ECMA Technical Report TR/57
2nd Edition - June 1999

ECMA

Standardizing Information and Communication Systems

Private Integrated Services Networks

Phone: +41 22 849.60.00 - **Fax:** +41 22 849.60.01 - **URL:** http://www.ecma.ch - **Internet:** helpdesk@ecma.ch

ECMA Technical Report TR/57

2nd Edition - June 1999

ECMA

Standardizing Information and Communication Systems

Private Integrated Services Networks

Phone: +41 22 849.60.00 - **Fax:** +41 22 849.60.01 - **URL:** http://www.ecma.ch - **Internet:** helpdesk@ecma.ch

IW TR-57.DOC 28-06-99 16,04

Brief History

This Technical Report is the foundation for a series of standards applicable to Private Integrated Services Networks (PISNs). It includes guidelines for the definition and control of

- PISN-to-ISDN connections,
- intra-PISN connections,
- PISN addressing and routeing aspects, and
- PISN telecommunication services,

It is based on the ISDN concepts as developed by ITU-T and it is also within the framework of standards for open systems interconnection as defined by ISO.

In addition to the first edition (published in 1991) the second edition recognizes the generalization of the corporate network (CN) concept: CNs may comprise intranet technology (IP technology), in addition to PISN technology.

The Technical Report is based on the practical experience of ECMA member companies and the results of their active and continuous participation in the work of ISO, ITU-T, and various regional and national standardization bodies in Europe and in the USA. It represents a pragmatic and widely based consensus.

Adopted as 2nd Edition of Technical Report TR/57 by the General Assembly of June 1999.

Table of contents

Section 1 - General **1**

1 Scope **1**

2 Field of application **1**

3 References **1**

4 Definitions **3**
4.1 Corporate telecommunication Network (CN) 3
4.2 PISN Access 3
4.3 Inter-PINX Connection 3
4.4 Interconnecting Network 3
4.5 Internet 3
4.6 Intervening Network 4
4.7 Intranet 4
4.8 Private Integrated Services Network (PISN) 4
4.9 Private Integrated Services Network Exchange (PINX) 4
4.10 User 4
4.11 PISN User 4
4.12 Virtual Private Network (VPN) 4

5 Abbreviations **4**

6 Structure of this Technical Report **6**

Section 2 - Basic Concepts **7**

7 Reference Configuration for PINX Calls **7**

8 Architecture **9**
8.1 PISN Topology 9
8.2 Routeing Hierarchy 10
8.3 Capability Structures of a PISN 11
8.4 Capabilities of a PISN 11
8.4.1 PISN Low Layer Capabilities 12
8.4.2 Access Capability 14
8.5 PISNs connected to the Public ISDN 14
8.5.1 Interworking of PISN and Public ISDN Capabilities 14
8.5.2 Solutions for Accessing the Public ISDN Packet Switching Capabilities 15
8.6 Interconnected PINXs 17
8.6.1 Overlay Concept 18
8.6.2 Capability Structure of a PISN Employing IVNs or ICNs 19

9 Extended Protocol Reference Model **21**
9.1 Planes for Communication across the IVN 21

9.1.1 IVN Control Plane (NC) 21
9.1.2 IVN User Plane (NU) 21
9.2 Planes for Communication across the PISN 21
9.2.1 PISN Control Plane (PC) 21
9.2.2 PISN User Plane (PU) 21
9.3 Planes for Communication across the PISN Access 21
9.3.1 TE Control Plane (TC) 21
9.3.2 TE User Plane (TU) 21
9.4 Planes for Communication across an ICN 21

Section 3 - Inter-PINX Connections 23

10 Introduction 23
10.1 Multiple Instances of Q and C Reference Points 23
10.2 Shared Access Use 23
10.3 Mapping Functional Grouping (MP) 23

11 Scenarios 25

Section 4 - CN Addressing 25

12 General 25
12.1 Smallest Addressable Entity in a PISN 25
12.2 Addressing Principles 28
12.2.1 The ISO Global OSI Network Addressing Principle 29
12.2.2 The ITU-T ISDN Addressing Principle 29
12.2.3 The Domain Specific Part Addressing Principles 30
12.3 Purpose of Addresses 30
12.3.1 Selection 30
12.3.2 Identification 30
12.4 Address Interworking 32
12.5 Address Values of the Public ISDN Addressing Domain 32
12.6 Addressing Principles in LANs 32

13 CN numbering impact on public networks and their numbering plans 32
13.1 Current Situation 32
13.2 Ideal Situation 33
13.2.1 Structure of the globally unique CN Number 33

14 PISN Numbering Concept 34
14.1 Numbering Plans of PISNs 34
14.2 Private Numbering Plan Structure 35
14.3 Content of the Number Information in a Private Numbering Plan 35
14.4 Reference Configuration for PISN Address Treatment 35
14.5 Knowledge about other Numbering Plans 36

15 Support of subaddressing in PISNs **36**
15.1 Embedment of OSI Network Layer Addresses in Concatenated PISN Addressing Information 36
15.2 Embedment of Other Information in the Subaddress 37
15.3 Conveyance of Subaddresses through a PISN 37

Section 5 - Routeing **37**

16 General **38**

17 Routeing Requirements **38**
17.1 Functional Requirements 38
17.1.1 Factors Influencing Routeing through a PISN 39
17.1.2 Factors Influencing Routeing to Another Network 39
17.1.3 Factors Influencing the Selection of Networks beyond the Next Network 40
17.1.4 Other Factors Influencing Route Selection 40
17.2 Performance Requirements 40

18 Routeing Mechanisms **40**
18.1 Routeing Information Base 40
18.2 Source and Destination Routeing 41
18.2.1 Advantages of Source Routeing Compared with Destination Routeing 41
18.2.2 Advantages of Destination Routeing Compared with Source Routeing 41
18.2.3 Hybrid Methods 42
18.2.4 Impact on Signalling for Call Control 42
18.3 Subjects for Standardization 43

Section 6 - Services **43**

19 General Service Considerations **43**
19.1 Classification of Services 43
19.2 Control of Basic Services 43
19.3 Control of Supplementary Services 44
19.4 Specification Method for ECMA Standards on Services 44
19.4.1 Service Model for Stage 1 Specifications 44
19.4.2 Service Model for Stage 2 Specifications 45
19.5 Relationship to Services Provided in Public ISDNs 45
19.6 Service Interworking between PISNs and Public ISDNs 46
19.7 Additional Network Features 48

Annex A - Off-premises PISN Users **49**

Annex B - PINX Connections to Public ISDNs **51**

Annex C - Interworking for Identification Numbers between Public ISDN and PISN **53**

.

.

Section 1 - General

1 Scope

As a portion, a Corporate telecommunication Network (CN) can comprise a Private Integrated Services Network (PISN) which provides connection oriented switching and transmission functions for the provision of telecommunication services to its users which are similar to those provided by public ISDNs. In addition, a PISN can also extend to its users services provided by public ISDNs. Public ISDNs are described in ITU-T recommendations.

As another portion, CNs can employ connectionless services, as offered by internet and intranet technology ("IP technology").

This Technical Report concentrates on the issues of narrow-band PISNs (N-PISN). N-PISN are based on the switching capability of 64 kbit/s channels.

The main purpose of a CN, and in the context of this Technical Report thus of a PISN, is to serve the communication needs of an organization rather than to provide services to the general public.

A PISN comprises one or more interconnected Private Integrated Services Network Exchanges (PINXs) and their interconnecting links as provided by intervening networks. It may also be supported by Virtual Private Network (VPN) features offered by an interconnecting network.

This Technical Report discusses some of the technical aspects of PISNs and identifies areas for standardization. It also provides a common framework of concepts and terminology for standards in this field.

The discussion of VPN features provided by an interconnecting network is beyond the scope of this Technical Report. However, if VPN features are offered by other networks, they should follow the concepts established in this Technical Report and related Standards for PISNs consisting of PINXs. For VPNs see ETSI TCRTR 033.

Management aspects of PISNs are not subject of this Technical Report.

2 Field of application

This Technical Report applies to:

- Private Integrated Services Networks and their exchanges, e.g. Integrated Services Private Branch Exchanges (ISPBX) and/or Integrated Services Centrexes (ISCTX);
- Intervening Networks, e.g. public ISDNs, which are employed to support Private Telecommunication Networks by providing transmission links between PINXs without interacting in the services of the PISN;
- Interconnecting Networks, e.g. the transmission, switching and possibly service capabilities offered by public ISDNs to support PISNs;
- Public ISDNs with regard to support of interworking with PISNs or PINXs.

3 References

ECMA-133	Private Integrated Services Network (PISN) - Reference Configuration for PISN Exchanges (PINX)
ECMA-142	Private Integrated Services Network (PISN) - Circuit Mode 64kbit/s Bearer Services - Service Description, Functional Capabilities and Information Flows (BCSD)
ISO/IEC 7498-3	Information technology - Open Systems Interconnection - Basic Reference Model: Naming and addressing
ISO/IEC 8348	Information technology - Open Systems Interconnection - Network Service Definition
ISO/IEC 10589	Information technology - Telecommunications and information exchange between systems - Intermediate system to Intermediate system intra-domain routeing

	information exchange protocol for use in conjunction with the protocol for providing the connectionless-mode Network Service (ISO 8473)
ISO/IEC TR 9575	Information technology - Telecommunications and information exchange between systems - OSI Routeing Framework
ETSI TCRTR 033	Business TeleCommunications (BTC); Private Telecommunication Network (PTN); Integrated scenario for business communications
ETS 300 011	Integrated Services Digital Network (ISDN) Basic User Network Interface Layer 1 Specification and Test Principles
ETS 300 012	Integrated Services Digital Network (ISDN) Primary Rate User Network Interface Layer 1 Specification and Test Principles

NOTE

For the ITU-T recommendations listed below the Blue Book version, (CCITT, Melbourne 1988) shall apply.

ITU-T Rec. E.164	Numbering Plan for the ISDN era
ITU-T Rec. F.69	Plan for telex destination codes
ITU-T Rec. I.130	Method for the characterization of telecommunication services supported by an ISDN, and network capabilities of an ISDN
ITU-T Rec. I.210	Principles of telecommunication services supported by an ISDN and the means to describe them
ITU-T Rec. I.220	Common dynamic description of basic telecommunication services
ITU-T Rec. I.230	Definition of bearer service categories
ITU-T Rec. I.240	Definition of teleservices
ITU-T Rec. I.310	ISDN - Network functional principles
ITU-T Rec. I.320	ISDN protocol reference model
ITU-T Rec. I.324	ISDN network architecture
ITU-T Rec. I.325	Reference configuration for ISDN connection types
ITU-T Rec. I.330	ISDN numbering and addressing principles
ITU-T Rec. I.333	Terminal selection in ISDN
ITU-T Rec. I.334	Principles relating ISDN numbers/sub-addresses to the OSI reference model network layer addresses
ITU-T Rec. I.411	ISDN user-network interfaces – Reference configurations
ITU-T Rec. I.412	ISDN user-network interfaces – Interface structures and access capabilities
ITU-T Rec. Q.513	Exchange interfaces for operations, administration and maintenance
ITU-T Rec. Q.931 / ETS 300 102	ISDN user-network interfaces - Layer 3 specification
ITU-T Rec. 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
ITU-T Rec. X.31	Support of packet mode terminal equipment by an ISDN
ITU-T Rec. X.75	Packet-switched signalling system between public networks providing data transmission services
ITU-T Rec. X.121	International numbering plan for public data networks
ITU-T Rec. X.200	Reference model for Open Systems Interconnection for ITU-T applications

4 Definitions

Figure 1 gives an overview of a number of terms defined below.

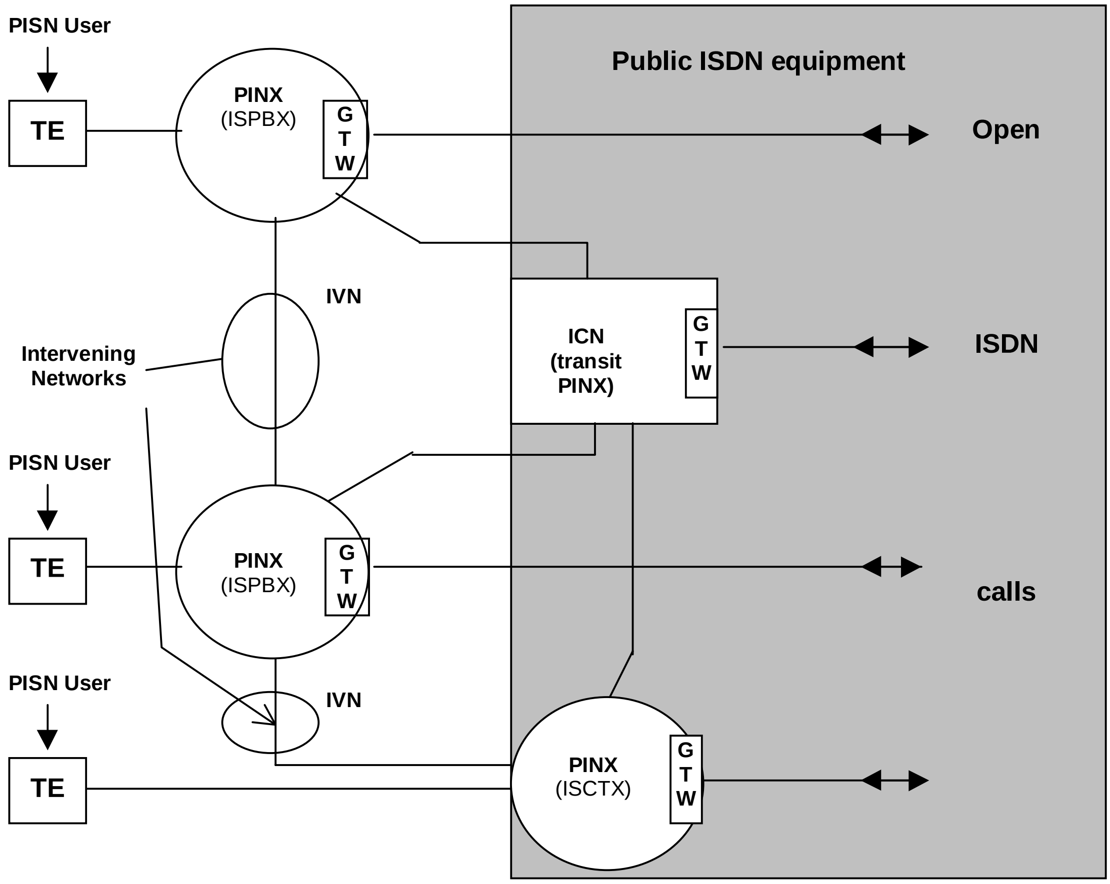


Figure 1 - Terminology in the Private Integrated Services Network Environment

NOTE

In most of its recommendations (Blue Book, Melbourne 1988), ITU-T globally distinguishes between “User" and "Network", without further distinction between NT2 and TE. Furthermore, the special case of a PINX as one specific NT2 representative has not been covered by ITU-T. However, any specification applicable to the PISN environment needs a more specific terminology, which is able to cover different types of PINXs (e.g. ISPBXs and ISCTXS), in a non-discriminatory way.

4.1 Corporate telecommunication Network (CN)

A telecommunication network serving a corporation, i.e. a single organization, an extended enterprise, or an industry application group as defined by the International Chamber of Commerce (ICC).

4.2 PISN Access

The line connecting a terminal (or in the case of multipoint configurations: terminals) to a PINX.

4.3 Inter-PINX Connection

The connection between two inter-connected PINXs. It is supported by an intervening network.

4.4 Interconnecting Network

A third-party network (typically using public ISDN infrastructure) providing transmission, switching and service capabilities for the purpose of linking two or more PINXs by means of inter-PINX call control.

4.5 Internet

A public connectionless network.

4.6 Intervening Network

A network which intervenes between any two PINXs in order to provide inter-PINX connections.

4.7 Intranet

An internet dedicated to the private use of a corporation.

4.8 Private Integrated Services Network (PISN)

A network comprising one or more interconnected PINXs. The PISN provides PISN services to its users which are based on those provided by its PINXs. A PISN may comprise more than one PINX spread over more than one user premises. In this case, inter-PINX connections between the PINXs serving the individual premises are required. The inter-PINX connections are considered part of the PISN.

In the context of this Technical Report a PISN is considered a private ISDN.

4.9 Private Integrated Services Network Exchange (PINX)

A nodal entity in a PISN which provides autonomous and automatic switching and call handling functions used for the provision of telecommunication services which are based on those specified for public ISDNs.

NOTE

If applicable, a PINX provides:

- *telecommunication services within its own area, and/or*
- *telecommunication services from a public ISDN, and/or*
- *telecommunication services from other public or private networks, and/or*
- *within the context of a PISN, telecommunication services from other PINXs*

to users of the same and/or another PINX.

A PINX may be represented by an ISPBX, or by equipment which is physically part of the equipment of, for example, a public ISDN local exchange.

4.10 User

The generic term for an entity, i.e. a process or human being, using, via the terminal, the network layer service provided by a network, independently of whether this is in a PISN, a public ISDN or another network.

4.11 PISN User

A user of the network layer service provided by a PISN.

4.12 Virtual Private Network (VPN)

The capabilities of third-party provided networks (typically using public ISDN infrastructure) to emulate ISCTX and/or ICN functions for a given PISN.

5 Abbreviations

ADD	Addendum
AFI	Authority and Format Identifier
AHLF	Additional High Layer Function
ALLF	Additional Low Layer Function
BHLF	Basic High Layer Function
BLLF	Basic Low Layer Function
C	C Reference Point
CC	Call Control
CCA	Call Control Agent
CE	Connection Element

CH	Call Handling (functional grouping)
CRF	Call Related Function
DCC	Data Country Code
DDI	Direct Dialling-In (supplementary service)
DSP	Domain Specific Part
EPRM	Extended Protocol Reference Model
FE	Functional Entity
FH	Frame Handler
ICD	International Code Designation
IDI	Initial Domain Identifier
IDP	Initial Domain Part
IH	Intervening Network Handler (functional entity)
ISCTX	Integrated Services Centrex
ISDN	Integrated Services Digital Network
ISPBX	Integrated Services Private Automatic Branch Exchange
IVN	Intervening Network
IWU	InterWorking Unit
LAN	Local Area Network
MAC	Medium Access Control
MP	Mapping (functional grouping)
MSN	Multiple Subscriber Number (supplementary service)
NC	Network Control plane, i.e. either IVN or Public ISDN control plane
NP	Numbering Plan
NPI	Numbering Plan Identifier
NSAP	Network Service Access Point
NT1	Network Termination 1
NT2	Network Termination 2
NU	Network User plane, i.e. either IVN or Public ISDN user plane
OSI	Open System Interconnection
PC	PISN Control plane
PH	Packet Handler
PINX	Private Integrated Services Network Exchange
PISN	Private Telecommunication Network
PNP	Private Numbering Plan
PSDN	Public Switched Data Network
PSTN	Public Switched Telephony Network
PU	PISN User plane
Q	Q Reference Point

RIB	Routeing Information Base
S	S Reference Point
S_0	Interface on a Basic Access at the S Reference Point [1]
S_1	Interface on a Primary Rate Access at the S Reference Point[2]
S_2	Interface on a Primary Rate Access at the S Reference Point[3]
SAP	Service Access Point
SAPI	Service Access Point Identifier
SNPA	SubNetwork Point of Attachment
SRF	Switching and Relaying Function
SW	Switching functional grouping
T	T Reference Point
TC	TE Control plane
TE	Terminal Equipment
TON	Type of Number
TOP	Technical and Office Protocol
TOS	Type of Subaddress
TU	TE User plane
VPN	Virtual Private Network (feature)

6 Structure of this Technical Report

This Technical Report is structured into a number of sections which cover individual aspects of PISNs and Public ISDNs:

Section 1: covers the general part, such as scope and definitions, which apply to all subsequent sections;

Section 2: discusses basic concepts of PINXs and PISNs, such as PISN architecture, connection types etc.

Section 3: discusses the interconnection of distant PINXs in order to form Private Integrated Services Networks: the necessary provisions on the PISN side as well as the provision of bearer services by intervening networks;

Section 4: discusses addressing aspects within PISNs, between PISNs and non-ISDN private networks, between PISNs and public ISDNs, and between PISNs and non-ISDN public networks;

Section 5: discusses routeing within a PISN;

Section 6: discusses services provided by a PISN, and in particular the impact of interworking with corresponding services in public ISDNs.

[1] Index 0: 0,144 Mbit/s (Basic Access)

[2] Index 1: 1,544 Mbit/s (23 B + D as used, e.g., in North America)

[3] Index 2: 2,048 MBit/s (30 B + D as used, e.g., in Europe and Australia)

Section 2 - Basic Concepts

This section discusses the general concepts which apply to a PISN and its PINXs. A reference configuration, architecture and connection types, and a protocol reference model are discussed. These general considerations are suitable for the applications:

- stand-alone PINX,
- PINX interworking with public ISDN, and
- PINXs interconnected via intervening or interconnecting networks.

7 Reference Configuration for PINX Calls

ITU-T's user-to-network access reference configuration (ITU-T Rec. I.411) classifies ISPBXs as a specific implementation of an NT2 functional grouping which is connected to the Public ISDN at its T reference point and fulfils ISDN access functions. Moreover, a PINX provides other functions in addition to functions for access to the public ISDN, and in particular can provide the following additional functions:

- internal communication between its users;
- direct communication with one or more other PINXs, via inter-PINX connections.

NOTE 1

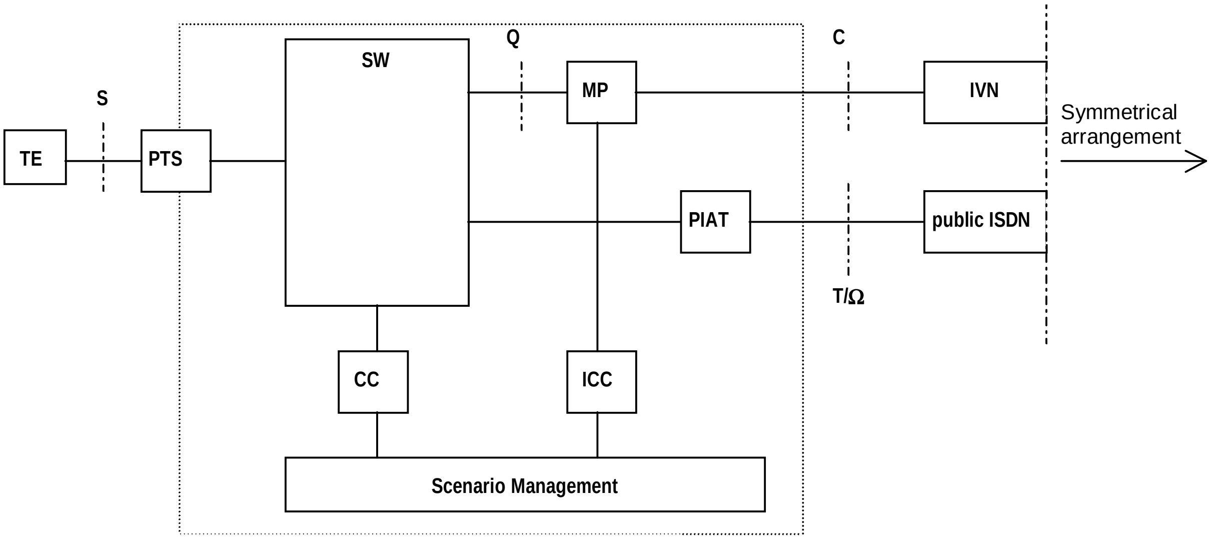
PINXs are not restricted to offering to their users the same services as public ISDNs. In addition they can provide PINX specific basic and supplementary services and enhanced forms of public ISDN services.

NOTE 2

PINXs may also connect to other private networks (e.g. LANs, intranets and private telephony networks) and to public non-ISDN networks (e.g. PSTN and internet). In each case the PINXs will perform specific gateway functions.

Intervening networks (IVN) will provide the services which are necessary to carry inter-PINX connections; these will allow the transfer of user information as well as of signalling information between the PINXs.

Standard ECMA-133 defines a reference configuration for PINX calls and derives two reference points, C and Q, relating to inter-PINX calls. An excerpt is reproduced in figure 2.



Legend for Functional Groupings:

CC = Call Control
ICC = Interconnection Handling
IVN = Intervening Network
MP = Mapping
PIAT = Public ISDN Access Termination
PTS = Private Termination System
SW = Switching
TE = Terminal Equipment

NOTE

The T reference point applies to the case where the PINX is an ISPBX.

The Ω reference point applies to the case where the PINX is an ISCTX. The specification of the Ω reference point is beyond the scope of this Technical Report.

Figure 2 - PINX Reference Configuration

This Reference Configuration can be interpreted as a superset of the user-to-network access reference configuration, as defined in ITU-T Rec. I.411. The dotted line showing the extent of the NT2 functional grouping helps to show the relationship to the reference configuration of ITU-T Rec. I.411. NT2 functions (i.e., public ISDN access functions) are spread across the SW, CH and PT functional groupings.

In addition, figure 2 shows the Ω reference point. This reference point is not yet defined in Standard ECMA-133 or in ITU-T Rec. I.411. The reference point is used here to conceptually indicate the boundary between the ISCTX variant of a PINX and the public ISDN.

The Reference Configuration for PINX Calls will be used throughout this Technical Report.

NOTE 1

Examples of commonality have been identified which show the similarity of the T and the Ω reference point.

T and Ω have in common that they define the boundary between two different network operating authorities, in particular with regard to

- *numbering,*
- *charging,*
- *management,*
- *routeing, etc.*

However, also examples of dissimilarity have been found, such as that a standardized physical interface is not necessarily required at Ω. This might mean that there is :

- *no need for a defined access structure;*
- *no transmission system required;*
- *no Layer 1 and no Layer 2 specifications etc. required.*

NOTE 2

Interfaces at the C reference point become identical with those at a T reference point, if the IVN is a public ISDN. Since IVNs do not see the Q reference point, PINXs always appear to a public ISDN as if connected at a T reference point. The functional groupings between the Q and C reference points are part of the PINX.

The concept of Q reference points relies on an ideal model, which allows the immediate interconnection of any pair of PINXs.

Within this model the PINXs have functions at their disposal for cooperation within a PISN, as if the PINXs were co-sited.

In practice, the PINXs will not be co-sited and will need bearer services of IVNs which convey the signalling information flows for the functions to be performed between them and, in addition, provide connection types according to the bearer services required for PISN user information transfer. The C reference point denotes the point of interconnection between the PINX and the IVN. The MP functional grouping provides the necessary adaptation of a PINX to a particular type of IVN, see figure 3.

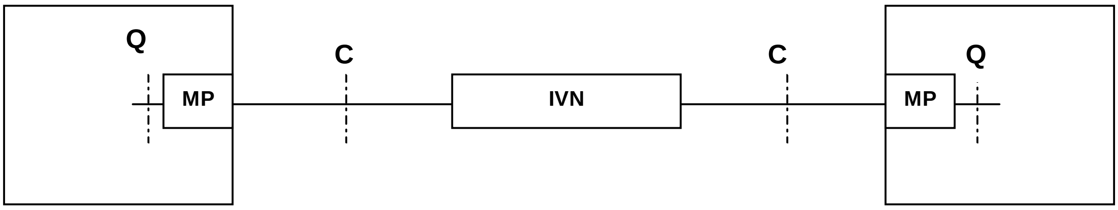


Figure 3 - Configuration of a PISN Employing an Intervening Network

8 Architecture

Whereas the Reference Configuration for PINX Calls lays the foundation for the principle of delimitation of a single PINX from its terminals, the public ISDN and IVNs, this Chapter looks into the architectural aspects of the PISN infrastructure and describes how the capabilities of a PINX are distributed over its functional groupings.

This can be seen as two different approaches of breaking down a PISN into its PINXs: one leads to the view of its topology and hierarchy, whereas the other one leads to the view of its capabilities.

8.1 PISN Topology

A PISN can consist of one PINX, or of two or more PINXs. Thus, the users of a PISN can be connected

- to the same PINX;
- to adjacent PINXs;
- to non-adjacent PINXs, i.e. PINXs connected only indirectly via other PINXs.

A PISN consisting of a single PINX is shown in figure 4.

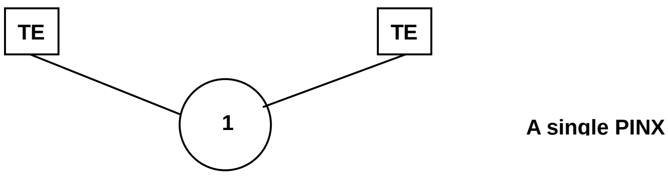


Figure 4 - Single PINX PISN Topology

Whenever a PISN consists of more than one PINX, IVNs need to be employed for their interconnection, as shown in figure 5.

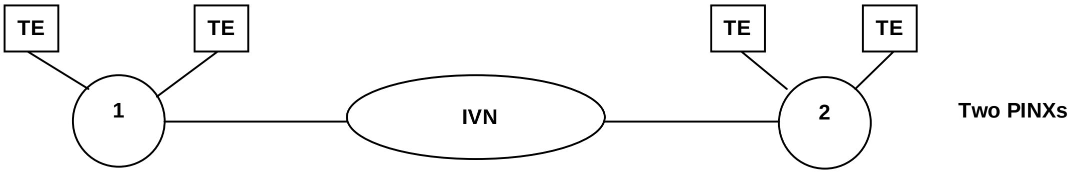


Figure 5 - PISN Topology Employing an IVN

PINXs need not be directly interconnected; instead, connections between their PISN users can be routed via one or more transit PINXs. An example for a topology with one transit PINX is given in figure 6.

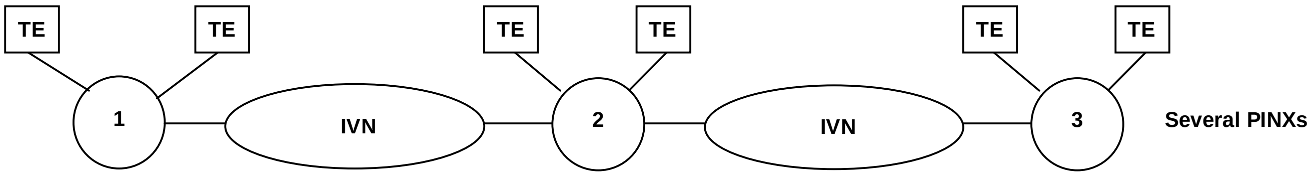


Figure 6 - PISN Topology with Transit PINX (Example)

Each of the PINXs interchanges signalling information with its neighbour via Q reference points. The PINXs adapt to (and, if applicable, control) the IVNs providing the inter-PINX connections, at C reference points.

In the example shown in figure 6, PINXs 1 and 3 serve as pure originating or terminating PINXs, whereas PINX 2 serves as a pure transit-PINX.

NOTE

ITU-T Rec. I.325 describes a method of subdividing a network into connection elements (CE). Two types of CEs are distinguished: access CEs and transit-CEs.

In PISNs an originating/terminating PINX belongs to a private access CE and a transit-PINX belongs to a private transit CE.

The access between a PISN and the public ISDN belongs to a (public ISDN) access CE.

A PINX may provide both, the private access CE and the private transit CE in one and the same physical implementation.

CEs consist of Connection Related Functions (CRF) and transmission functions.

8.2 Routeing Hierarchy

Within a particular PISN a multi-stage routeing hierarchy can be implemented by combining private transit-CEs in an appropriate way. If this is done on a permanent basis, they will be classified according to the hierarchical level, e.g., by transit-PINXs (transit CRFs) of different classes. If PINXs are interconnected on-demand, no firm routeing hierarchy will be established. Instead, only a numbering hierarchy will be achieved, see Section 4.

If the PISN employs PINXs which provide combined private access and transit-CEs, and if these PINXs are also directly connected to the public ISDN's access CEs, the hierarchy with relation to the public ISDN will be different from the intra-PISN hierarchy. Both hierarchies overlay each other, and for reasons of clarity it is important to indicate whether the public or private hierarchy is meant.

For a particular PISN the private hierarchy will usually be determined on the basis of connectivity arrangements between the various PINXs of a PISN. Such arrangements can be of a mesh form or of a star form or of a mixture of both forms (the example shown in figure 5 can be understood as the trivial case of a star form). The arrangements are normally optimized with regard to the traffic distribution throughout the PISN and may have impact on the routeing requirements and on the numbering plan of the PISN.

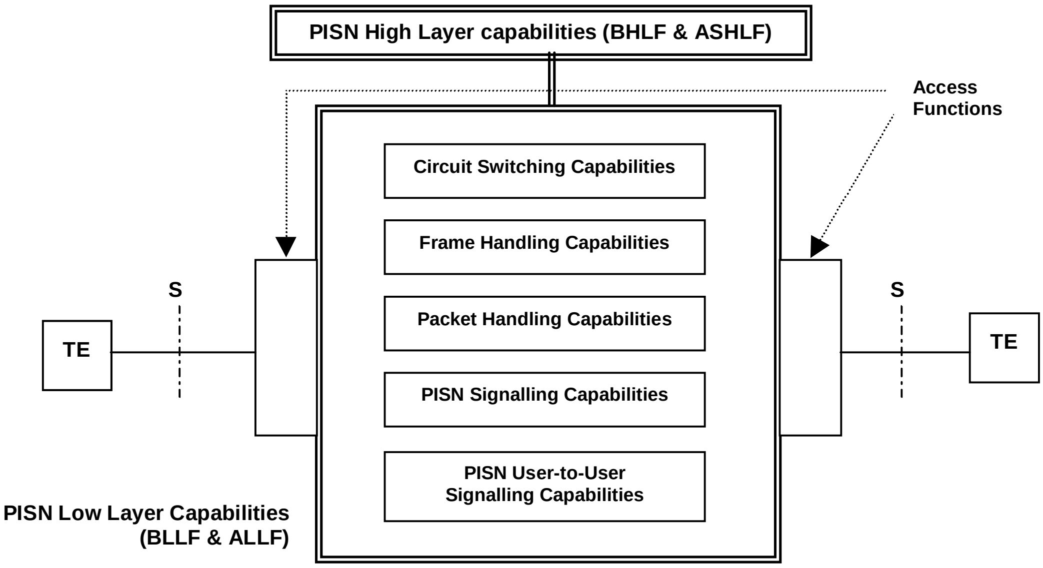
8.3 Capability Structures of a PISN

Based on the capability structure of a PISN, the capability structure of an overall ISDN, i.e. a PISN interworking with a public ISDN, is considered. Finally, the aspects of a PISN consisting of several PINXs and employing IVNs are discussed.

In actual PISN implementations some of the functions will be provided within PINXs whereas other specific PISN functions may be obtained from IVNs, or from a public ISDN, if applicable.

A basic component of a PISN is the capability of circuit-switching of 64 kbit/s end-to-end connections. In addition to the connection types supporting this capability, certain components of a PISN may support other connection types, such as packet mode connection types or n x 64 kbit/s circuit mode connection types.

Figure 7 shows the basic capability structure of a PISN, as being developed from ITU-T Rec. I.324.



Legend: AHLF = Additional High Layer Functions; ALLF = Additional Low Layer Functions
BHLF = Basic High Layer Functions; BLLF = Basic Low Layer Functions

NOTE

In conjunction with some public or private teleservices, AHLFs and BHLFs can be provided inside or outside the PISN.

Figure 7 - Basic Capability Structure of a PISN

8.4 Capabilities of a PISN

The basic capability structure contains the following capabilities of a PISN:

– PISN Low Layer capabilities; these may include:
  - circuit-switching capabilities;
  - frame handling capabilities;
  - packet handling capabilities;
  - PISN signalling capabilities;
  - PISN-user-to-PISN-user signalling capabilities.

– Access functions; these include:
  - termination of the physical medium;
  - Layer 1 functions;
  - access signalling capabilities;
  - PISN High Layer capabilities;

Distinction can be made between basic and additional high layer capabilities (BHLFs and AHLFs). They can, in conjunction with some public or private teleservices, be provided inside or outside the PISN. BHLFs and AHLFs are considered beyond the scope of this Technical Report.

Higher layer functions (HLF) necessary to provide the capabilities may be accessed by the means of any of the above mentioned functional entities.

NOTE

Not all of these components need to be provided by a distinct PINX, but can be combined as appropriate for a particular PISN implementation.

8.4.1 PISN Low Layer Capabilities

The main low layer capabilities of the PISN, as shown in figure 7, are described hereafter.

8.4.1.1 Circuit-Switching Capabilities

Circuit-switched connections with an information transfer rate of up to 64 kbit/s are carried by B-channels at PISN accesses, which are switched by the circuit-switching functional entities of the PISN. Circuit-switching can also be applied to information transfer rates greater than 64 kbit/s.

User bit rates of less than 64 kbit/s are rate adapted to 64 kbit/s before switching in the PISN. Multiple information streams from a given user may be multiplexed together in the same B-channel, but for circuit-switching an entire B-channel will be switched to a single PISN-user access.

8.4.1.2 Frame Handling Capabilities

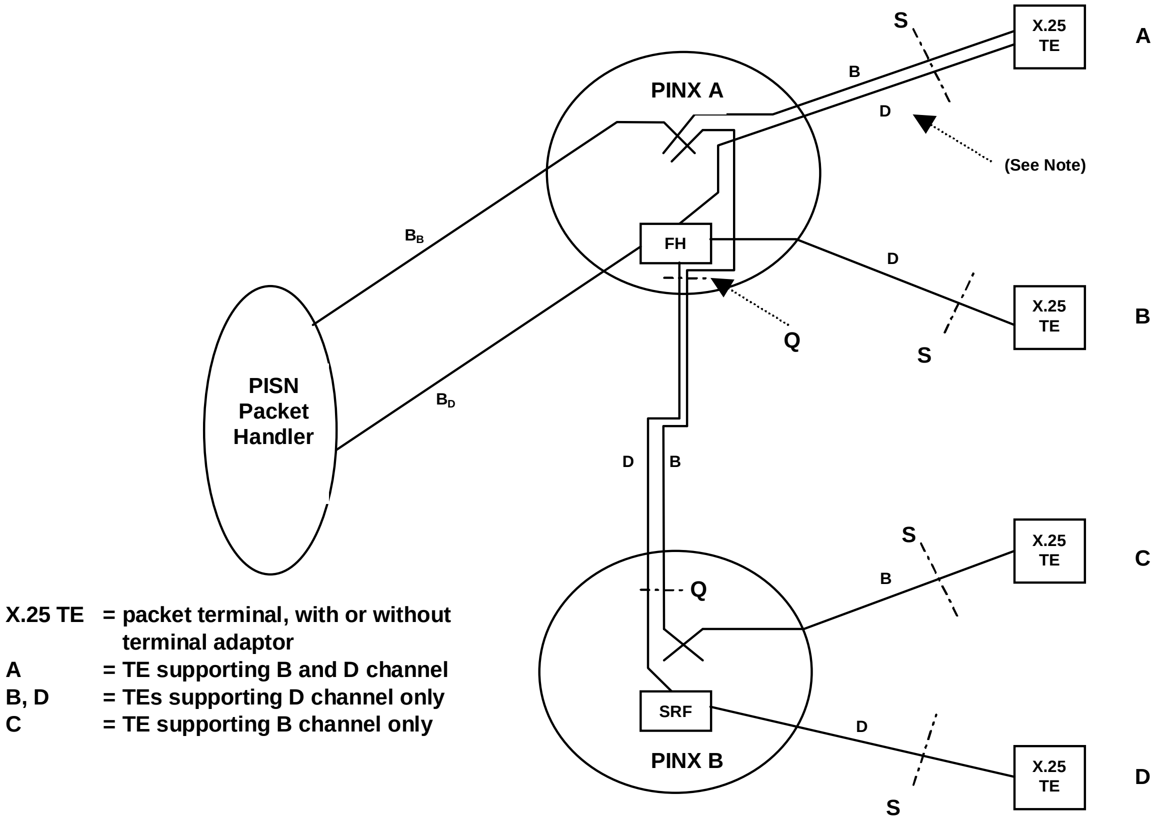
The type of functional entity involved in the provision of frame mode bearer services by a PISN is a Frame Handler (FH), which is based on one of the following principles:

- frame switching which allows, besides frame routeing, the full termination of the Data Link Layer protocol, with all functions as defined for the service of the Data Link Layer;
- frame relaying which allows, besides frame routeing, the partial termination of the Data Link Layer protocol. This includes the modification of the frame address information and the analysis and recalculation of the frame checking information. Further Data Link Layer functions are not provided, in particular no mechanisms for the repetition of invalid frames. Such frames will be discarded instead, and it is left to the end-systems to take care of repetition, correction etc.

8.4.1.3 Packet Handling Capabilities

A number of packet mode bearer services are described in the ITU-T I.230 series of recommendations.

ITU-T Rec. I.310 indicates functional principles, ITU-T Rec. X.31 defines a "Case B" for accessing the network's packet handling capabilities, and ITU-T Rec. Q.513 gives a description of exchange connections. If applied to a PISN, these documents can constitute the basis for the description of packet switching functions in a PISN, see figure 8.



Legend:

B_B-channel: A B-channel at the PH interface used for packet calls provided to a TE on one of its B-channels.
Multiple calls to/from the same TE are multiplexed on the same B_B-channel.

B_D-channel: A B-channel at the PH interface used for packet calls provided to a TE on its D-channel.
Multiple calls to/from TEs served by the same FH are multiplexed on the same B_D-channel.

NOTE

If the protocol for offering incoming calls to the X.25 TEs does not support the negotiation of a channel type (D or B), TEs supporting communication over both channel types need to have two numbers, each one dedicated to one channel type. This requires the use of the MSN (Multiple Subscriber Number) supplementary service (TE “A”).

Figure 8 - Example of a PISN using Layer 2 Relaying or Switching Capability for Accessing a Packet Handler of the Private ISDN (X.31 Case B)

Two types of functional entities are involved in the provision of packet switched bearer services:

- Packet Handler (PH) containing switching and call handling functions relating to packet calls within the PISN;
- FH as described in 8.4.1.2;
- Switching or Relaying functions (SRF) providing layer 2 switching or relaying between D-channels for the interconnection of X.25 TEs with the PH.

  NOTE

  The SRF can be considered as a subset of an FH which is restricted to switching and relaying between D-channels (i.e. not B-channels).

In addition, interworking functions can ensure interworking between PISN and packet switched data networks.

8.4.1.4 PISN Signalling Capability

This capability consists of the interchange and processing of information for the control of the circuit-switching, frame handling and packet handling capabilities used in the provision of basic and supplementary services.

8.4.1.5 PISN-User-to-PISN-User Signalling Capability

This capability consists of the end-to-end functions necessary to allow the interchange of signalling information between two PISN users whereby this signalling information is transparently conveyed through the PISN. The signalling information can be used for:

- indicating the protocol handling capabilities of the PISN users' endsystems; this type of information is marked appropriately and is typically exchanged during the establishment phase of a connection.
- enhanced addressing, i.e. beyond that provided by the numbering plan employed; this type of information is marked appropriately and is typically exchanged during the establishment phase of a connection.
- indicating additional functions during or after establishment of the connection between the PISN user; this type of information is only marked in a generic way, and therefore the additional functions need to be identifiable and thus addressable in a standardized way.

PISN-user-to-PISN-user signalling is associated with the access and intra-PISN signalling, related with connection control. It is carried on the D-channel and processed by the CRFs of the PISN.

8.4.2 Access Capability

The access capabilities include the functions which are necessary for

- termination of the physical medium;
- Layer 1 functions;
- access signalling capabilities.

8.4.2.1 Termination of the Physical Medium

This capability consists of the functions necessary to allow adaptation to the interface conditions at the PISN user-to PISN access.

ITU-T Rec. I.412 describes the structure of standardized accesses, e.g. the basic and the primary rate access.

8.4.2.2 Layer 1 Capability

This capability consists of the functions which are necessary for the Layer 1 access procedures. In the case of point-to-multipoint configurations (basic access), these functions ensure that only one PISN user terminal can transmit on the D-channel of the access at any one time.

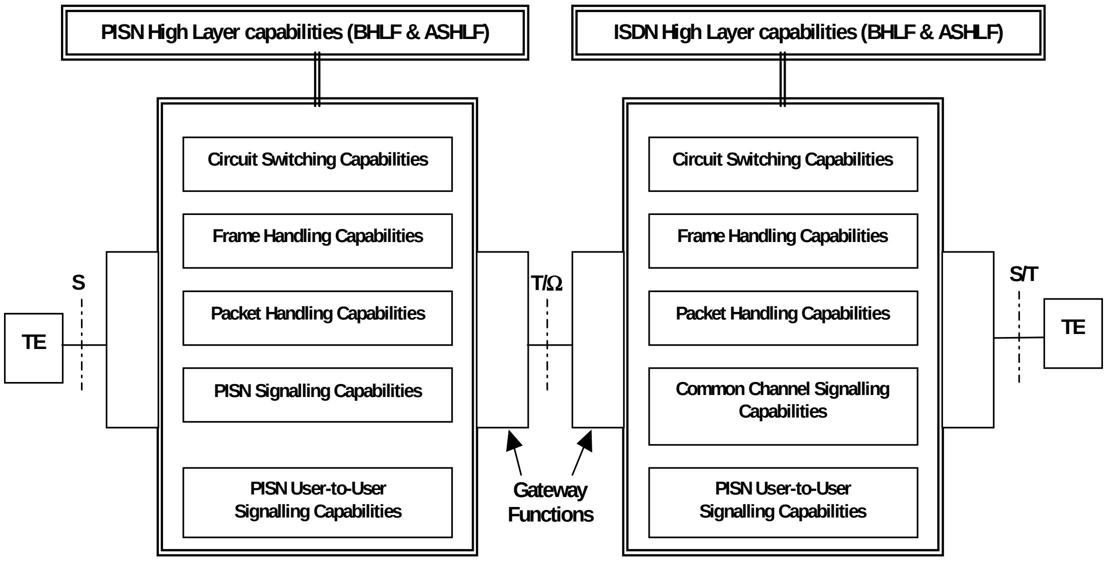
8.4.2.3 Access Signalling Capability

This capability consists of the functions necessary for secure interchange of signalling information between the PISN user and the PISN. The signalling information consists of information for the control of basic and supplementary services, and of information interchanged with the peer PISN user.

8.5 PISNs connected to the Public ISDN

8.5.1 Interworking of PISN and Public ISDN Capabilities

The interconnection of a PISN with the public ISDN takes place at the T or reference point. The public ISDN provides its services across this reference point which are extended to PISN users via the ISDN interworking functions of the PINX. As far as communication with users of the public ISDN is concerned, PISN users can only use services which are provided by the public ISDN and any other PINX services which do not require the cooperation of the public ISDN, e.g. abbreviated dialling, local conferencing. The overall capability structure of a PISN interworking with the public ISDN via a gateway PINX is shown in figure 9.



Legend: AHLF = Additional High Layer Functions; ALLF = Additional Low Layer Functions
BHLF = Basic High Layer Functions; BLLF = Basic Low Layer Functions

NOTE

In conjunction with some teleservices, AHLFs and BHLFs can be provided inside or outside the network.

Figure 9 - Overall Capability Structure of a Private Integrated Services Network Interworking with the Public ISDN

The one-to-one mapping between the capabilities of a PISN and a public ISDN is conceptual only and has been chosen here as an example. It depends on the actual implementation whether an individual capability is supported or not, and it is up to the interworking functions in the PISN to ensure compatibility as far as achievable. This is either achieved by PISN-to-public ISDN signalling means, or it needs to be known by the PISN in advance. If no compatible capabilities are available, a request might have to be rejected.

8.5.2 Solutions for Accessing the Public ISDN Packet Switching Capabilities

8.5.2.1 PISN without PH

If a PISN does not provide a PH of its own, it can use the X.31 Case B principle for accessing a PH connected to or being part of a public ISDN. This can be achieved in three ways, see figure 10.

i) The TE conveys its packet data on a B-channel. This is circuit-switched via a B-channel across the T reference point to the public ISDN PH.

NOTE 1

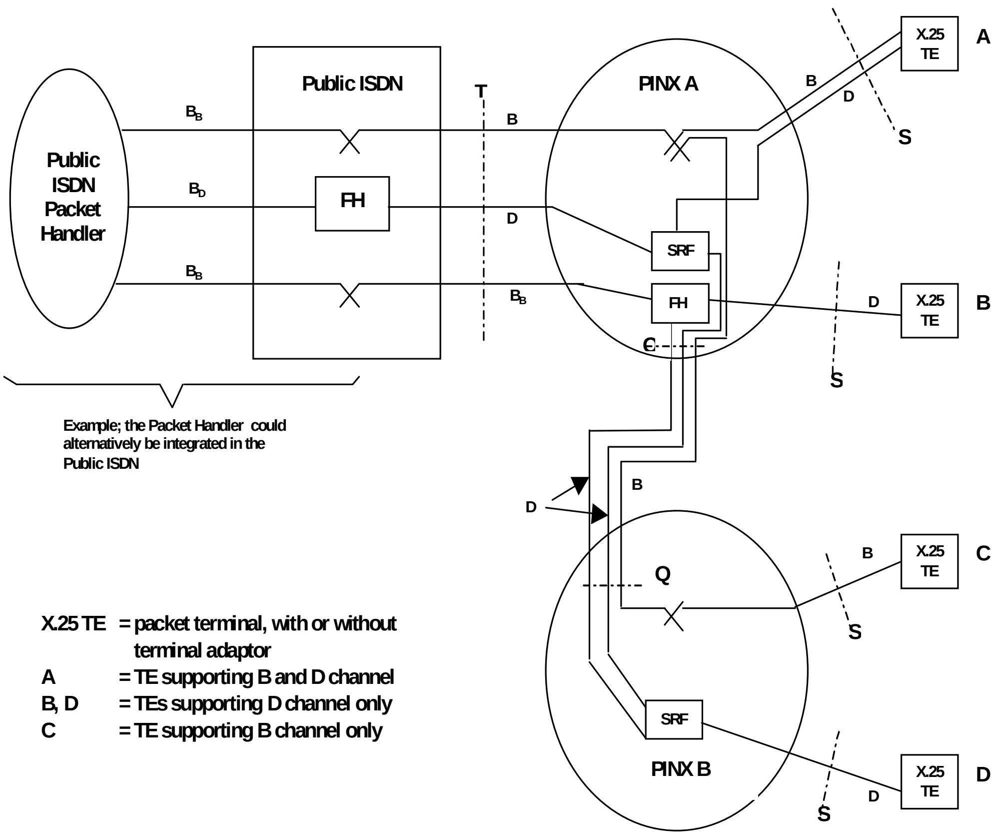
This case may under utilize the B-channel at the T reference point.

ii) The TE conveys its packet data on a D-channel which is switched or relayed by one or more SRFs via a D-channel across the T reference point to an FH in the public ISDN. Communication between the FH and the PH in the public ISDN is via a B-channel.

NOTE 2

This case could have negative impact on the traffic performance of the D-channel at the T reference point.

iii) The TE conveys its packet data on a D-channel which is either directly, or indirectly via one or more SRFs, connected to an FH in the PISN. Communication between the FH and the PH in the public ISDN is via a B-channel at the T reference point.



Legend:

B_B-channel: A channel at the PH interface used for packet calls provided to a TE on one of its B-channels. Multiple calls to/from the same TE are multiplexed on the same B_B-channel.

B_D-channel: A channel at the PH interface used for packet calls provided to a TE on its D-channel. Multiple calls to/from TEs served by the same SRF are multiplexed on the same B_D-channel.

NOTE

If the protocol for offering incoming calls to the X.25 TEs does not support the negotiation of a channel type (D or B), TEs supporting communication over both channel types need to have two numbers, each one dedicated to one channel type. This requires the use of the MSN (Multiple Subscriber Number) supplementary service (TE “A”).

Figure 10 - Example of a PISN using its Layer 2 Relaying or Switching Function for Accessing a Packet Handler of the Public ISDN (X.31 Case B)

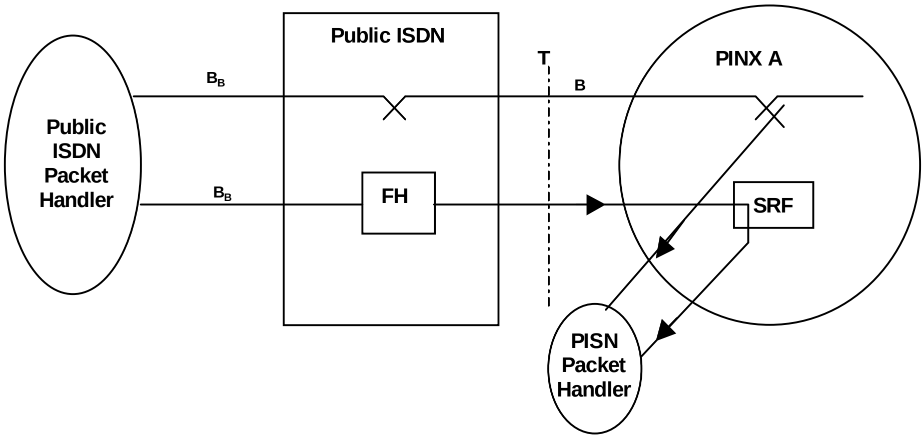
8.5.2.2 PISN with PH

A PH within the PISN can be used as a packet service gateway which connects to the PH of the public ISDN in accordance with X.31 case A or B, or by a direct X.25 or X.75 access circumvening the public ISDN. See figure 11.

X.25 case B can be achieved in two ways:

i) The PISN PH and the public ISDN PH communicate via a B-channel at the T reference point.

ii) The PISN PH and the public ISDN PH communicate via an SRF in the PISN, a D-channel at the T reference point and an FH in the public ISDN.



NOTE 1

For simplicity the TE is not shown.

NOTE 2

Since the calling user need to be aware of the existence of a private PH at the called side, the packet handler of the public ISDN needs to have the knowledge that calls to ISDN numbers of the PISN users are to be routed to the collective ISDN number(s) of the private PH(s). The public ISDN PH also needs to transmit the individual ISDN numbers (or X.121 numbers) in the X.25 call request in order to enable the private PH to further progress the call.

Figure 11 - Example of a PISN using its own Packet Handler for Accessing a Packet Handler of the Public ISDN (X.31 Case B or X.25)

8.6 Interconnected PINXs

Users of different PISNs can communicate via the public ISDN, thereby using the services which are provided by that public ISDN. These services need not be the same as provided by their PISNs, in fact they may be fewer or less sophisticated. The service provision functions of the PINXs interwork with corresponding functions residing in the public ISDN. This concept of interconnecting the two gateway PINXs of the PISNs and thus concatenating the PISN and public ISDN functions is known as the concatenation concept.

For details on service interworking within the concatenation concept see Section 6.

Alternatively, PINXs may functionally be interconnected in a way that any additional PINX services are, in principle, available to all users of the so formed single or unique PISN. The interconnected PINXs use the public ISDN (or other type of network) as an IVN. This concept is called the overlay concept.

The difference between the overlay and the concatenation concepts is shown in figure 12.

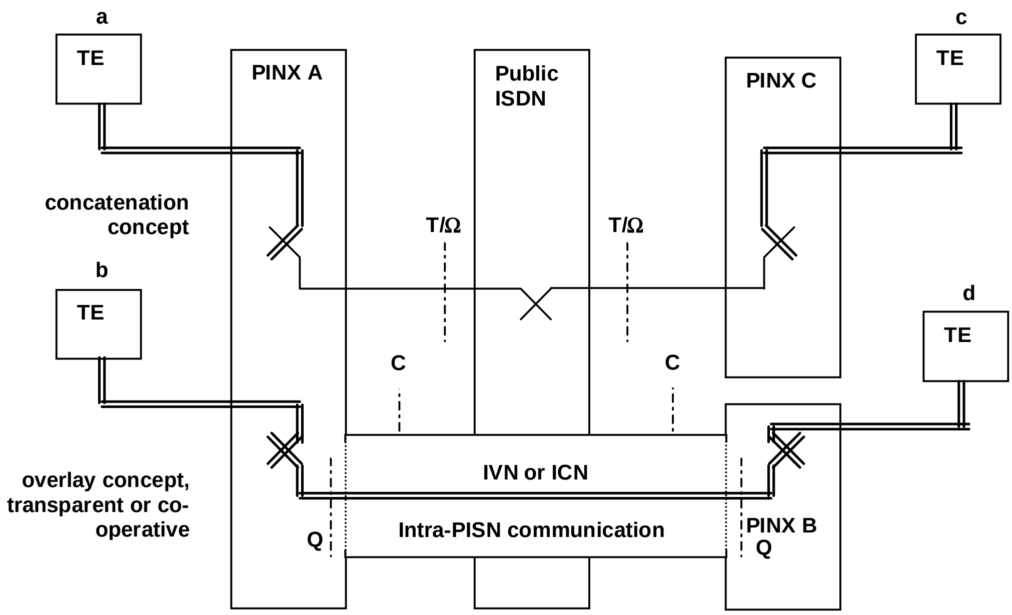


Figure 12 - Relation between the Concatenation Concept and the Overlay Concept

Users b and d in figure 12 have the impression of being connected to one homogenous PISN, i.e. the IVN, in this case the public ISDN, will be invisible to them.

Communication between two PINXs through the public ISDN according to the concatenation concept does not necessarily permit the two PINXs to co-operate in the provision of PISN services to their users. Any cooperation is limited by the capabilities of the public ISDN, and therefore the public ISDN becomes visible to the PISN users (e.g. a and c in figure 12). The two PINXs do not, by virtue of such communication, form a PISN.

It should be studied how PINXs not belonging to the same PISN, i.e. connected by means of the concatenation concept, can recognize each other's presence and capabilities, in order to provide PISN supplementary services not supported by the public ISDN.

8.6.1 Overlay Concept

In principle, the inter-PINX connections may be supported by dedicated physical media or transmission media, or by any appropriate kind of bearer services of (public) switching networks. Within the scope of this clause, the bearer services of intervening public ISDNs are of particular interest.

Two approaches can be distinguished for communication between PINXs via an intervening public ISDN. Both provide the PISN users connected to separate PINXs with the same service as if they were connected to one homogenous PINX: The service of the PISN overlays any service of the public ISDN.

In the transparent approach, the public ISDN provides transparency for the inter-PINX signalling information to allow the PINXs to co-operate in the provision of PISN services. The PISN services by-pass corresponding services of the public ISDN.

In the co-operative approach the interconnecting public ISDN transposes the PINX services by means of enhanced capabilities ("VPN") which enable the PINXs to provide their services integrally. The technical details of the integrated approach are not covered by this Technical Report (see ETSI TCRTR 033).

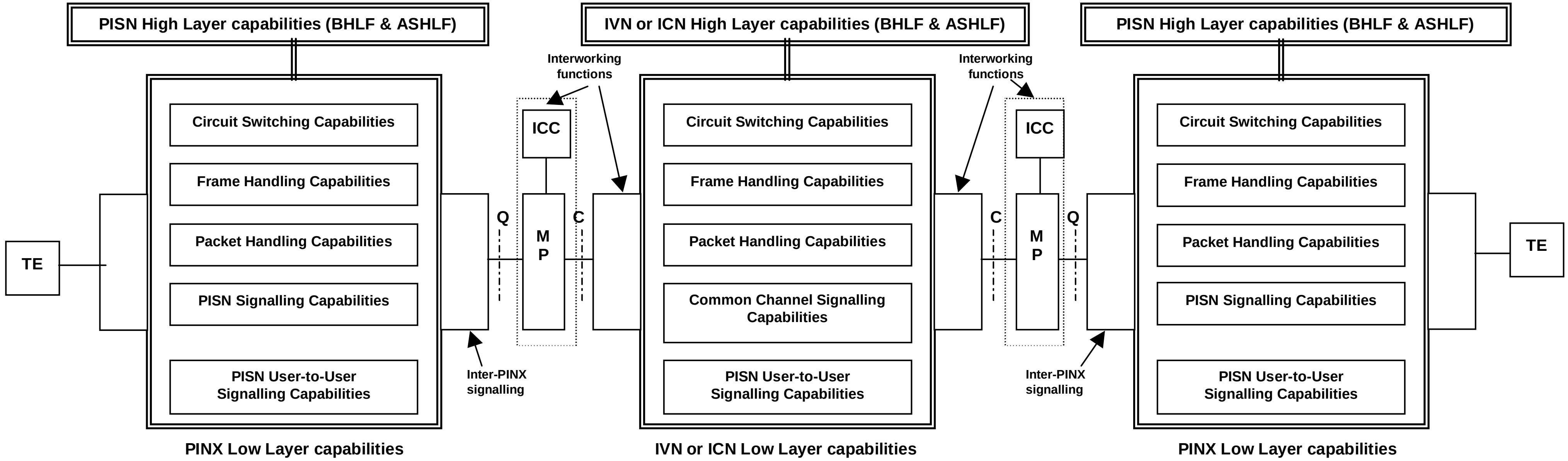
Various methods are conceivable how to achieve transparency, e.g. a two-step approach of inter-PINX connections on top of IVN connections, integrated call control and signalling which is supported by VPN features, etc. Although VPN features could be supported by the intervening public ISDN itself, they should be modelled and specified in a way which allows them to be provided by third parties.

The different scenarios (ISDN and non-ISDN based) providing transparent inter-PINX connections are discussed in Section 3 of this Technical Report. VPN support of a PISN can be modelled on top of the scenarios.

8.6.2 Capability Structure of a PISN Employing IVNs or ICNs

The overall capability structure of a PISN which spreads over more than one premises and employs a public ISDN as an IVN is shown in figure 13.

The one-to-one mapping between the capabilities of a PISN and the IVN is conceptual only and has been chosen here as an example. It depends on the actual implementation whether an individual capability is supported or not, and it is up to the Interconnection Handling functional grouping, interworking at the PISN side with the IVN or ICN, to ensure compatibility as far as achievable. This is either achieved by PISN-to-IVN/ICN signalling means, or it needs to be known to the PISN in advance.



Legend: AHLF = Additional High Layer Functions; ALLF = Additional Low Layer Functions; MP = Mapping Functional Grouping
BHLF = Basic High Layer Functions; BLLF = Basic Low Layer Functions; ICC = IVN Connectionl Control Functional Grouping

Figure 13 - Overall Architecture of a Private Integrated Services Network Employing a Public ISDN as an Intervening Network

9 Extended Protocol Reference Model

Based on the ISDN protocol reference model (ITU-T Rec. I.320, excerpt is given in annex B), an extended protocol reference model (EPRM) is used which describes PINX-interconnection via an intervening public ISDN according to the overlay concept. Other types of IVNs can be described in a similar way.

Figure 14 shows an example of the application of the EPRM to the overlay concept. In Section 3 the EPRM is used to show the impact on protocol architecture when PINXs are interconnected by various types of IVN.

The EPRM uses the planes described in ITU-T Rec. I.320 and some additional planes. The full set of planes is described below.

9.1 Planes for Communication across the IVN

9.1.1 IVN Control Plane (NC)

The NC plane conveys information for the control (e.g. establishment and dis-establishment) of inter-PINX connections.

9.1.2 IVN User Plane (NU)

The NU plane conveys information between the two PINXs.

9.2 Planes for Communication across the PISN

9.2.1 PISN Control Plane (PC)

The PC plane conveys PISN signalling information.

The PINX maps the PC plane onto the NU plane of the IVN.

9.2.2 PISN User Plane (PU)

The PU plane conveys information between PISN users.

The PINX maps the PU plane onto the NU plane of the IVN.

9.3 Planes for Communication across the PISN Access

9.3.1 TE Control Plane (TC)

The TC plane conveys access signalling information.

9.3.2 TE User Plane (TU)

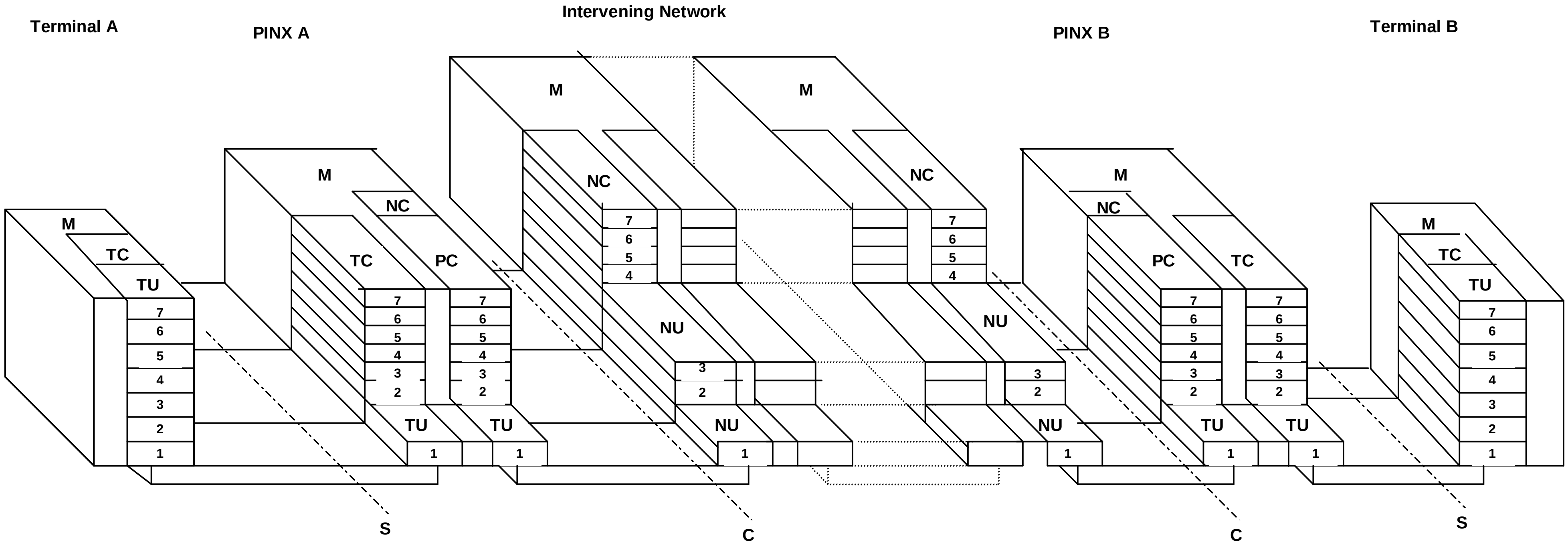
The TU plane conveys information between PISN users, i.e. user information or user-to-user signalling information.

NOTE

The TU plane at a PISN access corresponds to the PU plane within the PISN.

9.4 Planes for Communication across an ICN

The protocol reference model depends largely on the implementation of the ICN and is thus not shown in this Technical Report.



Legend: **M** Management Entity

S, **C** S, C reference points

Notes: *1 As an example, the NU plane provides a packet mode bearer service via the D-channel supporting the PC plane and a circuit mode bearer service supporting the PU plane.*

2 Also as an example, the control planes TC, PC and NC are modelled into 7 layers. Whether for all functions a full 7 layer model is required, is not the subject of this Technical Report.

3 For simplicity, the co-ordination functions between the user plane and the control plane, and the mapping functions in the PINXs, have been omitted.

Figure 14 - Extended Protocol Reference Model

Section 3 - Inter-PINX Connections

This section discusses the possibilities for the provision of bearer services for the transparent interconnection of PINXs forming a PISN according to the overlay concept. Reference solutions are defined and classified which will enable evaluation and harmonization between the provisions of the PISN and those of the third parties.

10 Introduction

In general, a PISN may consist of any number of interconnected PINXs. For the purpose of studying inter-PINX connections it is sufficient to consider a configuration consisting of only two PINXs, as shown in figure 5.

The interconnection media can be

- a physical carrier, or
- an appropriate bearer service

of an IVN; in the latter case the IVN can also be the public ISDN.

Guidelines are given in this section for the specification of the characteristics and of the provision of such interconnecting media as well as of possible restrictions which might be imposed by some solutions.

NOTE

Some of the scenarios described in this section are also suitable for the support of off-premises PISN users. For further information see annex A.

10.1 Multiple Instances of Q and C Reference Points

This section focusses on the Q and C reference points as discussed in Section 2.

If a PINX provides multiple groups of inter-PINX connections leading to different peer PINXs, it is considered to employ multiple instances of Q reference points which may be distinguished by appropriate indexes, e.g. Q1, Q2, etc.

The different instances of Q reference points correspond to different instances of C reference points. Depending on the type of IVN, a one-to-one, a one-to-many or a many-to-one correspondance can occur between instances of C reference points and accesses between a PINX and the IVN(s). This is shown in figure 15.

The use of multiple instances of Q reference points, together with the capabilities of the different IVNs, allows the implementation of any conceivable PISN topology.

10.2 Shared Access Use

Where a public ISDN is employed as an ICN, C and T reference points can exist on the same access(es). This is known as shared access use. Whereas the C reference point enables communication with another PINX according to the overlay concept, the T reference point enables communication with other public ISDN users and with users of other PISNs. See figure 16.

NOTE

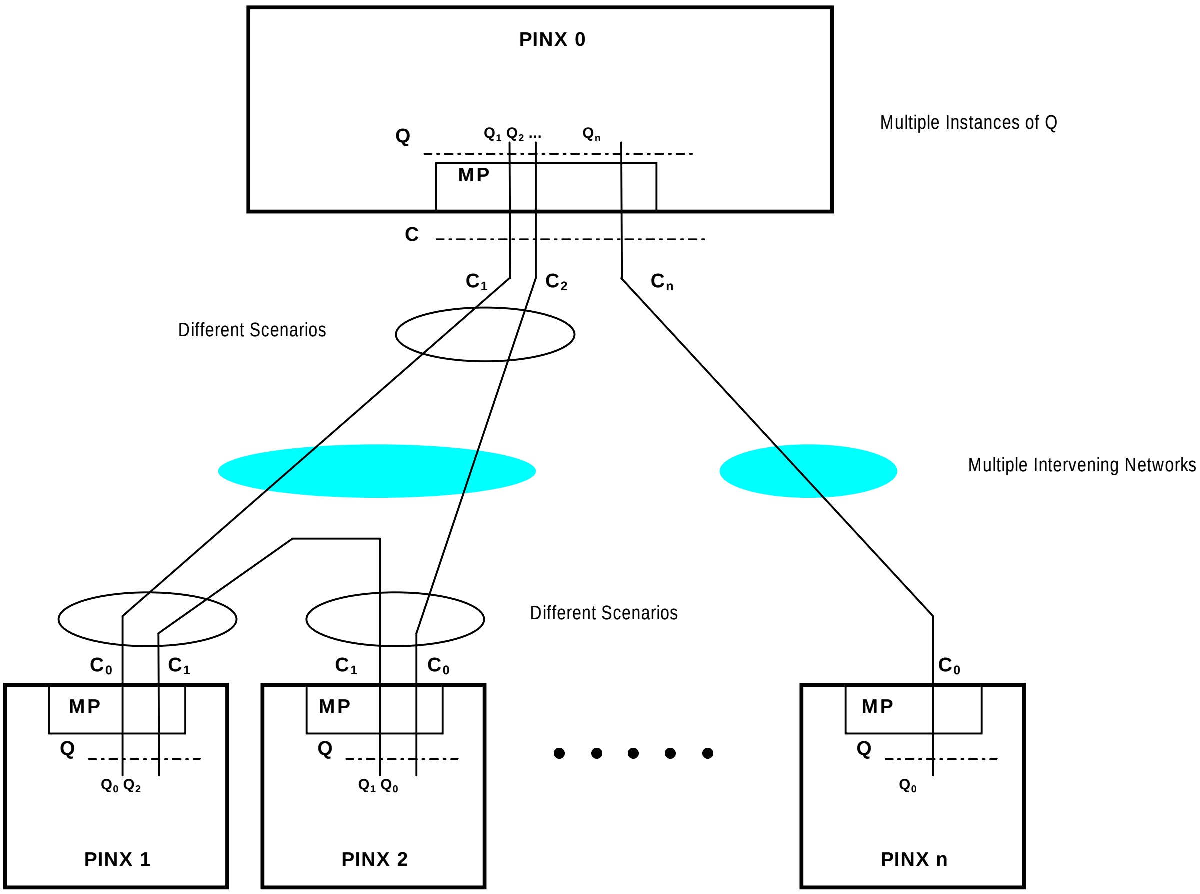
Since a public network typically serves more than one PISN with its interconnecting capabilities, multiple instances of C and T reference point will exist. Each set of them belongs to a different PISN. The public network will have to distinguish between them by means of some sort of CN Identities.

10.3 Mapping Functional Grouping (MP)

The MP functional grouping provides adaptation functions to the interface at the C reference point and, if applicable, to the IVN control mechanisms.

The MP also provides switching and/or mapping functions of the signalling information at the Q reference point to the appropriate channel or time-slot at the C reference point, depending on the type of inter-PINX connection. In the case of intervening ISDNs the inter-PINX signalling information would be carried on top of Layer 1 in a B-channel or on top of Layer 2 or 3 in a D-channel.

The MP also provides switching or mapping functions from B-channels for user information transfer at the Q reference point to channels or time-slots at the C reference point.



Legend:
C_i = within the context of a given PINX, the instance of C reference point for the connections(s) leading to $PINX_i$.
Q_i = within the context of a given PINX, the instance of Q reference point for the connections(s) leading to $PINX_i$.

Figure 15 - Multiple Instances of Q and C Reference Points

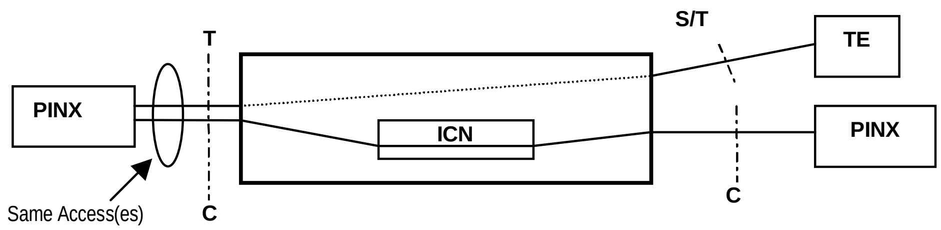


Figure 16 - Shared Access Use

In the case of multiple instances of a Q reference point and/or shared access use, the MP also provides multiplexing functions.

Other possible MP functions, partially depending on the type of inter-PINX connection, can be:

– address mapping or conversion at and/or between Layers 1, 2 and 3,

– supervision of channels or time-slots for user information transfer,

- inter-PINX connection establishment and disestablishment,
- end-to-end channel negotiation and/or indication,

The MP functions are strongly related to and rely upon the PINX management entity.

11 Scenarios

The classification of scenarios described here is given in International Standard ISO/IEC 14475.

The evaluation and selection of scenarios for further standardization should be the subject of separate standards or technical reports.

Possible criteria for the selection could be:

- the intervention level of the IVN, which might lead to further sub-criteria, e.g.
  - throughput delay and capacity;
  - signalling transparency, i.e. independency of possible restrictions imposed by the IVN;
- synchronization;
- resilience, e.g.
  - safety against failure;
    - mechanisms for re-establishment of the inter-PINX connections by the IVN;
    - failure reporting;
    - PISN's ability to discover a failure in the absence of failure reporting;
    - re-establishment of inter-PINX connections by the PISN;
- impact on obtaining inter-PINX connections (e.g. administrative actions, subscription);
- configuration flexibility, e.g.
  - shared access use;
  - multiple Q reference points;
  - use of the same access(es) for PISN signalling and for PISN user information.

Section 4 - CN Addressing

This section discusses aspects of addressing at the Network Layer of PISNs.

This section defines strategies for addressing within a PISN and for interworking situations, e.g. with the public ISDN and other public or private Networks. Addressing aspects of the IP part of a CN are outside the scope of this document.

The information provided in this section should be used to develop a standard on addressing in PISNs which can be used as a common reference document for all addressing related aspects of other standards or technical reports.

This section also treats the impact of CN addressing on the public network numbering plan (ITU-T Recommendation E.164) for the situation where numbering of addressable entities spread over multiple sites of the same CN forms a unique integral numbering system connected to the public numbering plan under a single CN access number.

12 General

Addresses are the means to identify entities which need to communicate. They are embedded in addressing domains. Within a given addressing domain the addresses are unambiguous.

The subsequent clauses treat the particularities of addressing in PISNs in more detail. Addressing issues of IP networks are reserved for a separate document.

12.1 Smallest Addressable Entity in a PISN

Conventional public telecommunication networks are dedicated networks, i.e. designed to provide single services typically. Unless other arrangements are made by specific supplementary services, a telecommunication network's addressing domain boundaries coincide with the network's physical boundaries, i.e. with its subscriber accesses. There has been no need with these networks to extend the addressing domain from their accesses to a user application level, since typically a one-to-one relationship applies.

The smallest addressable entity in such networks is the user access to the network, corresponding to a terminal (subscriber equipment) which in turn corresponds to a given application, see figure 17.

NOTE

Typically, telecommunication networks employ addresses which exclusively consist of decimal digits. Thus, the access/application addresses are constrained to numbers and the addressing plans of telecommunication networks are constrained to numbering plans.

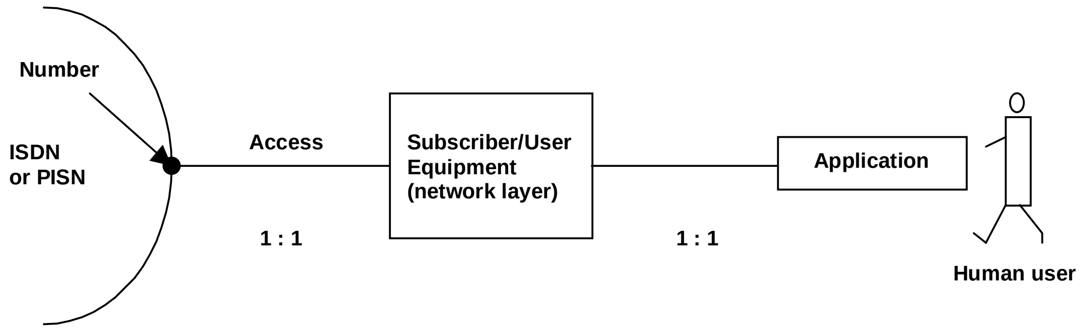


Figure 17 - Smallest Addressable Entity in Conventional Telecommunication Networks

If the one-to-one relation principle within a terminal cannot be maintained (e.g., because a bearer service of the telecommunication network is used for multiple applications), the addressing capability needs to be extended in order to allow a mechanism to identify, and to route to, the NSAPs (network layer service access points) in that endsystem. This situation is typical for ISDNs (and PISNs), see figure 18.

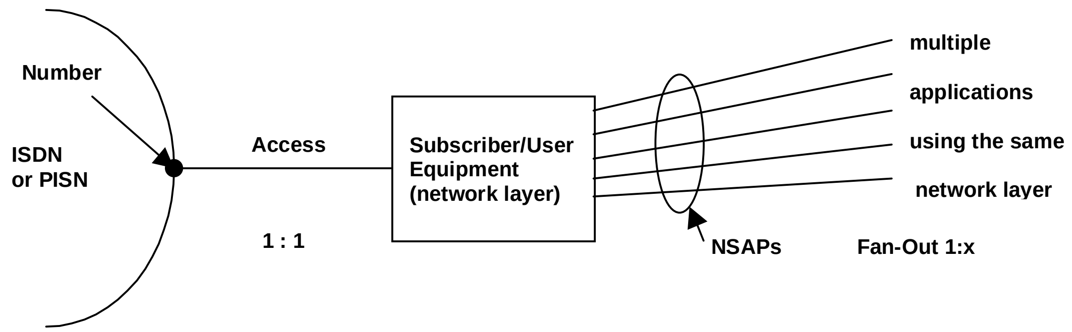


Figure 18 - NSAP Addressing Principle in OSI Endsystems

Such an extended (ISDN or PISN) addressing capability may make use of

– explicit NSAP identification;

– implicit NSAP identification, e.g. by means of extended telecommunication network address information of which a significant part will be used in the terminal for NSAP determination;

– higher layer identification by any other means, especially the identification of the Application Layer.

For further information on terminal selection see ITU-T Rec. I.333.

The combined use of these addressing methods leads to the typical addressing situation on an ISDN/PISN basic access, see figure 19.

NOTE

For PISN primary rate accesses the situation as shown in figure 18 applies.

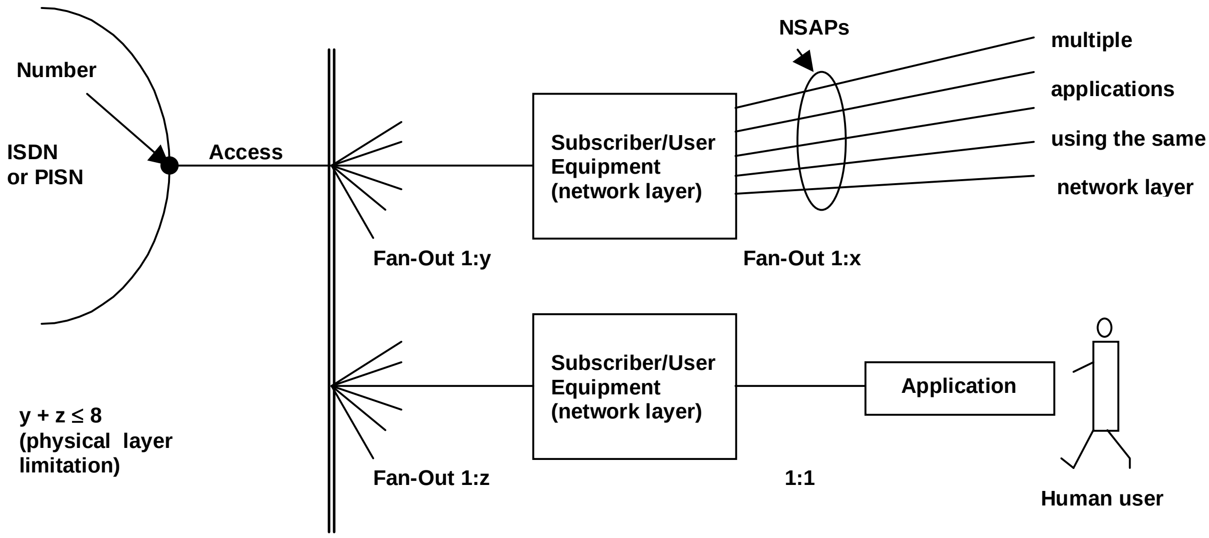
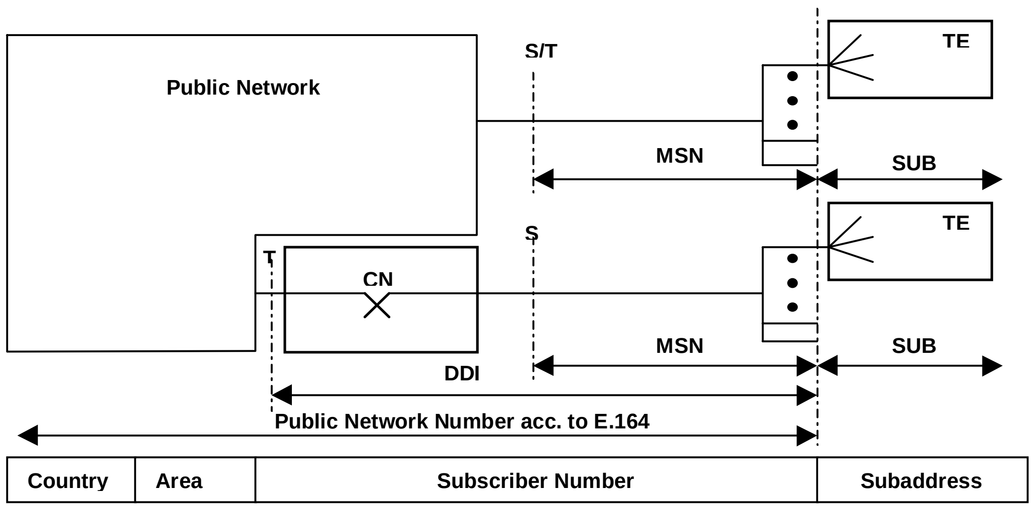


Figure 19 - ISDN/PISN Basic Access Addressing Situation

In the public ISDN the different Fan-Out situations are considered the subject of supplementary services, i.e. Direct-Dialling-In (DDI) and Multiple Subscriber Number (MSN). In addition, the Subaddressing supplementary service (SUB) provides for addressing beyond the ISDN numbering domain. The relationship between the numbering impact of these supplementary services is shown in figure 20.



Legend: DDI = Direct-Dialling-In MSN = Multiple Subscriber Number SUB = Subaddressing

NOTE

As an example, the figure shows the relationship at a basic access, where a passive bus allows physical point-to-multipoint configuration and operation. The same principle may, also apply to a primary rate access, where a physical point-to-multipoint configuration is not possible, but a point-to-multipoint operation is still possible.

Figure 20 - Relationship between Direct-Dialling-In, Multiple Subscriber Number and Subaddressing

In PISNs a similar approach should be taken. In neither case (public or private) should the subaddressing capability of the networks be consumed if the addressing requirements can be solved by mere ISDN or PISN numbering solutions.

In PISNs the following addressing related supplementary services of the public ISDN are fundamental, and corresponding PISN functionality should be included in PISN standard(s) on basic services for the reasons given hereafter:

DDI describes a public ISDN network feature which enables a PISN user to also be addressed by means of public ISDN numbers; from a PISN point of view the receipt of an incoming call request addressed to a PISN user is a basic interworking function of a PISN with a public ISDN;

MSN describes the possibility of allocating multiple numbers to a particular access; although the term "subscriber" implies that this is an access of the public ISDN, the same term should be used with regard to a PISN access.

SUB is considered a much more usual supplementary service in PISNs than in public ISDNs; its inclusion in basic services is a matter of practicality.

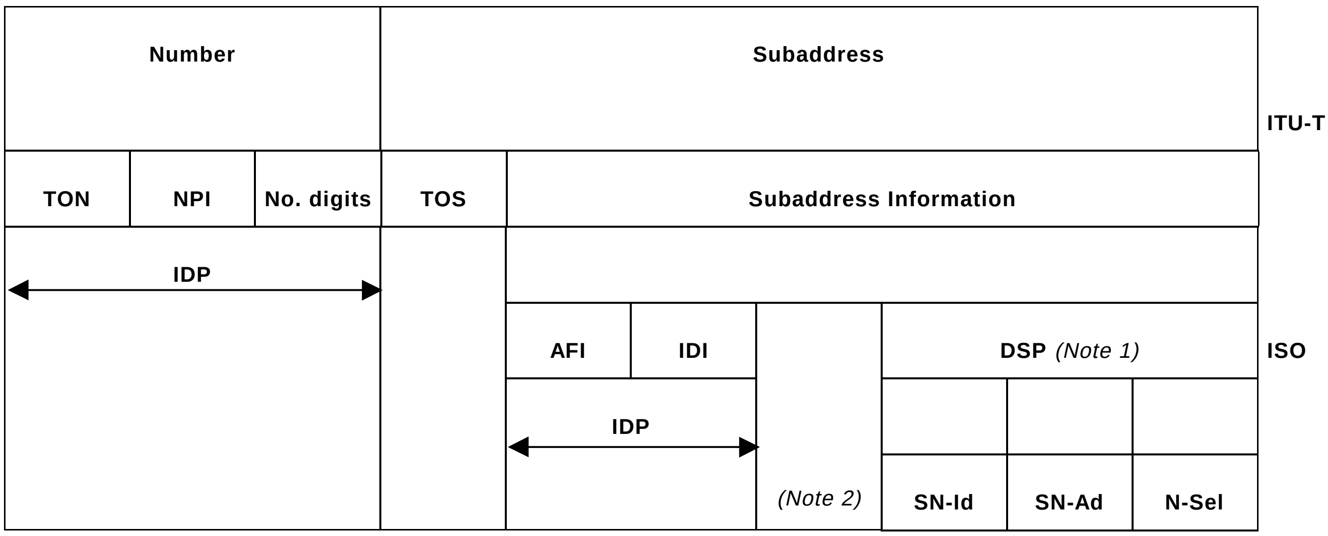
12.2 Addressing Principles

ISO has defined a global OSI network addressing principle, see ISO 8348/ADD2.

Beside an addressing scheme for worldwide public addressing, the global OSI network addressing principle provides also for addressing in private domains.

The global OSI network addressing principle has been taken into account by ITU-T when structuring the ISDN numbering plan, see ITU-T Rec. E.164.

The overview of all three addressing principles is given in figure 21.



Legend:

Ad	Address	N-Sel	N Selector
AFI	Authority and Format Identifier	NPI	Network Plan Identifier
DSP	Domain Specific Part	SN	Subnetwork
Id	Identifier	TON	Type Of Number
IDI	Initial Domain Identifier	TOS	Type Of Subaddress
IDP	Initial Domain Part		

NOTE 1

For the length of the DSP see ISO 8348, ADD.2

NOTE 2

This portion is under the authority of a national registration body.

Figure 21 - Addressing Principles

12.2.1 The ISO Global OSI Network Addressing Principle

Several international standards for numbering/addressing exist for the various public networks, namely

ITU-T Rec. X.121	for data networks (packet and circuit-switched)
ITU-T Rec. F.69	for telex networks
ITU-T Rec. E.164	for ISDNs

NOTE

ITU-T Rec. X.121 is being included in Rec. E.164. ITU-T Rec. F.69 does not have any support outside the telex network.

These public networks are subnetworks in the sense of the OSI Network Service, and their numbering plans are a subset of the global network addressing domain, which contains all network addresses in the OSI environment.

The ISO specification of a global OSI network addressing principle declares the various subnetworks to addressing subdomains and assumes that each subdomain is administered directly by one and only one addressing authority which is authorized by the authority for the higher domain.

In addition to ITU-T, ISO has specified two world-wide addressing schemes, which can be used by customers ("enterprises") on a per-country basis (ISO DCC) or on a per organization basis (ISO ICD).

The addressing authority for the global network addressing domain is ISO 8348/ADD2, specifying the authorities (ISO, ITU-T). These authorities are responsible for the first stage subdomains representing themselves by the above mentioned numbering plans.

Beside public addressing subdomains, the global OSI network addressing principle basically includes also private (in the context of ISO 8348 meaning: not ISO-regulated) addressing subdomains, as far as they are involved in a global OSI communication.

ISO separates between

– an initial domain part (IDP) reflecting the public addressing subdomain and

– a domain specific part (DSP) reflecting the private addressing subdomain.

The IDP is composed of an authority and format identifier (AFI) and an initial domain identifier (IDI). The AFI specifies

– the network addressing authority responsible for allocating the IDI values,

– the format of the IDI and

– the abstract syntax of the DSP.

The IDI specifies

– the network addressing authority responsible for allocating the DSP values and

– the network addressing domain to which the DSP values are allocated.

The semantic of the DSP is determined by the network addressing authority identified by the IDI. A further substructure of the DSP may or may not be defined by this authority.

12.2.2 The ITU-T ISDN Addressing Principle

ITU-T has based its definitions for the ISDN numbering principle on the Global OSI Network Addressing Principle. The definitions are reflected in various ITU-T Recommendations, e.g. I.330, E.164, Q.931.

Basically, the ISDN numbering principle focuses on the IDP. In addition to the AFI (which in the ISDN terminology is called numbering plan identity, NPI), ITU-T introduces the type of number (TON). This is due to the fact that within the conventional telephony networks and ISDN "abbreviated" numbers are very common, e.g. local "subscriber" numbers. Thus, the ISDN numbering principle provides information on

- the type of number (TON),
- the numbering plan identity (NPI),
- the number itself (number digits).

NOTE

Whereas ISO has assigned AFIs to the ITU-T numbering plans and thus allows for transition from an ISO addressing domain to an ITU-T addressing domain, ITU-T has not provided mechanisms for the opposite direction.

ITU-T allows for an additional use of ISO addresses only by offering the transport of subaddresses, with a net content of up to 20 octets. Similar to the number, the subaddress consists of a type of subaddress (TOS, indicating whether the subaddress information is an NSAP address or not) and the subaddress information itself. The latter is not defined to any more detail by ITU-T.

The capacity of the subaddress is intended to accommodate the global OSI network address including the DSP, if present.

12.2.3 The Domain Specific Part Addressing Principles

Except for the structurization into the elements *sub-network identifier SN-Id, sub-network address SN-Ad and N selector N-Sel*, see figure 21, no further definitions have been standardized by ISO for the Domain Specific Part.

12.3 Purpose of Addresses

12.3.1 Selection

A selection address or number is used for intra-network purposes, i.e. for routeing through the domain and, if applicable, through subsequent domains. The user who requests communication supplies a selection address or number and is responsible for its correctness.

12.3.2 Identification

An identification address or number identifies a user involved in a communication. It can, subject to possible restrictions, be presented to other users in order to allow for the execution of subsequent tasks, e.g. access control, reverse calls, etc. The responsibility for the correctness of this type of information differs between ISDN/PISN and OSI addressing principles.

12.3.2.1 Identification according to the PISN Addressing Principle

The requirements on terminal and/or user identification are different for the two cases

- fixed connection to a PISN;
- mobile connection to a PISN.

12.3.2.1.1 Non-mobile Terminals

ISDN basic access terminals are, in general, assumed to be physically interchangeable meaning that they can be moved from network to network, e.g. from the public ISDN to a PISN and vice versa, or from one PISN to another PISN. The basic call description for the public ISDN does not provide any management transaction by which the ISDN terminal could obtain its number from the ISDN on a per call basis.

Consequently, the terminal in general does not have

- any awareness of its actual ISDN number, nor
- any knowledge of the numbering plan it is actually operating with, e.g. ISDN.

Therefore the identification number is supplied by the public ISDN, which is responsible for its correctness.

However, in the context of the MSN supplementary service, a terminal might be required to provide information indicating which of the possible numbers applies.

Similar principles should be adopted for identification numbers in PISNs. Further details should be defined in a standard on addressing in PISNs.

A network receiving an identification number from another network does not have responsibility for its correctness. In particular, a public ISDN receiving an identification number from a PISN should be able to by-pass any screening which it would perform when receiving information from a terminal.

For further information on the necessity for non-screening see annex C.

12.3.2.1.2 Mobile Terminals

In practice, terminal and/or user mobility will be catered for by radio techniques. This requires location determination techniques in the PISN in order

- to determine the most suitable network entity (e.g. radio transmitter/transceiver) to communicate with the terminal at its current whereabout (e.g. a specific radio cell);
- to derive the necessary information for routeing the call from the callers location to that suitable entity;
- to provide the terminal or its user with particular services or a particular service profile as assigned to it or him on initialization.

Mobile terminals need to have awareness of their identity. The terminal identity needs to be independent of the call number of its user.

In public networks ITU-T Recommendation E.212 allows a worldwide unique numerical identification of mobile terminals. The practical allocation of identification codes is via national regulatory registration authorities.

If PISN terminal mobility is limited to the addressing domain of a single PISN, any identification system could be used provided that it guarantees uniqueness of the identities in its domain.

If mobile terminals are to be used on multiple CNs, they could be assigned a unique identity for each of their serving CNs. Alternatively, their identities could be made globally unique as is the case for public network mobile terminals. ITU-T Recommendation E.212 would have to be enhanced in a suitable manner to allow the accommodation of private network terminals.

This issue needs to be studied during the actual standardization process.

12.3.2.2 Multi-Tenancy

The same physical PISN equipment may serve multiple corporations, i.e. multiple logical PISNs are based on the same physical PISN. This situation is called multi-tenancy, and each logical PISN forms an instance of PISN of its own.

Each instance of PISNs behaves independent of the other ones with which it shares the physical infrastructure. Each may have its own numbering and addressing plan, each may provide different services to its users, etc.

Signalling information flows of multi-tenancy PISNs must be clearly distinguishable. This applies to both, the corporation owned equipment and any common infrastructure, such as VPN equipment.

NOTE

The operator of common infrastructure, such as VPN equipment, has the need to distinguish between different PISNs independently of multi-tenancy. However, this issue is outside the scope of this Technical Report.

Suitable solutions for the identification of CNs shall be developed to allow their distinction in the context of shared use of a common infrastructure.

12.3.2.3 Identification according to the OSI Addressing Principle

The OSI network service definition demands the exchange of the identification information of the respective users across the Transport-to-Network Layer boundary. It does not imply that each endsystem knows its own identity. The identification address may be provided as a network layer service. However, most of the current implementations are based on the user's knowledge of his own identification address.

If an OSI endsystem wants to retain a specific Network Layer address (which might have been agreed upon on a long term basis with another OSI endsystem, e.g. between data terminal and its host) independently of its actual ISDN number, it will have to establish this identification address as its OSI NSAP address. This identification address can then be conveyed as a subaddress through the public ISDN or PISN, in addition to the ISDN number.

12.4 Address Interworking

When calling and called entities do not reside in the same addressing domain, address interworking becomes necessary. The global OSI network as well as the ISDN addressing principle are based on a (worldwide) knowledge of addressing domains. Whether this is valid for every interworking situation should be investigated.

If this knowledge is not available, the "port technique" will have to be employed. The selection address or number will have to explicitly identify the port of entry to the subsequent domain. The more domains that have to be traversed, the more sets of address information need to be concatenated.

The domain specific parts of the selection address or number have to be transparently conveyed through each "foreign" addressing domain. The provision of the necessary transport capacity may cause problems.

In a similar way, also identification addresses or numbers will consist of concatenated domain specific information.

12.5 Address Values of the Public ISDN Addressing Domain

ITU-T distinguishes between ISDN numbers and ISDN addresses. It is the ISDN number which fully identifies the addressable entities of the Public ISDN addressing domain.

NOTE

The term ISDN address designates the concatenation of ISDN number and ISDN subaddress. It thus identifies entities which are explicitly outside the ISDN addressing domain. From a terminology point of view, this definition is more confusing than clarifying. Its use is therefore avoided in this Technical Report.

The values of ISDN numbers are defined in the ISDN numbering plan, see ITU-T Rec. E.164.

The ISDN number consists of a sequence of decimal digits, 0, 1, 2...9. Whether also the characters *, #, A, B, C, D shall be used in an ISDN number should be defined.

12.6 Addressing Principles in LANs

The specific example of LAN-PISN interworking is kept outside the scope of this Technical Report, and left for further study.

13 CN numbering impact on public networks and their numbering plans

13.1 Current Situation

PISNs typically consist of several PINXs which are linked together to allow simple and feature tailored inter-communication among the users dispersed over the various sites of the corporation.

The PINXs at each site are typically locally connected to the public network(s). This results in

- multiple allocations of public numbering resources to each of the PINXs;
- different lengths of the individual DDI numbers according to the size of the PINXs and to public network numbering capabilities at the individual access;
- the need to overlay a private numbering plan with private site codes over the local DDI numbers in order to obtain the numbering uniqueness in the PISN.

In addition to these technical arguments modern commercial life urges corporations to establish a corporate identity. Among others, a unique and consistent appearance of the communicative availability belongs to its components.

Thus, there is a need to stride for a change of the CN numbering system which avoids the above disadvantages.

13.2 Ideal Situation

In the ideal situation a CN appears to the general public under a globally unique E.164 access number behind which all CN users can be reached via DDI independently of the individual location at which they reside (“Global DDI”).

The ideal situation, however, causes some impact on the capabilities of the public networks.

The corporation should be granted a sufficient numbering space behind that globally unique CN access number.

The ideal situation can only be achieved with the agreement of ITU-T.

13.2.1 Structure of the globally unique CN Number

The structure of the CN number should be as shown in figure 22 (see also figure 36 for comparison).

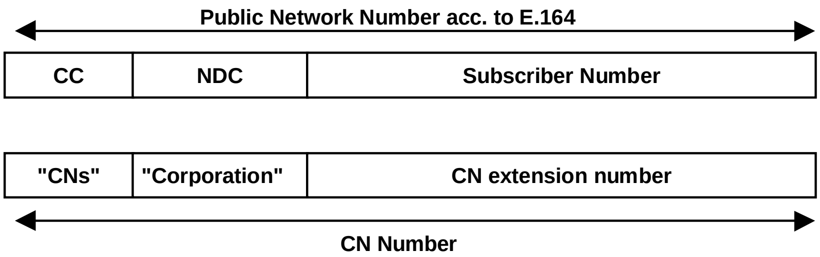


Figure 22 - Structure of the CN Number

"CNs" takes the place of a pseudo Country Code (CC), by which the E.164 subdomains of the ITU-T members are addressed. In the context of Global CN Numbering this pseudo CC acts as a pointer to CNs in general. It does not contain the identity of a particular CN or of the corporation running it. A single pseudo CC needs to be allocated for the purpose of CN numbering by ITU-T.

"Corporation" identifies the corporation. Concatenated with "CNs" it forms the globally unique E.164 number of the corporation's access to the public network. A registration authority is required to administer the values of "Corporation" worldwide.

CN extension number uniquely identifies the addressable entities within a given corporation. CN extension numbers shall be administered by each corporation for its domain.

13.2.1.1 Lengths of the CN Number Elements

Respecting the maximum length of any E.164 number, the value for “CNs” should be as short as possible, e.g. 2 or 3 digits. This leaves 13 or 12 digits for the overall length of “Corporation” + CN extension number.

Since not all CNs employ the same number of extensions, the lengths of “Corporation” and CN extension number should be chosen adequately. Larger CNs should have a shorter value for “Corporation” leaving them a larger volume for CN extension numbers, and vice versa.

13.2.1.2 Aspects of the Public Network User

One major motivation for a corporation to employ the Global CN Number is the improvement of its appearance to the general public.

This has the following consequences:

- The identity information given to the user on the public network (or on another private network when setting up the connection via the public network) must consist of the CN Number and not of potential routeing information which might have been used for call establishment; this must equally apply for incoming and outgoing calls;
- Since the CN Number does not provide any charging information (i.e. the caller has no idea to which part of the world his connection is actually set up), the call charge should be partitioned between the calling user and the corporation in a way that the calling user

- is charged at a minimum level;
- is charged the same amount independently of which CN he sets up the connection to.

13.2.1.3 Routeing in the Public Network

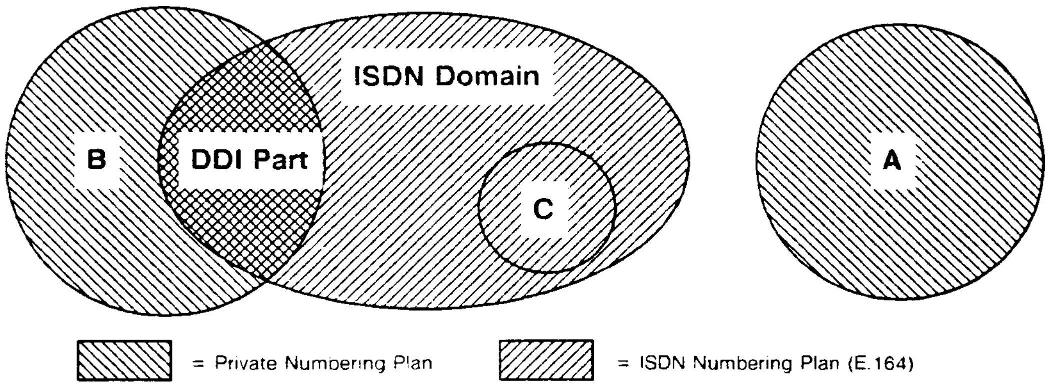
CN Numbers do not contain any location information. Special routeing servers need to be employed which transform the destination address into the routeing information required for connection setup. Such a mechanism should not affect any number presentation services (see 13.2.1.2 above).

14 PISN Numbering Concept

PISNs are part of the so called Wide Area Networks (WANs). This allows the endsystems connected to them to communicate with global networks, in particular with the public ISDN. The global public ISDN employs a numbering plan, i.e. the addresses used in its addressing do main are numbers. Due to terminal interchangeability between PISNs and public ISDNs also a PISN should employ a numbering plan.

14.1 Numbering Plans of PISNs

A PISN typically follows the ISDN addressing principle, see 12.2.2. Within this context, the PISN may use either the ISDN Numbering plan itself or, alternatively or in addition, a dedicated private numbering plan (PNP). This situation is shown in more detail in figure 23.



Legend: A, B, C: Possible Numbering Domains of Private Telecommunication Networks

Figure 23 - Employment of the PNP and/or the ISDN Numbering Plan as PISN NPs

Domain A employs a PNP exclusively, which means that this domain does not provide any addressable entity that could be directly addressed from the public ISDN.

Domain B employs a PNP and the ISDN numbering plan, such that each addressable entity within the double-shaded area has a number from each numbering plan.

NOTE 1

In the extreme, all addressable entities in a domain can have a number from each numbering plan.

Domain C employs the ISDN numbering plan exclusively, which means that no addressable entity can be operated in this domain with a number of a significance different from that of the ISDN NP. Although such a restriction is conceivable in theory, it is very unlikely in practice, since such a concept would preclude also any private network specific or abbreviated number.

Assuming that a PISN typically is connected to the public ISDN via its DDI supplementary service, or that, if not so, the PISN Authority may choose at any time to have DDI provided, a PISN will have to be prepared to conform to two numbering plans in parallel, namely:

- its own PNP which, in principle, allows the use of the same digits or digit sequences as in the public ISDN, however, with a different significance, and
- the numbering plan of the public ISDN.

NOTE 2

The number of addressable entities need not be the same in the two numbering plans.

Interworking between both numbering plans will be simplified if the PNP number digits form a subset of the ISDN number digits, i.e. when the last significant digits of both numbers are identical. Otherwise, mapping between the PISN and the public ISDN numbering plan will be more complex and will require the PISN users to publish both numbers separately for intra-PISN and for public ISDN communication.

Within the scope of this Technical Report the combination of

– the ITU-T defined ISDN numbering principle, especially the enhancement for private numbering plans, and

– the OSI addressing principle,

are to be covered by the PISN addressing concept.

14.2 Private Numbering Plan Structure

As for the ISDN numbering plan it should be possible to organize a PNP hierarchically so that shortened forms of PISN numbers can be used in certain parts of a PISN. This will then lead to a PNP structure as indicated in table 1. For the purpose of comparability, also the structure of the public ISDN numbering plan is shown.

Table 1 - Structure of the Private and Public ISDN Numbering Plans

Explicit Format	
NPI = E.164	NPI = PNP
International Number	Level 2 Regional Number
National Number	Level 1 Regional Number
Subscriber Number	Local Number
Partial	Partial
Unknown	Unknown
Network specific Number	PISN specific Number
Abbreviated Number	Abbreviated Number

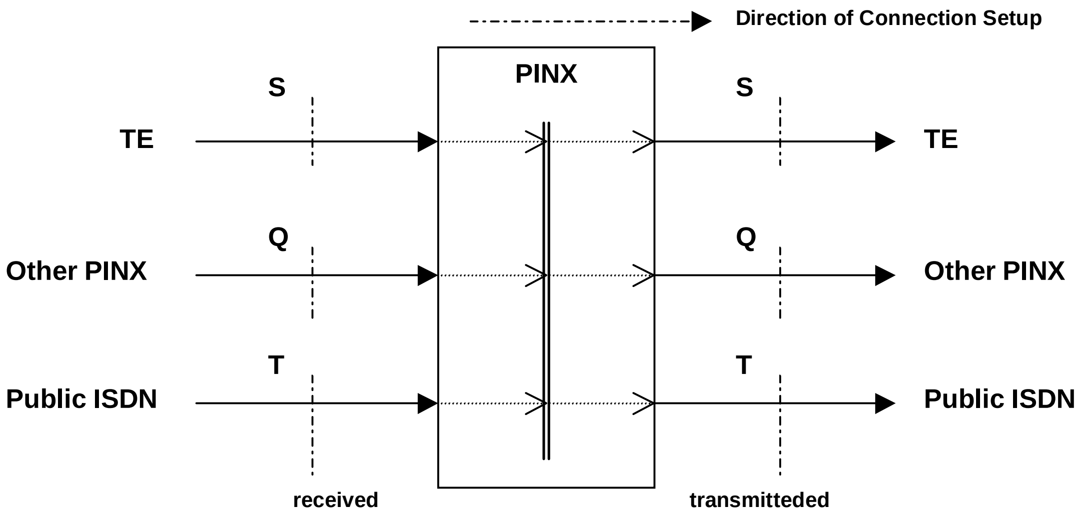
14.3 Content of the Number Information in a Private Numbering Plan

A PNP number should comprise a sequence of decimal digits with the possibility that different numbers within the same PNP can have different lengths. The maxi mum length and the minimum length to be supported by a PNP should be specified in the addressing standard.

14.4 Reference Configuration for PISN Address Treatment

The addressing principles to be adhered to in PISNs can best be determined by studying the requirements for typical connections through a PISN, i.e. for selection numbers and for originating and destination identification numbers.

Figure 24 shows a reference configuration, in which such typical connections are depicted for selection numbers. Similar reference configurations apply for originating and destination identification numbers.



Legend: **Q, S, T** = Reference Points

Figure 24 - Numbering Formats for Selection Numbers

The figure shows a PINX to which two TEs are connected via interfaces at an S reference point. Further, the PINX is connected to a public ISDN via two interfaces at the T reference point, and to other PINXs via two Q reference points. For the purpose of this model, the connections are used uni-directionally.

14.5 Knowledge about other Numbering Plans

For interworking with foreign addressing domains (e.g. under ISO or ITU-T authority) the following approaches can be used:

i) The address information explicitly indicates the foreign domain by the appropriate AFI/NPI. As far as selection address information is concerned, the responsible net work layer entities have to have the necessary knowledge to derive the routeing information.

ii) The address information implicitly indicates the foreign domain by, e.g., prefixes or numbers of the PISN or ISDN numbering plan, depending on which network the foreign domain is attached to.

iii) The address information indicates by means of a PNP or ISDN number a gateway to the foreign domain. Further address information (applicable within the foreign domain) needs to be conveyed as subaddress information in the PISN (or public ISDN, if applicable).

It should be studied which NPI values other than "ISDN" and "Private" should be sup ported by a PISN.

15 Support of subaddressing in PISNs

This clause shows which type of information can be conveyed in subaddresses. The actual use of subaddresses for specific applications is outside the scope of this Technical Report.

15.1 Embedment of OSI Network Layer Addresses in Concatenated PISN Addressing Information

A terminal may house an end-system conforming to the X.200 Open Systems Interconnection (OSI) reference model ("OSI endsystem"). The concatenated PISN addressing information will then include the OSI network layer address and thus provide the capability to identify the OSI network layer service access point (NSAP).

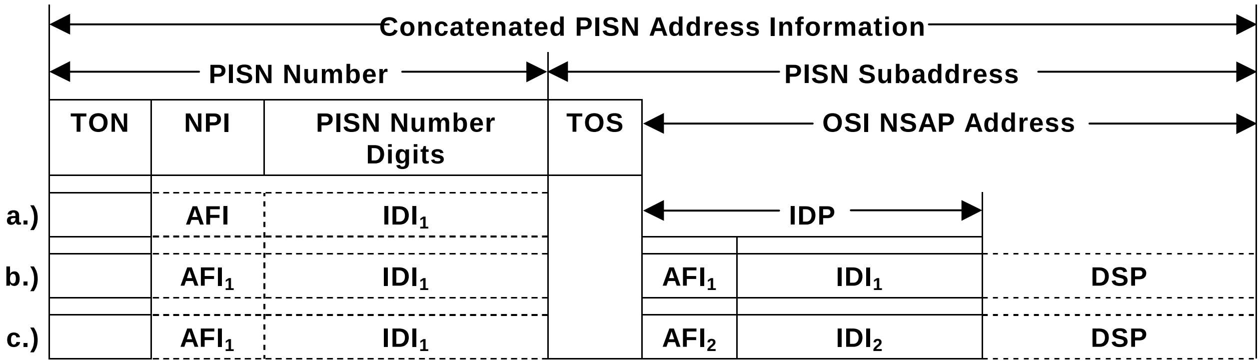
The syntaxes and semantics of OSI NSAP addresses are defined in IS 8348/ADD 2.

OSI NSAPs can be addressed in one of the three following ways, see figure 25:

i) The OSI NSAP address consists of the IDP only. There is no subaddress, and the OSI endsystem infers the complete NSAP address from the PISN number, i.e. from the NPI, the TON and the number digits. There is no Domain Specific Part (DSP).

ii) The OSI NSAP address comprises an AFI and an IDI. The PISN number, i.e. the NPI, TON and dumber digits, is repeated in the subaddress. A DSP may or may not be present.

iii) The OSI NSAP address, conveyed as the subaddress, comprises AFI and IDI which are not related to the PISN number but, e.g., to another private or public network number. A DSP may or may not be present.



NOTE

The semantic content of the AFI is contained in the numbering addressing plan identification (NPI) of the PISN number or implied by network arrangement.

Figure 25 - Embedment of OSI Network Layer Addresses in Concatenated PISN Addressing Information

15.2 Embedment of Other Information in the Subaddress

Information other than OSI NSAP addresses can be interchanged as a subaddress between TEs. Possible applications are:

- non-OSI domain specific addresses;
- personal identification or password information.

15.3 Conveyance of Subaddresses through a PISN

A subaddress can contain information which is not available from the corresponding number. For example:

- case ii) in 15.1, if a DSP is included;
- case iii) in 15.1;
- other information as described in 15.2.

Therefore the conveyance of the subaddress across the PISN is fundamental, and should be supported as part of signalling protocols for the basic call. Furthermore, the presentation of subaddresses to TEs should not be subject to the various restrictions which may apply to the presentation of numbers.

NOTE

If a user wishes to restrict the presentation of his subaddress to other users, he can arrange that his TE does not submit the subaddress to the network.

Section 5 - Routeing

This Section 5 is concerned with the subject of routeing at the Network Layer in PISNs, primarily with routeing for connection oriented services. It examines strategies for routeing within a PISN and for interworking situations, e.g. with public ISDNs and other public networks. Further information on routeing in general can be found in ISO/IEC TR 9575.

16 General

Routeing at the Network Layer is the process of selecting a sequence of connection elements which are able to provide a continuous communication path with a defined capability between users which require to communicate. For routeing within a PISN, connection elements include the following:

- exchanges of the PISN,
- inter-PINX connections,
- PISN accesses,
- TEs attached to PISN accesses,
- accesses to other networks,
- other resources within a PISN, e.g. conference bridges, interworking units.

A call, or instance of a service, within a PISN is established by providing a communication path between the two PISN users involved. It is the routeing function which selects the path. One of the PISN users (the calling user, or source of the call) is used as a starting point for the routeing process. The routeing process also requires the address of the other user (the called user, or destination of the call), which it uses to determine the location of the called user and potential paths through the PISN to that location. The path chosen must satisfy the requirements of the service requested and must meet the requested bearer capability.

Where the source of a call is outside the PISN, the PISN receives a call request from another network. The point of access from that other network can be regarded as the source of the call, as far as PISN routeing is concerned.

Where the destination is outside the PISN, the PISN is responsible for selecting the next network, whose responsibility it will be to continue routeing towards the destination. The PISN is also responsible for selecting the point of access from the PISN to the next network, and a path through the PISN to that point of access. Optionally the PISN may also select networks beyond the next network, e.g. public transit networks, and indicate those networks to the next network.

Sometimes the destination may be within the PISN, but because there is no path available through the PISN to that destination it becomes necessary to choose a path through another network. The considerations above for destinations outside the PISN also apply in this situation.

To reach a given destination from a given source, there is frequently a choice of possible paths, and the routeing process is required to choose a path with spare capacity, i.e. the necessary resources need to be available. Where there is more than one suitable path with spare capacity, the choice is normally required to be based on cost, either direct (e.g. call charges by other networks) or indirect (e.g. leasing charges).

Where the routeing process is unable to find a suitable path with spare capacity, the call has to be rejected. The possibility of negotiating service parameters or queuing for resources is for further study.

17 Routeing Requirements

This clause lists the requirements which should be met by a routeing mechanism in a PISN.

17.1 Functional Requirements

i) The routeing process has to determine, from the destination address (e.g. the PISN number) the location of the destination, i.e. whether it is within the PISN or in another network.

ii) If the destination is within the PISN, the routeing process has to determine the PINX to which the destination is attached, and then determine a path through the PISN to that PINX. Factors influencing the selection of a path through the PISN are listed in 17.1.1.

iii) If the destination is outside the PISN, the routeing process has to determine the next network to route to, the PINX from which to access the next network, and also the choice of the first exchange of the next network if more than one exchange is accessible from the gateway PINX. Factors influencing these are listed in 17.1.2. The routeing process also has to select a path through the PISN to the gateway PINX. Factors influencing this are listed in 17.1.1. Routeing to a destination outside the PISN is therefore influenced by the combination of the factors in 17.1.2 and the factors in 17.1.1.

iv) If the destination is outside the PISN, the routeing process may also optionally select networks beyond the next network and indicate these to the next network. Factors influencing the selection of networks beyond the next network are listed in 17.1.3.

v) If the destination is within the PISN but not reachable by paths within the PISN, it may be possible to route to the destination via (an)other network(s). The requirements above for routeing to a destination outside the PISN apply.

vi) Mobility should be catered for, by allowing a PISN user (identified by a PISN number) to move between different PINXs in a PISN. The degree with which this is dynamic can vary. e.g.:

- moves can only be made by manual instruction to network management;
- moves can be indicated by inserting a smart card into a terminal at the new location;
- roaming cordless terminals.

vii) Certain supplementary services may affect the destination. In particular, automatic call distribution involves the distribution of calls between different destinations, depending on the ability of each destination to accept calls.

17.1.1 Factors Influencing Routeing through a PISN

Routeing through a PISN to the destination PINX or gateway PINX will depend on the following.

i) The ability of a path to support the required basic service and any other user-specified requirements, e.g. special QOS, special routeing (e.g. for maintenance).

ii) The cost of a path, in terms of the cost of the resources used. This is normally indirect, e.g. based on leasing costs for resources used. Typically it depends on the number of hops and the distance of each hop, but it could also have an adjustment according to (long term) scarcity of resources (e.g. if a path between two PINXs is known to be under-equipped) or according to quality (e.g. to discourage use of higher quality paths than needed).

iii) Resources (e.g. PINXs, inter-PINX connections) which are out of service or scheduled to be taken out of service within the expected duration of the call.

iv) Resources which are congested at the time of routeing.

v) Possibly resources which are approaching congestion at the time of routeing.

vi) The positioning and availability of resources for the support of supplementary services, e.g. conference bridges.

17.1.2 Factors Influencing Routeing to Another Network

The choice of the next network to route to when the destination is outside the PISN or not currently reachable by paths within the PISN, the choice of the gateway PINX, and also the choice of the first exchange of the next network if more than one exchange is accessible from the gateway PINX are dependent on the following.

i) The ability of a network to reach the destination.

ii) The ability of another network and an access to that network to support the required basic service and any other user-specified requirements, e.g. special QOS, transit network selection. This may be known in advance by the PISN or may have to be determined by trial and error.

iii) The cost of using the other network, which will depend on the service, the distance through the other network (e.g. local, national, international, which in turn are affected by the point of access) and the time of day. It may also be possible to take into account any anticipated tariff changes during the expected duration of a call. This information should be known in advance by the PISN.

iv) Accesses out of service or congested. This is known by the PISN (although not necessarily by all PINXs).

v) The ability of the other network to route the call (i.e. depending on static ability to reach the required destination, and whether there is congestion or equipment out of service). This information is not necessarily available in advance to the PISN, and therefore may have to be determined by trial and error.

17.1.3 Factors Influencing the Selection of Networks beyond the Next Network

The selection of a network or networks beyond the next network, e.g. public transit networks, depends on the following.

i) The ability of a network to reach the destination.

ii) User requirements for routeing via a specific network.

iii) The ability of a network to support the required basic service and any other user-specified requirements, e.g. special QOS. This may be known in advance by the PISN or may have to be determined by trial and error.

iv) The cost of using a network, which will depend on the service, the distance through the network (e.g. local, national, international, which in turn may be affected by the point of exit from the PISN), and the time of day. It may also be possible to take into account any anticipated tariff changes during the life of a call. This information should be known in advance by the PISN.

v) The ability of a network to route the call (i.e. depending on whether there is congestion or equipment out of service). This information is not necessarily available in advance to the PISN, and therefore may have to be determined by trial and error.

17.1.4 Other Factors Influencing Route Selection

i) Although the user should not normally need to supply any routeing information to the network when requesting call establishment, it should be permissible in circumstances such as the following:

- the need to route through a particular network where the user has an account, in order for that user to be charged, rather than the PISN (which may not have an account);
- where the user has special knowledge of costs, malfunctions, quality of service, etc.;
- for maintenance purposes, in order to check out a particular route.

ii) PISN user service profiles may impose restrictions on routeing, in particular as far as access to other networks are concerned. The reasons for such restrictions include:

- to deny unauthorized access (normally where charging is involved);
- to reserve limited resources for those with the most need.

iii) There may be regulatory restrictions on routeing, e.g. on routeing a call from a public network on to the same or another public network.

17.2 Performance Requirements

In addition to the functional requirements listed above, the routeing mechanism should take account of and strike a suitable balance between the following performance requirements:

i) The routeing mechanism should not use excessive resources of the communications network.

ii) The routeing mechanism should enable an adequate response to changes in the network, including configuration changes (e.g. installation of a new PINX, inter-PINX connection or access to another network) and equipment states (e.g. faulty, maintenance states, congested).

iii) The user should be given an adequate quality of service from the point of view of the time taken to establish a call or to notify the user of failure to route a call.

18 Routeing Mechanisms

18.1 Routeing Information Base

For any call incoming to an PINX, the PINX must determine from the address of the called user whether it is a PISN user on that PINX. If it is not, the PINX must, as a minimum, determine the route to be taken out of that PINX, taking into account the location of the destination and the PINXs knowledge of the PISN and of any other networks which might be involved in reaching the destination. This knowledge is assumed to be held in a Routeing Information Base (RIB). The RIB might be physically in the PINX or elsewhere, e.g. centralized. However, the separation of the RIB from the PINX may have impact on quality of service.

Keeping the RIB up-to-date is the responsibility of Network Management. This can be dynamic to varying degrees, e.g.:

– the RIB is virtually static, being changed only when new equipment is installed;

– the RIB is dynamic to the extent of taking account of resources temporally out of service;

– the RIB is dynamic to the extent of having knowledge of resources in use.

Also there are different degrees to which the RIB can automatically adapt to changes, as opposed to relying on human input.

Possible mechanisms for maintaining the RIB will be considered as part of ECMA studies on Management of PISNs.

18.2 Source and Destination Routeing

As a minimum, the routeing function of an PINX must determine the path, i.e. circuit and, if applicable, channel, out of that PINX towards the next PINX or network. This is done on the basis of the destination address, using the RIB to identify possible paths out of the PINX towards that destination, and choosing the optimum (e.g. cheapest) path with available capacity. The next PINX must then perform a similar operation, again based on the destination address. This means of routeing can be called "destination routeing", since at each node routeing is aimed at getting to the destination.

Alternatively, an PINX may have sufficient information in its RIB to enable it to determine the entire path to the destination or to the point of access to the next network, and optionally the identification of networks beyond the next network. Where an PINX determines the entire path, information needs to be passed forward to subsequent PINXs to inform them of the selected path. Onward routeing by subsequent PINXs is then constrained to using this path. Similarly, any information regarding networks beyond the next network needs to be passed to the next network, and subsequent routeing is constrained to using those networks. This method of routeing can be called "source routeing", since the entire path is determined at the source.

Source routeing might typically be done at an originating PINX. Alternatively, it could be done at an originating TE, e.g. where the user specifies the sequence of routes, perhaps for maintenance purposes.

Source routeing and destination routeing each have advantages and disadvantages over the other.

18.2.1 Advantages of Source Routeing Compared with Destination Routeing

i) Route determination only has to be done once, thus minimising computation overheads in the PISN.

ii) Avoids the possibility of looping, which could occur with destination routeing under certain conditions, particularly if the routeing algorithm is not chosen carefully.

iii) Avoids the possibility of a transit PINX choosing an alternative route which is not the cheapest route available from the source to the destination, but happens to be the cheapest from that transit PINX to the destination.

iv) Avoids independent attempts by several PINXs at trying to route through a distant PINX, inter-PINX connection or access to another network which is not currently available.

v) Only the PINX doing the source routeing (normally the originating PINX) needs to have knowledge of the calling user's service profile in order to ensure that the calling user is authorized to use potential routes. With destination routeing the service profile (or relevant parts) has to be passed forward and has to be meaningful to each PINX.

18.2.2 Advantages of Destination Routeing Compared with Source Routeing

i) Avoids the need for PINXs to have a complete knowledge of the network topology and states other than immediate inter-PINX connections and accesses to other networks. With source routeing an PINX has to have a complete knowledge of the network topology and the states of all PINXs, inter-PINX connections and accesses to other networks. Ideally this knowledge should include the state of occupancy of such resources so that congestion can be avoided, which implies that the RIB has to be highly dynamic.

ii) Each PINX can select from a number of possible ongoing routes, without being constrained by the sequence of routes determined by source routeing. This means that a call is less likely to have to be cleared back to the PINX which carried out the source routeing, in order to select an alternative sequence of routes. This will have a beneficial effect on call establishment times.

The chances of having to clear back a call to the PINX which carried out source routeing can be significantly reduced by ensuring that that PINX has sufficient information on the occupancy of resources. But this information can never be 100% up-to-date and the provision of such information incurs large overheads.

18.2.3 Hybrid Methods

A combination of source and destination routeing can be employed, whereby an PINX imposes some constraints on routeing by subsequent PINXs and/or networks but does not specify the exact path. For example, an PINX may determine that a call is to be routed to a particular network and that access to that other network is to be from a particular gateway PINX, but without constraining the path through the PISN to that gateway PINX. As another example, the originating TE or PINX may specify a particular public transit network to be used, but without specifying the path to that transit network.

In other words, routeing can be viewed as being performed in stages, where each stage uses destination routeing to get to the destination for the stage. The destination for a stage is in fact an entity determined by source routeing for that stage.

A hybrid method could also include the possibility of specifying at source an entity (e.g. inter-PINX connection, PINX, network) to be avoided (because of known problems).

The requirement that PISNs should cater for the mobility of PISN users and therefore the mobility of PISN numbers leads to the need to translate a PISN number into a physical address of a port on the PISN where that user is to be found. Mechanisms for doing this are for further study. Whatever mechanism is used, the translation will probably be performed only once (at source) and with subsequent routeing on the basis of the physical address so obtained.

Hybrid methods can be used to capitalize on the advantages of the two methods. The most appropriate balance between source and destination routeing for a given PISN will depend on factors such as:

- the topology of the PISN;
- the locations of accesses to adjacent networks;
- the ability to access networks beyond adjacent networks;
- charges incurred in using other networks;
- the requirements of the PISN administration;
- the methods available for maintaining the RIB, etc..

A typical solution might be the use of source routeing to identify points of access to adjacent networks and networks beyond adjacent networks, but destination routeing for selecting a path through the PISN (except where routes through the PISN are specified by the originating TE, e.g. for maintenance purposes). Translation between PISN numbers and physical addresses should also be done only at source.

18.2.4 Impact on Signalling for Call Control

Source routeing requires the passing forward of additional signalling information at call establishment time in order to constrain routeing at subsequent PINXs. This capability is therefore also required for hybrid routeing. Even if a PISN were to normally operate on a fully destination basis, there would still be a need to pass forward routeing information originating at the TE. Signalling protocols shall therefore be capable of passing forward routeing information, including the following:

- identification of the next network to route to;
- identification of the gateway PINX from which to access the next network;

- identification of the local exchange of the next network, if more than one local exchange can be accessed from the gateway PINX;
- identification and authorisation codes for networks beyond the next network;
- identification of transit PINXs;
- identification of particular inter-PINX connections or accesses to other networks, and possibly particular channels on such connections and accesses.
- physical address of the called user, as distinct from its PISN number.
- identification of entities to be avoided.

A PINX receiving such information should route via or towards (or avoid) the entities specified and pass such information on to the next PINX or network if still of relevance.

18.3 Subjects for Standardization

An ECMA Standard on routeing in PISNs should be based on the following considerations:

- destination routeing should be a minimum which a PISN and its PINXs support;
- source or hybrid routeing should be options which have to be tolerated by those parts of the PISN which by themselves do not employ source or hybrid routeing;
- any routeing other than destination routeing should be treated as an additional network feature, see 19.7;
- routeing functional entities, the types of information to be interchanged between them and the signalling protocols needed to convey them should neither prevent nor hinder any enhanced routeing strategy.

A possible ECMA Standard on routeing in PISNs should also identify requirements to be fulfilled by public ISDNs.

Documents which should be taken into consideration are ISO 9542 and ISO 10589.

Section 6 - Services

This Section 6 specifies general concepts for the description and definition of the basic and supplementary services applicable to PISNs. The impact on both the public ISDN and the PISN is defined and solutions are proposed which will enable harmonization between PISNs and public ISDNs.

19 General Service Considerations

19.1 Classification of Services

The services offered to a PISN user comprise basic and supplementary services.

Basic services are divided into basic bearer services and basic teleservices.

Supplementary services can apply to both basic bearer services and basic teleservices.

The classification of services is the same as for an ISDN, see ITU-T Rec. I.210.

These terms, when applied to public ISDNs, emphasize possible marketing relevance to a public ISDN provider, i.e. subscription and charging on a per service basis. For consistency, these terms are used also for PISNs, even though a PISN provider might make some services generally available (without the need for "subscription") and might not charge on a per service basis.

19.2 Control of Basic Services

A basic call is an instance of the use of a basic service, see Standard ECMA-142.

Functionality for the control of a basic call is required in the calling PISN user's TE, in the called PISN user's TE, and in each of the PINXs through which the call is routed, i.e. the Originating PINX, the Terminating PINX and any Transit PINXs. Signalling protocols within the Control Plane of the Protocol

Reference Model enable functions in different physical equipment to communicate in order to co-operate in the control of basic calls. A signalling connection is established between the various equipment involved for the duration of the basic call.

Signalling protocols are required at the Q reference point and at the S reference point.

19.3 Control of Supplementary Services

Functionality for the control of a supplementary service will exist in various places, e.g.:

- the TE of the served user;
- the TEs of other users affected by the service;
- the served user's PINX;
- the PINXs of other users affected by the service;
- PINXs with special capabilities, e.g. conference bridging.

Signalling protocols within the Control Plane of the Protocol Reference Model enable supplementary service functions in different physical equipment to communicate in order to co-operate in the control of supplementary services. Signalling information has to be passed transparently through intervening equipment (e.g. Transit PINXs) not involved in the supplementary service.

Where signalling is required between supplementary service functions which are located at physical equipment involved in the basic call to which the supplementary service applies, the signalling connection which exists for basic call control can also be used to support supplementary service signalling. At other times supplementary service signalling will be independent of any basic call signalling, e.g.:

- where the supplementary service signalling is outside the context of a basic call (e.g. for activation or deactivation of a supplementary service);
- where the supplementary service signalling occurs prior to establishment or after cleardown of the signalling connection for the basic call to which it applies;
- where the supplementary service signalling involves physical equipment which are not involved in the basic call (e.g. equipment containing databases).

Signalling protocols for use in conjunction with a basic call signalling connection and for use independently of any basic call signalling connection are required at the Q and S reference points.

NOTE

Supplementary services which have not been standardised can still be supported in a PISN. Signalling protocols will provide escape mechanisms for manufacturer specific information for the support of supplementary services which are not standardised, or for the support of non-standard extensions to standardised supplementary services.

19.4 Specification Method for ECMA Standards on Services

The three stage method as specified and used by ITU-T is applicable to ECMA Standards for basic and supplementary services.

For a given service or set of related services, the following ECMA Standards will be produced:

- a Standard containing the stage 1 and stage 2 specifications;
- a Standard containing the stage 3 specification for the protocol at the Q reference point, if applicable;
- a Standard containing the stage 3 specification for the protocol at the S reference point.

Whilst stage 3 specifications are concerned with physical interfaces, state 1 and stage 2 specifications provide a conceptual view of the service. The models to be used for stage 1 and stage 2 specifications are described below.

19.4.1 Service Model for Stage 1 Specifications

The Network Layer provides the bearer capabilities necessary for the support of bearer services, teleservices, i.e. for the support of calls. It also provides support for supplementary services. A user accesses the Network Layer service through Network Service Access Points (NSAP). An NSAP is identifiable by an address, which in a PISN is generally in the form of a PISN number or the concatenation of a PISN number and a subaddress (see Section 4).

The Network Layer incorporates functions for the control of calls and supplementary services and functions for the transfer of user information. Control functions are viewed as being provided by a Network Call Control entity, which provides, through service access points (SAPs), a service for the control of calls and supplementary services. Within a user's equipment, co-ordination functions make use of the services of the Network Call Control entity and co-ordinate call control with the transfer of user information, thereby providing a complete Network Layer service to users. See figure 26.

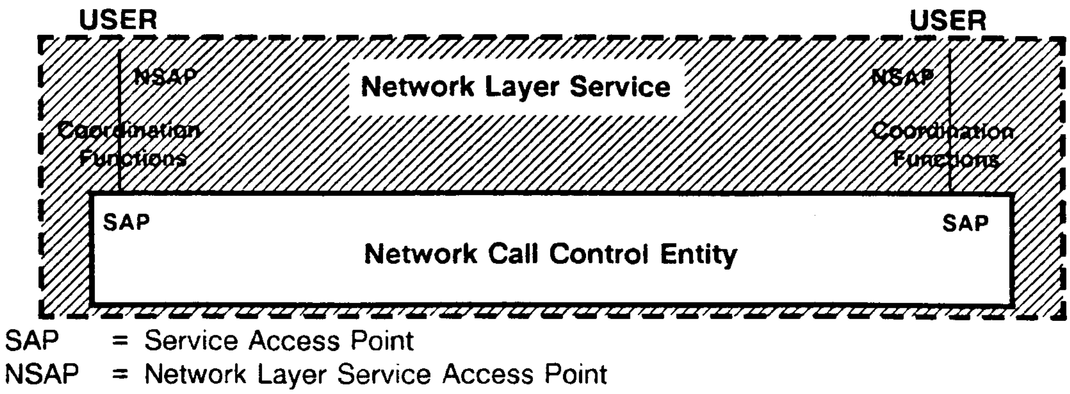


Figure 26 - Service Model

The Network Call Control SAPs are indirectly accessible via NSAPs. Primitives used across Network Call Control SAPs are mappable to primitives at an NSAP. However, NSAP primitives relating to the transfer of user information do not have equivalents at a Network Call Control SAP. An address which identifies an NSAP also identifies a Network Call Control SAP by implication.

In a Stage 1 specification, the control aspects of services are specified in terms of the primitives at Network Call Control SAPs. The entire Network Call Control is treated as a single entity.

19.4.2 Service Model for Stage 2 Specifications

In Stage 2 specifications, the internal behaviour of Network Call Control is specified by breaking it down into a number of Functional Entities (FE) and specifying the information flows between them. The result is a model of the form shown in figure 27. Particular basic and supplementary services will use particular models based on this generic model.

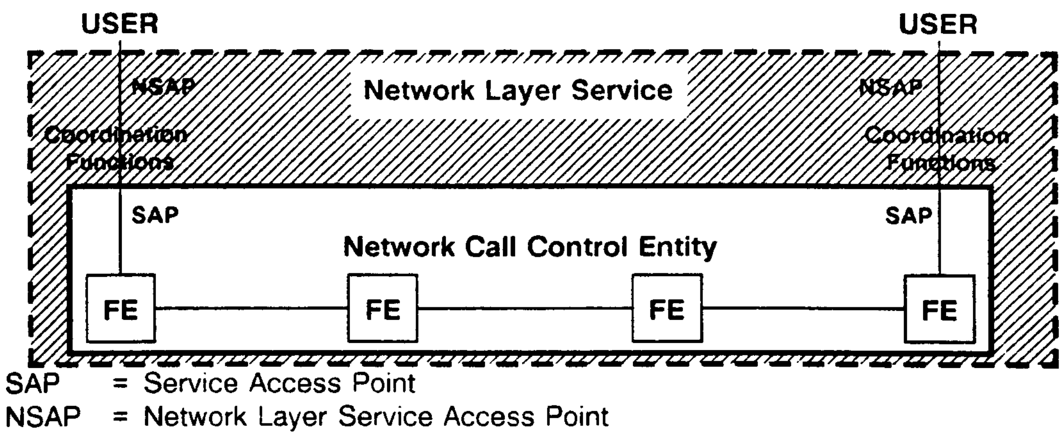


Figure 27 - Generic Model for Stage 2

19.5 Relationship to Services Provided in Public ISDNs

Basic services specified for PISNs will in general be the same as those specified for public ISDNs.

For many of the supplementary services specified for PISNs there will be corresponding services specified for public ISDNs. There will be other supplementary services specified for PISNs which will not be specified for public ISDNs, and vice versa.

Where the same service is to be specified for PISNs and public ISDNs, the service specification (stage 1) should be common, as far as possible, so that users can have similar expectations. This does not prevent the specification of enhancements to services only for PISNs or only for public ISDNs.

The concept of terminal interchangeability, not only between different PISN accesses and between different public ISDN accesses, but also between PISN and public ISDN accesses, is important, see figure 28.

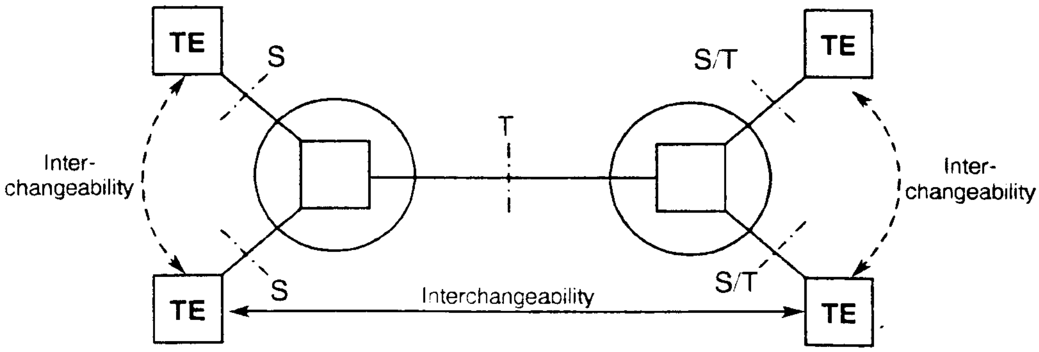


Figure 28 - Terminal Interchangeability

The need for terminal interchangeability between PISNs and public ISDNs means that signalling protocols at the S reference point should be compatible with public network signalling protocols at the coincident S/T reference point. This applies to any basic or supplementary service which is common to PISNs and public ISDNs. This does not preclude protocol extensions being specified for the support of additional services or extensions to services applicable only to PISNs or only to public ISDNs. However, this should be done in a manner which allows clean recovery from any attempt by a TE to use a protocol extension which is not supported by the network to which the TE is attached, or by a network to use a protocol extension which is not supported by the TE.

This also means that those aspects of stage 2 specifications which impact upon the signalling protocol at the S reference point should be compatible with the corresponding parts of the stage 2 specifications for public ISDNs.

With the above points in mind, the production by ECMA of "delta" Standards specifying only differences compared with corresponding standards for the public ISDN, where they already exist, might be a possibility. This avoids the unnecessary duplication of large amounts of text and diagrams, and also minimises the possibility of inadvertently producing differences between standards for the private and public ISDN. "Delta" standards can be used for stages 1 and 2 and for stage 3 at the S reference point, but not at the Q reference point.

In some cases it may not be necessary to produce a separate Standard for PISNs.

19.6 Service Interworking between PISNs and Public ISDNs

Each service requires that a served user can access a service provider. Service interworking between networks involves service providers in different networks.

NOTE

The term "service provider" is to indicate, in a generic way, all technical means outside the TE which are required to fulfil a particular service. The term does not address any regulatory or legal issues.

When calls pass through a PISN and a public ISDN, the service providers of both networks co-operate in the provision of basic and supplementary services. For basic services, both service providers have a certain level of involvement, but there may be some aspects of a service which are catered for by only one of the service providers, e.g. echo cancellation for certain basic services.

For supplementary services the degree of involvement of each service provider can vary considerably according to service and circumstances. To give an indication of how the involvement is shared for particular supplementary services, the following categories have been identified.

– Local

The service provider in only one of the networks (the served user's network) is involved (see figure 28). Some supplementary services in this category involve the sending of notifications to remote parties attached to the other network. Therefore the only involvement of the service provider in the other network is in the transparent conveyance of these notifications.

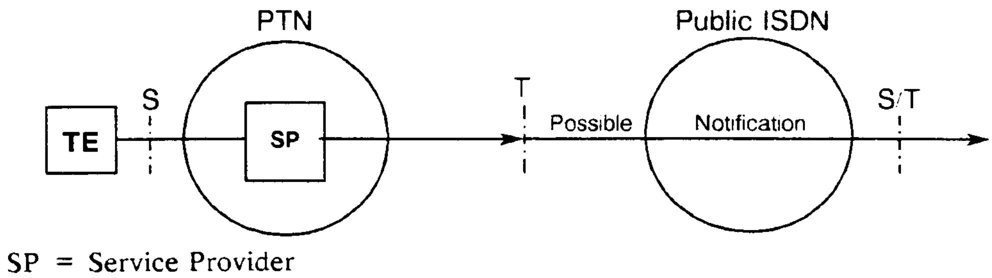


Figure 28 - Example of Local Provision of a Supplementary Service by a PISN

In some cases a PISN can act as the user of a supplementary service provided by a public ISDN, see figure 29.

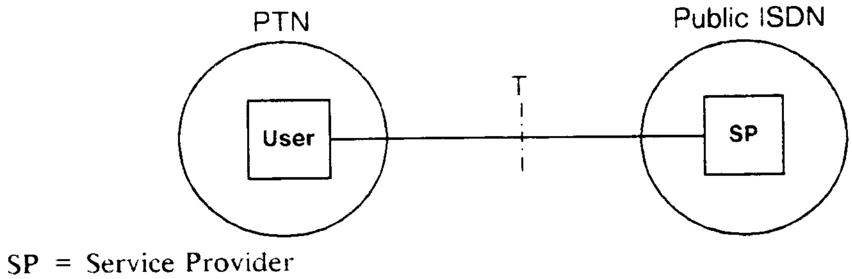


Figure 29 - Example of a PISN as User of a Service Locally Provided by the Public ISDN

– Double

This is a special case of "local", whereby a PISN uses a service provided locally by a public ISDN while simultaneously providing a similar service locally to PISN users, see figure 30.

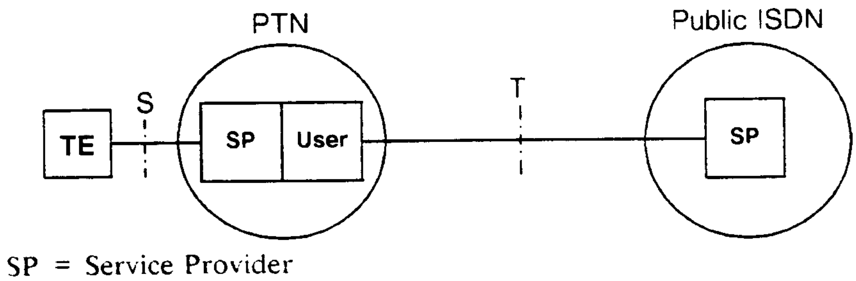


Figure 30 - Example of Dual Provision of a Supplementary Service

– Co-operative

The service providers of both networks are involved. This requires intercommunication between both networks' service providers, whose functions complement each other, see figure 31.

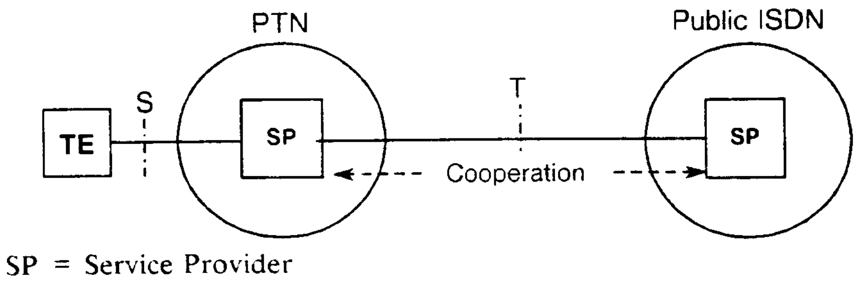


Figure 31 - Example of Co-operative Provision of a Supplementary Service

Some services can fall into different categories, depending on the actual routeing of a call.

The above considerations are to be taken into account by the signalling protocol at the T reference point. Basically signalling at the T reference point has to cater for the following:

i) Co-operation between service providers in the provision of basic services;

ii) use by the PISN of supplementary services provided locally by the public ISDN;

iii) sending of notifications to the PISN resulting from supplementary services provided locally in the public ISDN;

iv) sending of notifications to the public ISDN resulting from supplementary services provided locally in the PISN;

v) co-operation between service providers in the provision of co-operative supplementary services.

Items ii) and iii) can be satisfied by a signalling protocol similar to that at the coincident S/T reference point. Items i), iv) and v) mean that there are special signalling requirements at the T reference point, compared with the coincident S/T reference point.

19.7 Additional Network Features

PISNs can offer various features which can improve the handling of certain calls or the performance of the network as a whole, rather than directly benefiting a particular served user. However, indirect benefits may be perceived by users, e.g. the avoidance of calls with inadequate quality of service or the minimising of charges incurred. As there is no served user, these features are not called supplementary services. Instead they are given the name Additional Network Features (ANF).

Certain ANFs are appropriate for standardisation. These will be specified using a three stage method similar to the method used for supplementary services. However, the "user" of an ANF is not an ordinary PISN user but an entity within the PISN.

NOTE

ANFs which have not been standardised can still be supported in a PISN. Signalling protocols will provide escape mechanisms for manufacturer specific information for the support of ANFs which are not standardised, or for the support of non-standard extensions to standardised ANFs.

In general, ANFs have impact on the signalling protocols only at the Q reference point. At the present time there are no prospects of interworking with equivalent features in public ISDNs.

Annex A

Off-premises PISN Users

Figure A.1 shows remote users of an ISPBX type PINX which are located outside the ISPBX premises.

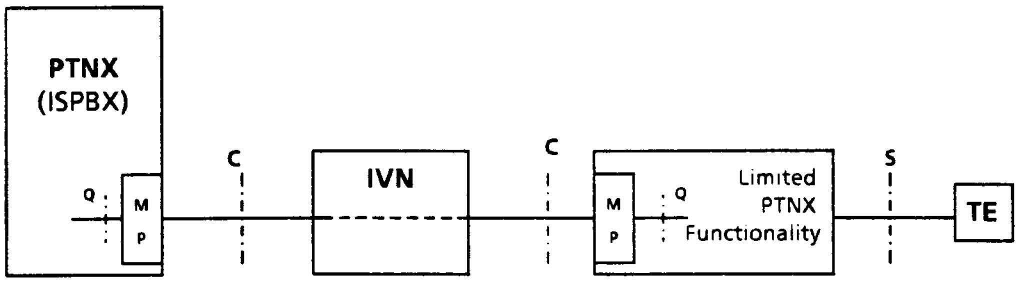


Figure A.1 - Off-Premises Extensions

Any of the scenarios described in Section 3 for inter-PINX connections can, in principle, be used to connect a remote user's TE to the ISPBX.

The TE needs to be adapted to the IVN. As a minimum this involves relevant MP functions on the PISN user's premises.

Annex B

PINX Connections to Public ISDNs

This annex deals with the connection of PINXs to public ISDNs. The description of this connection serves as a basis for the understanding of PINXs within the overlay concept as well as of problems which may arise when public ISDNs have to interwork with PINXs within the concatenation concept.

B.1 Access Types and Physical Interfaces

The access types underlying this interworking function and used at the T reference point can be

– one or a multiple of basic accesses, or

– one or a multiple of primary rate accesses, or

– any combination of basic and primary rate accesses.

The physical interfaces used are the S0 and the S2 interfaces, as described in ETS 300 011 and ETS 300 012.

NOTE

For primary rate accesses, the S2 interface is predominant in Europe and some other regions of the world outside North America. In the latter, the S1 interface is used instead.

B.2 Protocol Reference Model

Based on the ISDN protocol reference model (ITU-T Rec. I.320), the connection of a PINX to the Public ISDN can be characterized by

- the PINX control plane PC and the Network control plane NC interwork directly:
- the user control planes of the terminals, through the PINX and through the public ISDN are mapped 1:1 and form a transparent pipe.

The control planes are as defined in clause 8.

Annex C

Interworking for Identification Numbers between Public ISDN and PISN

It is assumed that:

- all PISN users reachable from the public ISDN can be reached via the DDI supplementary service;
- identification numbers according to the ISDN numbering plan are interchanged between the PISN and the public ISDN numbering domains in both directions;
- either network will obey any presentation restrictions, i.e. it will indicate restriction to the foreign domain without revealing the number itself.

In figure C.1 public ISDNs A and B are assumed to be different local exchanges of the same or of different public ISDNs. Normally, call requests from PISN user A to user B are routed via PINX A and public ISDN A. In re-routing situations (e.g. due to failure, congestion) the call may be established via PINX B and public ISDN B, as shown by the dotted line.

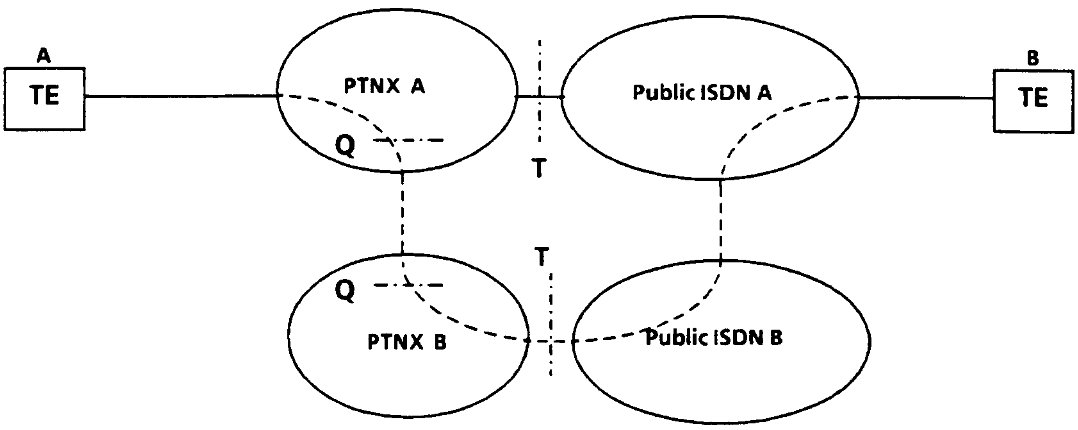


Figure C.1 - Example of Interworking between PISN and Public ISDN

PINX B should not include user A's DDI number, according to the DDI arrangement between PINX A and public ISDN A, when establishing the call to public ISDN B. This is because public ISDN B will understand only DDI numbers in accordance with the DDI arrangement between PINX B and public ISDN B. Instead, PINX B should supply public ISDN B with an identification number which is significant to public ISDN B. An international ISDN number will also be significant, but a national number will suffice when public ISDN A and public ISDN B are in the same country.

Public ISDN B should accept this identification number even though it is outside the context of any DDI arrangement with PINX B and therefore cannot be verified. Public ISDN B should mark a number as "user provided, not screened".

Free printed copies can be ordered from:
ECMA
114 Rue du Rhône
CH-1204 Geneva
Switzerland

Fax: +41 22 849.60.01
Email: documents@ecma.ch

Files of this Technical Report can be freely downloaded from the ECMA web site (www.ecma.ch). This site gives full information on ECMA, ECMA activities, ECMA Standards and Technical Reports.

ECMA
114 Rue du Rhône
CH-1204 Geneva
Switzerland

See inside cover page for obtaining further soft or hard copies.