPD procedures have local significance (i.e. only relevant for that link) and therefore need not be mapped to the other link. However, it is possible that the receipt of a supervisory or unnumbered frame should result in the transmission of such a frame on the other link; for instance a SABM(E) frame (when both links are in the disconnected state) or an RR frame may result in the transmission of an equivalent frame on the other link.

The information transfer frames have to be mapped if both links are in the transfer phase. The following mapping functions for these frames can be distinguished:

- Address field mapping;
- Control field mapping;
- Frame check sequence recalculation.

These functions are subject of the following subclauses.

8.4.2.1.1 Information frame-address field mapping

The LAPB address length is 1 octet.

The LAPD address length is 2 octets.

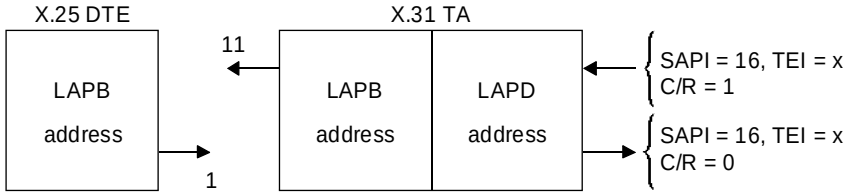


Figure 6: Mapping of LAPB/LAPD addresses by a TA for information frames

8.4.2.1.2 Information frame-control field mapping

LAPB sequence numbering on the I-frames is in general modulo 8, though it might be modulo 128.

LAPD sequence numbering of the I-frame is modulo 128.

The sequence numbers N(S) and N(R) on the LAPB and LAPD link are independent.

In the case where the LAPD window size of 8 would fulfill (e.g., the throughput requirements), the maximum number of I-frames to be buffered in the TA's relay function is 7 in each direction.

The use of the P/F bit in the LAPB link is independent of the use of that bit in the LAPD link.

8.4.2.1.3 Information frame-frame check sequence recalculation

The FCS values on the LAPB and LAPD link are independent. For every frame the FCS values need to be recalculated.

8.4.2.2 Mapping by minimum link layer termination

In addition a simpler implementation of the LAPB-LAPD mapping is possible, without implementing the flow control and error recovery procedures. Such a TA has as a minimum to implement the following mapping functions:

- frame type recognition;
- mapping of address field;
- mapping of control field;
- administration of the state variables (V(S) and V(R) at both interfaces);
- FCS handling.

8.4.3 Signalling

This part defines the functionalities to be supported by the TA to establish, maintain and release a LAPD, SAPI=16, logical link to the PH at the S/T reference point and a LAPB link at the R reference point. These functionalities require a different degree of capabilities by the TA on the bases of the different implementation of CCITT Recommendation X.25 [14] procedures in the DTE.

Several types may be identified, depending on the criteria at the R reference point to initiate call set up:

Type 1: Establishment of a logical, SAPI=16, link in the D-channel upon recognition of the receipt of a SABM frame

Type 2: Idem on receipt of an I frame

Type 3: Idem on receipt of a *call request* packet

NOTE: Alternatively, initiation of call set-up can be carried out by manual means, for example a push button on the TA.

Type 1 is the most simple one because a minimum mapping between LAPB and LAPD is implemented in the TA. This type is described in subclauses 8.4.3.1, 8.4.3.2 and 8.4.3.3. Types 2 and 3, which require full protocol termination in the TA (as described in subclause 8.4.2) are more complicated, but application of these types may be necessary depending on the needs of existing CCITT Recommendation X.25 [14] DTEs. More details about these types are given in Appendix IV.

8.4.3.1 Outgoing call

At the outgoing call the TA initiates the establishment of a D-channel SAPI=16 link to the PH.

The several conditions which force the TA to initiate this establishment are described in subclause 8.4.3.1.1. The establishment of the D-channel link is in accordance with the procedures described in subclause 7.1.2.2.

8.4.3.1.1 Conditions for the establishment of a logical link between the DTE and the PH

Two situations can be identified to categorise the condition which may cause the TA to attempt to establish a D-channel SAPI=16 logical link:

a) (semi-) permanent logical link

In this case the logical link is always available. No TA functionality is required to initiate the establishment of a logical link.

b) Logical link establishment is initiated by actions at the R reference point

The layer 1 interface at the R reference point is in accordance with X.21, X.21 *bis*, or V.25 *bis* interface procedure. Subsequently the DTE will establish the LAPB link at the R reference point and as a consequence the TA will activate the LAPD link (SAPI=16) at the S/T reference point.

NOTE: In principle it is also possible to activate the link between DTE an PH as a result of a manual action at the TA.

8.4.3.1.2 Mapping of link procedures

The mapping between the LAPD logical link at the S reference point and the LAPB link at the R reference point is described in subclause 8.4.2.

8.4.3.1.3 CCITT Recommendation X.25 Procedures

After the establishment of a LAPD link at the S/T and a LAPB link at the R reference point and the concatenation of both links via a mapping function in the TA, CCITT Recommendations X.25 [14] layer 3 procedures are possible between the DTE and the PH. The TA is transparent for these CCITT Recommendation X.25 [14] layer 3 procedures.

8.4.3.2 Incoming call

8.4.3.2.1 ETS 300 102-1 call offering

When notification of the incoming call applies (see subclause 4.2.3), the incoming call is first offered using the ETS 300 102-1 [26] procedures described in subclause 7.2.2.3.1 (channel selection through call offering).

The TA accepts the incoming call when the R reference point is or can be placed in one of the following states:

- the ready or send data state for an R reference point conforming to X.21 procedures;
- circuits 125 and 108 ON with 107 OFF for an R reference point conforming to X.21 *bis* and V.25 *bis* procedures.

The TA shall respond to the offered call according to the same subclause 7.2.2.3.1.

After a successful incoming call procedure, the PH will initiate the establishment of a LAPD SAPI=16 link between the PH and the TA. The LAPB link at the R reference point will be established at the same time via the mapping procedures described in subclause 8.4.2.

The link level layers are now in the data transfer phase.

8.4.3.2.2 CCITT Recommendation X.25 procedures

After the establishment of a LAPD link at the S/T and a LAPB link at the R reference point and the concatenation of both links via a mapping function in the TA, CCITT Recommendation X.25 [14] layer 3 procedures are possible between the DTE and the PH. The TA is transparent for these CCITT Recommendation X.25 [14] layer 3 procedures.

8.4.3.3 Data link disconnection

To initiate the clearing of a D-channel, SAPI=16 logical link, it is necessary to detect the clearing of the last virtual call on that logical link. This detection can be done by two parties:

a) the PH; clearing of the LAPD logical link is initiated by the PH;

b) the DTE; clearing is initiated by actions at the R reference point.

NOTE: In principle it is possible to clear the DTE and the PH as a result of a manual action at the TA.

8.4.3.3.1 Disconnection by the PH

The PH clears the LAPD logical link in accordance with the procedures described in subclause 7.4.2. Via the mapping function between that LAPD logical link and a LAPB link at the R reference point, clearing of the former will be followed by clearing of the latter, applying the appropriate LAPD procedures. After having cleared the LAPB link, the TA will disconnect the layer 1 interface at the R reference point by either:

- A transition from ON to OFF on the I-lead in case of an X.21 interface; the DTE has to respond with an ON to OFF transition of the C-lead. After that the interface is in the ready state;

  or:

- A transition from ON to OFF on circuit 107 in case of an X.21 *bis* or a V.25 *bis* interface; the DTE has to respond with an ON to OFF transition on circuit 108.

8.4.3.3.2 Disconnection by the DTE

The DTE indicates to the TA that the logical link between the TA and the PH has to be cleared, by clearing the LAPB link at the R reference point between the DTE and the TA.

The appropriate LAPB procedures apply. Following that DTE action, the TA will clear the logical link between the TA and the PH.

After having completed the disconnection procedure of the LAPB link, the DTE disconnects the layer 1 interface at the R reference point, by either:

- A transition from ON to OFF on the C-lead in case of an X.21 interface; the TA has to respond with an ON to OFF transition on the I-lead. After that the interface is in the ready state.

  or:

- A transition from ON to OFF on circuit 108 in case of an X.21 *bis* or a V.25 *bis* interface; the TA has to respond with an ON to OFF transition on circuit 107.

8.5 Access through the B- and D- channel

8.5.1 General

This part defines the functionalities to be supported by a TA when the access through both B and D channel is used. This applies only to Case B (access to the ISDN virtual circuit service). Everything described in subclauses 8.3 and 8.4 is applicable except the following.

8.5.2 Outgoing call

When the PH can be accessed by either the B- or the D-channel, the call request will be sent by an ETS 300 102-1 [26] message with the request for packet mode bearer service.

The TA may express its preference for a particular channel based on preselected criteria such as CCITT Recommendation X.25 [14] packet size (limited in the D-channel to 256 bytes) or throughput requirements (limited to less than 16 kbit/s on the basic access D-channel).

If the "any channel" option is retained by the TA, the network will allocate a B-channel based on CCITT Recommendation X.25 [14] Quality of Service requirements that are assumed a priori.

8.5.3 Incoming call

The network will issue a call offering on the D-channel according to ETS 300 102-1 [26] procedures. The TA will proceed according to the procedures defined in previous subclauses (see subclause 7.2).

8.6 Test loops

The maintenance concept of the TA shall comply with the maintenance concept of the ISDN subscriber access and subscriber installation as defined in the CCITT Recommendations of the I.600 Series (Maintenance principles) and in CCITT Recommendation I.430 [7] on ISDN subscriber access and installation maintenance. The test loops are specified in these CCITT Recommendations. The ISDN communication architecture enables communication of maintenance information over bearer connections between network service access points (NSAPs). Accordingly, bearer service may be used on either a B- or the D-channel to transport the protocol.

Maintenance entities can choose to communicate information about performance management, fault management, configuration and naming management, etc. using an application layer protocol using OSI. The specification of these management capabilities to be supported by TAs is outside the scope of this ETS.

8.6.1 Test loops for TA with access through the B-channel

8.6.1.1 Test loop reference configuration

Figure 7 shows the location of test loops within the TA.

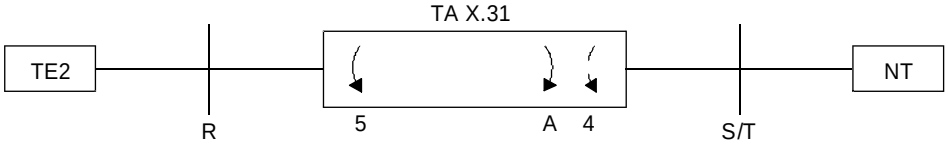


Figure 7: Location of test loops

Loop 4 shall be allocated close to the coincident S and T reference point. Loop 5 shall be allocated close to the R reference point. Loop A shall be allocated close to the coincident S and T reference point.

8.6.1.2 Test loop characteristics

The test loop characteristics for loops 4, 5, and A are defined in CCITT Recommendations I.430 [7] and the I.600 Series.

8.6.1.3 Loop activation/deactivation mechanism

(i) Test loop 4

Test loop 4 being controlled from the network side of the TA is activated either via an application layer protocol on the B/D-channel or via a layer 1 message on the selected B-channel after a connection has been established from the control point to the TA. Selection of the B-channel to be looped is part of the call set-up procedure.

Whilst the loop is established the following states shall apply at the R reference point (X.21): towards the terminal R=0/1...,I=OFF (DCE controlled not ready) shall apply.

(ii) Test loop 5

For activation/deactivation of test loop 5, the definition as under (i) apply. Since the test loop 5 is close to the R reference point, the loop point is located within the R reference point circuitry and not within the B-channel. Due to the rate adaption mechanism the composition of the bit-stream received at the TA and the composition of the bit-stream which is looped and sent back on the B-channel may not be identical at the S/T reference point. At the loop point, however, the incoming and outgoing (looped) bit-streams are identical.

Whilst the loop is established the states as defined in CCITT Recommendation X.21 [12] for loop 2b shall apply.

(iii) Test loop A

Test loop A is activated/deactivated by procedures defined in CCITT Recommendations X.21 [12]/X.21 *bis* [13].

NOTE 1: Since selection of a specific B-channel is not part of X.21/X.21 *bis*, the subject of B-channel selection within test loop A, if required, is outside the scope of this ETS.

NOTE 2: Loop activation/deactivation for the above 3 test loops can optionally as an alternative also be provided manually.

8.6.1.4 Coding of activation/deactivation control messages

- Loop 4 control via B-or D-channel application layer protocol is outside the scope of this ETS;

- loop 4 control via B-channel layer 1 message is outside the scope of this ETS;

- loop 5 control via B- or D-channel application layer protocol is outside the scope of this ETS;

- loop 5 control via B-channel layer 1 message: as in X.21/X.21 *bis*;

- loop A: as in X.21/X.21 *bis*.

Appendix I (informative): B-channel TA acting on layer 2 and 3 of CCITT Recommendation X.25

I.1 Introduction

On the basis of the different implementation of CCITT Recommendation X.25 [14] procedures in existing DTEs, two types of terminal adaptors can be identified, namely:

a) TA acts only on layer 1 at the R reference point;

b) TA acts also on layer 2 and 3 at the R reference point.

The first type applies to DTEs which can disconnect at the physical layer, of the R reference point, when no virtual calls are in progress.

For CCITT Recommendation X.25 [14] DTEs which are not able to disconnect at the physical layer, the consequence in that case may be the automatic allocation of the B-channel, immediately after power-on.

Therefore, for such DTEs, alternatively the second type may be used.

The first case is described in subclause 8.3 of this ETS.

This appendix presents some possible approaches for the functionalities and signalling mapping procedures of terminal adaptors of the second type.

These examples should not constrain implementations and not cover all possible types.

This type of TA covers Case A access, as well as Case B access.

I.2 Call control

In this appendix the following call phases are specified:

- idle phase;
- establishment phase;
- data transfer phase;
- clearing phase.

When no virtual calls are in progress, the TA is in the idle phase. Incoming or outgoing calls force transition to the data transfer phase, via the establishment phase. After the clearing of the last virtual call the TA transits from the data transfer phase via the clearing phase to the idle phase.

I.2.1 Idle phase

In the idle phase no virtual calls are in progress.

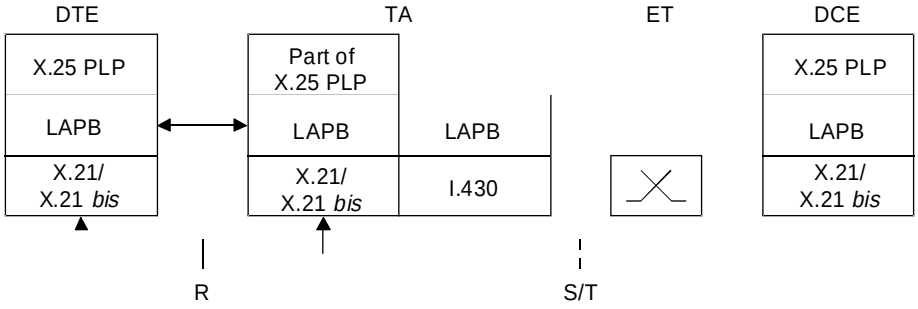


Figure I.1: Example configuration in idle phase, non transparent at layer 3

NOTE: Events and protocols on the D-channel are not shown in this figure.

In the idle phase, the TA acts on the R reference point as X.25 DCE (figure I.1). All CCITT Recommendation X.25 layer 2 procedures are supported. Some layer 3 procedures, including the handling of the restart procedures shall be supported.

When the beginning of a call establishment phase is indicated by manual methods (e.g. a push button on the TA), there is in principal no need for the TA to support layer 3 procedures, see figure I.2.

I.2.1.1 Transferring to the establishment phase

The TA transits to establishment phase at:

- the detection of an outgoing call:

  outgoing calls are detected by the reception of a *call request* packet;

- the detection of an incoming call:

  the TA applies the procedures of subclause 7.2 for the detection and acceptance of incoming calls.

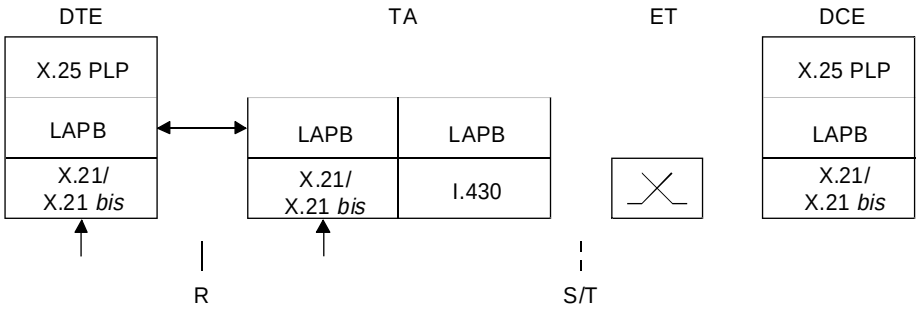


Figure I.2: Example configuration in the idle phase, transparent at layer 3

NOTE: Events and protocols on the D-channel are not shown in this figure.

I.2.2 Establishment phase

For call establishment the following functions are defined:

1) establishment of a B-channel;

2) establishment of a layer 2 connection between the TA and the X.25 DCE in the PH/AU;

3) synchronisation of the layers 3 of the X.25 DTE and the X.25 DCE in the PH/AU;

4) changing to the data transfer phase configuration.

For the establishment phase also a layer 2 implementation is needed on the coincident S and T reference point side of the TA (figure I.3). Only layer 3 dedicated procedures apply.

Figure I.4 gives an example of the message sequence for the establishment phase.

I.2.2.1 Outgoing call

The *call request* packet received from the X.25 DTE is buffered in the TA. For the allocation of a B-channel the procedures of subclause 7.1 apply. After allocation of a B-channel a link is established between the DCE in the PH/AU and the TA, following the layer 2 procedures of CCITT Recommendation X.25 [14]. Layer 3 of the DCE in the PH/AU may be reset by means of a restart procedure. The buffered *call request* packet is sent to the DCE in the PH/AU. At the acknowledgement of the correct reception of the *call request* packet, the TA changes to the data transfer phase following the procedures of subclause I.2.2.3 of this appendix.

I.2.2.2 Incoming call

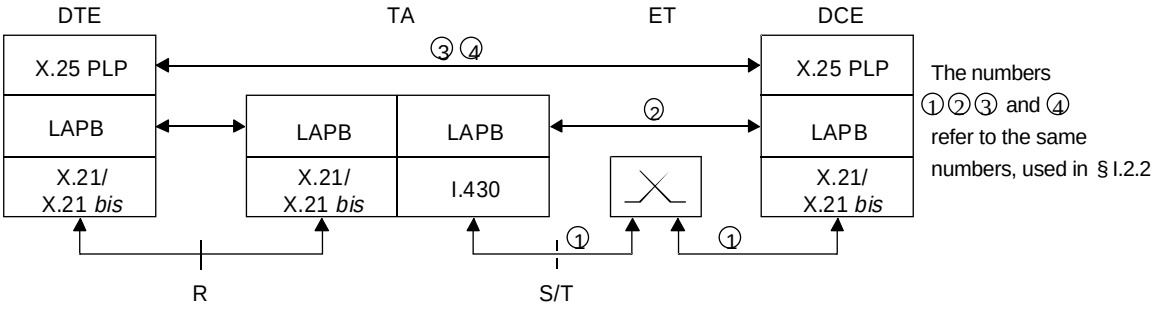


Figure I.3: Active layers in the establishment phase.

NOTE: Events and protocols on the D-channel are not shown in this figure.

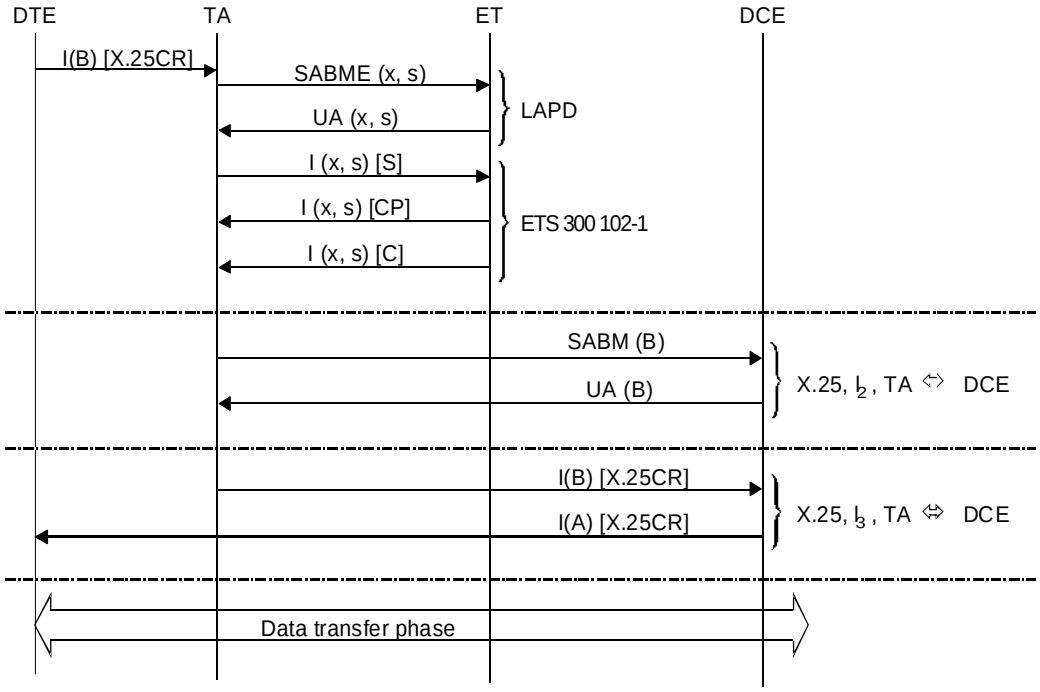


Figure I.4: Example ETS 300 102-1 and CCITT Recommendation X.25 message sequences for the establishment phase.

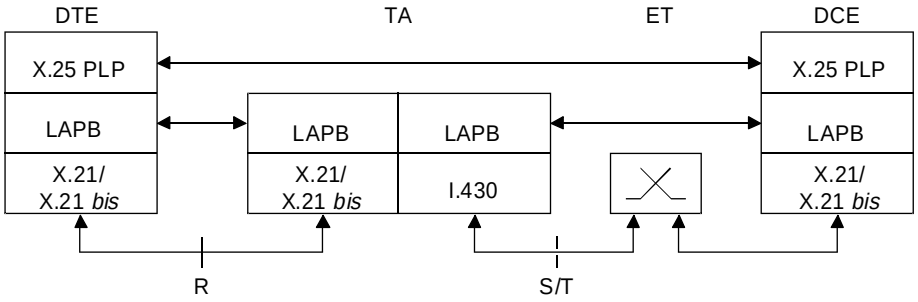
At the reception of an incoming call the procedures of subclause 7.2 of this ETS apply for the allocation of a B-channel. After allocation of a B-channel a link is established between the DCE in the PH/AU and the TA according to the layer 2 procedures of CCITT Recommendation X.25 [14]. Layer 3 of the X.25 DCE may be reset by means of a restart procedure. The TA can change to the data transfer phase following the procedures of subclause I.2.2.3 of this appendix.

I.2.2.3 Changing to the data transfer phase

After sending the *call request* to the network the TA becomes a layer 2 relay by terminating the layer 2 protocols on both sides. Detailed procedures specification of layer 2 relaying are for further study.

I.2.3 Data transfer phase

In the data transfer phase the TA acts as layer 2 relay (figure I.5).



NOTE: Events and protocols on the D-channel are not shown in this figure.

Figure I.5: Example configuration in the data transfer phase.

I.2.3.1 Transferring to the clearing phase

The clearing phase is entered at the detection that no virtual calls are in progress any more. This detection can be done by:

- the PH/AU;
- the user (manually).

I.2.4 Clearing phase

For call clearing the following functions are defined:

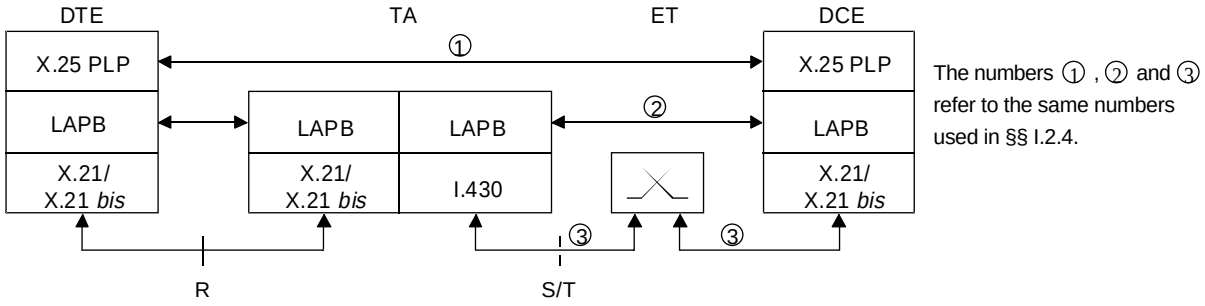
1) clearing of the layer 3 connection;

2) clearing of the layer 2 connection;

3) release of the B-channel;

4) changing to the idle phase;

The active layers in the DTE, the TA and the DCE in the clearing phase are show in figure I.6.



NOTE: Events and protocols on the D-channel are not shown in this figure.

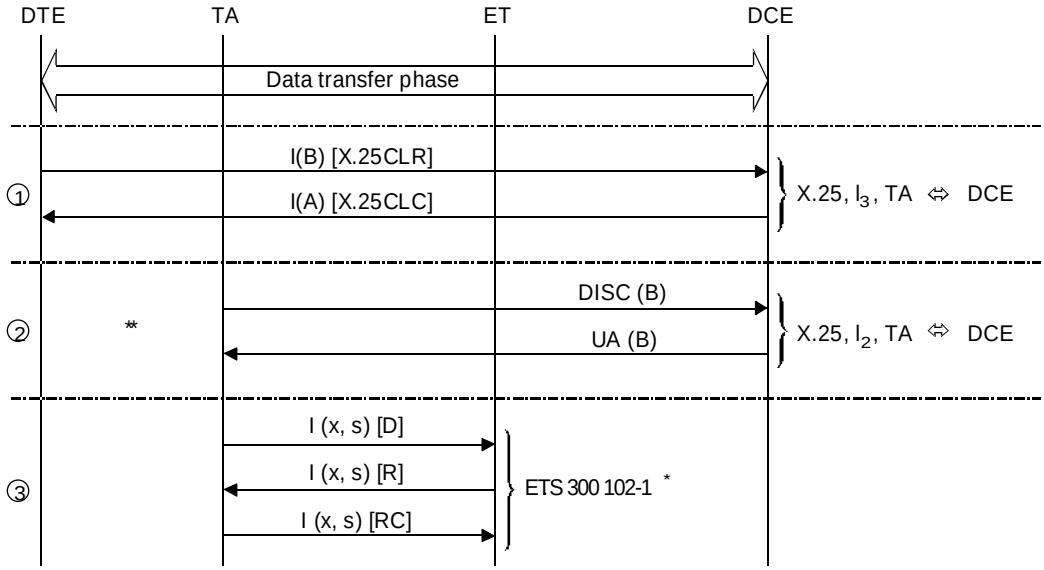
Figure I.6: Active layers an example in the clearing phase.

Figure I.7 gives an example of the message sequence for the clearing phase.

I.2.4.1 Detection by the user

After the notification by the user, DISC frame is sent to the PH/AU which is answered with a UA frame. After reception of the UA frame by the TA, the procedures of subclause 7.4 of this ETS apply. After these procedures the TA enters the idle phase.

I.2.4.2 Detection by the network



* The B-channel is cleared, only if the cleared virtual call was the last one via that B-channel.

** Layer 2 between DTE and TA is always established.

Figure I.7: Example ETS 300 102-1 and CCITT Recommendation X.25 message sequences for the clearing phase.

The DISC frame sent by the network is answered by the TA with a UA frame. The procedures of subclause 7.4 of this ETS apply to clear the B-channel. After these procedures the TA enters the idle phase.

Appendix II (informative): Interconnection of packet-mode TE2s which use the circuit-mode bearer service of the ISDN

When two packet mode TE2s are interconnected by an ISDN circuit-mode connection they will make use of TAs as shown in figure II.1.

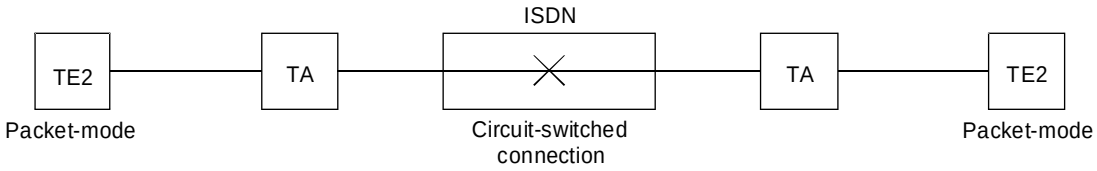


Figure II.1: Use of circuit-switched connection for communications between packet mode TE2s

For such connections the ETS 300 102-1 [26] end-to-end parameter exchange procedures will be used to exchange the characteristics of protocols that will be used over the circuit-switched connection by the DTEs. The TAs may examine the frames and packets of the B-channel in order to perform the necessary functions to support packet mode DTE to DTE communication.

Appendix III (informative): Example message flow diagrams and example conditions for cause mapping

III.1 Example message flow diagrams

Examples of the procedures for the use of the B- and D-channel network connection types and the selection of the appropriate channel types are summarised in figures III.1 to III.7. These figures are intended to complement the description in the preceding text and do not illustrate all possible situations.

NOTE: Not all frames that may be sent across the TA interface may be represented in the following figures.

III.1.1 Key to the figures

ETS 300 102-1 [26] messages:

[] Layer 3;

C CONNECT;

CA CONNECT ACKNOWLEDGE;

CP CALL PROCEEDING;

D DISCONNECT;

R RELEASE;

RC RELEASE COMPLETE;

S SETUP;

CCITT Recommendation X.25 [14] layer 3 messages:

Any layer 3 message preceded by X.25 indicates an X.25 layer 3 packet (e.g. X.25 CR means X.25 *call request*).

CA - call accepted;

CC - call connected;

CLC - clear confirmation;

CLI - clear indication;

CLR - clear request;

CR - call request;

IC - incoming call.

Layer 2 frames:

() - layer 2;

GTEI - Group TEI(127);

A.B. - X.25 layer 2 addresses (includes command and response);

SABM - Set asynchronous balance mode;

SABME - Set asynchronous balance mode extended;

UA - Unnumbered acknowledgement frame;

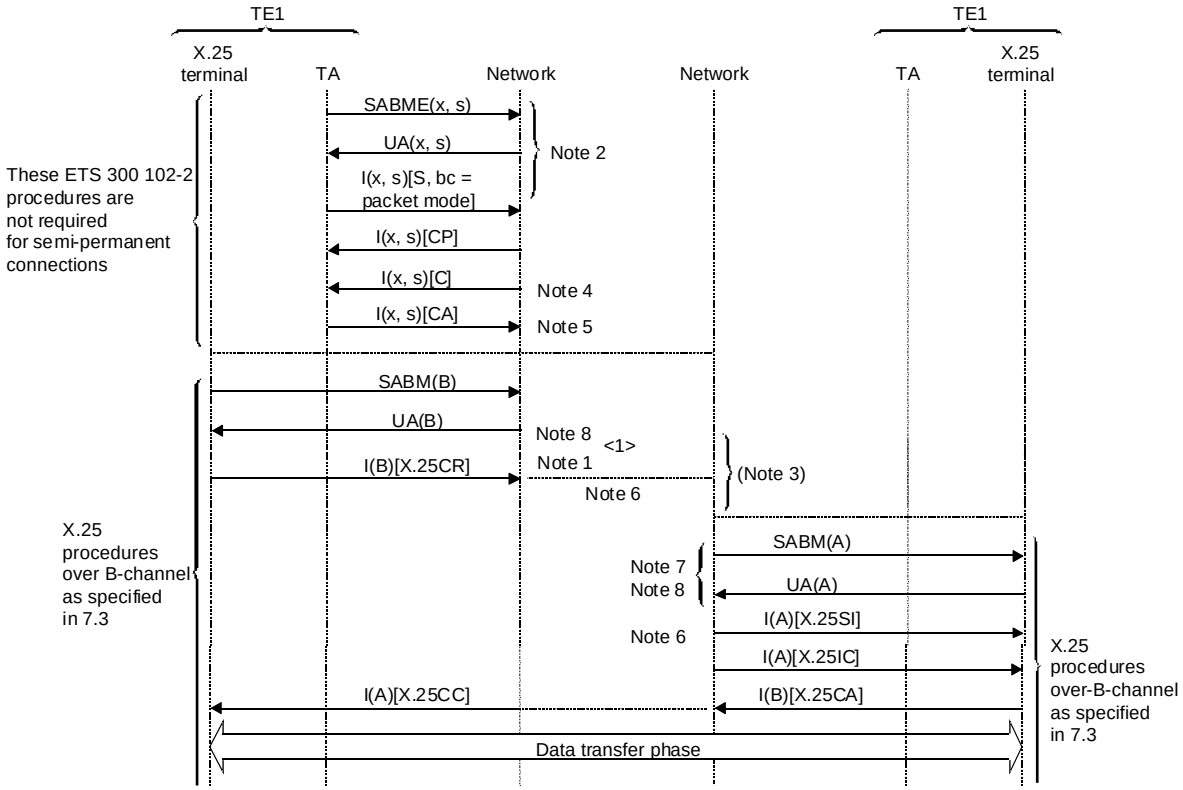
UI - Unnumbered information frame (i.e. using unacknowledged information transfer at layer 2);

I - Information frame;

DISC - Disconnect frame.

Layer 2 addresses marked (x,p) indicates that the SAPI element of the frame address is coded for packet type (SAPI=16) information as described in ETS 300 125 [28]. Layer 2 addresses marked (x,s) refer to signalling type (SAPI=0) information.

III.1.2 Example message flow diagrams



NOTE 1: When the called side establishes the call using D-channel Access, the message sequence will continue as from point <3> in figure III.3.

NOTE 2: If signalling link is not already established.

NOTE 3: For packet call offering the incoming call may be offered to the TA and a B-channel established using the procedure shown in figure III.5 and ETS 300 102-1 figure III.6.

NOTE 4: The network starts timer T320, if implemented.

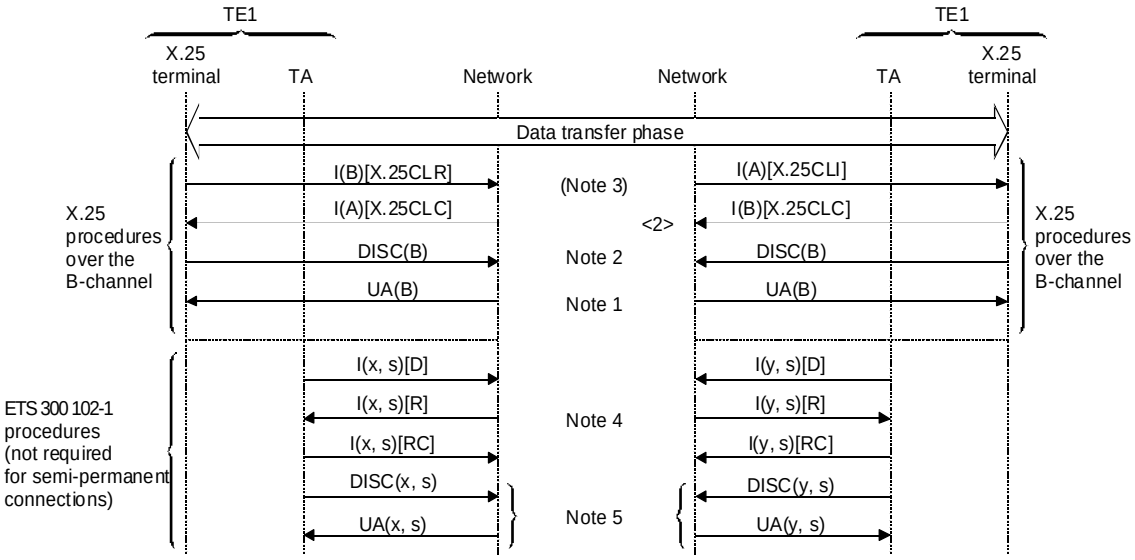
NOTE 5: This message is optional.

NOTE 6: The network cancels timer T320, if implemented and running.

NOTE 7: The network establishes the link layer on the B-channel, if it is not already established as specified in subclause 7.3.

NOTE 8: Not shown in the diagram is a possible X.25 restart procedure performed after link set up.

Figure III.1: Example message sequence for the ISDN virtual circuit service B-channel access, first virtual call set-up in this channel



NOTE 1: When the cleared side has set up the call using D-channel access, the message sequence at the cleared side will be as from point <4> in figure III.4.

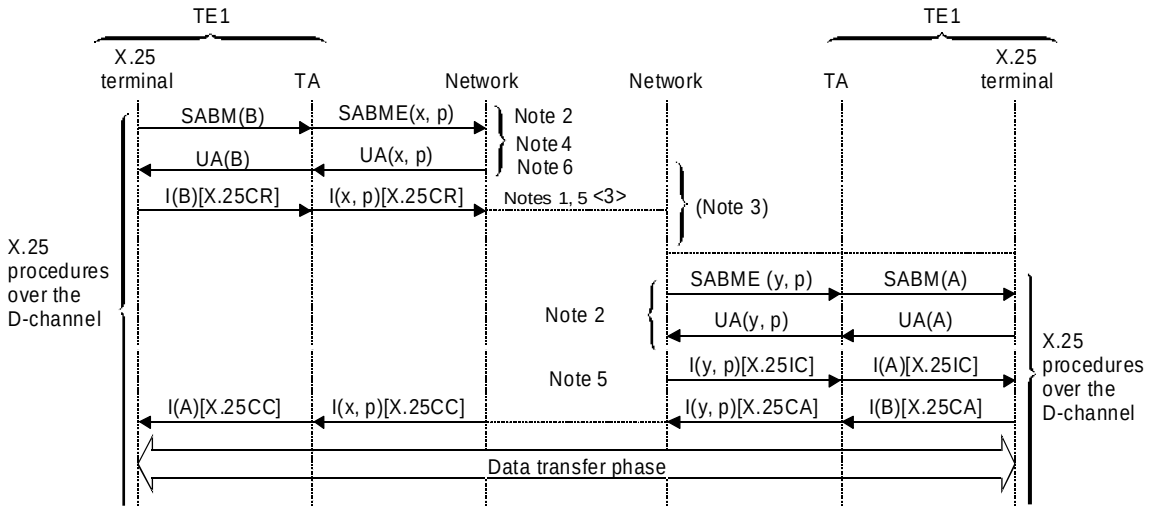
NOTE 2: Clearing of the B-channel may be initiated by the network upon expiry if timer T320, if implemented. See subclause 7.4.

NOTE 3: The network starts timer T320 , if implemented.

NOTE 4: The network cancels timer T320, if implemented and running.

NOTE 5: This sequence is only required if the terminal does not wish to continue with further communication.

Figure III.2: Examples message sequence for the ISDN virtual circuit service B-channel access, last virtual call cleared in this channel



NOTE 1: When the called side established the call using B-channel access, the message sequence will continue as from point <1> in figure III.1.

NOTE 2: If SAPI = 16, link is not already established

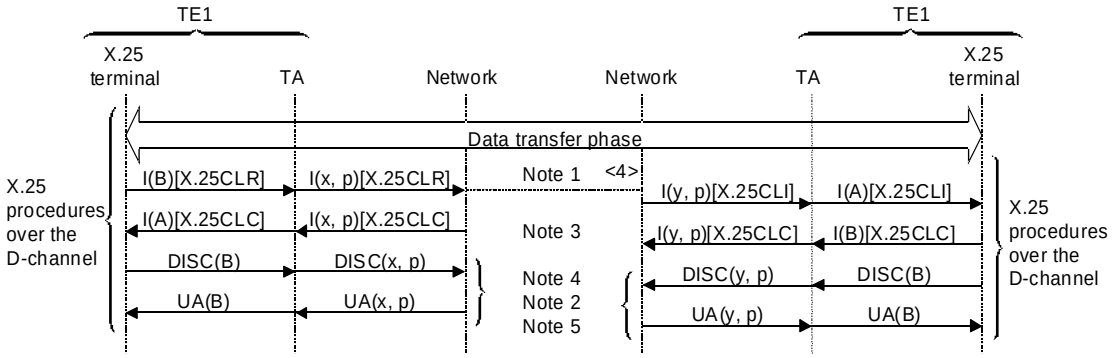
NOTE 3: The incoming call may be offered to the TA using the procedures shown in figure III.7.

NOTE 4: The network starts timer T320, if implemented.

NOTE 5: The network stops timer T320, if implemented and running.

NOTE 6: Not shown in the diagram is a possible X.25 restart procedure performed after link set up.

Figure III.3: Example message for the ISDN virtual circuit service D-channel access, first virtual call set-up in this SAPI=16 link



NOTE 1: When the cleared side has set up the call using B-channel access, the message sequence at the cleared side will be as from point <2> in figure III.2.

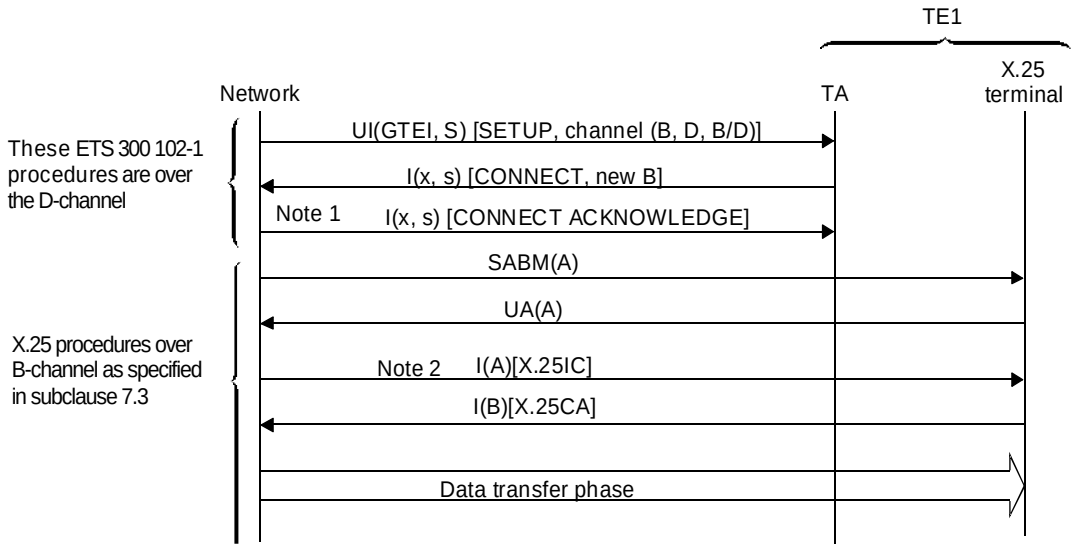
NOTE 2: This sequence is only required if the X.25 DTE does not wish to continue with further communications.

NOTE 3: The network starts timer T320, if implemented.

NOTE 4: The network cancels timer T320, if implemented and running.

NOTE 5: Link layer may be initiated by the network upon expiry of timer T320, if implemented (see subclause 7.4).

Figure III.4: Examples message sequence for the ISDN virtual service D-channel access, last virtual call cleared in this SAPI=16 link



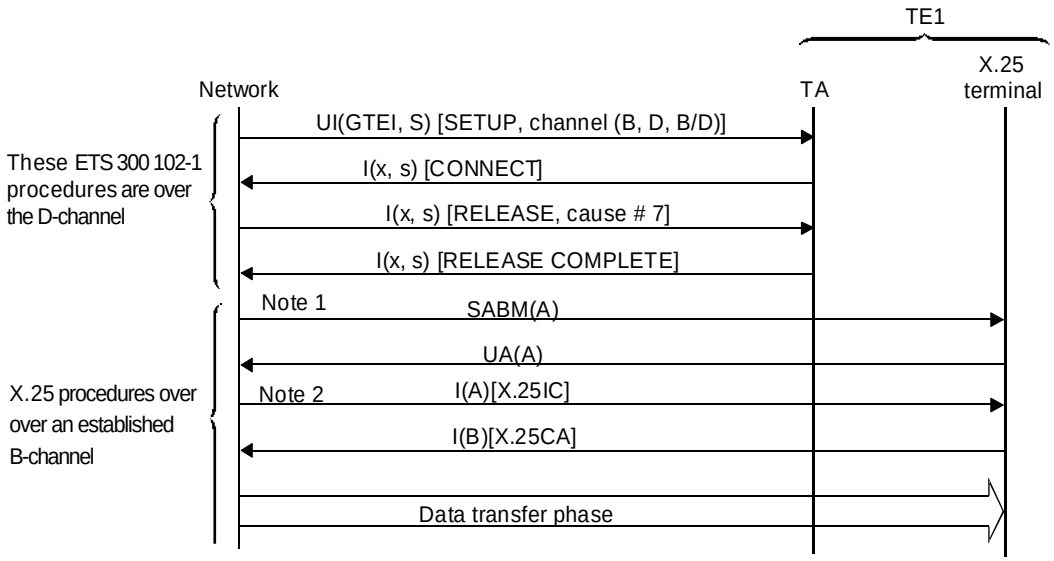
NOTE 1: The network starts timer T320, if implemented.

NOTE 2: The network cancels timer T320, if implemented and running.

NOTE 3: Not shown in the diagram is a possible X.25 restart procedure performed after link set up.

ETSI Requirement: The B/D channel negotiation is not offered by ETSI networks. This is network dependent.

Figure III.5: Example of incoming call offering procedures using signalling on SAPI=0 link: Terminal accepts call on a new B-channel



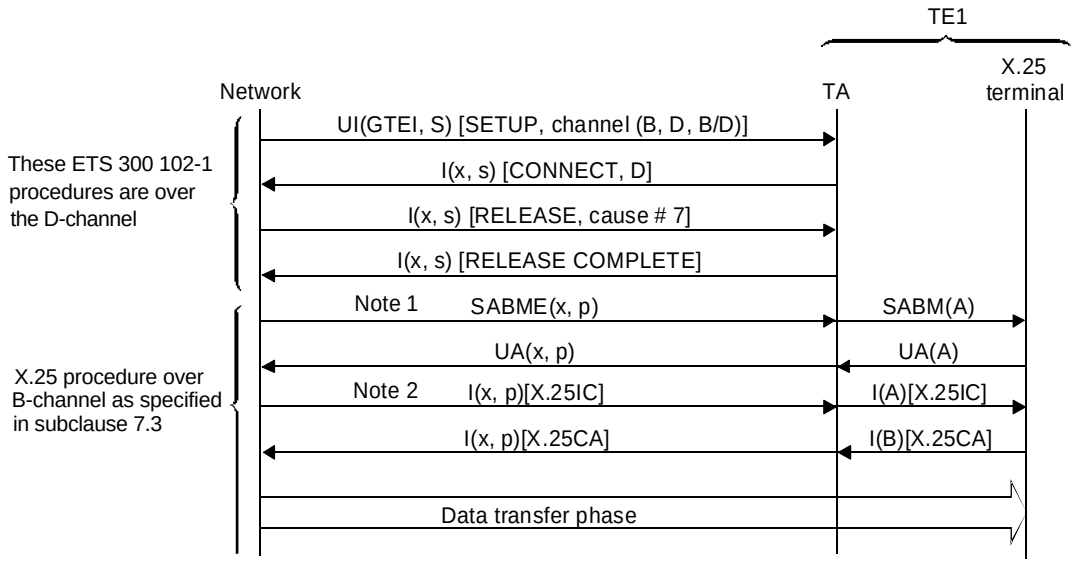
NOTE 1: The network established the link layer in the B-channel if is not already established (see subclause 7.4).

NOTE 2: The network cancels timer T320, if implemented and running.

NOTE 3: Not shown in the diagram is a possible X.25 restart procedure performed after link set up.

ETSI Requirement: The B/D channel negotiation is not offered by ETSI networks. This is network dependent.

Figure III.6: Example of incoming call offering procedures using signalling on SAPI=0 link: Terminal accepts call on an established B-channel



NOTE 1: The network establishes the link layer in the D-channel if it is not already established (see subclause 7.3). The network starts timer T320, if implemented.

NOTE 2: The network cancels timer T320, if implemented and running.

NOTE 3: Not shown in the diagram is a possible X.25 restart procedure performed after link set up.

ETSI Requirement: The B/D channel negotiation is not offered by ETSI networks. This is network dependent.

Figure III.7: Example of incoming call offering procedures using signalling on SAPI=0 link: Terminal accepts call on the D-Channel

III.2 Example conditions for cause mapping

Figures III.8 through III.16 show example conditions when cause mapping would be utilised between ETS 300 102-1 [26] and CCITT Recommendation X.25 [14] messages and utilise the specific mapping of table 6 and table 7 as shown below:

Table III.1

ETS 300 102-1 failures during call establishment		
Figure	Reference table	NOTE
III.8 III.9 III.10 III.11 III.12	table 6 table 6 table 6 table 6 table 6	

Table III.2

User side failures during CCITT Recommendation X.25 data transfer phase		
Figure	Reference table	NOTE
III.13 III.14	table 6 table 6	1 2

Table III.3

Network side premature clearing		
Figure	Reference table	NOTE
III.15 III.16	table 7 table 7	

NOTE 1: This mapping is only needed in the case of the ETS 300 102-1 [26] message arriving prior to the clearing of the last virtual call.

NOTE 2: This situation always results in either an X.25 *clear indication* packet with cause #9, "out of order" for switched virtual call, or an X.25 *reset* packet with cause #9, "out of order" for permanent virtual circuits.

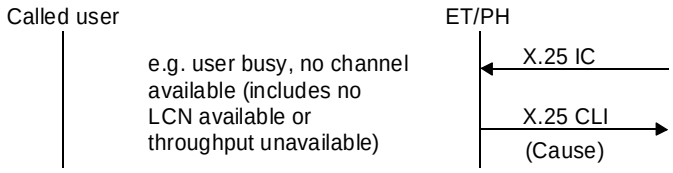
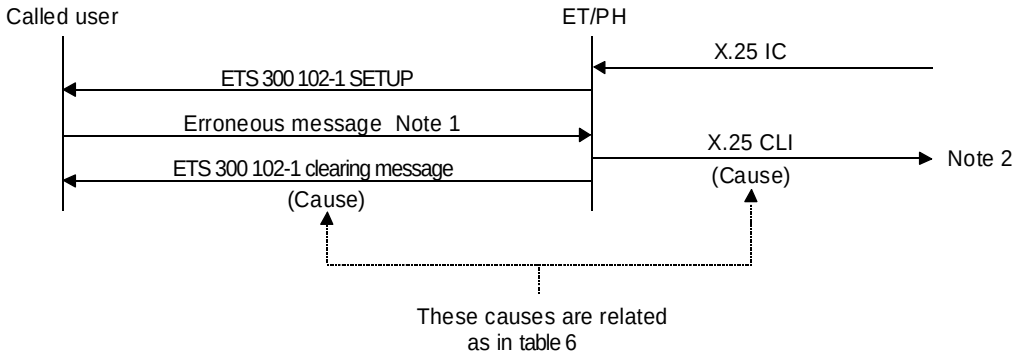


Figure III.8: Undeliverable call

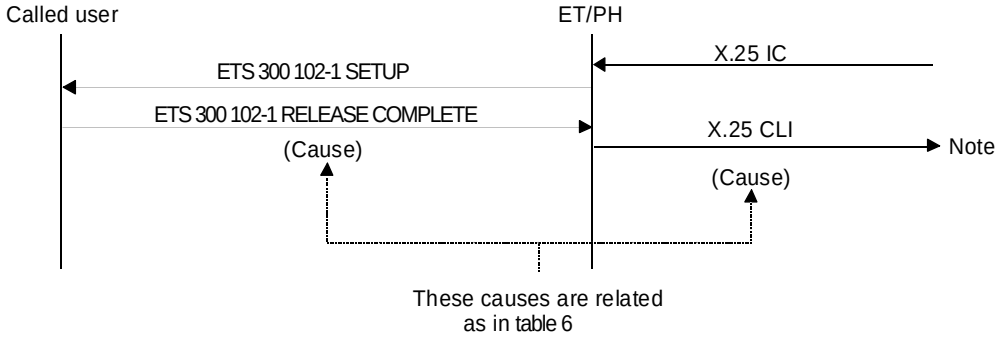


NOTE 1: This figure only applies to the case where the erroneous message results in an ETS 300 102-1 [26] clearing message. See subclause 7.4.3 for more information.

Figure III.9: Erroneous message (e.g. format error)

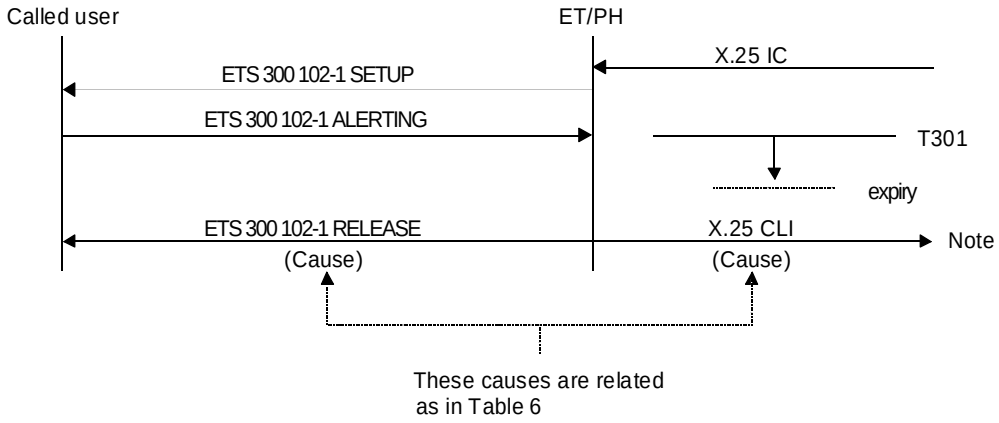
NOTE: This message is sent after the second expiry of timer T301 (defined in ETS 300 102-1 [26]).

Figure III.10: No responding user



NOTE: This message would be sent after the expiry of T303 when on a multipoint interface.

Figure III.11: Expiry of timer T301



NOTE: This message is sent after the expiry of timer T301 (defined in ETS 300 102-1 [26]).

Figure III.12: Call rejection by called party

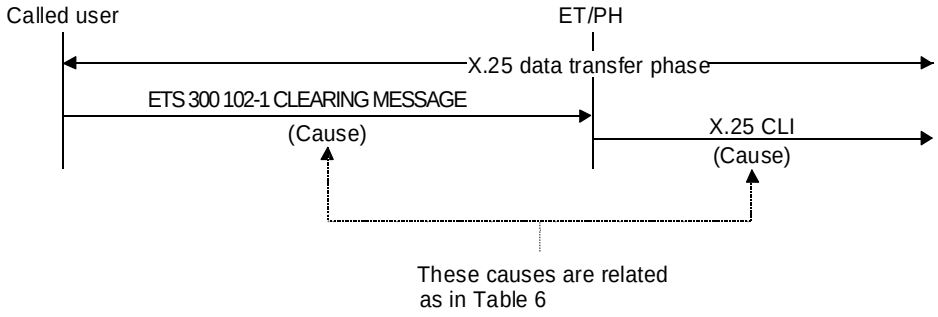
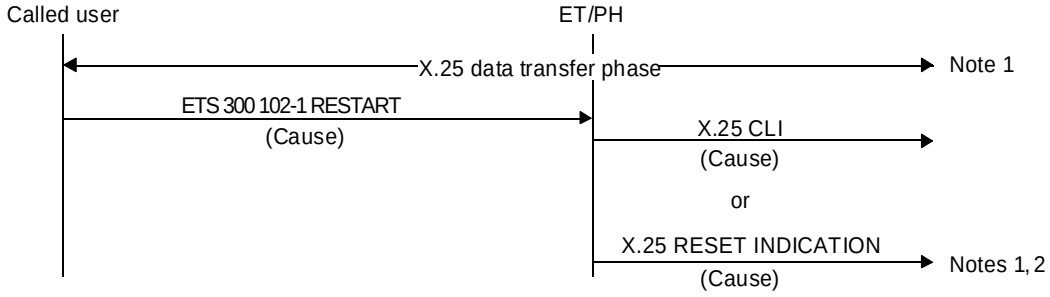


Figure III.13: ETS 300 102-1 clearing during X.25 data transfer phase



NOTE 1: Only for SVC or PVC established on the switched B-chammel(s) being restricted. The cause parameter in the X.25 CLI packet will indicate "out of order" with diagnostic value O.

NOTE 2: For permanent virtual circuits only.

Figure III.14: ETS 300 102-1 RESTART during X.25 data transfer phase

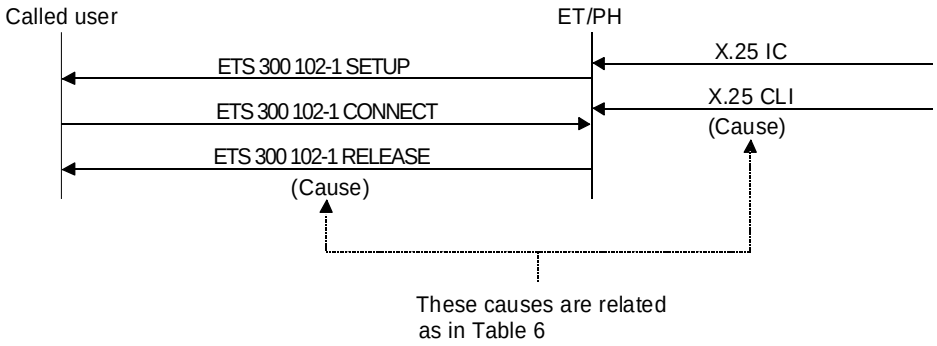
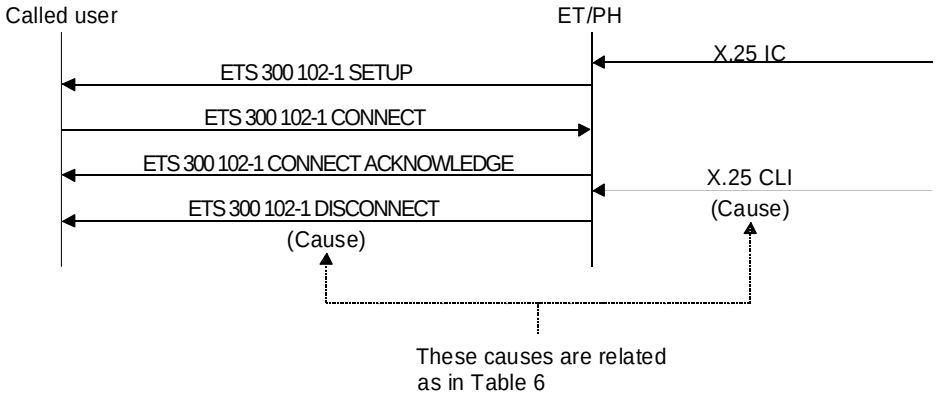


Figure III.15: Premature clearing of the virtual circuit (e.g. expiry of CCITT Recommendation X.25 [14] timer T21)



NOTE: This is the case when X.25 *incoming call* packet has not been delivered.

Figure III.16: Premature clearing of the virtual call

Appendix IV (informative): D-channel TAs requiring full protocol termination in the TA

IV.1 Introduction

On the basis of different implementations of CCITT Recommendation X.25 [14] procedures in existing DTEs, several types of terminal adaptors can be identified, namely:

Type 1: Establishment of a logical, SAPI =16, link in the D-channel upon recognition of the receipt of a SABM frame.

Type 2: Idem, on receipt of an I frame.

Type 3: Idem on receipt of a CR packet.

NOTE: Alternatively, initiation of call set-up can be carried out by manual means, for example a push button on the TA.

The first type applies to DTEs which disconnect the link at the R reference point, when no virtual calls are in progress, and is described in subclause 8.4 of this ETS.

However, there are also DTEs which are not able to disconnect the link at the R reference point. Therefore, this appendix presents possible approaches for the functionalities and the signalling mapping procedures of terminal adaptors, applicable to DTEs of this type.

These examples should not constrain implementations and do not cover all possible cases.

IV.2 Call control

In this appendix the following call phases are specified:

- idle phase;
- establishment phase;
- data transfer phase;
- clearing phase;

When no virtual calls are in progress, the TA is in the idle phase.

Incoming or outgoing calls force transition to the data transfer phase, via the establishment phase.

After the clearing of the last virtual call the TA transits from the data transfer phase via the clearing phase to the idle phase.

IV.2.1 Idle phase

In the idle phase no virtual calls are in progress

In the idle phase the layers 1 and 2 on the R reference point are established, see figure IV.1. All CCITT Recommendation X.25 [14] layer 2 procedures are supported by the TA. Some layer 3 procedures, for instance the restart procedures, may be supported too.

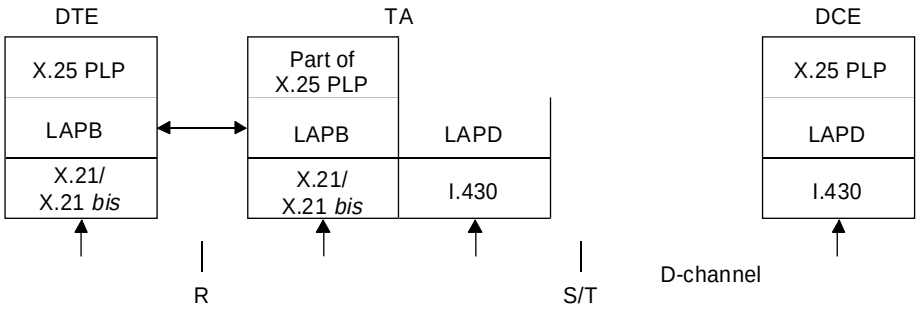


Figure IV.1: Example configuration in the idle phase, non transparent at layer 3

There is no need to support layer 3 procedures, when an outgoing call is initiated by the DTE by sending an I frame to the TA. Receipt of that I frame is followed by setting up a D-channel, SAPI=16, logical link by the TA; as soon as that link is established, the TA will transmit the packet contained in the received I frame to the DCE; that packet has to be an X.25 CR packet.

Figure IV.2 depicts this situation.

NOTE: When only incoming calls are to be supported or the beginning of an outgoing call is initiated via the human/machine interface of the TA (e.g. a push button on the TA), there is in principle no need for the TA to support layer 3 procedures.

IV.2.1.1 Transferring to the establishment phase

The TA transits to the establishment phase at:

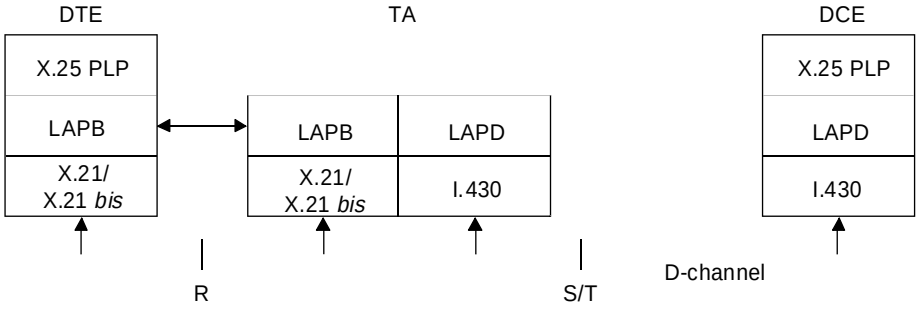


Figure IV.2: Example configuration in the idle phase, transparent at layer 3

- The detection of an outgoing call:

  Outgoing calls are detected by the receipt of an X.25 call request packet, or via the human/machine interface of the TA, or by the receipt of an I frame (see subclause IV.2.2.1).

- The detection of an incoming call:

  The TA applies the procedures of subclause 7.2 for the detection and acceptance of incoming calls (see also subclause IV.2.2.2).

IV.2.2 Establishment phase

For call establishment the following subsequent actions can be distinguished:

1. establishment of a SAPI=16, logical link via the D-channel;

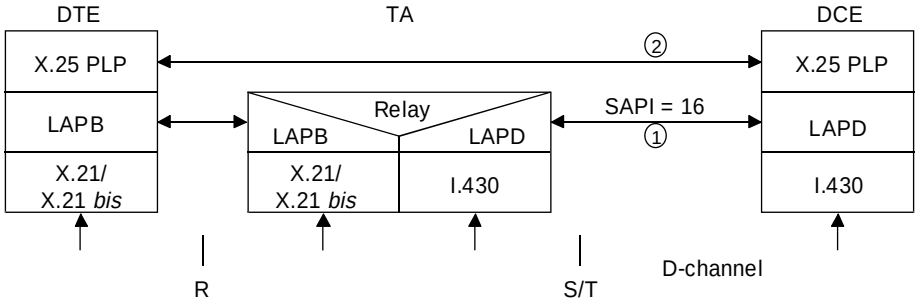
2. establishment of layer 3 between the X.25 DTE and the X.25 DCE in the PH;

3. proceeding to the data transfer phase, during which the TA is always transparent at layer 3.

IV.2.2.1 Outgoing call initiated via a call request packet or an I frame

NOTE: Reference to an I frame throughout this appendix means that the TA has no knowledge about the type of X.25 packet, contained in that I frame.

The call request packet received from the X.25 DTE is buffered in the TA. A D-channel logical link, SAPI=16, is established between the DCE in the PH and the TA, following the procedures of ETS 300 125 [28]. Layer 3 of the DCE in the PH may be reset by means of the restart procedure. The buffered call request packet is sent to the DCE in the PH.



NOTE: The numbers 1 and 2 refer to the numbered actions in this section.

Figure IV.3: Example configuration in the establishment phase

After that the TA proceeds to the data transfer phase.

Figure IV.4 gives an example of the message sequence for establishment phase.

NOTE: After initiation via the human/machine interface of the TA, a D-channel logical link, SAPI=16, between the PH and the TA, following the procedures of ETS 300 125 [28]. Layer 3 of the DCE of the PH may be reset by means of the restart procedure.

The TA then proceeds to the data transfer phase.

IV.2.2.2 Incoming call

At the reception of an incoming call, the procedures of subclause 7.2.2 of this ETS apply for the allocation of a D-channel SAPI=16 link between the TA and the PH.

The TA proceeds to the data transfer phase after the sending of a UA frame, acknowledging the received SABME frame from the PH.

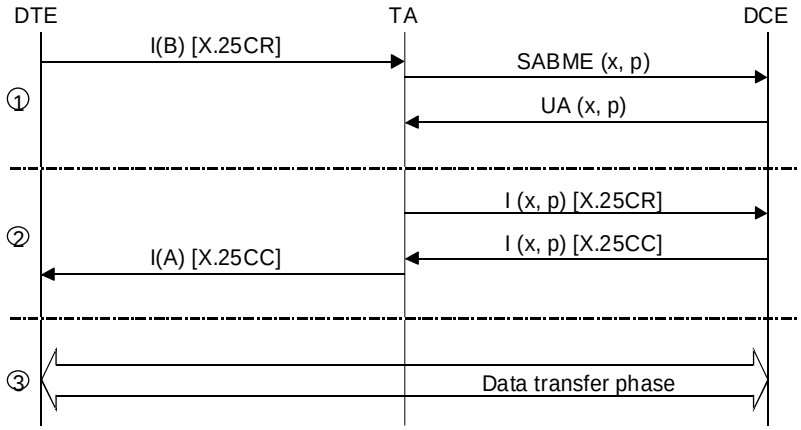


Figure IV.4: Example ETS 300 125 and X.25 message sequence for an outgoing call initiated by the DTE

IV.2.3 Data transfer phase

In the data transfer phase the TA acts as a layer 2 relay by terminating the layer 2 links at both sides and performing a mapping function between them, see figure IV.5. The mapping is described in subclause 8.4.2 of this ETS.

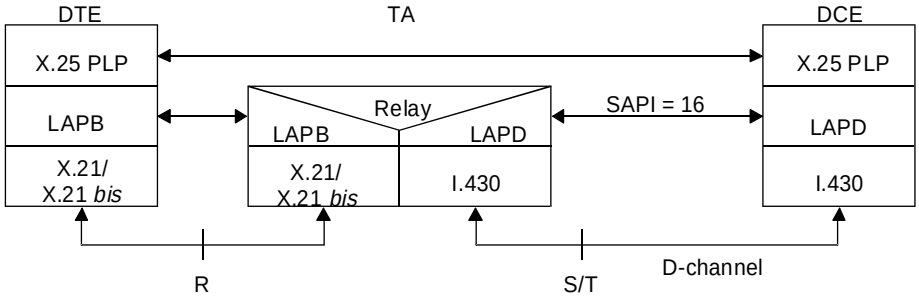


Figure IV.5: Example configuration in the data transfer phase

IV.2.3.1 Transferring to the clearing phase

The clearing phase is entered at the detection that no virtual calls over the D-channel link are in progress any more. This detection will be done by the PH (see subclause IV.2.4)

NOTE 1: Alternatively, this detection is done by the user, e.g., notification via a push button on the TA.

NOTE 2: Detection by the DTE is not relevant because there are no means to notify the detection of the clearing of the last virtual call to the TA (layers 1 and 2 are always established here).

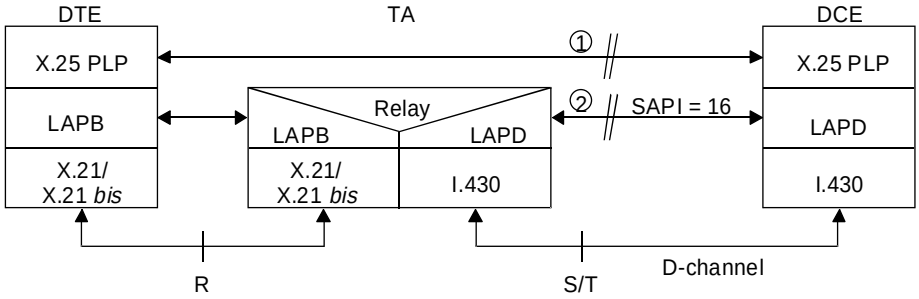
IV.2.4 Clearing phase

For call clearing the following actions can be distinguished (see figure IV.6):

1) clearing of the layer 3 connection;

2) clearing of the SAPI=16, logical link via the D-channel;

3) transferring to the idle phase.



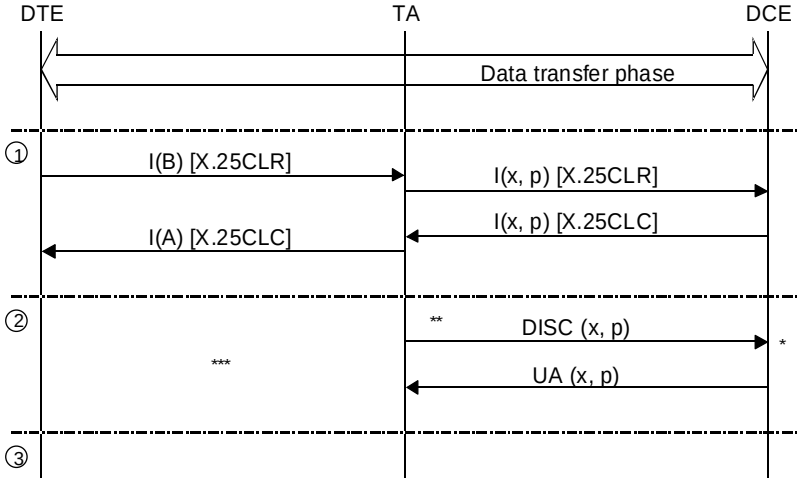
NOTE: The numbers 1 and 2 refer to the numbered actions in this section.

Figure IV.6: Example configuration in clearing phase

IV.2.4.1 Detection by the PH

After the clearing of the last virtual call via a certain logical link the PH sends a DISC frame to the TA, initiating the disconnection of the D-channel, SAPI=16 logical link. The TA enters the idle phase, after acknowledging this disconnection by sending a UA frame.

Figure IV.7 gives an example of the message sequence for the clearing phase.



* The D-channel logical link is disconnected, only if the cleared virtual call was the last one via that link.

** Manual notification by the user is supposed.

*** Layer 2 between DTE and TA is always established.

NOTE: After the manual notification by the user via the human/machine interface of the TA, the TA sends a DISC frame to the PH, requesting for disconnection of the D-channel, SAPI=16 logical link. After reception of the UA frame by the TA (acknowledging this disconnection), the TA enters the idle phase.

Figure IV.7: Example ETS 300 125 and X.25 message sequence for the clearing phase (detection by the user)

Annex A (informative): States applicable to packet mode access connection (case B services)

This annex defines the basic packet-mode access connection control states for access to the ISDN virtual circuit bearer service (case B). The procedures for access connection control are given in subclause 7 of this ETS.

NOTE: The states associated with the use of the Global Call Reference are also applicable when the Restart procedures are used. These states are defined in ETS 300 102-1 [26], subclause 2.4.

A.1 Access connection states at the user side of the interface

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

A.1.1 Null state (U0)

No access connection exists.

A.1.2 Call initiated (U1)

This state exists for an outgoing access connection, when the user requests access connection establishment from the network.

A.1.3 Outgoing call proceeding (U3)

This state exists for an outgoing access connection when the user has received acknowledgement that the network has received all access connection information necessary to effect access connection establishment.

A.1.4 Call present (U6)

This state exists for an incoming access connection when the user has received a access connection establishment request but has not yet responded.

A.1.5 Call received (U7)

This state exists for an incoming access connection when the user has indicated alerting but has not yet answered.

A.1.6 Connect request (U8)

This state exists for an incoming access connection when the user has accepted the access connection and is waiting to be awarded the access connection.

A.1.7 Incoming call proceeding (U9)

This state exists for an incoming access connection when the user has sent acknowledgement that the user has received all access connection information necessary to effect access connection establishment.

A.1.8 Active (U10)

This state exists for an incoming access connection when the user has received an acknowledgement from the network that the user has been awarded the access connection. This state exists for an outgoing access connection when the user has received an indication that the local network has completed the access connection.

A.1.9 Disconnect request (U11)

This state exists when the user has requested the local network to clear the access connection and is waiting for a response.

A.1.10 Disconnect indication (U12)

This state exists when the user has received an invitation to disconnect because the network has disconnect the access connection to end connection (if any).

A.1.11 Release request (U19)

This state exists when the user has requested the network to release the access connection and is waiting for a response.

A.2 Access connection states at the network side of the interface

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

A.2.1 Null state (N0)

No access connection exists.

A.2.2 Call initiated (N1)

This state exists for an outgoing access connection when the network has received an access connection establishment request but has not yet responded.

A.2.3 Outgoing call proceeding (N3)

This state exists for an outgoing access connection when the network has sent acknowledgement that the network has received all access connection information necessary to effect access connection establishment.

A.2.4 Call present (N6)

This state exists for an incoming access connection when the network has sent an access connection establishment request but has not yet received a satisfactory response.

A.2.5 Call received (N7)

This state exists for an incoming access connection when the network has received an indication that the user is alerting but has not yet received an answer.

A.2.6 Connect request (N8)

This state exists for an incoming access connection when the network has received an answer but the network has not yet awarded the access connection.

A.2.7 Incoming call proceeding (N9)

This state exists for an incoming access connection when the network has received acknowledgement that the user has received all access connection information necessary to effect access connection establishment.

A.2.8 Active (N10)

This state exists for an incoming access connection when the network has awarded the access connection to the called user. This state exists for an outgoing access connection when the local network has indicated that the access connection has been completed.

A.2.9 Disconnect request (N11)

This state exists when the network has received a request from the user to clear the access connection.

A.2.10 Disconnect indication (N12)

This state exists when the network has sent an invitation to disconnect the user-network access connection.

A.2.11 Release request (N19)

This state exists when the network has requested the user to release the access connection and is waiting for a response.

A.2.12 Call Abort (N22)

This state exists for an incoming access connection for the point-to-multipoint configuration when the access connection is being cleared before any user has been awarded the access connection.

Annex B (normative): Messages for control of packet-mode access connections

Table B.1 summarises the messages for packet-mode access connection control. The message tables in this subclause should be used for Case B (packet switched access to an ISDN virtual circuit service) as defined in subclause 7 of this ETS. For Case A (circuit switched access to PSPDN services) the message tables in subclause 3.1 of ETS 300 102-1 [26] should be used.

Table B.1: Messages for packet-mode access connection control

	Reference (in this annex)
Access connection establishment messages:	Clause
ALERTING	B.1
CALL PROCEEDING	B.2
CONNECT	B.3
CONNECT ACKNOWLEDGE	B.4
PROGRESS	B.6
SETUP	B.9
Access connection clearing messages:	
DISCONNECT	B.5
RELEASE	B.7
RELEASE COMPLETE	B.8
Miscellaneous messages:	
STATUS	B.10
STATUS ENQUIRY	B.11

In addition, RESTART, RESTART ACKNOWLEDGE and STATUS messages usable with the Global Call Reference shall apply when the Restart procedures are used. These messages are defined in subclause 3.4 of ETS 300 102-1 [26].

B.1 Alerting

This message may be sent by the called user to the network to indicate that called user alerting has been initiated.

ALERTING message content

Message type: ALERTING
Significance: local
Significance: local
Direction: user to network

Information element	Reference (in ETS 300 102-1)	Direction	Type	Length
Protocol discriminator	4.2	u > n	M	1
Call reference	4.3	u > n	M	2-3
Message type	4.4	u > n	M	1
Channel identification	4.5	u > n	O (NOTE 1)	2-5
Progress indicator	4.5	u > n	O (ETSI NOTE)	2-4

NOTE 1: Mandatory if this message is the first message in response to SETUP, unless the user accepts the channel indicated in the SETUP message.

ETSI NOTE: May be included in the event of interworking with a private network. Public networks will ignore this information element.

B.2 Call proceeding

This message is sent by the called user to the network or by the network to the calling user to indicate that the requested access connection establishment has been initiated.

CALL PROCEEDING message content

Message type: CALL PROCEEDING
Significance: local
Direction: both

Information element	Reference (in ETS 300 102-1)	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	2-3
Message type	4.4	both	M	1
Channel identification	4.5	both	O (NOTE 1)	2-5
Progress indicator	4.5	u > n	O (ETSI NOTE)	2-4
Display	4.5	n > u	O (NOTE 3)	2-34

NOTE 1: Mandatory in the network to user direction if this message is the first message in response to SETUP. Mandatory in the user to network direction if this message is the first message in response to SETUP, unless the user accepts the channel indicated in the SETUP message.

NOTE 2: Spare in this ETS.

NOTE 3: Included if the network provides information that can be presented to the user.

ETSI NOTE: May be included in the event of interworking with a private network. Public networks will ignore this information element.

B.3 Connect

This message is sent by the called user to the network and by the network to the calling user to indicate acceptance of the access connection.

CONNECT message content

Message type: CONNECT
Significance: local
Direction: both

Information element	Reference (in ETS 300 102-1)	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	2-3
Message type	4.4	both	M	1
Channel identification	4.5	u > n	O (Note 1)	2-5
Progress indicator	4.5	u > n	O (ETSI Note)	2-4
Display	4.5	n > u	O (Note 2)	2-34

NOTE 1: Mandatory if this message is the first message in response to SETUP, unless the user accepts the channel indicated in the SETUP message.

NOTE 2: Included if the network provides information that can be presented to the user.

ETSI NOTE: May be included in the event of interworking with a private network. Public networks will ignore this information element.

B.4 Connect acknowledge

This message is sent by the network to the called user to indicate the user has been awarded the access connection. It may also be sent by the calling user to the network to allow symmetrical access connection control procedures.

CONNECT ACKNOWLEDGE message content

Message type: CONNECT acknowledge
Significance: local
Direction: both

Information element	Reference (in ETS 300 102-1)	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	2-3
Message type	4.4	both	M	1
Display	4.5	n > u	O (NOTE 1)	2-34

NOTE 1: Included if the network provides information that can be presented to the user.

B.5 Disconnect

This message is sent by the user to request the network to clear an access connection or is sent by the network to the user to indicate that the access connection clearing has been initiated.

DISCONNECT message content

Message type: DISCONNECT
Significance: local
Direction: both

Information element	Reference (in ETS 300 102-1)	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	2-3
Message type	4.4	both	M	1
Cause	4.5	both	M	4-32
Display	4.5	n > u	O (NOTE 1)	2-34
User-user	4.5	-	(ETSI NOTE)	-

NOTE 1: Included if the network provides information that can be presented to the user.

ETSI NOTE: Not supported by ETSI networks.

B.6 Progress

This message is sent by the called user to indicate the progress of an access connection establishment in the event of interworking with a private network. The public networks will ignore this message.

PROGRESS message content

Message type: PROGRESS
Significance: local
Direction: user to network

Information element	Reference (in ETS 300 102-1)	Direction	Type	Length
Protocol discriminator	4.2	u > n	M	1
Call reference	4.3	u > n	M	2-3
Message type	4.4	u > n	M	1
Cause	4.5	u > n	O (NOTE 1)	2-32
Progress indicator	4.5	u > n	O	4

NOTE 1: Included by the called user to provide additional information.

B.7 Release

This message is sent by the user or the network to indicate that the equipment sending the message has disconnected the channel (if any) and intends to release the channel and the call reference, and that the receiving equipment should release the channel and prepare to release the call reference after sending RELEASE COMPLETE. This message is also sent by the network to the called user to indicate that the access connection is awarded on either the D-channel or an existing channel and that the network intends to release the call reference.

RELEASE message content

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

Information element	Reference (in ETS 300 102-1)	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	2-3
Message type	4.4	both	M	1
Cause	4.5	both	O (NOTE 2)	2-32
Display	4.5	n > u	O (NOTE 3)	2-34
User-user	4.5	-	(ETSI NOTE)	-

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

NOTE 2: Mandatory in the first clearing message, including when the RELEASE message is sent as a result of an error handling condition.

NOTE 3: Included if the network provides information that can be presented to the user.

ETSI NOTE: Not supported by ETSI networks.

B.8 Release complete

This message is sent by the user or the network to indicate that the equipment sending the message has released the channel (if any) and call reference, the channel is available for reuse, and the receiving equipment shall release the call reference.

RELEASE COMPLETE message content

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

Information element	Reference (in ETS 300 102-1)	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	2-3
Message type	4.4	both	M	1
Cause	4.5	both	O (NOTE 2)	2-32
Display	4.5	n > u	O (NOTE 3)	2-34
User-user	4.5	-	(ETSI NOTE)	-

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

NOTE 2: Mandatory in the first clearing message, including when the RELEASE COMPLETE message is sent as a result of an error handling condition.

NOTE 3: Included if the network provides information that can be presented to the user.

ETSI NOTE: Not supported by ETSI networks.

B.9 Setup

This message is sent by the calling user to the network and by the network to the called user to initiate access connection establishment.

SETUP message content

Message type: SETUP
Significance: local
Direction: both

Information element	Reference (in ETS 300 102-1)	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	2-3
Message type	4.4	both	M	1
Bearer capability	4.5	both	M (ETSI NOTE 1)	6-7
Channel identification	4.5	both	O (NOTE 2)	2-5
Progress indicator	4.5	u > n	O (ETSI NOTE 2)	2-5
Display	4.5	n > u	O (NOTE 4)	2-34
Calling party number	4.5	both	O (NOTE 12)	2-23
Calling party subaddress	4.5	both	O (NOTE 13)	2-23
Called party number	4.5	n > u	O (NOTE 14)	2-24
Called party subaddress	4.5	n > u	O (NOTE 15)	2-23
Redirecting number	C.5 of this Recomm.	n > u	O (NOTE 16)	2-25
User-user	4.5	-	(ETSI NOTE 3)	-

NOTE 1: Spare in this ETS.

NOTE 2: Mandatory in the network to user direction. Included in the user to network direction when the user wants to indicate a channel. If not included, its absence is interpreted as "any channel acceptable".

NOTE 3: Spare in this ETS.

NOTE 4: Included if the network provides information that can be presented to the user.

NOTES 5 to 11: Spare in this ETS.

NOTE 12: Included in the user to network direction depending on the user/network identification requirements. Included in the network to user direction if the network implements CCITT Recommendation X.25 [14] / ETS 300 102-1 [26] information element mapping and provides indication to the called user of the calling party number.

NOTE 13: Included in the user to network direction depending on the user/network identification requirements. Included in the network to user direction if the network implements CCITT Recommendation X.25 [14] / ETS 300 102-1 [26] information element mapping and provides indication to the called user of the calling party subaddress

NOTE 14: Included in the network to user direction if the network implements CCITT Recommendation X.25 [14] / ETS 300 102-1 [26] information element mapping and provides indication to the called user of the called party number.

NOTE 15: Included in the network to user direction if the network implements CCITT Recommendation X.25 [14] / ETS 300 102-1 [26] information element mapping and provides indication to the called user of the called party subaddress

NOTE 16: Included in the network to user direction if the network implements CCITT Recommendation X.25 [14] / ETS 300 102-1 [26] information element mapping and provides indication to the called user of the number from which a call diversion or transfer was invoked.

ETSI NOTE 1: Used to identify the ISDN packet mode bearer capability.

ETSI NOTE 2: May be included in the event of interworking with a private network. Public networks will ignore this information element.

ETSI NOTE 3: Not supported by ETSI networks.

B.10 Status

This message is sent by the user or the network in response to a STATUS ENQUIRY message or at any time to report certain error conditions listed in subclause 5.8 of ETS 300 102-1 [26].

STATUS message content

Message type: STATUS
Significance: local
Direction: both

Information element	Reference (in ETS 300 102-1)	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	2-3
Message type	4.4	both	M	1
Cause	4.5	both	M	4-32
Call state	4.5	both	M	3
Display	4.5	n > u	O (NOTE 1)	2-34

NOTE 1: Included if the network provides information that can be presented to the user.

B.11 Status enquiry

This message is sent by the user or the network at any time to solicit a STATUS message from the peer layer 3 entity. Sending a STATUS message in response to a STATUS ENQUIRY message is mandatory.

STATUS ENQUIRY message content

Message type: STATUS ENQUIRY
Significance: local
Direction: both

Information element	Reference (in ETS 300 102-1)	Direction	Type	Length
Protocol discriminator	4.2	both	M	1
Call reference	4.3	both	M	2-3
Message type	4.4	both	M	1
Display	4.5	n > u	O (NOTE 1)	2-34

NOTE 1: Included if the network provides information that can be presented to the user.

Annex C (normative): Information elements for the control of packet-mode access connections

This annex lists the information elements used by packet-mode access connections control procedures.

C.1 Protocol discriminator

Coded as specified by ETS 300 102-1 [26], subclause 4.2 (figure 4.2).

C.2 Call reference

The Call reference information element is managed and coded as defined by ETS 300 102-1 [26], 7 subclause 4.3.

It is two octets long on the basic rate access and three octets long on the primary rate access.

The Dummy Call reference value shall not be used.

The Global Call reference value is applicable only when the Restart procedure is used. (See ETS 300 102-1 [26], subclause 5.5).

C.3 Message type

This information element is coded as defined by ETS 300 102-1 [26], subclause 4.4. Table C.1 shows the coding of the message types applicable to the packet-mode access connections control procedures.

C.4 Other information elements

The list of the information elements and the coding of the information element identifiers of codeset 0 and specific to each message are shown in table C.2.

Their coding rules are specified in subclause 4.5.1 of ETS 300 102-1 [26], the use of other codeset than codeset zero is defined in subclause 4.5.2, and the procedures for changing from one codeset to another are defined in subclause 4.5.3 and 4.5.4.

The codings of the information elements listed in table C.2 are defined in ETS 300 102-1 [26], as shown in the reference column, with the exception of the coding of the Redirecting number information element which is specified in the following subclause C.5.

NOTE 1: The Bearer capability is coded with the attribute values defined in subclause 7.1.2.1 of this ETS. It shall be 7 octets long.

NOTE 2: The Cause information element shall only contain values defined in table 4.13 of ETS 300 102-1 [26]. Octet 3a shall therefore not be used. If present, the Cause information element shall be treated according to error handling procedures defined in subclause 5.8 of ETS 300 102-1 [26].

Table C.1: Messages types

8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	escape to nationally specific message type (see NOTE and ETSI NOTE)
0 0 0 - - - - -	Access connection 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 0 1 1	- PROGRESS
0 0 1 0 1	- SETUP
0 1 0 - - - - -	Access connection clearing messages:
0 0 1 0 1	- DISCONNECT
0 1 1 0 1	- RELEASE
1 1 0 1 0	- RELEASE COMPLETE
0 0 1 1 0	- RESTART
0 1 1 1 0	- RESTART ACKNOWLEDGE
0 1 1 - - - - -	Miscellaneous messages:
1 1 1 0 1	- STATUS
1 0 1 0 1	- STATUS ENQUIRY

NOTE: When used, the message type is defined in the following octet(s), according to the national specification.

ETSI NOTE: When allocating codes for national message types the following principle shall be applied for the first following octet:

1 0 X X X X X X : National standard
1 1 X X X X X X : ETSI standard.

Table C.2: Information element identifier coding

8 7 6 5 4 3 2 1		Reference (in ETS 300 102-1)	Maximum length (octets)
1 : : : - - - -	Single octet information elements:		
0 0 0 - - - -	Reserved		
0 0 1 - - - -	Shift (ETSI NOTE)	4.5.3/4.5.4	1
0 : : : : : : :	Variable length information elements:		
0 0 0 0 1 0 0	Bearer capability	4.5.5	7
0 0 0 1 0 0 0	Cause	4.5.12	32
0 0 1 0 1 0 0	Call state	4.5.7	3
0 0 1 1 0 0 0	Channel identification	4.5.13	5
0 0 1 1 1 1 0	Progress indicator	4.5.22	4
1 1 0 1 1 0 0	Calling party number	4.5.10	24
1 1 0 1 1 0 0	Calling party subaddress	4.5.11	23
1 1 1 0 0 0 0	Called party number	4.5.8	23
1 1 1 0 0 0 1	Called party subaddress	4.5.9	23
1 1 1 0 1 0 0	Redirecting number	C.5 of this Annex	25
1 1 1 1 0 0 1	Restart indicator	4.5.24	3
1 1 1 1 1 1 1	Escape for extension		
All other values are reserved			

ETSI NOTE: This information element may appear more than once in a message.

C.5 Redirecting number

The purpose of the Redirecting number information element is to identify the number from which a call diversion or transfer was invoked.

The Redirecting number information element is coded as shown in figure C.1 and table C.3.

The maximum length of this information element is network dependent. However it shall not exceed 25 octets.

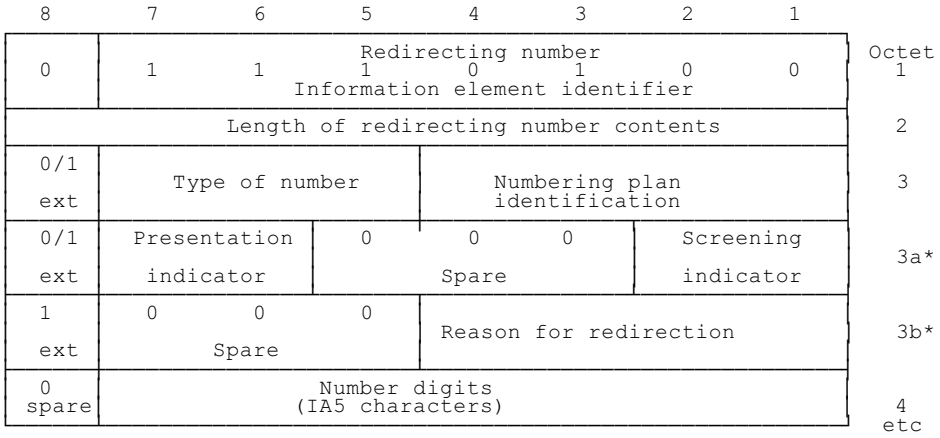


Figure C.1: Redirecting number information element

Table C.3: Redirecting number information element

Type of number (octet 3) (NOTE 1)

Bits 7 6 5	
0 0 0	unknown (NOTE 2)
0 0 1	international number (NOTE 3)
0 1 0	national number (NOTE 3)
0 1 1	network specific number (NOTE 4)
1 0 0	subscriber number (NOTE 3)
1 1 0	abbreviated number (ETSI NOTE)
1 1 1	reserved for extension

All other values are reserved.

NOTE 1: For the definition of international, national and subscriber number see CCITT Recommendation I.330 [5].

NOTE 2: The type of number "unknown" is used when the user or the network has no knowledge of the type of number e.g., international number, national number, etc. In this case the number digits field is organised according to the network dialling plan; e.g., prefix or escape digits might be present.

NOTE 3: Prefix or escape digits shall not be included.

Table C.3 (continued): Redirecting number information element

NOTE 4: The type of number "network specific number" is used to indicate administration/service number specific to the serving network, e.g., used to access an operator.

ETSI NOTE: This codepoint is not applicable to this ETS.

Numbering plan identification (octet 3)

Numbering plan (applies for type of number = 000, 001, 010 and 100)

Bits 4 3 2 1	
0 0 0 0	unknown (Note)
0 0 0 1	ISDN/telephony numbering plan (CCITT Recommendation E.164 [2]/E.163 [1])
0 0 1 1	data numbering plan (CCITT Recommendation X.121)
0 1 0 0	telex numbering plan (CCITT Recommendation F.69)
1 0 0 0	national standard numbering plan
1 0 0 1	private numbering plan
1 1 1 1	reserved for extension

All other values are reserved.

NOTE: The numbering plan "unknown" is used when the user or the network has no knowledge of the numbering plan. In this case the number digits field is organised according to the network dialling plan; e.g., prefix or escape digits might be present.

Presentation indicator (octet 3a)

Bits 7 6	
0 0	Presentation allowed
0 1	Presentation restricted

All other values are reserved.

NOTE: At the redirecting user-network interface, the presentation indicator is used for indicating the intention of the redirecting user for the presentation of the redirecting number to the called user. This may also be requested on a subscription basis. If octet 3a is omitted, and the network does not support subscription information for the redirecting number information restrictions, the value "00 presentation allowed" is assumed.

Table C.3 (continued): Redirecting number information element

Screening indicator (octet 3a)

Bits 2 1	
0 0	User provided, not screened
0 1	User provided, verified and passed
1 0	User provided, verified and failed (ETSI Note)
1 1	Network provided

NOTE: If octet 3a is omitted "00 User provided not screened" is assumed.

ETSI NOTE: Not applicable in ETSI ISDN.

Reason for redirection (octet 3b)

Bits 4 3 2 1	
0 0 0 1	Call forwarding busy or called DTE busy
0 0 1 0	Call forwarding no reply
1 0 0 1	Called DTE out of order
1 0 1 0	Call forwarding by the called DTE
1 1 1 1	Call forwarding unconditional or systematic call redirection

All other values are reserved.

Number digit (octet 4, etc.)

This field is coded with IA5 characters, according to the formats specified in the appropriate numbering/dialling plan.

Annex D (informative): Example of ISDN CCITT Recommendation X.25 packet-mode bearer service access on the D-channel through a NT2 with frame handling functions

Various scenarios are possible for ISDN Packet Mode Bearer Service provision to private networks, including:

- NT2 circuit switched access to the PH via a B channel;
- NT2 with CCITT Recommendation X.25 [14] packet concentration or switching functions, to access the PH via B or D channel;
- NT2 with Frame Handling (e.g. full layer 2 frame switching or only frame relaying functions) functions, to access the PH via a D channel.

NOTE 1: The case of a NT2 implementing frame relaying functions may require further study, in particular with regard to traffic management.

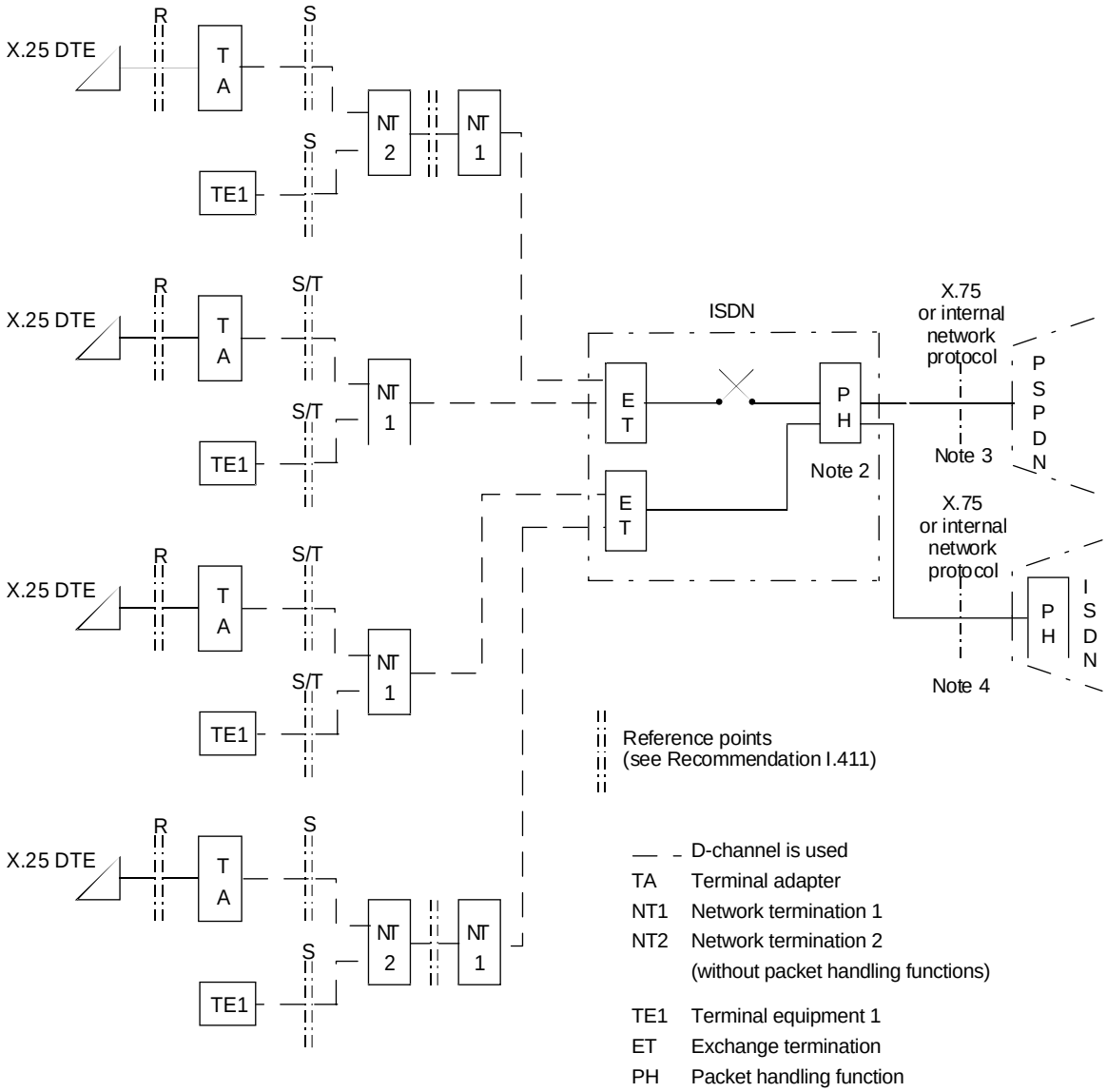
NOTE 2: The term Frame Relaying and Frame Switching are used in the context of the layer 2 protocols according to ETS 300 125 [28] and do not relate to the protocols being defined to support Frame Mode Bearer Service.

This annex more specifically shows, as an example and for illustration purpose only the case of an NT2, without packet handling functions, accessing ISDN packet switching functions via the D-channel at the T reference point and supporting terminals operating the ISDN packet mode bearer capability in the D-channel at the S reference point (see figure D.1).

In this case the NT2 has to perform layer 2 multiplexing (e.g. by a frame relaying or a frame switching function acting as a Frame Handler) in order to give access to the ISDN packet handler. The NT2 may support multiple data link connections concurrently at the T reference point of either a basic or a primary rate access. Any TEI value in the range 0 - 126 can be used for each of the data links.

As shown in figure D.2 which depicts the example of an incoming call offering to such an NT2 hosting a Frame Handler, the network must use the broadcast data link (i.e. an UI frame with TEI = 127) for incoming call offering, thus allowing the NT2 to establish the SAPI 's' data link with the appropriate TEI value in order to respond; the network is then able to subsequently establish the SAPI 'p' data link with the same TEI value in order to convey the CCITT Recommendation X.25 [14] Incoming Call packet to the selected user.

The support of such a call offering procedure is a network option. When supported, the maximum number of data links allowed to be concurrently active on a D-channel is network dependant.



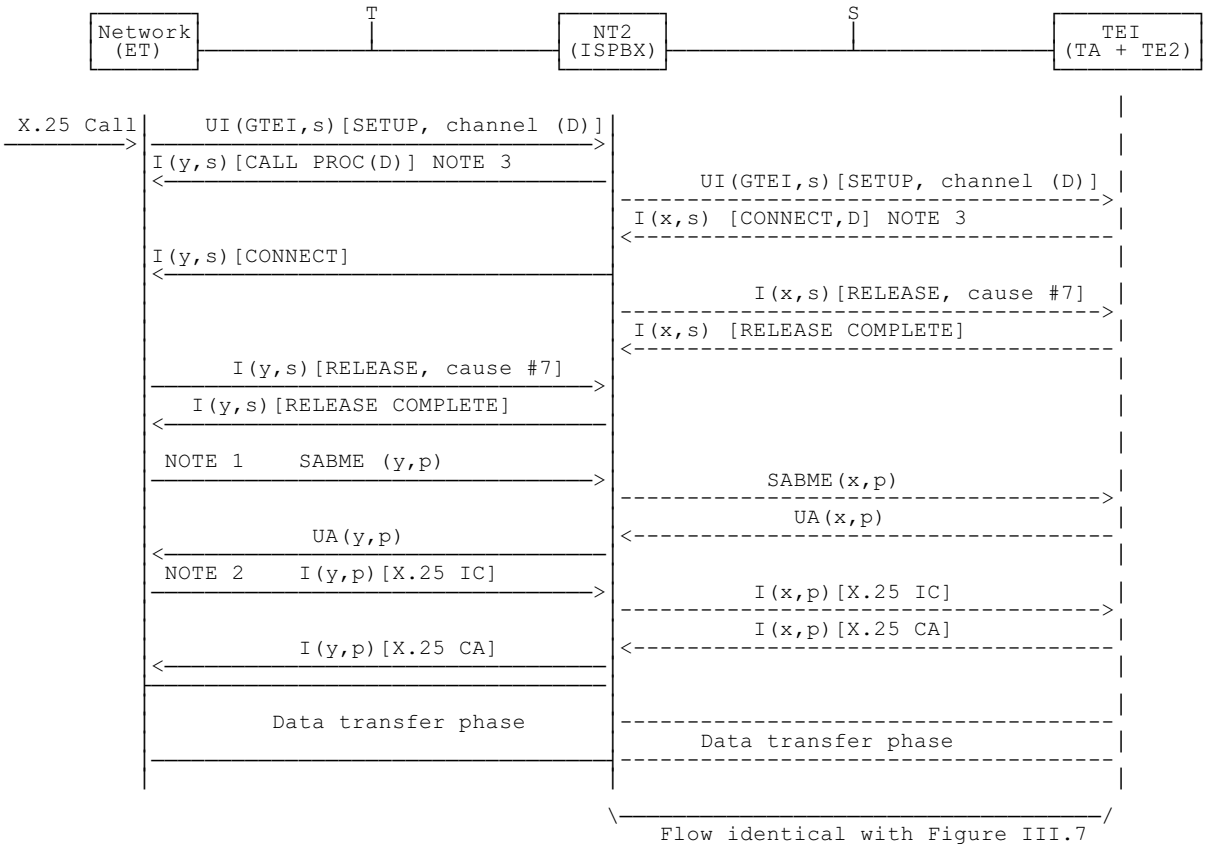
NOTE 1: This figure is only an example of many possible configurations and is included as an aid to text describing the various interface functions.

NOTE 2: In some implementations, the PH functions logically belonging to the ISDN may reside physically in a node of the PSPDN. The service provided is still the ISDN virtual circuit service.

NOTE 3: See CCITT Recommendation X.325 [21].

NOTE 4: See CCITT Recommendation X.320 [20].

Figure D.1: Configuration for the ISDN virtual circuit service (access via D-channel)



NOTE 1: The link layer is established in the D-channel if it is not already established. See subclause 7.3. The timer T320 is started.

NOTE 2: The timer T320 is cancelled, if running.

NOTE 3: According to ETS 300 102-1 [26] subclause 3.1.2 and subclause 3.1.4 it is possible to transfer no channel indication information element for the exception of the offered channel.

x - TEI at the S reference point s - SAPI "s" (0)

y - TEI at the T reference point p - SAPI "p" (16)

Figure D.2: Example of incoming call offering procedures via an NT2 (ISPBX) using signalling on SAPI=0 link: NT2 accepts call on a new D-channel data link

History

Document history	
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