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ETSI

European Telecommunications Standards Institute

ETSI Secretariat

Postal address: F-06921 Sophia Antipolis CEDEX - FRANCE
Office address: 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE
X.400: c=fr, a=atlas, p=etsi, s=secretariat - **Internet:** secretariat@etsi.fr

Tel.: +33 92 94 42 00 - Fax: +33 93 65 47 16

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Foreword

This Technical Committee Reference Technical Report (TCR-TR) was prepared by the Business Telecommunications (BT) Technical Committee of the European Telecommunications Standards Institute (ETSI).

A TCR-TR is a deliverable for use inside ETSI which records output results of ETSI TC or STC studies which are not appropriate for European Telecommunication Standard (ETS), Interim European Telecommunication Standard (I-ETS) or ETSI Technical Report (ETR) status. They can be used for guidelines, status reports, co-ordination documents, etc. They are to be used to manage studies inside ETSI and shall be mandatorially applied amongst the concerned TCs. They shall also be utilised by the TC with overall responsibility for a study area for co-ordination documents (e.g. models, reference diagrams, principles, structures of standards, framework and guideline documents) which constitute the agreed basis for several, if not all, TCs and STCs to pursue detailed standards.

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1 Scope

This TCR-TR is based on ENV 41006 [8], on "Scenarios for interconnections between exchanges of Private Telecommunication Network", where various means of connecting adjacent Private Telecommunication Network Exchanges (PTNX) to create a Private Telecommunication Network (PTN), using the transport capabilities of different types of InterVening Networks (IVNs) have been classified.

ENV 41006 [8] defines two different kinds of connections: those for exchanging the signalling between PTNXs for circuit mode PTN calls, and those for carrying the exchange of informations during these PTN calls. In this TCR-TR, the first ones are called "inter-PTNX signalling connections", and the second ones, "user information connections".

This TCR-TR describes the requirements for the provision of these two kinds of connections, to be met by Intervening Network Operators in providing these connections and it describes the requirements to be met by Private Telecommunications Network Operators wishing to interconnect PTNXs via these connections.

The inter-PTNX signalling connections described in this TCR-TR can be provided as:

- dedicated connections, by means of transmission systems;

- semi-permanent connections via digital cross-connectors, via a public ISDN or public ISDNs, or via an X.25 Packet Switched Public Data Network (PSPDN) or PSPDNs, possibly with access to the latter through public ISDN VC or PVC bearer services;

- switched connections via a public ISDN or public ISDNs or via PSPDN(s), possibly with access to the latter through public ISDN VC or PVC bearer services;

The inter-PTNX user information connections described in this TCR-TR can be provided as:

- dedicated connections, by means of transmission systems;

- semi-permanent connections, via digital cross-connectors or via a public ISDN (else public ISDNs);

- switched connections via the public ISDN.

The use of networks other than those mentioned above as IVNs is outside the scope of this TCR-TR (e.g. Public Switched Telephone Network (PSTN)).

This TCR-TR contains:

- introductory material and definitions of terms used throughout the TCR-TR;

- the general requirements that exist for all types of connections;

- the requirements which shall be met by the PTNX and by the IVN, at the interface between them;

- those combinations of connection types defined within this TCR-TR that are valid, and the minimum requirements to be supported by PTN operators and IVN operators, the "scenarios".

This TCR-TR applies to digital inter-PTNX connections with access rates up to and including 2 048 kbit/s. Leased lines in the Open Network Provision (ONP) minimum set have not been taken into account and are for further study.

2 Field of application

PTNs may be implemented using PTNXs which are either Integrated Services Private Branch Exchanges (ISPBX) or Integrated Services CENTREXs (ISCTX). PTNs can use a combination of both ISPBXs and ISCTXs if required.

This TCR-TR defines how inter-PTNX user information connections and inter-PTNX signalling connections should be established and controlled to implement the network scenarios described in ENV 41006 [8], in order to allow circuit mode PTN calls between PTNXs. This is to be considered as a PTN configuration and management task. It does not describe how these connections should be used by the PTNXs for the making of these PTN calls; for Basic Call this is described in ETS 300 172 [22].

ENV 41004 [7] describes concepts upon which this TCR-TR is based.

Detailed procedures for the establishment and control of the connections are not described in this TCR-TR; reference is made instead to appropriate technical standards. Where the referenced standards contain options, this TCR-TR will select or exclude them as appropriate.

In order for PTNs to be implemented in accordance with this TCR-TR, requirements are imposed on both the PTNXs themselves, and on the IVN used for the provision of connections between them. These requirements are specified in this TCR-TR, and are the requirements which apply at the C reference point identified in ENV 41004 [7].

NOTE: If the IVN is implemented as a public ISDN, the interface specifications of the T reference point apply to the interface at the C reference point.

3 References

This TCR-TR incorporates by undated reference, provisions from other publications. These references are cited at the appropriate places in the text and the publications are listed hereafter. The edition of the publication referred to which applies is at the date of publication of this TCR-TR.

[1] CCITT Recommendation G.704: "Synchronous frame structures used at primary and secondary hierarchical levels".

[2] CCITT Recommendation I.112: "Vocabulary of terms for ISDNs".

[3] CCITT Recommendation I.113: "Vocabulary of terms for broadband aspects of ISDN".

[4] CCITT Recommendation I.140: "Attribute technique for the characterization of telecommunication services supported by an ISDN and network capabilities of an ISDN".

[5] CCITT Recommendation I.210: "Principles of telecommunication services supported by an ISDN and the means to describe them".

[6] CCITT Recommendation X.25: "Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".

[7] ENV 41004: "Reference configuration for calls based on ISDN connection types through Private Telecommunication Network Exchanges".

[8] ENV 41006: "Scenarios for interconnections between exchanges of Private Telecommunication Networks".

[9] ENV 41007-1: "Definition of terms in private telecommunication networks, Part 1: Definition of general terms".

[10] ETS 300 007: "Integrated Services Digital Network (ISDN); Support of packet-mode terminal equipment by an ISDN".

[11] ETS 300 010-1: "Synchronous cross connect equipment; 64 and n x 64 kbit/s cross connection rate, 2 048 kbit/s access ports; Part 1: Core functions and characteristics".

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

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

[14] ETS 300 048: "Integrated Services Digital Network (ISDN); ISDN Packet Mode Bearer Service (PMBS); ISDN Virtual Call (VC) and Permanent Virtual Call (PVC) bearer services provided by the B-channel of the user access - basic and primary rate".

[15] ETS 300 049: "Integrated Services Digital Network (ISDN); ISDN Packet Mode Bearer Service (PMBS); ISDN Virtual Call (VC) and Permanent Virtual Call (PVC) bearer services provided by the D-channel of the user access - basic and primary rate".

[16] ETS 300 099: "Integrated Services Digital Network (ISDN); Specification of the Packet Handler access point Interface (PHI)".

[17] ETS 300 104: "Integrated Services Digital Network (ISDN); Attachment requirements for terminal equipment to connect to an ISDN using ISDN basic access; Layer 3 aspects (Candidate NET 3 Part 2)".

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

[19] ETS 300 153: "Integrated Services Digital Network (ISDN); Attachment requirements for terminal equipment to connect to an ISDN using ISDN basic access (Candidate NET 3 Part 1)".

[20] ETS 300 156: "Integrated Services Digital Network (ISDN); Attachment requirements for terminal equipment to connect to an ISDN using ISDN primary rate access (Candidate NET 5)".

[21] I-ETS 300 170: "Private Telecommunication Network (PTN); Inter-exchange signalling; Data link layer protocol".

[22] ETS 300 172: "Private Telecommunication Network (PTN); Inter-exchange signalling protocol; Circuit mode basic services".

[23] ETS 300 286: "Integrated Services Digital Network (ISDN); User-to-User Signalling (UUS) supplementary service; Digital Subscriber Signalling System No. one (DSS1) protocol".

4 Definitions

In addition to the terms and definitions defined in ENV 41007-1 [9], the terms defined in this Clause are used throughout this TCR-TR.

4.1 Call

A particular instance of unspecified duration of a service invocation.

NOTE: This definition is derived from CCITT Recommendation I.210 [5].

4.1.1 PTN Call

A particular type of "call" in which all parties involved in the call are users attached to PTNXs of the same PTN.

NOTE: The way it is used in this document, the definition of PTN call could be considered to apply also in the case of public call between a public user and a PTN user when this call is routed through one or more transit PTNX (of the PTN): more precisely, it would apply to that PTN transit part of the overall call (so called public call). But such a case is not in the scope of this TCR-TR.

4.2 Connection (inter-PTNX connection)

CCITT Recommendation I.112 [2] defines that a connection is a concatenation of transmission channels or telecommunication circuits, switching, and other functional units set up to provide for the transfer of signals between two or more points in a telecommunication network, to support a single communication.

An inter-PTNX connection is a connection established between two PTNXs in order to allow calls to be established between extension users; this connection consists of the concatenation of the IVN connection elements. For inter-PTNX connections the above definition of connection is qualified as follows:

- there shall be only two points (and not more), and these two points shall be PTNXs;

- connections are differentiated depending on the type of information they convey: signalling or user information. The definition for inter-PTNX signalling and user information is given below, but this difference will be indicated here for added clarity:

    - in the case of inter-PTNX signalling connection, the last part of the definition above ("to support a single communication") is not relevant;

    - while in the case of inter-PTNX user information connection, these same last part should be understood with the qualification "at a time". Further, this applies only for the case of a one-to-one mapping between the channels defined at the Q reference point of each PTNX and the inter-PTNX user information connection (i.e. no sub-division of the transmission capability provided by multiplexing of this inter-PTNX user information connection into several sub-rate channels available at the Q reference point).

Connections are classified according to a number of attributes, for instance, the type of information they convey, their mode of establishment, etc. Tables 1 and 2 list the values that the attributes may take for various types of connections.

NOTE: The terminology used to name attributes and their values is based on the terminology defined in CCITT Recommendation I.140 [4], except for the value "dedicated", which is being used instead of "permanent" for the attribute "Establishment of connection", to differentiate from the value "permanent" of the attribute "Establishment of communication".

Table 1: Attribute values for inter-PTNX signalling connections

ATTRIBUTE (NOTE 1)	Circuit mode	Circuit mode	Circuit mode	Signalling Bearer Service		User-to-User Signalling Supplementary service (Service 3)	VC and PVC bearer services (X.31 case B) or Public Switched Packet Data Network (X.25)	
	Dedicated	Semi-permanent	Switched	Semi-permanent	Switched		Semi-permanent (NOTE 5)	Switched
Type of Information	signalling	signalling	signalling	signalling	signalling	signalling	signalling	signalling
Information transfer mode	circuit	circuit	circuit	packet	packet	packet	packet	packet
Information transfer rate	64 kbit/s	64 kbit/s	64 kbit/s	<16 kbit/s (BA) <64 kbit/s (PRA)	<16 kbit/s (BA) <64 kbit/s (PRA)	limited by "leaky bucket" method (NOTE 3)	(NOTE 6)	(NOTE 6)
Structure	service data unit integrity	service data unit integrity	service data unit integrity	service data unit integrity	service data unit integrity	service data unit integrity	service data unit integrity	service data unit integrity
Establishment of connection	dedicated	semi-permanent	switched	semi-permanent	switched	switched (NOTE 4)	semi-permanent (PVC)	switched (VC)
Access channel and rate (NOTE 2)	Timeslots 1-31	B1-2 (BA) B1-15,17-31(PRA) 64 kbit/s	B1-2 (BA) B1-15,17-31(PRA) 64 kbit/s	D 16 kbit/s (BA) 64 kbit/s (PRA)	D 16 kbit/s (PRA) 64 kbit/s (PRA)	D 16 kbit/s (BA) 64 kbit/s (PRA)	For PVC bear. sv.: D 16 kbit/s (BA) 64 kbit/s (PRA) or B For PSPDN: digital leased line	For VC bear. sv.: D 16 kbit/s (BA) 64 kbit/s (PRA) or B For PSPDN: digital leased line

NOTE 1: For the definition of "attributes" and the values they may take for the ISDN case, see CCITT Recommendation I.140 [4]. For the non-ISDN cases new values have been defined for some attributes where appropriate.
NOTE 2: "BA" = Basic Access. "PRA" = Primary Rate Access.
NOTE 3: The "leaky bucket" method is described in ETS T/NA1(89)06 "ISDN; User-to-User Signalling (UUS) supplementary service; Service description.
NOTE 4: This is the only type of inter-PTNX signalling connection which can be established as a supplementary service to a circuit basic call.
NOTE 5: The value "semi-permanent" or "switched" for the attribute "Establishment of connection" relates only to the packet mode connection, i.e. a connection established by permanent virtual circuit is considered as being semi-permanent, and one established by virtual call, as being switched. It does not relate to the access connection elements which link each PTNX to the packet handler, in the case of VC or PVC bearer services, nor to the digital leased lines for attaching each PTNX to a packet switched public data network.
NOTE 6: The information transfer rate is dependent upon the access channel and rate and upon the throughput class of the permanent virtual circuit or of the virtual call. The allowable throughput classes are defined in CCITT Recommendation X.25, table 30/X.25.

Table 2: Attribute values for inter-PTNX user information connections

ATTRIBUTE (NOTE 1)	Dedicated Circuit mode User Information connection	Semi-Permanent Circuit mode User Information connection	Switched Circuit mode User Information connection
Type of Information	user information	user information	user information
Information transfer mode	circuit	circuit	circuit
Information transfer rate	64 kbit/s	64 kbit/s	64 kbit/s
Information transfer capability	unrestricted	unrestricted speech 3,1 kHz audio 7 kHz audio	unrestricted speech 3,1 kHz audio 7 kHz audio
Structure	8 kHz integrity	8 kHz integrity	8 kHz integrity
Establishment of connection	dedicated	semi-permanent	switched
Symmetry	bidirectional	bidirectional	bidirectional
Communication configuration	point-to-point	point-to-point	point-to-point
Access Channel and rate (NOTE 2)	Timeslots 1-31 64 kbit/s	B1-2 (BA) B1-15, 17-31 (PRA) 64 kbit/s	B1-2 (BA) B1-15, 17-31 (PRA) 64 kbit/s

NOTE 1: For the definition of "attributes" and the values they may take for the ISDN case, see CCITT Recommendation I.140 [4]. For the non-ISDN cases new values have been defined for some attributes where appropriate.
NOTE 2: "BA" = Basic Access. "PRA" = Primary Rate Access.

Although there are many attributes, the fundamental divisions in the classification are based on the Type of Information, the Establishment of Connection, and Information Transfer Mode attributes. These divisions result in the possible connection types shown in figure 1, their definition being given below. These connections are the subject of this TCR-TR.

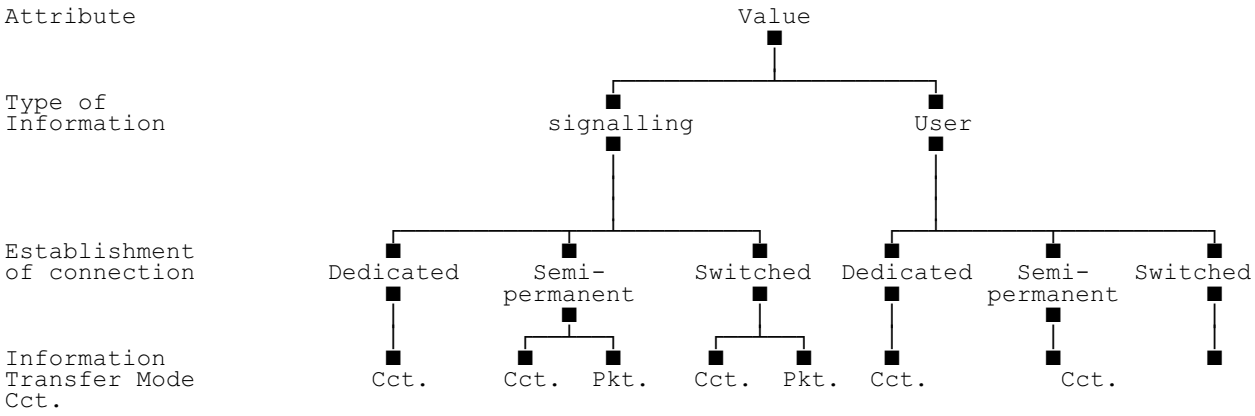

Figure 1: Division of inter-PTNX connections based on 3 major attributes

4.2.1 Circuit mode connection

A connection in which transmission functions and switching functions (if involved in the connection) are achieved by permanent allocation of channels/bandwidth.

NOTE: This definition is derived from that of "Circuit Transfer Mode" in CCITT Recommendation I.113 [3].

4.2.2 Packet mode connection

A connection in which transmission functions and switching functions (if involved in the connection) are achieved by packet oriented techniques so as to dynamically share network resources between a multiplicity of connections.

NOTE: This definition is derived from that of "Packet Transfer Mode" in CCITT Recommendation I.113 [3].

4.2.3 Inter-PTNX signalling connection

A connection between two PTNXs for the transfer of signalling information.

4.2.4 Inter-PTNX user information connection

A connection between two PTNXs for the transfer of extension circuit mode user information between them. Typically, the user information represents a particular instance of a specific telecommunications service, i.e. a PTN call.

4.2.5 Dedicated connection

As illustrated in figure 2, a dedicated connection is a connection between two PTNXs which is established using specific transmission resources (i.e. with no shared resources) for the (circuit mode) transfer of information. A dedicated connection may use the same transmission network as the public ISDN and the same type of interface access but ISDN services and dedicated connections will not share an individual interface. The establishment of these connections is carried out by pre-arrangement between the PTN operator and the network operator responsible for providing the connections. The connection is available to the subscriber at any time during the period of subscription.

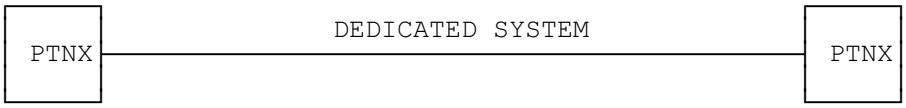

Figure 2: Dedicated connections

4.2.6 Semi-permanent connection

As illustrated in figure 3, a semi-permanent connection is a connection between two PTNXs which is established using circuit mode or packet mode transfer of information through digital cross-connectors, or through a public ISDN or public ISDNs. A semi-permanent connection may use both the transmission network and the interface access of a public ISDN. Whether or not it uses all of the public exchanges which might be involved in the path between PTNXs (i.e. subscriber connection unit, local exchange, transit exchange) is under the responsibility of the public network operator. The establishment of these connections is carried out by pre-arrangement between the PTN operator and the network operator responsible for providing the connections or by other network management means. As defined in CCITT Recommendation I.140 [4], the connection may be provided for an indefinite period of time after subscription, for a fixed period or for agreed periods during a day, week or other interval.

This definition covers also the resources in a PSPDN or PSPDNs, to offer a PVC.

NOTE 1: This definition is used instead of "permanent connection" as used in ENV 41006 [8] to align with CCITT Recommendation I.140 [4].

NOTE 2: From the perspective of the PTN operator, or of the PTNX, a dedicated connection will appear similar to a semi-permanent connection established by pre-arrangement and made available for an indefinite period of time.

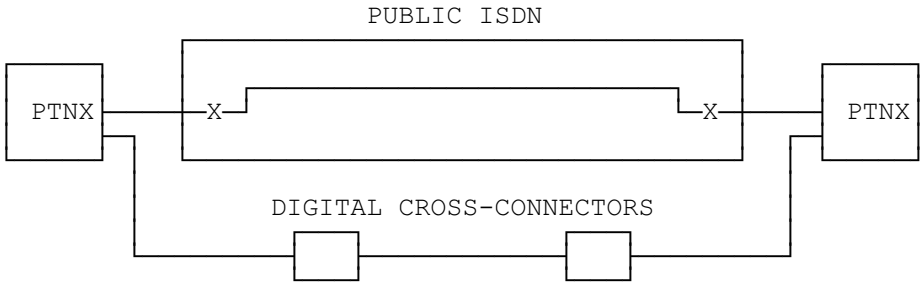

Figure 3: Semi-permanent connections

4.2.7 Switched connection

As illustrated in figure 4, a switched connection is a connection between two PTNXs which is established using circuit mode or packet mode transfer of information through the public ISDN. The connection uses both the transmission network and the exchanges of the public ISDN. The establishment of these connections is carried out (as and when the connections are required), by the exchange of signalling information between the PTN and the public ISDN providing the connections. This signalling occurs across the user-network interface at the T reference point.

This definition covers also the resources in a PSPDN or PSPDNs, to offer a VC.

NOTE: This definition is used instead of "on demand connection" as used in ENV 41006 [8] to align with CCITT Recommendation I.140 [4].

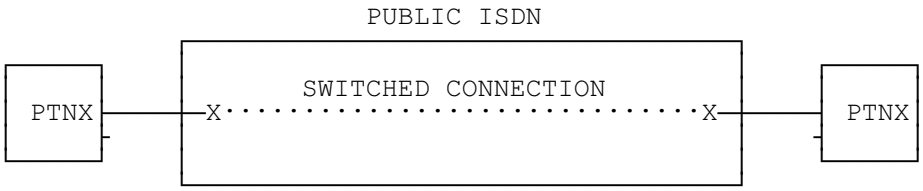

Figure 4: Switched connections (transparent) via the public ISDN

5 Abbreviations

ISCTX	Integrated Services CENTREX
ISDN	Integrated Service Digital Network
ISPBX	Integrated Services Private Branch eXchange
IVN	InterVening Network
LAPB	Link Access Protocol on the B-channel
LAPD	Link Access Protocol on the D-channel
ONP	Open Network Provision
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network
PTN	Private Telecommunication Network
PTNX	Private Telecommunication Network eXchange
PVC	Permanent Virtual Circuit
UUS	User-to-User Signalling
VC	Virtual Call

6 Common requirements for all connections

This Clause describes the general requirements to be met by both inter-PTNX user information connections and inter-PTNX signalling connections.

A PTNX should be connected to another PTNX by means of one or more inter-PTNX user information connections and one or more inter-PTNX signalling connections.

NOTE: These connections need to be established prior to the completion of the establishment phase of a call between two extension users in order for such a call to be successful.

It should be possible to establish inter-PTNX user information connections and inter-PTNX signalling connections independently of one another, i.e. it should be possible to establish the inter-PTNX signalling connection(s) without having previously established the inter-PTNX user information connection(s) and vice versa.

It should be possible to clear inter-PTNX user information connections and inter-PTNX signalling connections independently of one another, i.e. it should be possible to clear the inter-PTNX user information connection(s) without having previously cleared the inter-PTNX signalling Information connection(s) and vice versa.

It should be possible to establish a connection at some point in time prior to its use for the conveyance of PTN calls.

It should be possible to use an inter-PTNX user information connection for the conveyance of more than one PTN call (either at the same time by sub-rate multiplexing or successively) without the need to clear the connection between calls.

It should not (under normal operational conditions) be possible for a PTNX to clear an inter-PTNX user information connection before all the calls carried by that connection have been cleared. Under some operational circumstances (i.e. for network management purposes) it may be desirable for the PTN operator to have the capability to clear the connections without waiting for all calls carried over those connections to be cleared.

When a connection is being established between two PTNXs the PTNX at each end of the connection should be capable of determining whether the connection is to be used for the carriage of signalling information or for the carriage of user information.

Within the two classes of connections, inter-PTNX signalling connections and inter-PTNX user information connections, each connection should be uniquely identified to distinguish it from any other connection of the same type between the same two PTNXs.

Depending on the level of security required, the PTNXs involved can exchange identities after the establishment of an inter-PTNX connection. In addition, authentication may be required.

7 Requirements for inter-PTNX user information connections

Three types of inter-PTNX user information connections can be used for carrying the user information exchanged during calls between two PTNXs. A PTN may use one or more types of inter-PTNX user information connections at the option of the PTN operator.

The three types of connection are:

- dedicated inter-PTNX user information connections;
- semi-permanent inter-PTNX user information connections;
- switched inter-PTNX user information connections.

7.1 General requirements

Inter-PTNX user information connections should be only offered in the circuit mode at 64 kbit/s.

In the case where an IVN is a public ISDN, inter-PTNX user information connections can share the same interface structure (e.g. primary rate) as used by a PTNX to access services of the public ISDN for purposes other than inter-PTNX connection. Inter-PTNX user information connections can also share the same interface structure as inter-PTNX signalling connections.

7.2 Requirements for dedicated inter-PTNX user information connections

Dedicated inter-PTNX user information connections should be automatically re-established by the IVN following the repair of failed IVN equipment.

NOTE: The methods of blocking and reactivating the use of inter-PTNX user information connections are beyond the scope of this TCR-TR.

7.3 Requirements for semi-permanent inter-PTNX user information connections

Whether offered by IVN comprising digital cross-connectors or by public ISDN, the provision of semi-permanent inter-PTNX user information connections should be by request from the PTN Operator to the IVN Operator, or by other network management means.

The provision of semi-permanent connections by a public ISDN Operator is optional. However, if offered, these connections should be provided using the circuit mode 64 kbit/s unrestricted bearer service. Optionally, they may also be provided using other standard ISDN bearer services, e.g.:

- circuit mode speech;
- circuit mode 3,1 kHz audio;
- circuit mode 7 kHz audio.

Semi-permanently established inter-PTNX user information connections should be automatically re-established by the IVN following the repair of failed IVN equipment.

NOTE: The methods of blocking and reactivating the use of inter-PTNX user information connections are beyond the scope of this TCR-TR.

7.4 Requirements for switched inter-PTNX user information connections

Inter-PTNX user information connections should be provided using standard ISDN bearer services, e.g.:

- circuit mode 64 kbit/s unrestricted;
- circuit mode speech;
- circuit mode 3,1 kHz audio;
- circuit mode 7 kHz audio.

PTNs operating in circuit mode should be capable of using the circuit mode 64 kbit/s unrestricted service as a means of establishing connections.

Public ISDNs should support all of the circuit mode services in the above list.

The selection of the appropriate bearer service should take place at the time of connection establishment.

Control of the connection is carried out by the PTN, through signalling between a PTNX and the public ISDN.

In the case of failure of the inter-PTNX connection, this connection will be cleared, then the PTNX which initiated this inter-PTNX connection has the choice of:

- clearing all the associated inter-PTNX calls; or
- initiating the re-establishment of the inter-PTNX connection whilst keeping the associated inter-PTNX calls active.

As an IVN provider option, switched inter-PTNX user information connections can be automatically re-established by the IVN in the case of failure in the IVN. The PTNXs involved should receive the message "temporary failure - re-establishment started" from the IVN when the failure is detected, and the message "re-establishment completed" when the connection is re-established. Re-establishment should take place between the same accesses and access channels as used for the original establishment of the connection. Failure detection within a PTNX or at the access between the PTNX and the IVN will result in clearing of the connection.

NOTE: The action taken by the PTNX in response to these messages is outside the scope of this TCR-TR.

7.5 Performance requirements

The performance requirements to be met at the C reference point by all types of inter-PTNX user information connection should be the same as those specified for other types of connections/calls through each type of IVN.

NOTE 1: The performance characteristics of inter-PTNX connections will normally affect the overall performance characteristics for PTN calls.

NOTE 2: For scenarios in which a switched inter-PTNX connection has a long holding time, then the connection setup/disconnection delay of the PTN connection is not important.

For scenarios where the switched inter-PTNX connections are established on a per PTN call basis, then the inter-PTNX connection setup/disconnection delay may be a significant part of the corresponding PTN call setup/disconnection delay.

NOTE 3: The propagation delay of the inter-PTNX connection will add to that in the private part of the PTN to make up the overall PTN propagation delay.

8 Requirements for inter-PTNX signalling connections

Four types of inter-PTNX signalling connections can be used for signalling between two PTNXs.

These are:

- circuit mode inter-PTNX signalling connection; (identical to inter-PTNX user information connection).
- signalling bearer service inter-PTNX signalling connection;
- VC or PVC bearer service inter-PTNX signalling connection, or PSPDN inter-PTNX signalling connection;
- User-to-User Signalling (UUS) supplementary service (Service 3) inter-PTNX signalling connection.

NOTE: The use of frame mode bearer service to offer inter-PTNX signalling connections has not been considered due to a lack of information on this new service. Thus the fact that this service is not mentioned above should not be interpreted as an indication that it could not be used for offering inter-PTNX signalling connections.

A PTN may use more than one inter-PTNX signalling connection between any two given PTNXs, furthermore these inter-PTNX signalling connections may be of different types. These should be PTN options dependent on operator etc.

8.1 General requirements

If an IVN is represented by a public ISDN or by public ISDNs, inter-PTNX signalling connections can share the same access (e.g. primary rate) as used by a PTNX to access the services of the ISDN(s) for purposes other than establishing inter-PTNX connections. Inter-PTNX signalling connections can also share the same access as inter-PTNX user information connections.

An inter-PTNX signalling connection can be used to control the establishment of calls over one or a number of inter-PTNX user information connections. These inter-PTNX user information connections need not share the same access as the inter-PTNX signalling connection and may themselves spread over a number of accesses.

These inter-PTNX user information connections can be of any type, possibly many, independently of the type of the inter-PTNX signalling connection.

8.2 Requirements for circuit mode inter-PTNX signalling connections

The circuit mode inter-PTNX signalling connections may be dedicated or semi-permanent. In the latter case, they may be provided by IVN comprising digital cross-connectors or by public ISDN. The provision of these semi-permanent connections should be by request from the PTN Operator to the IVN Operator, or by other network management means.

The circuit mode inter-PTNX signalling connection may also be a switched connection provided by public ISDN(s). In this case, control of the connection is carried out by the PTN, through signalling between a PTNX and the public ISDN.

The connection should be operated in circuit mode (i.e. via a B-channel), and should make use of the 64 kbit/s unrestricted bearer service.

In the case of failure of the PTN connection, the PTN connection will be cleared then the PTNX requesting the PTN connection has the choice of:

- clearing all the associated inter-PTNX calls; or

- initiating the re-establishment of the PTN connection whilst keeping the active associated inter-PTNX calls.

As an IVN provider option, switched inter-PTNX signalling connections can be automatically re-established by the IVN in the case of failure in the IVN. The PTNXs involved should receive the message "temporary failure - re-establishment started" from the IVN when the failure is detected, and the message "re-establishment completed" when the connection is re-established. Re-establishment should take place between the same accesses and access channels as used for the original establishment of the connection. Failure detection within a PTNX or at the access between the PTNX and the IVN will result in clearing of the connection.

NOTE: The action taken by the PTNX in response to these messages is outside the scope of this TCR-TR.

8.3 Requirements for signalling bearer service inter-PTNX signalling connections

The signalling bearer service is a new service yet to be created. It should be provided on the D-channel at the T reference point, and might be used in either a semi-permanent or a switched mode (of establishment) through the public ISDN. In the first case, the means of establishment should be by request from the PTN Operator to the public ISDN Operator, or by other network management means. In the second case, control of the connection is carried out by the PTN, through signalling between a PTNX and the public ISDN.

The information transfer rate of a particular inter-PTNX signalling connection will be limited by the number of inter-PTNX signalling connections contained within a particular interface structure, the degree of usage and the public ISDN capabilities.

NOTE: It is likely that the new service "user signalling bearer service" which is being defined by ITU-T will be adequate for offering the signalling bearer service mentioned above. The "users" of this "user signalling bearer service" would then be the PTNXs."

8.4 Requirements for VC or PVC bearer service inter-PTNX signalling connections or for PSPDN inter-PTNX signalling connections

The VC or PVC bearer services used for inter-PTNX signalling connections should allow together with any interworking PSPDN, the default throughput class of 9600 bit/s of their standard service profile (see subclause 11.2.3.3), with a transit delay (see CCITT Recommendation X.25 [6] for the definition of these two expressions) which should not exceed a few hundred milliseconds, so as not to delay significantly the exchange of signalling between the PTNXs.

The same holds true for PSPDN inter-PTNX signalling connections, where the PTNXs are directly attached to a PSPDN, with such connections being established either by Permanent Virtual Circuit, hence semi-permanent, or by Virtual Call, hence switched.

NOTE: Actually, the need for offering both Permanent Virtual Circuit and Virtual Call should be examined, and as a result of this examination, possibly only one of them should be chosen as the standard offering.

ISDN VC or PVC bearer services being provided either by the D-channel or by a B-channel of a ISDN public access, at least one of these two provision means should be available for VC or PVC bearer service inter-PTNX signalling connections. If available, the first one, by the D-channel, should be preferable since it allows to save a B-channel in a public ISDN access.

NOTE: The use of X.31 case A for packet mode inter-PTNX signalling connections is an open issue.

8.5 Requirements for User-to-User Signalling (UUS) supplementary service (Service 3) inter-PTNX signalling connection

The User-to-User Signalling (UUS) supplementary service (Service 3) inter-PTNX signalling connection is different from other inter-PTNX signalling connections since it is established simultaneously with a circuit mode inter-PTNX user information connection as a result of being requested as a supplementary service.

NOTE: The use of this type of inter-PTNX signalling connection is an open issue.

8.6 Performance requirements

The transmission performance characteristics of the connections offered by the IVN for inter-PTNX signalling connections should be adequate for the operation of the inter-PTNX signalling system, notably regarding the transit delay.

The connection set up / disconnection delay of the inter-PTNX will be important to offer a high flexibility in establishing and clearing an inter-PTNX connection when there is no need for the PTNXs to exchange signalling.

9 Dedicated transmission system used as an IVN

This Clause applies only in the case of a 2 048 kbit/s inter-PTNX connection structured according to CCITT Recommendation G.704 [1].

9.1 Method of connection

The PTNX is connected to the transmission system via one or more accesses at the C reference point.

9.1.1 Layer 1 procedures

The physical interface to the transmission system should be implemented as described in Annex A of ETS 300 011 [12].

NOTE: For an interim period (to be defined) and for reasons of backwards compatibility, it should not be a mandatory requirement to support the CRC-4 mechanism described in ETS 300 011 [12].

9.2 Mode of establishment

The establishment of inter-PTNX connections (regardless of whether an inter-PTNX signalling connection or an inter-PTNX user information connection) on a permanent basis should be controlled by the provider of the dedicated transmission system and should take place at the time of subscription. No activation or invocation procedures should be required from the PTN.

9.3 Provision of connections

For each access any number of inter-PTNX connections between 1 and the maximum number provided may be established at subscription time. The maximum number should be 31 inter-PTNX connections as defined by ETS 300 011 [12].

NOTE: The PTNXs at each end of a link should reach a common agreement concerning which timeslots are to be used for inter-PTNX signalling connections and which timeslots are to be used for inter-PTNX user information connections, prior to the use of these connections.

Only dedicated circuit mode inter-PTNX signalling connections and dedicated circuit mode inter-PTNX user information connections can be established via an IVN implemented as a specific transmission system.

10 IVN comprising digital cross-connectors

This Clause applies only to accesses at 2 048 kbit/s.

10.1 Method of connection

The PTNX shall be connected to a digital cross-connector via one or more accesses at the C reference point.

10.1.1 Layer 1 procedures

The physical interface to a digital cross-connector should be implemented as described in ETS 300 010-1 [11]. The features and functions defined as mandatory in ETS 300 010-1 [11] should be supported.

10.2 Mode of establishment

The establishment of an inter-PTNX connection (regardless of whether it is an inter-PTNX signalling connection or an inter-PTNX user information connection) on a semi-permanent basis should be controlled by the provider of the digital cross-connector and should take place at the time of subscription. No activation or invocation procedures should be required.

NOTE: Alternatively, inter-PTNX connections may be established by means of network management requests sent by the PTNX to the digital cross-connector.

10.3 Provision of connections

Any number of inter-PTNX connections between 1 and 31 may be established.

NOTE: The PTNXs at each end of a link should reach a common agreement concerning which timeslots are to be used for inter-PTNX signalling connections and which timeslots are to be used for inter-PTNX user information connections, prior to the use of them.

The group of inter-PTNX connections at one particular access between a PTNX and digital cross-connector may be established to more than one PTNX; however, any one connection should only be established to one other PTNX.

Only semi-permanent circuit mode inter-PTNX signalling connections and semi-permanent circuit mode inter-PTNX user information connections can be established via an IVN implemented using digital cross-connectors.

11 Public ISDN used as an IVN

11.1 Method of connection

In the case where a physical interface at the T reference point exists between a PTNX and the public ISDN the requirements of this clause should apply.

The interface structure could comprize one or more Basic Accesses and/or one or more Primary Rate Accesses.

These Basic Access and Primary Rate Access interfaces should meet the requirements specified in subclause 11.2.

11.2 Basic Access and Primary Rate Access procedures

The requirements in ETS 300 153 [19] and ETS 300 104 [17] (candidates NET 3 Part 1 and 2, respectively) should be met by the PTNX connected to the public ISDN through Basic Accesses. And those in ETS 300 156 [20] (candidate NET 5) should be met by the PTNX connected to the public ISDN through Primary Rate Accesses.

11.2.1 Layer 1 procedures

The Primary Rate Access interface between a PTNX and the IVN should be implemented as described in ETS 300 011 [12]. The features and functions defined as mandatory in this ETS should be supported. No activation or invocation procedures should be required.

The Basic Access interface between a PTNX and the IVN should be implemented as described in ETS 300 012 [13]. The features and functions defined as mandatory in this ETS should be supported.

11.2.2 Layer 2 procedures

NOTE: In the case of circuit mode inter-PTNX signalling connection, a layer 2 logical link has to be established for use by the signalling between these two PTNXs (QSIG protocol defined for circuit-switched calls in ETS 300 172 [22], or any other upper layer protocol). The corresponding layer 2 protocol is defined in I-ETS 300 170 [21] but it should be noted that the provision of this protocol is not at the C reference point. Hence it is outside the scope of this TCR-TR.

11.2.2.1 D-channel general procedures

The D-channel layer 2 procedures should be implemented as described in ETS 300 125 [18], with the features and functions defined as mandatory in this ETS being supported.

These will be used for the ISDN signalling through the D-channel for establishing circuit mode calls through that access, notably switched inter-PTNX connections.

It will also be used for inter-PTNX signalling connections when these are of the following types:

- signalling bearer service;
- VC or PVC bearer services provided by a D-channel;
- User-to-User Signalling (UUS) supplementary service (service 3).

For VC or PVC bearer services provided by a D-channel, the requirements are defined in ETS 300 049 [15]. They are recalled in Annex A.

11.2.2.2 VC or PVC bearer service inter-PTNX signalling connection by the B-channel

Inter-PTNX signalling connections may also use VC or PVC bearer services by the B-channel. In that case, the requirements are defined in ETS 300 048 [14]. They are recalled in Annex A.

11.2.3 Layer 3 procedures

11.2.3.1 Establishment of circuit mode switched inter-PTNX connections

In addition to the standard procedures for other ISDN calls, the following specific procedures apply:

- request procedure from the originating PTNX to the public ISDN, for a switched inter-PTNX signalling or user information connection, with some complementary information elements, to be determined, which need to be carried end-to-end between the PTNXs for fully characterizing the inter-PTNX connection being established;

- indication from the public ISDN to the terminating PTNX that a switched inter-PTNX signalling or user information connection is being established, with the complementary information elements sent by the originating PTNX in its request procedure mentioned just above.

  In addition, on an optional basis, they could comprise:

  - use of Calling PTNX Identification Presentation supplementary service by the called PTNX to allow a (security) check by the latter that the connection is authorized;

  - use of Connected PTNX (identification) Presentation supplementary service by the calling PTNX to allow a (security) check by the latter;

  - use of Closed User Group supplementary service;

  - authentication procedure (end to end);

  - notification for failure situation - re-establishment initiated;

  - notification for re-establishment being completed.

  NOTE: Public ISDNs which automatically release calls when they exceed a certain duration should not do so in the case of inter-PTNX connections.

11.2.3.2 Establishment and clearing of signalling bearer service inter-PTNX signalling connections

The layer 3 procedures for the signalling bearer service will be defined in a new ETS where the requirements for re-establishment (whether they are optional or always available with the signalling bearer service, depending on how it is finally defined) should be defined, as well as the means for end-to-end identification of that connection.

11.2.3.3 Establishment and clearing of VC or PVC bearer service inter-PTNX signalling connections

For establishment and clearing of VC or PVC bearer service inter-PTNX signalling connections provided by a D-channel, ETS 300 049 [15] applies, it being understood that the PTNX acts as the user of the service. Virtual Call or Permanent Virtual Circuit procedures should be offered according to CCITT Recommendation X.25 [6] packet layer procedures.

The same applies for VC or PVC bearer service inter-PTNX signalling connections provided by a B-channel, using ETS 300 048 [14] instead of ETS 300 049 [15]. Notably this ETS specifies the B-channel access to the packet handler, which is recalled in Annex A.

The standard service profile defined in Annex A of both ETS 300 048 [14] and ETS 300 049 [15] should be the only one applicable.

It will be necessary to define the coding in the X.25 packet layer protocol of the identification of VCs carrying inter-PTNX signalling connections, and that of some complementary information elements, to be determined, for fully characterising the connections being established. In addition, if possible, the use of some Closed User Group related optional user facilities for VCs should be specified for screening the connection attempts. A new ETS will be required to cover all of this.

11.2.3.4 Establishment of User-to-User Signalling (UUS) supplementary service (Service 3) inter-PTNX signalling connections

The D-channel layer 3 procedures are described in draft ETS 300 286 [23].

The definition of the procedures specific to this case is for further study.

11.3 Provision of connections

The maximum number of circuit mode connections should be 2 per Basic Access and 30 per Primary Rate Access.

No B-channel should be specifically devoted to switched circuit mode connections i.e. it should be possible to use any B-channel either for an "ordinary" public ISDN call or for establishment of inter-PTNX user information or inter-PTNX signalling connections.

Any number of connections between one and the maximum number provided may be established simultaneously either when subscribing to semi-permanent connections or when demanding switched connections. Combinations of semi-permanent connections and switched connections within the same interface structure should not be prohibited.

NOTE: In the case of semi-permanent connections, the PTNXs at each end of a link should reach a common agreement concerning which channels are to be used as inter-PTNX signalling connections and which channels are to be used as inter-PTNX user information connections, prior to the use of these connections.

When an inter-PTNX signalling connection operates in packet mode, the maximum number of connections can be much higher and be limited by the throughput values of VCs and PVCs over:

- the D channel of a Basic Access;
- and/or the D channel of a Primary Rate Access;
- and/or a B-channel.

The group of connections at one particular access between a PTNX and the public ISDN may be established to more than one PTNX.

11.4 Modes of establishment

11.4.1 Semi-permanent mode of establishment

The establishment of both inter-PTNX user information connections and inter-PTNX signalling connections on a semi-permanent basis should be controlled by the public ISDN operator and should take place at the time of subscription. Re-establishment should take place automatically if a failure occurs in the ISDN.

NOTE: Alternatively, inter-PTNX connections may be established by means of network management requests sent by the PTNX to the public ISDN.

11.4.2 Switched mode of establishment

The switched connections are requested from the ISDN by signalling procedures at the T-reference point. The PTN controls the establishment and clearing of the connections.

12 Preferred scenarios

As indicated in subclause 8.1, the types of inter-PTNX signalling and user information connections are independent from each others. Thus any combination of one inter-PTNX signalling connection of a given type, with a number of inter-PTNX user information connections of any type, possibly of many types, constitutes a possible scenario for linking PTNXs in a PTN.

This Clause describes the preferred scenarios to be supported by both PTN Operators and IVN Operators, where the following simplifications have been made:

- only one type of inter-PTNX signalling connection is shown per scenario. But it is possible to combine this type with other preferred types of inter-PTNX signalling connections to create more complex scenarios;

- many types of inter-PTNX user information connections can be associated to each preferred type of inter-PTNX signalling connection.

Table 5: Preferred scenarios to be supported in phases 1 and 2

		inter-PTNX user information connections		
		Dedicated Circuit mode	Semi-Permanent Circuit mode	Switched Circuit mode
PTN signalling connection	Circuit Mode: dedicated	1, 2	1, 2	1, 2
	Circuit Mode: semi-permanent		1, 2	1, 2
	Circuit Mode: switched			1, 2
	signalling Bearer Service: semi-permanent (NOTE)	2	2	2
	signalling Bearer Service: switched	2	2	2
	PVC bearer service: semi-permanent	1	1	1
	VC bearer service: switched	1	1	1
	User-to-User Signalling supplementary service (Service 3): switched			

NOTE: If the future semi-permanent signalling bearer service includes re-establishment then it may be preferable to switched signalling bearer service.

Phase 1: supportable following the introduction of MoU ISDN.

Phase 2: aim to support by late-1990's.

13 Outstanding Issues

13.1 Layer 2 problems

As a part of the provision of a signalling link at the Q-reference point, there is the requirement to provide a suitable data link layer on which QSIG will be run (see ETS 300 172 [22]). The IVN capabilities will in general not provide the complete data link service. In the case that the IVN provides a bit synchronous connection, then I-ETS 300 170 [21] can be used. For IVNs that provide packet mode services then the functions to be provided by the Mapping Unit need to be detailed for each packet bearer service.

13.2 Use of Open Network Provision (ONP) leased lines

The standards being developed for ONP leased lines should be taken into account in a future version of this TCR-TR.

13.3 Synchronisation

Any requirements on connections between PTNXs concerning synchronisation are not covered by this TCR-TR. Special consideration should be given to the cases where dedicated transmission systems are used. prETS 300 241, on synchronisation, might give additional requirements to ETS 300 011 [12].

13.4 Signalling connections through packet switched data IVN

This TCR-TR does not address all possible cases of PSPDN inter-PTNX signalling connection, especially circuit switched attachment to PSPDN, specified in CCITT Recommendations X.32 and X.31 case A in the case of switching through PSTN and public ISDN, respectively.

The interest of these cases is to be assessed taking into account their availability in the various countries of Europe and comparing this availability to the future availability in these countries of VC or PVC bearer services as defined by CCITT Recommendation X.31, case B, and more specifically by ETSs 300 048 [14] and 300 049 [15] for stage 1.

While VC or PVC bearer services are most likely the most elegant means, it might take some time before they are widely available in Europe (even though they are in the list of services included in the ISDN MoU).

On the other hand, direct attachment is available practically everywhere in Europe now, but it may be more expensive than VC or PVC bearer services.

In any case it should be noted that although the use of packet switched data network necessitates the introduction of a layer 2 protocol different from that for VC or PVC bearer services (LAPB, as specified by CCITT Recommendation X.25 possibly complemented by CCITT Recommendation X.32, as opposed to LAPD defined for ISDN layer 2), the various cases can be mixed at both ends since they can interwork.

13.5 Semi-permanent connections

Semi-permanent connections established by network management may be an important feature of future networks; work on the definition of the establishment procedures is needed.

13.6 Terminology

The terminology relevant to inter-PTNX connections is not harmonised. Further work is needed on sets of terminology relevant on the one hand to public network operators, and on the other hand to private network operators and PTNXs.

Annex A: Reminder on VC or PVC bearer service procedures

A.1 Layer 2 of VC or PVC bearer service by the D-channel

- SAPI=16 logical link shall be supported;

- for the case of Virtual Call (VC), any of the three basic methods for Layer 2 activation (which according to ETS 300 049 [15], are public "network options") may be used:

  method 1: semi-permanent data link layer (i.e. the data link layer is permanently activated);

  NOTE 1: This method is allowed only if Layer 1 is permanently activated.

  NOTE 2: This is always the case for primary rate access, but it will be a problem with basic access.

  method 2: on-demand data link layer with fixed TEI values, where one TEI value corresponds to the Layer 3 service access point of the inter-PTNX signalling connection.

  method 3 (optional): on-demand data link layer with dynamic TEI allocation:

- for the case of PVC, Layer 1 and Layer 2 need to be permanently activated. For the latter this can be done by either of methods 1 or 2 above.

A.2 Layer 2 of VC or PVC bearer services by the B-channel

In the case of VC or PVC bearer service inter-PTNX signalling connection by the B-channel, it should be understood that (as stated in ETS 300 099 [16]) the X.25 Link Access Procedure Balanced (LAPB) specified in CCITT Recommendation X.25 [6] shall apply, for both the VC and PVC cases. As stated in ETS 300 048 [14], in the case of PVC, a permanent B-channel access (to the Packet Handler) should be established and layer 2 permanently activated, while in the case of VC, it is also possible to have on demand B-channel connection with on demand layer 2 activation. Actually, according to ETS 300 048 [14], this could also be possible for PVCs with some networks.

A.3 Specification of the B-channel access to packet handler

As indicated above, it should always be possible to use a permanent B-channel access to the packet handler for VC or PVC, the use of on demand B-channel connection being also possible for VC - and for PVC with some networks. In the case of on demand access, the B-channel connection to the packet handler is established as an ISDN circuit switched basic call, as defined in ETS 300 007 [10] (see subclause 7.1.2 for outgoing calls and subclauses 7.2.2.1 and 7.2.2.2 for incoming calls).

History

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