ETSI TECHNICAL COMMITTEE REFERENCE TECHNICAL REPORT

TCR-TR 021

November 1994

Source: ETSI TC-NA

Reference: DTR/NA-025101

ICS:

Key words: ISDN, PMBS

Integrated Services Digital Network (ISDN); Amendment of the CCITT Recommendation X.31, case B Packet Mode Bearer Service (PMBS)

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Executive Summary

This TCR/TR has been developed by the Joint Activity Group (JAG) established under the auspices of STC NA2 and initiated by the 11th meeting of the ISDN Standardization Management group (ISM). The JAG was entrusted to set up guidelines for the amendment of the Stage 1 and Stage 3 descriptions, as well as for the development of a Stage 2 description of the X.31 Case B packet mode bearer services (PMBS) via the B and the D-channel. The amendment has to cover

- the inclusion of private ISDNs in the public X.31 services
- the selection of options from possible modes of operations and scenarious.

The JAG recommendations are based on ISM's assumption that the amendment of the currently developed ETSs will be pursued with highest priority. In brief, these amendments should encompass:

1. The notion of *modes of operation* developed in this document. Data customers finally subscribing to the services and thus stimulating the use of the ETSI standards are used to map their operational requirements into modes of operation in order to determine which arrangements suit them best.

   Modes of operation as defined and classified in this TR need to be identifiable throughout the entire documentation for all three stages of service description.

   This requires to re-structurize the existing (pr)ETSs accordingly, whenever applicable at any of the ETSs concerned.

   This also requires to unify and adhere to the terminology employed in this TR.

2. The notion of priorities when re-specifying the ETSs. The priorities take account of the majority of user needs and of envisaged network implementations. To come up with the most important modes of operation as soon as possible is the most urgent need.

3. Modes of operation achievable by management tools rather than by sophistcated signalling procedures are favoured and have been allocated higher priority. In other words: Permanent logical link approaches have been given higher priorities than demand requests requiring complex signalling protocols.

4. Studies on the Frame Mode Bearer Service (FMBS) are carried out with high priority, and the intention is to await conceptual outputs from these studies first before making a final recommendation on demand D-channel packet mode bearer service.

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0 Introduction

At its 11th meeting the ISDN Standardization Management group (ISM) in ETSI decided that detailed technical coordination should take place in the field of X.31 packet mode bearer service specifications in order to cover the inclusion of private ISDNs in the public X.31 services and the selection of profiles from possible modes of operation and scenarious. A Joint Activity Group (JAG) was established under the auspices of STC NA2 which (at the 12th ISM meeting) was entrusted with the preparation of this TCR/TR.

1 Scope

The purpose of this TCR/TR is to provide binding guidelines for the amendment of the Stage 1 and Stage 3 descriptions, as well as for the development of a Stage 2 description of the X.31 Case B packet mode bearer services via the B and the D-channel.

This TCR/TR applies to

- the ETSI stage 1 descriptions of the X.31 case B service over the B- and D-channel (ETS 300 048 [1] and ETS 300 049 [2]),
- the stage 3 description at the ISDN user-network access (S/T reference point; ETS 300 007 [3]),
- the stage 3 description at the ISDN - packet handler access point interface (PHI, ETS 300 099 [4]),
- the stage 3 description at the T reference point between public and private ISDN,
- the stage 2 description(s) to be developed for the services described in [1] and [2].

2 References

[1] ETS 300 048 Integrated Services Digital Network (ISDN) – Packet Mode Bearer Service – B-Channel

[2] ETS 300 049 Integrated Services Digital Network (ISDN) – Packet Mode Bearer Service – D-Channel

[3] ETS 300 007 Integrated Services Digital Network (ISDN) – Packet Mode Bearer Service – Support of Packet Mode Terminal Equipment by an ISDN

[4] ETS 300 099 Integrated Services Digital Network (ISDN) – Specification of the Packet Handler Access Point Interface (PHI) for the Provision of ETS 300 007 (CCITT Recommendation X.31) Packet Mode Services

[5] T/NA1(89)33TR Supplementary Services associated with bearer services

[6] ETS 300 102 Integrated Services Digital Network (ISDN) – User Network Interface; Layer 3 Specification for Basic Call Control

[7] ETS 300 125 Integrated Services Digital Network (ISDN) – User Network Interface; Data Link Layer Specification; Application of CCITT Rec. Q.920 and Q.921

[8] ENV 41007-1 Definition of Terms in Private Telecommunications network Part 1: Definition of General Terms

[9] ENV 41004 Reference Configuration for Connectivity Relations of Private Telecommunication Network Exchanges

[10] D-ETS NA-22108 Routing for ISUP Version 2 Services

3 Definitions

3.1 Private Telecommunication Network (PTN)

A private ISDN providing services to a specific set of users (contrary to a public ISDN which provides services to the general public).

NOTE – This definition does not include legal and regulatory aspects and does not indicate any aspects of ownership.

3.2 Private Telecommunication Network Exchange (PTNX)

A PTN nodal entity which provides automatic connection handling functions used for the provision of telecommunication services based on the definitions of the public ISDN services. A nodal entity consists of one or more nodes.

NOTE – If applicable, a PTNX provides:
-telecommunication services within its own area, and/or
-telecommunication services from the public ISDN, and/or
-telecommunication services from other public networks, and/or
-within the context of a private ISDN, telecommunication services from other PTNXs to users of the same and/or other PTNXs.

A PTNX can be presented by an ISPBX, ISCTX (CENTREX), or other equipment performing the functions outlined above (e.g. LAN-Gateway).

3.3 Long Duration Connection

A connection which can be established in order to convey multiple overlapping X.25 Calls. In principle, the connection is retained for an unlimited period of time, unless faults occur which cause its forced release (and later re-establishment). The establishment and release of a Long Duration Connection are independant of X.25 Calls. Such a connection lasts longer than the last X.25 Call.

3.4 Fixed Address

A Layer 2 address consisting of SAPI 16 and a pre-agreed TEI value. For TEs the pre-agreed TEI values are within the range of non-automatic TEI values, see ETS 300 125.

3.5 Call-Determined Layer 2- Address

A Layer 2 address consisting of SAPI 16 and a TEI value which is determined by an ISDN call offering procedure, see ETS 300 007. The TEI values can be in the ranges of automatic and non-automatic TEI values, see ETS 300 125.

3.6 Data Link Control Information

The information interchanged between the public network packet handler at the private network frame handler for controlling data links on B-channels (see 7.5 Scenario 5). This information is conveyed in a layer 3 signalling protocol.

4 Symbols and Abbreviations

B B-Channel, in general

B_B B-Channel at the PHI used for the Packet Mode Bearer Service on B-channels

B_D B-Channel at the PHI used for the Packet Mode Bearer Service on D-Channels

CS Circuit Switching function

D D-Channel, in general

DLCI Data Link Connection Identifier

FH Frame Handler

LAPB Link Access Procedure B (CCITT X.25 Layer 2 HDLC)

LAPD Link Access Procedure on the D-channel (CCITT Recommendations Q.920/Q.921)

LAPDe LAPD with extended Address Field

LIC Link Identifier Code

PH Packet Handler

PHI Packet Handler Access Point Interface

PLL Permanent Logical Link

PLP Packet Layer Protocol

PMBS Packet Mode Bearer Service

PTN Private Telecommunication Network (private ISDN)

PTNX Private Telecommunication Network Exchange

PTN-FH A Frame Handler within a Private Telecommunication Network

PVC Permanent Virtual Call

TA Terminal Adaptor

TE Terminal Equipment

UNI User-Network Interface at the S or S/T reference point

VC Virtual Call

5 Current Situation

Note: During the public enquiries on ETSs [1] through [4], a number of comments have been made to better separate between stages 1 and 3. This material could not fully be taken into account at the resolution meetings. It is advisable to again have a look at the comments during the establishment of this TCR/TR.

5.1 Stage 1 Descriptions

ETSs [1] and [2] are to cover the stage 1 descriptions, however, some important applications are not worked out, e.g. the use of permanent logical links (PLL). On the other hand, stage 3 definitions which should appear in [3] only, are included and, furthermore, the stage 1 descriptions import material from [3] in a normative way.

ETSs [1] and [2] do not address service interworking with PTNs.

5.2 Stage 2 Description(s)

A Stage 2 description does not exist. This is seen as an important reason why the inclusion of private ISDNs has not properly been taken care of by ETSs [1] through [4]. Thus, ISM has decided that the inclusion of private ISDNs has explicitly to be taken out of the scope of these ETSs.

One of the tasks of this TCR/TR is to provide the guidelines for a stage 2 description which would sufficiently allow the participation of users of private ISDNs in the public X.31 services. This would then be specified in amendments leading to 2nd editions of the ETSs concerned.

A lot of stage 2 material is already implicitly included in ETS 300 099 [4]. This material, however, covers only the range between the packet handler (PH) and the frame handler (FH) in the ISDN local exchange. It does not extend to the user (according to the scope of ETS 300 099 [4]). As far as applicable, this material is to be taken as a basis for the development of (the) stage 2 description(s).

To also cover the requirements from private ISDNs, scenarios should be developed within the scope of this document from which the necessary conclusions can be derived.

5.3 Stage 3 Descriptions

Stage 3 descriptions apply twice, i.e. at the user network interface (ETS 300 007, [3]) and at the PHI (ETS (300 099, [4]).

[3] contains stage 1 relevant material which needs to be taken out from this standard. [4] contains some stage 2 material which can be used as the basis for the establishment of a stage 2 description.

Neither [3] nor [4] address interworking requirements with PTNs.

5.4 Terminology

Different terminology has been used by the STCs involved in the stage 1 and stage 3 descriptions. Annex C shows the original discrepancies together with the mapping onto the clauses of this Technical Report, which define the new terminology, as proposed now.

6 Future Private ISDN Objectives and Requirements

In the future, the general attachment and interworking problems between public and private ISDNs should be considered, such as:

1. PTNs may consist of more than one PTNX; the PTNXs may be interconnected in any form of geographical topology, according to the customer's extension over separate premises; in particular, concatenations of PTNXs can occur, in principle, up to any number of PTNXs in tandem;

2. the access between a gateway PTNX and the public ISDN may consist of any number of basic and/or primary rate interfaces which are combined to a so called trunk hunting group, sharing a trunk hunting number; for circuit mode bearer services, the selection of a particular channel from a particular interface is covered by the trunk hunting algorithm (at both sides, PTNX and local exchange); for frame and packet mode services, the problem of distributing the amount of data traffic somewhat equally over multiple D-channels needs to be considered; one sub-problem is how to identify a particular D-channel within the totality of interfaces employed.

3. depending on the actual data traffic, a given (B or D) channel may be exhausted up to its capacity; the management issues of handing over logical links from one channel to a further one needs to be considered.
   To a certain degree, this problem is related to the problem above.

4. A PTNX may be represented by an ISPBX or ISCTX (see ENV 41007-1, [8]). Both may have packet or frame handling facilities. An ISCTX may share the physical equipment with the public ISDN, e.g. providing FH or PH functions.

Not all of the problems apply to each of the scenarios, see Clause 7.

7 Scenarios

The characteristics of the scenarios and the specific problems which need to be solved are briefly introduced hereafter. Since a distinct reference point for the delimitation of a public ISDN against an ISCTX has not been defined, the T reference point applies instead. Also in the case of ISCTX, terminals are attached to a PTN at the S reference point (see ENV 41004, [9]).

7.1 Scenario 1 – TE uses the Public ISDN PMBS via B-Channel

Scenario 1 is shown in Figure 1.

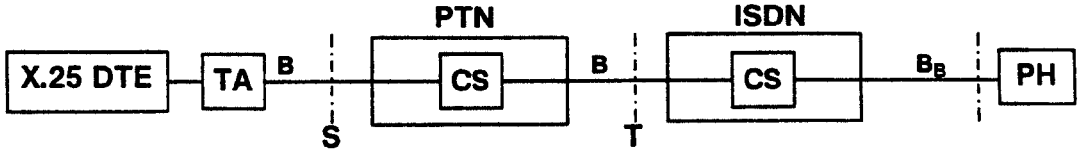


Figure 1 – Scenario 1

This scenario does not seem to require any particular specifications additional to those applicable at the S/T reference point.

7.2 Scenario 2 – Concatenation of Public ISDN FH with Private ISDN FH(s)

Scenario 2 is shown in Figure 2.

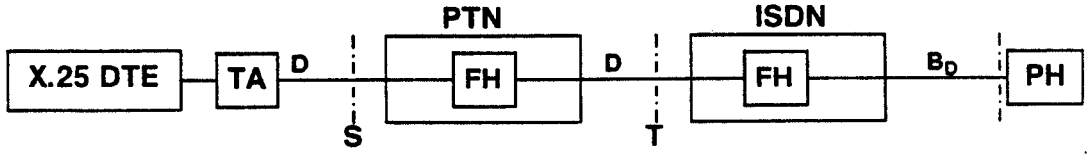


Figure 2 – Scenario 2

This scenario needs to be studied with regard to FH capabilities in the PTNX, to the mapping process which is necessary in the PTNX between S and T (or between S and Q (and further Q reference points, if applicable) and T reference points in the case of concatenated PTNXs).

Also the number of available TEIs which finally is responsible for the total number of TEs supported at the various instances of S reference points over a given D-channel at the T reference point needs to be studied.

The more TEs are connected to a PTN, the more likely is the fact that multiple instances of T reference points exist, each one represented by an interface of the basic or primary rate access with its associated D-channel.

7.3 Scenario 3 – Private Network PH uses the PMBS via D-Channel

In this scenario a private packet handler is connected to the public X.31 service acting on behalf of numerous terminals connected to the PTN at its S reference points, see Figure 3.

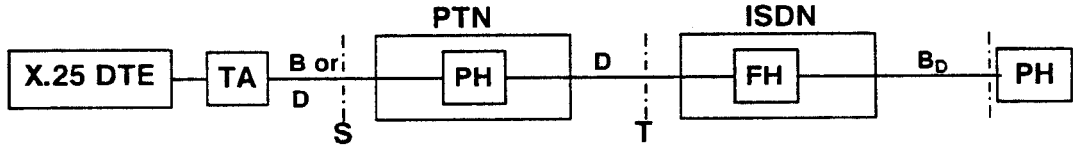


Figure 3 – Scenario 3

This scenario allows for intra-private ISDN packet calls. Internal calls can, in principle, be handled in the same manner as in the public network. External packet calls are extended by the private PH in either direction similar to the principles following [2], [3] and [4].

Within the PTN both services, i.e. via B and via D-channel, are available. If necessary repacketizing according to the restrictions at the T reference point shall be performed by the private PH.

All incoming calls to the X.25 TEs of a particular private network must be routed to its PH rather than to the TEs directly. Either the public PH has to provide address mapping, or the private network has to route, on the basis of the requested bearer capability, to the private PH.

Similarly, outgoing calls from the TEs must be routed to the private PH which will then determine whether the call has to be forwarded to the public PH.

This scenario is of interest where there is enough traffic internal to the private network, and where the nature and volume of the external traffic allows the use of a D-channel to the FH/PH of the public network.

Only one logical link is required across the T reference point. Any multiplexing will take place at the X.25 packet layer.

7.4 Scenario 4 - Private Network PH uses the PMBS via B-Channel

In this scenario a private packet handler is connected to the public X.31 service acting on behalf of numerous terminals connected to the PTN at its S reference points, see Figure 4.

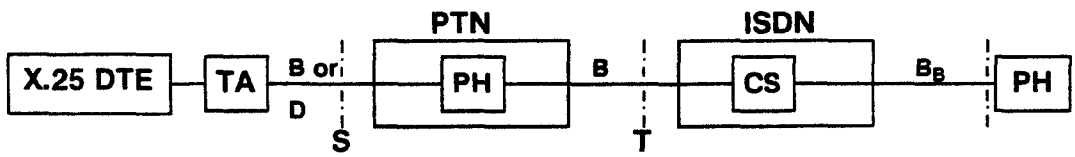


Figure 4 - Scenario 4

The scenario corresponds to scenario 3 with the exception, that a B-channel is used at the T reference point.

7.5 Scenario 5 - Private Network FH uses the PMBS via B-Channel

This scenario uses a private FH which connects to the public PH via circuit-switching capabilities of the public ISDN, see Figure 5. Scenario 5 represents the extension of the public network D-channel-PMBS into the PTN by allocating the PHI-relevant local connection related functions (CRF-S) to the Frame Handler of the PTN. The B-channel carrying multiplexed packet traffic between the PTN-FH and the PH is in fact a B_d-channel prolonged through the public ISDN to the PTN-FH.

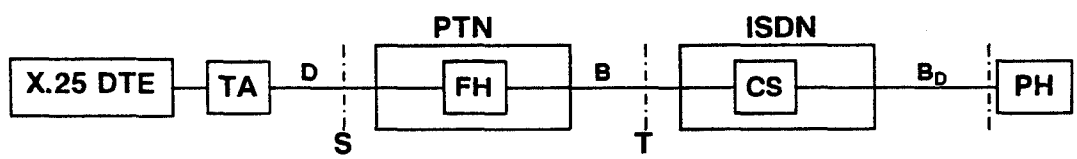


Figure 5 - Scenario 5

This scenario corresponds to scenario 2 with the difference that a B-channel is used at the T reference point, but there is no increased traffic overload and no additional transit delay. Hence, the Quality of Service offered to the users in private networks is the same as to the users in public networks.

A mapping process which is necessary in the PTNX between S and T or between S and Q and T reference points in the case of concatenated PTNXs.

Also the number of available DLCIs which finally is responsible for the total number of TEs supported at the various instances of S reference points over a given B-channel at the T reference point needs to be studied.

The more TEs are connected to a PTN, the more likely is the fact that multiple instances of T reference points exist, each one represented by a single basic or primary rate access with its associated D-channel.

7.6 Overview Description of the Five Scenarios

The fol

Table 1 - Scenario 1: TE uses the public PMBS via B-Channel

Item	Impact
X.25 TE	None
PTN	Handling of Packet mode capability (i.e. routeing on the bearer capability indication)
T Ref. Point	None
Public PH	Each terminal connected to the PTN is seen by the public PH as an individual DTE.
Service Aspects, Q.o.S	Increased call set-up delay for the establishment of the B-Channel
General Remarks	Internal packet communication only possible via the public PMBS; The non-screening arrangement needs to be supported by the ISDN (see ETS 300 089)

Table 2 - Scenario 2: Concatenation of public FH with private FH(s)

Item	Impact
X.25 TE	None
PTN	Support of multiple TEIs on the access to the public ISDN. The same TEI values could occur at the S reference point, each on a different interface.
T Ref. Point	On demand with dynamic TEI assignment does not work if more than one terminal on the PTN use this service option. PLL or semi-permanent do. Dynamic provisioning of the PLL service is not possible.
Public PH	As in Scenario 1.
Service Aspects, Q.o.S	Increased probability of traffic overload on the D-channel, competition with signalling (which is a trunk load at the T reference point). Additional transit delay due to two D-channels in series.
General Remarks	Internal packet communication only possible via the public PMBS; The non-screening arrangement needs to be supported by the ISDN (see ETS 300 089)

Note 1: Possible interworking between frame switching and frame relaying is an open issue.

Table 3 - Scenarios 3 and 4 : PTN PH uses the PMBS via D or B-Channel

Item	Impact
X.25 TE	None
PTN	PH capability. From the public PH the private PH is seen as a single DTE. Handling of Packet mode capability (i.e. routeing on the bearer capability indication). Loadsharing/overflow functionality is required.
T Ref. Point	One data link is necessary only.
Public PH	The DDI range of terminal numbers needs to be known (X.25 screening and mapping).
Service Aspects, Q.o.S	Services at the PTN side are the largest common subset of the private and public PMBS. Additional transit delay and less throughput. The services of scenarios 3 and 4 are different.
General Remarks	Internal packet communication possible; Selection of a distinct D-channel out of a multiplicity at the T reference point.

Table 4 - Scenario 5: PTN FH uses the PMBS via B-Channel

Item	Impact
X.25 TE	None
PTN	Support of PHI B_D-channel protocol. Mapping of Layer 2 addresses.
T Ref. Point	Semi-permanent B-channels required (to be used as B_D-channels)
Public PH	The DDI range of terminal numbers needs to be known (X.25 screening and mapping).
Service Aspects, Q.o.S	Advantage to Scenario 2: Q.o.S same as in public networks
General Remarks	Internal packet communication only possible via the public PMBS; Editorial: B_D-channel application currently not standardized at the T reference point.

Note 1: Possible interworking between frame switching and frame relaying is an open issue.

8 Modes of Operation

The reduction of options should be based on two general considerations: the mode of operation of the ISDN connection (hereafter abbreviated to: modes of operation) and the scenario. The selection of a particular mode of operation will depend on the user's needs, on the service option the network operator provides, and on the cost.

All conceivable modes of operation are classified and listed here. For the possible reduction of standardization efforts to certain modes of operation see Clause 10.

Clause 8.1 lists the different modes of operation for the S and the S/T reference points; Clause 8.2 comments the particularities of these operational modes when applied to the T reference point. Clause 8.3 deals with logical data links on B-channel at the T Reference Point. A concise overview of the modes of operation listed in clauses 8.1 and 8.3 are shown in Annexes A and B in tabular form.

8.1 Modes of Operation at the S/T and at the S Reference Points

In the following sub-clauses the term "network" is to be understood as the private ISDN (PTN) with regard to the S reference point, and as the public ISDN with regard to the S/T reference point. The term "user" is to be understood as the user of a TE which is attached to an interface at either of these reference points.

8.1.1 Case B, B-Channel

At the user network interface (UNI) and at the PHI the circuit switched connection is conveyed on a B-channel.

8.1.1.1 Demand Circuit , X.25 Call Dependent

The establishment of the circuit switched connection between PH and TE is initiated by the beginning of the first X.25 call, and its release is initiated by the end of the last X.25 call. Connection establishment and disestablishment are under ISDN call control in both directions, and follow ETS 300 102 [6].

Table 5 – Demand Circuit, X.25 Call Dependent

X.25 Services	ISDN Channel	Initialization	Service Invoc.	ISDN U-Plane
VC	B-Channel	X.25 Call dependent (first/last X.25 call)	Demand	L.2: LAPB L.3: X.25 PLP

8.1.1.2 Demand Circuit, Long Duration, X.25 Call Independent

Establishment and release of the circuit switched connection between PH and TE are independent of X.25 calls; instead, they are initialized by the user (for VCs) or by the PH (for PVCs). Typically the circuit switched connection lasts longer than the last active X.25 call (long duration). Connection establishment and disestablishment will use ISDN call control and follow ETS 300 102 [6].

Table 6 – Demand Circuit, Long Duration, X.25 Call Independent

X.25 Service	ISDN Channel	Initialization	Service Invoc.	ISDN U-Plane
VC	B-Channel	By the user	Demand	L.2: LAPB L.3: X.25 PLP
PVC	B-Channel	By the packet handler	Demand	L.2: LAPB L.3: X.25 PLP

8.1.1.3 Permanent Circuit , X.25 Call Independent

Establishment and release of the circuit switched connection between PH and TE are achieved independently of X.25 calls, by O&M procedures of the network provider.

Table 7 – Permanent Circuit, X.25 Call Independent

X.25 Service	ISDN Channel	Initialization	Service Invoc.	ISDN U-Plane
VC or PVC	B-Channel	Subscription	Permanent	L.2: LAPB L.3: X.25 PLP

8.1.2 Case B, D-Channel

At the UNI the data link is conveyed on a D-channel. At the PHI the data link is conveyed on a B-channel ("B_D").

8.1.2.1 Demand Data Link, Call-determined Layer 2-Address, X.25 Call Dependent

The establishment of the data link between PH and TE is initiated by the beginning of the first X.25 call, and its release is initiated by the end of the last X.25 call. Link establishment and disestablishment are under link control in both directions and follow ETS 300 125 [7]. Prior to an incoming connection set-up, the ISDN determins the link address (which is unknown to it) by means of ISDN call control functions (Layer 3, ETS 300 007 [3] call offering procedure).

Table 8 – Demand Data Link, Call-determined Layer 2 -Address, X.25 Call Dependent

X.25 Service	ISDN Channel	Initialization	Service Invoc.	Addressing	ISDN U-Plane
VC	Data Link on D-Channel	X.25 Call dependent (first/last X.25 call)	Demand	Variable	L.2: LAPD L.3: X.25 PLP

8.1.2.2 Data Links with Fixed Addresses

There are two types of data links working with fixed addresses and thus avoiding call-related address determination: demand data links and permanent data links. Also the latter one requires setup of the data link either by the user (VC) or, in both directions alternatively, by the user or the network (PVC).

8.1.2.2.1 Demand Data Link, Fixed-Address, X.25 Call Dependent

The establishment of the data link between PH and TE is initiated by the beginning of the first X.25 call, and its release is initiated by the end of the last X.25 call. Link establishment and disestablishment are under link control in both directions and follow ETS 300 125 [7]. The link address is pre-agreed on subscription.

Table 9 – Demand Data Link, Fixed Address, X.25 Call Dependent

X.25 Service	ISDN Channel	Initialization	Service Invoc.	Addressing	ISDN U-Plane
VC	Data Link on D-Channel (PLL)	X.25 Call dependent (first/last X.25 call)	Demand	Subscription (Fixed)	L.2: LAPD L.3: X.25 PLP

8.1.2.2.2 Demand Data Link, Long Duration, Fixed Address, X.25 Call Independent

Establishment and release of the data link between PH and TE is independent of X.25 calls; instead, it is initialized by the user (for VCs) or by the user/network (for PVCs). Typically the data link lasts longer than the last active X.25 call (long duration). Link establishment and disestablishment are under link control in both directions and follow ETS 300 125 [7]. The link address is pre-agreed on subscription.

Table 10 – Demand Data Link, Long Duration, Fixed Address, X.25 Call Independent

X.25 Service	ISDN Channel	Initialization	Service Invoc.	Addressing	ISDN U-Plane
VC	Data Link on D-Channel (PLL)	By the user	Demand	Subscription (fixed)	L.2: LAPD L.3: X.25 PLP
PVC	Data Link on D-Channel (PLL)	By the user or by the packet handler	Demand	Subscription (fixed)	L.2: LAPD L.3: X.25 PLP

8.1.2.2.3 Permanent Data Link, Fixed Address, X.25 Call Independent

Establishment and release of the data link between PH and TE are achieved independently of X.25 calls, by O&M procedures of the network provider.

Table 11 – Permanent Data Link, Fixed -Address, X.25 Call Independent

X.25 Service	ISDN Channel	Initialization	Service Invoc.	Addressing	ISDN U-Plane
VC or PVC	Data Link on D-Channel	Subscription	Perman.	Subscription (fixed)	L.2: LAPD L.3: X.25 PLP

8.2 Particularities of the Modes of Operation at the T Reference Point

This Clause discusses the particularities which occur at the T reference point, i.e. a PTNX is attached to the public ISDN access. If in the following sub-clauses reference is made to 8.1 or its sub-clauses, the term "user" is to be interpreted as the PTNX, whereas the term "network" designates the public ISDN.

8.2.1 Case B, B-Channel

8.2.1.1 Demand Circuit, X.25 Call Dependent

No particularities are seen for this mode of operation, since basic call control procedures apply, together with the DDI supplementary service in the i/c direction.

8.2.1.2 Demand Circuit, Long Duration, X.25 Call Independent

No particularities are seen for this mode of operation, since basic call control procedures apply, together with the DDI supplementary service in the i/c direction, or management intervention as described in 8.1.1.2.

8.2.1.3 Permanent Circuit, X.25 Call Independent

No particularities are seen for this mode of operation. Management interventions apply as described in 8.1.1.3.

8.2.2 Case B, D-Channel

As a general remark the statements given in Clause 6 apply (e.g. multiple basic access and/or primary rate access interfaces combined to a trunk hunting group).

Typically, PTNXs interchange signalling information in a point-to-point mode of operation with the public ISDN, i.e. only one Layer 2 address is used (TEI 0 in combination with SAPI 0). Thus, the method specified for terminals (S/T reference point), i.e. to "copy" the TEI value from SAPI 0 to SAPI 16, is restricted to applications where one data link per D-channel is sufficient at the T reference point.

For any other application multiple data links (multiple TEIs in combination with SAPI 16) need to be supported, even if only one Layer 2 link is used for signalling (TEI = 0/SAPI = 0).

The number of TEI values is restricted to 128, one of them being already allocated to a special purpose (broadcast and TEI assignment procedure). This leaves a maximum of 127 usable TEI values (i.e. number of data links) per D-channel at the T reference point.

8.2.2.1 Demand Data Link, Call-determined Layer 2-Address, X.25 Call Dependent

ETS 300 007 incoming call offering procedure applies in order to determine the data link address.

ETS 300 007 describes the application of the basic circuit mode call control protocol (ETS 300 102) for TEs using the X.31 PMBS at the S/T reference point. Although ETS 300 102 covers also the protocol at the T reference point, ETS 300 007 does not. This standard needs to be enhanced.

8.2.2.2 Data Links with Fixed Addresses

Clause 8.1.2.2 applies accordingly.

8.2.2.2.1 Demand Data Link, Fixed Address, X.25 Call Dependent

Clause 8.1.2.2.1 applies accordingly.

8.2.2.2.2 Demand Data Link, Fixed Address, X.25 Call Independent

Clause 8.1.2.2.2 applies accordingly.

8.2.2.3 Permanent Data Link, Fixed Address, X.25 Call Independent

Clause 8.1.2.2.3 applies accordingly.

8.3 Case B, Multiple Logical Data Links on B-channel at the T Reference Point

The characteristic of this mode of operation is that the logical data links are conveyed within a B-channel. As a result, several combinations of B-channel modes and data link modes are alredy possible at the T-reference point. Thus, this mode of operation suits only to scenario 5.

8.3.1 B-channel, Modes of Operation

The establishment of a "demand, long duration B-channel" at the T reference point requires the specific extended D64*-signalling which has been specified for the PHI D64-channel for setting up B_d-channels.

8.3.1.1 Demand Circuit, X.25 Call Dependent

The establishment of the circuit switched connection between the PH and the PTN-FH is initiated by the beginning of the first X.25 call, and its release is initiated by the end of the last X.25 call.

Connection establishment and disestablishment are under ISDN call control in both directions, and follow ETS 300 102 [6]. In the case of multiple B-channels and/or multiple private FHs additional signalling information is needed.

Table 12 – Demand Circuit, X.25 Call Dependent

X.25 Service	ISDN Channel	Initialization	Service Invoc.	ISDN U-Plane
VC	B-Channel	X.25 Call dependent (first/last X.25 call)	Demand	L.2: LAPDe L.3: X.25 PLPs

8.3.1.2 Demand Circuit, Long Duration, X.25 Call Independent

Establishment and release of the circuit switched connection between the PH and the PTN-FH are independent of X.25 calls; instead, they are initialized by the PTN-FH (for VCs) or by the PH (for PVCs). Typically the circuit switched connection lasts longer than the last active X.25 call (long duration).

Connection establishment and disestablishment will use ISDN call control and follow ETS 300 102 [6]. In the case of multiple B-channels and/or multiple private FHs additional signalling information is needed.

Table 13 – Demand Circuit, Long Duration, X.25 Call Independent

X.25 Service	ISDN Channel	Initialization	Service Invoc.	ISDN U-Plane
VC	B-Channel	By the PTN-FH	Demand	L.2: LAPDe L.3: X.25 PLPs
PVC	B-Channel	By the packet handler	Demand	L.2: LAPDe L.3: X.25 PLPs

8.3.1.3 Permanent Circuit, X.25 Call Independent

Establishment and release of the circuit switched connection between the PH and the PTN-FH are achieved independently of X.25 calls, by O&M procedures of the network provider.

Table 14 – Permanent Circuit, X.25 Call Independent

X.25 Service	ISDN Channel	Initialization	Service Invoc.	ISDN U-Plane
VC or PVC	B-Channel	Subscription	Permanent	L.2: LAPDe L.3: X.25 PLPs

8.3.2 Logical Data Link, Modes of Operation

At the the S reference point the data link is conveyed on a D-channel. At the T reference point and across the PHI the data link is conveyed on a B-channel (which corresponds to a B_D channel at a PHI).

8.3.2.1 Demand Data Link, Call-determined Layer 2-Address, X.25 Call Dependent

The establishment of the data link between the PH and the PTN-FH is initiated by the beginning of the first X.25 call, and its release is initiated by the end of the last X.25 call. Link establishment and disestablishment are under link control in both directions in accordance with LAPDe.

Table 15 - Demand Data Link, Call-determined Layer 2-Address, X.25 Call Dependent

X.25 Service	ISDN Channel	Initialization	Service Invoc.	Addressing	ISDN U-Plane
VC	Data Link on B-Channel	X.25 Call dependent (first/last X.25 call)	Demand	Variable	L.2: LAPDe L.3: X.25 PLPs

8.3.2.2 Demand Data Link, Fixed-Address, X.25 Call Dependent

The establishment of the data link between the PH and the PTN-FH is initiated by the beginning of the first X.25 call, and its release is initiated by the end of the last X.25 call. Link establishment and disestablishment are under link control in both directions and follow LAPDe. The link address is pre-agreed on subsription

Table 16 - Demand Data Link, Fixed Address, X.25 Call Dependent

X.25 Service	ISDN Channel	Initialization	Service Invoc.	Addressing	ISDN U-Plane
VC	Data Link on B-Channel (PLL)	X.25 Call dependent (first/last X.25 call)	Demand	Subscription (Fixed)	L.2: LAPDe L.3: X.25 PLPs

8.3.2.3 Demand Data Link, Long Duration, Fixed Address, X.25 Call Independent

Establishment and release of the data link between PH and the PTN-FH is independent of X.25 calls; instead, they are initialized by the PTN-FH (for VCs) or by the PTN-FH/PH (for PVCs). Typically the data link lasts longer than the last active X.25 call (long duration). Link establishment and disestablishment are under link control in both directions and follow LAPDe. The link address is pre-agreed on subsription.

Table 17 - Demand Data Link, Long Duration, Fixed Address, X.25 Call Independent

X.25 Service	ISDN Channel	Initialization	Service Invoc.	Addressing	ISDN U-Plane
VC	Data Link on B-Channel (PLL)	By the PTN-FH	Demand	Subscription (fixed)	L.2: LAPDe L.3: X.25 PLPs
PVC	Data Link on B-Channel (PLL)	By the PTN-FH or by the packet handler	Demand	Subscription (fixed)	L.2: LAPDe L.3: X.25 PLPs

8.3.2.4 Permanent Data Link, Fixed Address, X.25 Call Independent

Establishment and release of the data link between PH and PTN-FH are achieved independently of X.25 calls, by O&M procedures of the network provider.

Table 18 - Permanent Data Link, Fixed-Address, X.25 Call Independent

X.25 Service	ISDN Channel	Initialization	Service Invoc.	Addressing	ISDN U-Plane
VC or PVC	Data Link on B-Channel	Subscription	Perman.	Subscription (fixed)	L.2: LAPDe L.3: X.25 PLPs

8.3.3 Combination of B-channel Modes and Logical Data Link Modes at the T Reference Point

Not all of the 12 possible combinations of the three B-channel modes with the four Logical Data Link modes within the multiplexed B-channel are equally reasonable. For instance, the combination of a permanent Logical Data Link with demand or long duration B-channels does not make much sense. In Table 19 the feasible combinations are marked by two digits; the first digit refers to a column, i.e. to a B-channel mode and the second digit to a row, i.e. to a Logical Data Link mode. For example, 2/3 denotes the combination of the B-channel, long duration mode with the long duration, fixed address Logical Data Link mode.

Table 19 – Combination of B-channel modes with Logical Data Link modes

Logical Data Link modes	B-channel, demand (see 8.3.1.1)	B-channel, long duration (8.3.1.2)	B-channel, permanent (8.3.1.3)
demand (see 8.3.2.1)	1/1	2/1	3/1
demand, fixed address (see 8.3.2.2)	1/2	2/2	3/2
long duration, fixed address (see 8.3.2.3)		2/3	3/3
permanent (see 8.3.2.4)			3/4

9 Combinations of Modes of Operation at the S and T Reference Points

9.1 Mapping between D-Channel PMBS and B-Channel PMBS

Mapping between the D-channel PMBS (ETS 300 049) at the S reference point and the B-channel PMBS (ETS 300 048) at the T reference point (Scenario 4), and vice versa (Scenario 3), requires service interworking between B-channel and D-channel PMBS. However, service interworking between B-channel and D-channel PMBS is not discussed in this Clause, since it would dilute the consideration of interworking between the modes of operation within a given PMBS.

9.2 Combinations of Modes of Operation within the B-Channel PMBS

A bit stream transparent circuit mode connection will be used between the TE at the S reference point and the PHI, which transits the PTNX access at the T reference point without any PMBS related type of interworking.

Once a demand service is employed at one of the interfaces (S or T reference point), PVC cannot be used. Signalling and switching impact within the PTN is involved when demand circuits need to be interconnected with permanent circuits.

9.3 Combinations of Modes of Operation within the D-Channel PMBS

The combinations between the various modes of operation are listed in Table 20. The modes of operation at the S reference point are combined with those at the T reference point.

The following key applies:

- Column 1: These are the modes of operation at the S reference point, according to Clause 8.
- Column 2: These are the modes of operation at the T reference point, according to Clause 8.
- Columns 1 and 2: Operation modes 8.1.2.2.2 and 8.1.2.2.3 differ only in the way they are activated, i.e. either as long duration connections using the ISDN call control mechanism or as semi-permanent connections being established by management interactions. In either case this is X.25 call independent.
  The indication "**PVC**" means that a permanent virtual call does not apply when one of the accesses (at the S or T reference point) employs demand service.
- Column 3: Incoming (i/c) and outgoing (o/g) calls are considered separately.
- Columns 4 through 6: The vertical displacements of entries in the three sub-columns denoted by "**Actions At**" indicate the logical sequence in which the actions take place.
  In the X.25 call dependent modes of operation, X.25 messages are not mentioned.

9.4 Combinations of Modes of Operation for Scenario 5

Scenario 5 represents the extension of the public network PMBS into the PTN by allocating the PHI relevant connection related subscriber functions (CRF-S) to the PTN. Thus, the arrangement of Scenario 5 offers other combination of Modes of Operation than 9.3. The combinations between the various Modes of Operation are listed in Table 21; the keys are the same as in Table 20. Combinations requiring X.25 Call Control Functions are excluded, since these functions cannot be provided by a PTN FH.

Table 20 - Combinations of Modes of Operation at the S and at the T Reference Points

Mode of Operation at S	Mode of Operation at T	Dir	Actions At		
			S Reference Point	PTNX	T Reference Point
8.1.2.1 Demand data link, Call-determined address, X.25 call dependent **VC**	**8.1.2.1** Demand data link, Call-determined address, X.25 call dependent **VC**	i/c	ISDN Layer 3 call offering procedure (ETS 300 007), however see 8.2.2.1. Activation of the data link (SAPI 16; TEI value of the TE)	(Basic Call) The PTNX determins the TEI values / interfaces at both reference points. FH functions are required.	ISDN Layer 3 call offering procedure similar to (ETS 300 007), however see 8.2.2.1. Activation of the data link (SAPI 16; TEI value determined by the PTNX)
		o/g	Activation of the data link (SAPI 16; TEI value of the TE)	The PTNX chooses one TEI value / interface at T and maps it onto the TEI value / interface of the TE. FH functions are required.	Activation of the data link (SAPI 16; TEI value determined by the PTNX)
	8.1.2.2.1 Demand data link, Predetermined address, X.25 call dependent **VC**	i/C	ISDN Layer 3 call offering procedure (ETS 300 007), however see 8.2.2.1. Activation of the data link (SAPI 16; TEI value of the TE)	The PTNX derives the TE number from a mapping table of TE numbers versus TEI values / interfaces at T. The PTNX derives the TEI values / interfaces at S from ISDN call control and maps it onto the link at T. Beside enhanced call control FH functions are required.	Activation of the data link (SAPI 16; TEI value pre-determined)
		o/g	Activation of the data link (SAPI 16; TEI value of the TE)	The PTNX derives the predetermined TEI value/ interface at T from a mapping table between interfaces at S and TEI values/ interfaces at T. *(Note 1)* FH functions are required.	Activation of the data link (SAPI 16; TEI value pre-determined)
	8.1.2.2.2 Demand data link (long duration), Predetermined address, X.25 call independent **VC, ~~PVC~~** **8.1.2.2.3** Permanent data link, Predetermined address. X.25 call independent **VC, ~~PVC~~**	i/C	ISDN Layer 3 call offering procedure (ETS 300 007), however see 8.2.2.1. Activation of the data link (SAPI 16; TEI value of the TE) i/c X.25 call request on the data link	The PTNX derives the TE number from the X.25 call request and initiates an ISDN call offering procedure at S. The PTNX extends the X.25 call to the TE. PH functions are required.	X.25 call independently activated data link (SAPI 16; TEI value predetermined) i/c X.25 call request message on the data link
		o/g	Activation of the data link (SAPI 16; TEI value of the TE) o/g X.25 call request on the data link	The PTNX derives the destination number from the X.25 call request and routes this call (if it is external) to T. PH functions are required. *(Note 2)*	X.25 call independently activated data link (SAPI 16; TEI value pre-determined) o/g X.25 call request on the data link

Table 20 - Combinations of Modes of Operation at the S and at the T Reference Points

Mode of Operation at S	Mode of Operation at T	Dir	Actions At		
			S Reference Point	PTNX	T Reference Point
8.1.2.2.1 Demand data link, Predetermined address, X.25 call dependent **VC**	**8.1.2.1** Demand data link, Call-determined address, X.25 call dependent **VC**	i/c	Activation of the data link (SAPI 16; pre-determined TEI value of the TE)	The PTNX derives the TEI value/interface at S from a mapping table between the TE number contained in the ISDN connection initialization message (SETUP) and TEI values / interfaces at S. Beside enhanced call control FH functions are required.	ISDN Layer 3 call offering procedure similar to (ETS 300 007), however see 8.2.2.1. Activation of the data link (SAPI 16; TEI value determined by the PTNX)
		o/g	Activation of the data link (SAPI 16; pre-determined TEI value of the TE)	The PTNX chooses one TEI value / interface at T and maps it onto the TEI value / interface of the TE. FH functions are required.	Activation of the data link (SAPI 16; TEI value determined by the PTNX)
	8.1.2.2.1 Demand data link, Predetermined address, X.25 call dependent **VC**	i/c	Activation of the data link (SAPI 16; pre-determined TEI value of the TE)	The PTNX derives the predetermined TEI value / interfaces at S from a mapping table of TEI values/interfaces at S and TEI values/interfaces at T. FH functions are required.	Activation of the data link (SAPI 16; TEI value predetermined)
		o/g	Activation of the data link (SAPI 16; pre-determined TEI value of the TE)	The PTNX derives the predetermined TEI value/interface at T from a mapping table between TEI values/interfaces at S and TEI values/interfaces at T. FH functions are required.	Activation of the data link (SAPI 16; TEI value predetermined)
	8.1.2.2.2 Demand data link (long duration), Predetermined address, X.25 call independent **VC, ~~PVC~~** **8.1.2.2.3** Permanent data link Predetermined address. X.25 call independent **VC, ~~PVC~~**	i/c	Activation of the data link (SAPI 16; pre-determined TEI value of the TE) i/c X.25 call request on the data link	The PTNX derives the TEI value /interface at S from the TE number in the X.25 call request. The PTNX extends the X.25 call to the TE. PH functions are required.	X.25 call independently activated data link (SAPI 16; TEI value predetermined) i/c X.25 call request on the data link
		o/g	Activation of the data link (SAPI 16; pre-determined TEI value of the TE) o/g X.25 call request on the data link	The PTNX derives the destination number from the X.25 call request and routes this call (if it is external) to T. PH functions are required. *(Note 2)*	X.25 call independently activated data link (SAPI 16; TEI value predetermined) o/g X.25 call request on the data link

Table 20 - Combinations of Modes of Operation at the S and at the T Reference Points

Mode of Operation at S	Mode of Operation at T	Dir	Actions At		
			S Reference Point	PTNX	T Reference Point
8.1.2.2.2 Demand data link (long duration), Predetermined address, X.25 call independent **VC, ~~PVC~~** **8.1.2.2.3** Permanent data link, predetermined address, X.25 call independent **VC, ~~PVC~~**	**8.1.2.1** Demand data link, Call-determined address, X.25 call dependent **VC**	i/c	X.25 call independently activated data link (SAPI 16, predetermined TEI value of the TE). i/c X.25 call request on the data link	The PTNX derives the predetermined TEI value/interface at S from a mapping table between TEI values / interfaces at S and the TE number contained in the ISDN connection initialization message at T (SETUP). The PTNX throughconnects the two data links. Beside enhanced call control FH functions are required.	ISDN Layer 3 call offering procedure similar to (ETS 300 007), however see 8.2.2.1. Activation of the data link (SAPI 16; TEI value determined by the PTNX) i/c X.25 call request on the data link
		o/g	X.25 call independently activated data link (SAPI 16; TEI of the TE) o/g X.25 call request on the data link	The PTNX derives the called number from the X.25 call request and routes the call to the public PH (if it is external). PH functions are required.	Activation of the data link (SAPI 16; TEI value determined by the PTNX) o/g X.25 call request on the data link
	8.1.2.2.1 Demand data link, Predetermined address, X.25 call dependent **VC**	i/c	X.25 call independently activated data link (SAPI 16, predetermined TEI value of the TE). i/c X.25 call request on the data link	The PTNX derives the predetermined TEI value / interface from a mapping table of TEI values / interfaces at S and T. FH functions are required.	Activation of the data link (SAPI 16; TEI value predetermined) i/c X.25 call request on the data link
		o/g	X.25 call independently activated data link (SAPI 16, predetermined TEI value of the TE). o/g X.25 call request on the data link	The PTNX derives the called number from the X.25 call request and routes the call to the public PH (if it is external). PH functions are required.	Activation of the data link (SAPI 16; TEI value predetermined) o/g X.25 call request on the data link
	8.1.2.2.2 Demand data link (long duration), Predetermined address, X.25 call independent, **VC, PVC**	i/c	X.25 call independently activated data link (SAPI 16, predetermined TEI value of the TE). i/c X.25 call request (VC) or X.25 data message (PVC) on the data link	The PTNX derives the predetermined TEI value/interface at S from a mapping table between TEI values / interfaces at S and at T. Throughconnection of the two links is X.25 call independent. FH functions are required.	X.25 call independently activated data link (SAPI 16; TEI value pre-determined) i/c X.25 call request (VC) or X.25 data message (PVC) on the data link
	8.1.2.2.3 Permanent data link, Predetermined address. X.25 call independent **VC, PVC**	o/g	X.25 call independently activated data link (SAPI 16, predetermined (may be fixed) TEI value of the TE. o/g X.25 call request (VC) or X.25 data message (PVC) on the data link	The PTNX derives the predetermined TEI value/interface at S from a mapping table between TEI values / interfaces at S and at T. Throughconnection of the two links is X.25 call independent. FH functions are required.	X.25 call independently activated data link (SAPI 16; TEI value pre-determined) o/g X.25 call request (VC) or X.25 data message (PVC) on the data link

Note 1: A problem can occur, if more than one TE use the PMBS on the same D-channel at S.

Note 2: For o/g calls an alternative solution is possible not requiring a PH in the PTN.

Table 21/1 - Combinations between Modes of Operation at the S and at the T Reference Points

Mode of Operation at S	Mode of Operation at the T Ref. Point		Dir.	Actions at		
				S Reference Point	PTNX	T Reference Point
	B channel	Data Link				
8.1.2.1 Demand data link, call determined address, X.25 call dependent VC	**8.3.1.1** Demand circuit	**8.3.2.1** Demand data link, call determined address, X.25 call dependent VC	i/c	ISDN layer 3 call offering procedure (ETS 300 007), however see 8.2.2.1. Activation of the data link (SAPI 16; TEI value of the TE)	The PTNX derives the TE number from the Data Link Control Information.	If first/additional B channel required: ISDN layer 3 call (based on ETS 300102) for B channel establishment Activation of the data link (SAPI 16; LIC value determined by the Data Link Control Information within the B channel)
			o/g	Activation of the data link (SAPI 16; TEI value of the TE)	If first/additional B channel required: ISDN layer 3 call (based on ETS 300102) for B channel establishment The PTNX initiates signalling within the B channel for the registration of a chosen LIC and the determination of the B channel at T. Mapping of the DLCI value at T onto the TEI value /access used by the TE at S.	Activation of the data link (SAPI 16; LIC value determined by the Data Link Control Information within the B channel)
		8.3.2.2 Demand data link, fixed address, X.25 call dependent VC	i/c	ISDN layer 3 call offering procedure (ETS 300 007), however see 8.2.2.1. Activation of the data link (SAPI 16; TEI value of the TE)	The PTNX derives the TE number from the Data Link Control Information.	If first/additional B channel required: ISDN layer 3 call (based on ETS 300102) for B channel establishment Activation of the data link (SAPI 16, LIC value fixed)
			o/g	Activation of the data link (SAPI 16; TEI value of the TE).	If first/additional B channel required: ISDN layer 3 call (based on ETS 300102) for B channel establishment Mapping of the DLCI value at T onto the TEI value/access used by the TE at S.	Activation of the data link (SAPI 16, LIC value fixed)

Table 21/2 - Combinations between Modes of Operation at the S and at the T Reference Points

Mode of Operation at S	Mode of Operation at the T Ref. Point		Dir.	Actions at		
				S Reference Point	PTNX	T Reference Point
	B channel	Data Link				
8.1.2.1 Demand data link, call determined address, X.25 call dependent VC	8.3.1.2 / 8.3.1.3 Demand, long duration / Permanent	8.3.2.1 Demand data link, call determined address, X.25 call dependent VC	i/c	ISDN layer 3 call offering procedure (ETS 300 007), however see 8.2.2.1. Activation of the data link (SAPI 16; TEI value of the TE)	The PTNX derives the TE number form the Data Link Control Information.	X.25 call independently activated (permanent) B channel(s) Activation of the data link (SAPI 16; LIC value determined by the Data Link Control Information within the B channel)
			o/g	Activation of the data link (SAPI 16; TEI value of the TE)	The PTNX initiates signalling within the B channel for the registration of the LIC and the determination of the B channel at T. Mapping of the DLCI value at T onto the TEI value /access used by the TE at S.	X.25 call independently activated (permanent) B channel(s) Activation of the data link (SAPI 16; LIC value determined by the Data Link Control Information within the B channel)
		8.3.2.2 Demand data link, fixed address, X.25 call dependent VC	i/c	ISDN layer 3 call offering procedure (ETS 300 007), however see 8.2.2.1. Activation of the data link (SAPI 16; TEI value of the TE)	The PTNX derives the TE number from the Data Link Control Information.	X.25 call independently activated (permanent) B channel(s) Activation of the data link (SAPI 16, LIC value fixed)
			o/g	Activation of the data link (SAPI 16; TEI value of the TE).	Mapping of the DLCI value at T onto the TEI value / access used by the TE at S.	X.25 call independently activated (permanent) B channel(s) Activation of the data link (SAPI 16, LIC value fixed)

Table 21/3 - Combinations between Modes of Operation at the S and at the T Reference Points

Mode of Operation at S.	Mode of Operation at the T Ref. Point		Dir.	Actions at		
				S Reference Point	PTNX	T Reference Point
	B channel	Data Link				
8.1.2.2.1 Demand data link, fixed address, X.25 call dependent VC	8.3.1.1 Demand circuit	8.3.2.1 Demand data link, call determined address, X.25 call dependent VC	i/c	Activation of the data link (SAPI 16; fixed TEI value of the TE)	The PTNX derives the TE number from the Data Link Control Information. A mapping table between TE numbers and TEI values/ interfaces at S is used to determine the data link at S	If first/additional B channel required: ISDN layer 3 call (based on ETS 300102) for B channel establishment Activation of the data link (SAPI 16; LIC value determined by the Data Link Control Information within the B channel)
			o/g	Activation of the data link (SAPI 16; fixed TEI value of the TE)	If first/additional B channel required: ISDN layer 3 call (based on ETS 300102) for B channel establishment The PTNX initiates signalling within the B channel for the registration of a chosen LIC and the determination of the B channel at T. Mapping of the DLCI value at T onto the TEI value/access used by the TE at S.	Activation of the data link (SAPI 16; LIC value determined by the Data Link Control Information within the B channel)
		8.3.2.2 Demand data link, fixed address, X.25 call dependent VC	i/c	Activation of the data link (SAPI 16; fixed TEI value of the TE)	The PTNX derives the fixed TEI value/interface at S from mapping table of TEI values/ interfaces at S and DLCI values at T	If first/additional B channel required: ISDN layer 3 call (based on ETS 300102) for B channel establishment Activation of the data link (SAPI 16, LIC value fixed)
			o/g	Activation of the data link (SAPI 16; fixed TEI value of the TE).	If first/additional B channel required: ISDN layer 3 call (based on ETS 300102) for B channel establishment The PTNX derives the fixed DLCI value at T from mapping table of TEI values/ interfaces at S and DLCI values at T.	Activation of the data link (SAPI 16, LIC value fixed)

Table 21/4 - Combinations between Modes of Operation at the S and at the T Reference Points

Mode of Operation at S	Mode ofOperation at the T Ref. Point		Dir.	Actions at		
				S Reference Point	PTNX	T Reference Point
	B channel	Data Link				
8.1.2.2.1 Demand data link, fixed address, X.25 call dependent VC	8.3.1.2 / 8.3.1.3 Demand, long duration / Permanent	8.3.2.1 Demand data link, call determined address, X.25 call dependent; VC	i/c	Activation of the data link (SAPI 16; fixed TEI value of the TE)	The PTNX derives the TE number from the Data Link Control Information. A mapping table between TE numbers and TEI values/ interfaces at S is used to determine the data link at S	X.25 call independently activated (permanent) B channel(s) Activation of the data link (SAPI 16; LIC value determined by the Data Link Control Information within the B channel)
			o/g	Activation of the data link (SAPI 16; fixed TEI value of the TE)	The PTNX initiates signalling within the B channel for the registration of a chosen LIC and the determination of the B channel at T. Mapping of the DLCI value at T onto the TEI value/access used by the TE at S.	X.25 call independently activated (permanent) B channel(s) Activation of the data link (SAPI 16; LIC value determined by the Data Link Control Information within the B channel)
		8.3.2.2 Demand data link, fixed address, X.25 call dependent; VC	i/c	Activation of the data link (SAPI 16; fixed TEI value of the TE)	The PTNX derives the fixed TEI value/interface at S from mapping table of TEI values/ interfaces at S and DLCI values at T	X.25 call independently activated (permanent) B channel(s) Activation of the data link (SAPI 16, LIC value fixed)
			o/g	Activation of the data link (SAPI 16; fixed TEI value of the TE).	The PTNX derives the fixed DLCI value at T from mapping table of TEI values/ interfaces at S and DLCI values at T.	X.25 call independently activated (permanent) B channel(s) Activation of the data link (SAPI 16, LIC value fixed)

Table 21/5 - Combinations between Modes of Operation at the S and at the T Reference Points

Mode of Ope ration at S	Mode of Operation at the T Ref. Point		Dir.	Actions at		
				S Reference Point	PTNX	T Reference Point
	B channel	Data Link				
8.1.2.2.2 Demand data link (long duration), fixed address, X.25 call independent VC, (PVC) or 8.1.2.2.3 Permanent data link, fixed address, X.25 call independent VC, (PVC)	8.3.1.2 / 8.3.1.3 Demand, long duration/ Permanent	8.3.2.3 Demand data link, fixed address, X.25 call independent VC, (PVC) or 8.3.2.4 Permanent data link, fixed address, X.25 call independent	i/c	X.25 call independently activated data link (SAPI 16, fixed TEI value of the TE) i/c X.25 call request (VC) or X.25 data message (PVC) on the data link	The PTNX derives the TEI value/interface at S from a mapping table between TEI value/interface at S and the DLCI value at T. The throughconnection of the two links is X.25 call independent.	X.25 call independently activated (permanent) B channel(s) and data link (SAPI 16, LIC value fixed) i/c X.25 call request (VC) or X.25 data message (PVC) on the data link
			o/g	X.25 call independently activated data link (SAPI 16, fixed TEI value of the TE) o/g X.25 call request (VC) or X.25 data message (PVC) on the data link	The PTNX derives the TEI value/interface at S from a mapping table between TEI value/interface at S and the DLCI value at T. The throughconnection of the two links is X.25 call independent.	X.25 call independently activated (permanent) B channel(s) and data link (SAPI 16, LIC value fixed) o/g X.25 call request on the data link

10 Selection of Application Profiles for Modes of Operation and Scenarios

10.1 Selection for Attachement of TEs at the S and at the S/T Reference Point

ETSI/STC NA2, and in particular J.A.G., does not feel responsible for selections of Modes of Operations at the S and S/T reference points. This subject should be left to other appropriate organisations, such as ETSI/TC TE or IMIMG.

10.2 Selection for Interworking with PTNs at the T Reference Point

The great variety of possible combinations of modes of operations at the S and T reference points described in Clause 9 applied to each of the scenarios described in Clause 7 can hardly be dealt with at once in the standardization process, Moreover, not every of these combinations seems to be feasible. Hence, a step-by-step approach is recommended for the standardization giving the first priority to combinations which are necessary to offer PMBS to the users in private networks and where existing standardized concepts can be applied at the S and T reference points.

10.2.1 First Priority Profiles

The first priority profiles include minimum requirement for PMBS in private networks and cover the X.31 services offered by the most European public network operators. The profiles listed in Tables 22, 23 and 24 should be covered by the standardization with the first priority. Scenario 1 is rather obvious in the ISDN world. Hence, the standardization efforts for this scenario will be minimal and standardization can easily be accomplished.

Table 22 - Modes of operation for Scenario 1: TE uses the public ISDN PMBS via B-channel

Reference Point S	Reference Point T	X.25-Service
8.1.1.1: Demand Circuit, X.25 Call Dependent	8.1.1.1: Demand Circuit, X.25 Call Dependent	VC
8.1.1.2: Demand Circuit, (long duration) X.25 Call Independent	8.1.1.2: Demand Circuit, (long duration) X.25 Call Independent	VC/PVC
8.1.1.3: Permanent Circuit, X.25 Call Independent	8.1.1.3: Permanent Circuit, X.25 Call Independent	VC/PVC
8.1.1.2: Demand Circuit, (long duration) X.25 Call Independent	8.1.1.3: Permanent Circuit, X.25 Call Independent	VC/PVC

For Scenario 2 only profiles with fixed data link layer addresses and only those which do not require trunk hunting across D-channels are proposed, such reducing the standardization effort.

Table 23 - Modes of operation for Scenario 2: Concatenation of Public ISDN FH with private ISDN FH(s), TE uses the public ISDN PMBS via D-channel

Reference Point S	Reference Point T	X.25-Service
8.1.2.2.1: Demand Data Link, Fixed Address, X.25 Call Dependent	8.1.2.2.1: Demand Data Link, Fixed Address, X.25 Call Dependent	VC
8.1.2.2.2: Demand Data Link, (long duration) Fixed Address, X.25 Call Independent	8.1.2.2.2: Demand Data Link, (long duration) Fixed Address, X.25 Call Independent	VC/PVC
8.1.2.2.3: Permanent Data Link, Fixed Address, X.25 Call Independent	8.1.2.2.3: Permanent Data Link, Fixed Address, X.25 Call Independent	VC/PVC
8.1.2.2.2: Demand Data Link, (long duration) Fixed Address, X.25 Call Independent	8.1.2.2.3: Permanent Data Link, Fixed Address, X.25 Call Independent	VC/PVC

Table 24 - Modes of operation for Scenario 5: Private Network uses the public ISDN PMBS via B-channel

Reference Point S	Reference Point T B-channel	Reference Point T Logical Data Link	X.25-Service
8.1.2.2.1: Demand Data Link, Fixed Address, X.25 Call Dependent	8.3.1.2: Demand B-channel, long duration 8.3.1.3: Permanent Circuit, X.25 Call Independent	8.3.2.2: Demand Data Link, Fixed Address X.25 Call Dependent	VC
8.1.2.2.2: Demand Data Link, long duration Fixed Address, X.25 Call Independent	8.3.1.2: Demand B-channel, long duration 8.3.1.3: Permanent Circuit, X.25 Call Independent	8.3.2.3: Demand Data Link, long duration Fixed Address, X.25 Call Independent	VC/PVC
8.1.2.2.1: Demand Data Link, Fixed Address, X.25 Call Dependent	8.3.1.2: Demand B-channel, long duration 8.3.1.3: Permanent Circuit, X.25 Call Independent	8.3.2.3: Demand Data Link, long duration Fixed Address, X.25 Call Independent	VC

For scenario 5 only profiles with fixed data link layer addresses are proposed. The profiles based on "Permanent Circuit, X.25 Call Independent" as described in 8.3.1.3 do not require any additional standards, whereas those based on "Demand Circuit, Long Duration" as described in 8.3.1.2 require additional standardization efforts.

10.2.2 Second Priority Profiles

10.2.2.1 Scenarios 3 and 4

Both scenarios, providing a private network packet handler, can be regarded as either a special case of scenario 1 and 2 or a public ISDN packet subscriber scenario. Except for Quality of Service and numbering aspects these scenarios do not require new technical concepts.

10.2.2 2 Scenario 5

All profiles based on call determined layer 2 addresses at the T reference point, i.e based on combinations 1/1, 2/1 and 3/1 in Table 19 are classified as second priority profiles. Defining these profiles the forthcoming FMBS standardization should also be taken into account.

11 Numbering Aspects

Numbering aspects for the scenarios 1, 2 and 5 and for modes of operation recommended in the previous Clause are briefly outlined here.

Each of the PTN users participating in the public ISDN X.31 service shall be known by the public PH by an unambiguous address. No particular numbering mapping is required when PTNs are involved in extending the PMBS to their users.

In the case of establishing ISDN B-channel connections or data links on D-channels on demand each of the PTN users participating in the public ISDN X.31 service shall have an unambigous E.164 numbe. These numbers will be used as destination numbers (i.e. for connection establishment) as well as for identification purposes.

Any mapping between a private and public numbering plan is to be performed by the PH attached to the public ISDN. The numbering plan employed in the X.25 call set-up packets in the User Plan may be E.164 or X.121.

12 Proposed Enhancements for the ETSs on PMBS

This Technical Report implies changes to the following ETSs on PMBS:

ETS 300 048, ISDN B-channel PMBS [1]
ETS 300 049, ISDN D-channel PMBS [2]
ETS 300 007, ISDN-PMBS support of Packet Mode Terminal Equipment [3]
ETS 300 099, ISDN PHI [4]

In addition the ETSI Standard on EDSS1, Layer 3

ETS 300 102, ISDN User Network Interface Layer 3 [6]

may be affected, e.g. to cover a specific Bearer Capability for Bd-Channels, as well as

D-ETS NA-22108, Routing for ISUP Version 2 Services [10].

12.1 Stage 1 Standards

The modes of operation described in clause 8 shall be defined within the main body of ETSs [1] and [2]. This recognizes the fact that network operators and subcribers to data services usually map their operational requirements onto modes of operation.

Modes of operation at the T reference point need to be taken up in [1] and [2] in those clauses which deal with interworking between private and public ISDNs. Where applicable, these clauses shall also include statements

- that multiple interfaces are to be covered at the T reference point;
- on service interworking due to the five scenarios, e.g. the case of a PTN connecting directly to a Bd-channel which is "prolonged" to the T reference point.

12.2 Stage 2 Standards

It shall be decided whether separate stage 2 standards for the two services are required or whether one standard would be sufficient.

The modes of operation and the scenarios shall be identifiable throughout the standard(s) on stage 2.
ETS [4] includes information which is suitable as a basis for stage 2 descriptions, and which shall be taken into account. One item is that the CRF-S can reside in a local exchange of the public ISDN (as currently specified) but may alternatively reside in a PTN, as required by scenario 5.

12.3 Stage 3 Standards

12.3.1 General

The modes of operation and the five scenarios shall be identifiable throughout the stage 3 standards. This requires that permanent circuits and permanent data links also be covered, in both standards ETS [3] and ETS [4], although they do not require signalling information interchange. Still, the parameter values, which are under O&M control, shall be specified in the ETSs.

12.3.2 Enhancements required for the User Network Interface (UNI)

For ETS [3], several technical issues originating from the five scenarios will be relevant:

- Number of available TEI values;

  This issue becomes relevant to scenario 2 for the number of data links supported per D-channel at the (multiple) T reference point.

- Multiple interfaces at the T reference point;

  Although this issue applies to all five scenarios, it obtains particular relevance for scenarios 2 and 3. The issue comprises the selection of a particular D-channel out of a set of D-channels at a multiple interface.

- Extension of PHI signalling across the UNI;

  This issue applies to scenario 5 only. It has an impact on the ISDN control plane (D-channel signalling and Bd-channel inband signalling) and on the ISDN user plane.

  D-channel signalling
  For the control of "prolonged Bd-channels", the specific bearer capability code point defined at the PHI ("ETSI PHI Bd-channel link layer") needs to be specified.

  In the user-to-user information element the "sub-bundle/FH" reference and the "Bd-channel reference" need to be specified, as at the PHI.

  Bd-channel inband signalling
  In principle, the procedures and messages specified for the PHI need to be made normative at the UNI. However, first priority should be given to those modes of operation which can refrain from Bd channel inband signalling, so that the work on inband signalling could be postponed for later on.

12.3.3 Enhancements required for ETS [4] on the Packet Handler Interface (PHI)

While signalling protocols at the PHI remain unaffected, the figures showing reference configurations and functional models plus the accompanying text need to cover also PTN to public ISDN interworking at the T reference point, according to the five scenarios.

12.4 Other Issues

- Numbering
  This issue is relevant to scenarios 3 and 4, where the PTN includes its own packet handler.
  The PH behind the public ISDN needs to maintain mapping information which relates the E.164 number of a PTN X.25 terminal to the E.164 number of the private PH, in order to route the connection through the public ISDN accordingly.
- Load Management
  This issue is relevant to scenarios 3 and 4, where the PTN includes its own packet handler.
  A mechanism needs to be specified which allows to monitor and control the data load on the D or B-channel(s). The statements in ETS [4], Annex E, shall be checked for their applicability to scenarios 3 and 4.

12.5 Relevant bodies

The proposed enhancements should be accomplished by the ETSI/STCs NA1, NA2, SPS1 and SPS5 as well as ETSI/TC BT in accordance with their existing responsibilities. However, ETSI/STC NA2 is willing to provide assistance, if desired.

Load management shall become a new work item for ETSI/STC NA 2.

Annex A – Overview of Modes of Operation for Scenarios 1 to 4

This Annex shows an overview of the modes of operation of the X.31 Case B packet mode bearer service as specified in narrative form in Clauses 8.1 and 8.2

Mode of Operation	B-Channel					D-Channel					
	8.1.1.1 Demand Circuit, X.25 Call Dependent	8.1.1.2 Demand Circuit, "Long Duration Connection" X.25 Call Independent		8.1.1.3 Permanent Circuit, X.25 Call Independent		8.1.2.1 Demand Data Link.,Call-determ. Addr., X.25 Call Dependent	8.1.2.2.1 Demand Data Link, Fixed Address, X.25 Call Dependent	8.1.2.2.2 Demand Data Link, "Long Duration Connection" Fixed Address, X.25 Call Independent		8.1.2.2.3 Permanent Data Link, Fixed Address, X.25 Call Independent	
X.25 Service	**VC**	**VC**	**PVC**	**VC**	**PVC**	**VC**	**VC**	**VC**	**PVC**	**VC**	**PVC**
Communication	Demand	Demand	Permanent	Demand	Permanent	Demand	Demand	Demand	Permanent	Demand	Permanent
Connection	Packet switched	Packet switched	Packet switched	Packet switched	Packet switched	Packet switched	Packet switched	Packet switched	Packet switched	Packet switched	Packet switched
Addressing	X.121/E.164	X.121/E.164	Subscription	X.121/E.164	Subscription	X.121/E.164	X.121/E.164	X.121/E.164	Subscription	X.121/E.164	Subscription
ISDN channel	64 kbit/s unrestr. B-Channel	64 kbit/s unrestr. B-Channel	64 kbit/s unrestr. B-Channel	64 kbit/s unrestr. B-Channel	64 kbit/s unrestr. B-Channel	Data Link on D-Channel	Data Link on D-Channel	Data Link on D-Channel	Data Link on D-Channel	Data Link on D-Channel	Data Link on D-Channel
Initialization	by user or ntw., dependent on first X.25 call	by the user, independent of X.25 calls	by FH, independent of X.25 calls	by the network, on subscription	by the network, on subscription	by user or ntw., dependent on first X.25 call	by user or ntw., dependent on first X.25 call	by the user, independent of X.25 calls	by FH, independent of X.25 calls	by the network, on subscription	by the network, on subscription
Communication	Demand	Demand	Demand, X.25 PVC dependent	Permanent	Permanent	Demand	Demand	Demand	Demand, X.25 PVC dependent	Permanent	Permanent
Connection mode	Circuit	Circuit	Circuit	Circuit	Circuit	Packet	Packet	Packet	Packet	Packet	Packet
ISDN No.	Subscription, fixed	Subscription, fixed	Subscription, fixed	Subscription, fixed	Subscription, fixed	Subscription, fixed	–	–	–	–	–
Address Data Link	–	–	–	–	–	call-determined	fixed, (PLL)	fixed, (PLL)	fixed, (PLL)	fixed	fixed
ISDN User Plane											
Layer 2	X.25 LAP B	X.25 LAP B	X.25 LAP B	X.25 LAP B	X.25 LAP B	LAP D	LAP D	LAP D	LAP D	LAP D	LAP D
Layer 3	X.25 PLP	X.25 PLP	X.25 PLP	X.25 PLP	X.25 PLP	X.25 PLP	X.25 PLP	X.25 PLP	X.25 PLP	X.25 PLP	X.25 PLP

Annex B – Overview of Modes of Operation for Scenario 5

This Annex shows an overview of the modes of operation of the X.31 Case B packet mode bearer service as specified in narrative form in Clause 8.3

Mode of Operation	B-Channel					Data Link within a B-Channel					
	8.3.1.1 Demand Circuit, X.25 Call Dependent	8.3.1.2 Demand Circuit, Long Duration X.25 Call Independent		8.3.1.3 Permanent Circuit, X.25 Call Independent		8.3.2.1 Demand Data Link.,Call-determ. Addr., X.25 Call Dependent	8.3.2.2 Demand Data Link, Fixed Address, X.25 Call Dependent	8.3.2.3 Demand Data Link, Long Duration Fixed Address, X.25 Call Independent		8.3.2.4 Permanent Data Link, Fixed Address, X.25 Call Independent	
X.25 Service	**VC**	**VC**	**PVC**	**VC**	**PVC**	**VC**	**VC**	**VC**	**PVC**	**VC**	**PVC**
Communication	Demand	Demand	Permanent	Demand	Permanent	Demand	Demand	Demand	Permanent	Demand	Permanent
Connection	Packet switched	Packet switched	Packet switched	Packet switched	Packet switched	Packet switched	Packet switched	Packet switched	Packet switched	Packet switched	Packet switched
Addressing	X.121/E.164	X.121/E.164	Subscription	X.121/E.164	Subscription	X.121/E.164	X.121/E.164	X.121/E.164	Subscription	X.121/E.164	Subscription
ISDN channel	64 kbit/s unrestr. B-Channel	64 kbit/s unrestr. B-Channel	64 kbit/s unrestr. B-Channel	64 kbit/s unrestr. B-Channel	64 kbit/s unrestr. B-Channel	Data Link on B-Channel	Data Link on B-Channel	Data Link on B-Channel	Data Link on B-Channel	Data Link on B-Channel	Data Link on B-Channel
Initialization	by user/PTN-FH or PH, dependent on first X.25 call	by the PTN-FH, independent of X.25 calls	by PH, independent of X.25 calls	by the network, on subscription	by the network, on subscription	by PTN-FH or PH, dependent on first X.25 call	by PTN-FH, dependent on first X.25 call	by the PTN-FH, independent of X.25 calls	by PTN-FH or PH, independent of X.25 calls	by the network, on subscription	by the network, on subscription
Communication	Demand	Demand	Demand, X.25 PVC dependent	Permanent	Permanent	Demand	Demand	Demand	Demand, X.25 PVC dependent	Permanent	Permanent
Connection mode	Circuit	Circuit	Circuit	Circuit	Circuit	Packet	Packet	Packet	Packet	Packet	Packet
ISDN No.	Subscription, fixed	Subscription, fixed	Subscription, fixed	Subscription, fixed	Subscription, fixed	Subscription, fixed	–	–	–	–	–
Address Data Link	–	–	–	–	–	call-determined	fixed, (PLL)	fixed, (PLL)	fixed, (PLL)	fixed	fixed
ISDN User Plane											
Layer 2	LAPDe	LAPDe	LAPDe	LAPDe	LAPDe	LAPDe	LAPDe	LAPDe	LAPDe	LAPDe	LAPDe
Layer 3	-	-	-	-	-	X.25 PLP	X.25 PLP	X.25 PLP	X.25 PLP	X.25 PLP	X.25 PLP

Annex C - Mapping between Terminology and Refinement Oriented Structures

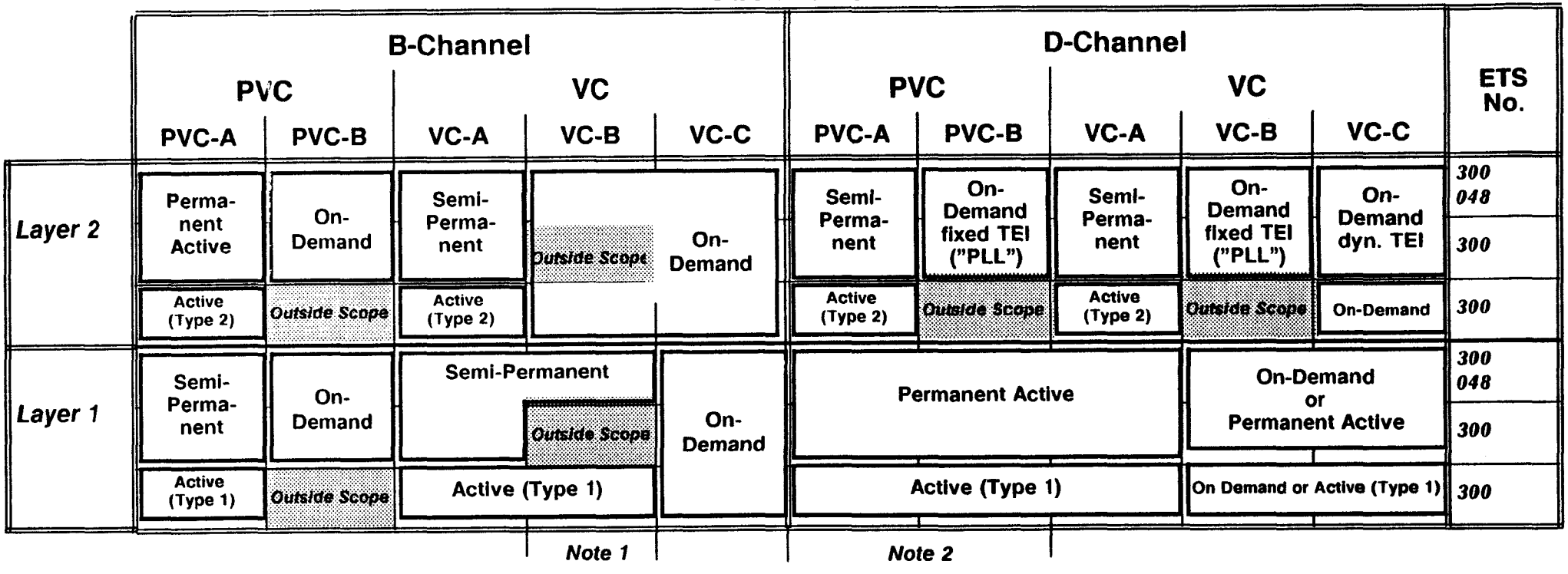
This Annex shows the unclear and ambiguous terminology used in the stage 1 and stage 3 descriptions (TC TE via ISM, winter 1991). The table has been enhanced by a shaded area which shows the relationship with the further refined structure of modes of operation, as employed in this Technical Report.

The main differences are that the definition "B-channel, VC-C" has not exhaustively been specified in that no distinction was made whether the demand call was initialized by a management entity (and then be maintained as a "long duration" connection for multiple X.25 calls) or whether it was always triggered by an X.25 call request (the same would have applied to the release of the X.31 connection).

The split applies to "D-channel, VC-B".

Note: The case "B-channel, VC-B" is impossible, due to the classification principle applied in this Technical Report.

X.31 Case B



Note 1: This profile is considered to be of no technical value and is proposed for deletion.
Note 2: These profiles are technically very similar and may be merged in future.

Clause Nos. of this Techn. Rep.	8.1.1.3 PVC	8.1.1.2 PVC	8.1.1.3 VC	Not Applicable	8.1.1.1 8.1.1.2 VC	8.1.2.2.3 PVC	8.1.2.2.2 PVC	8.1.2.2.3 VC	8.1.2.2.1 8.1.2.2.2 VC	8.1.2.1

History

Document history	
November 1994	First Edition
March 1996	Converted into Adobe Acrobat Portable Document Format (PDF)