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SERIES I: INTEGRATED SERVICES DIGITAL
NETWORK

Internetwork interfaces

Public/private ISDN interworking

Recommendation ITU-T I.570



ITU-T I-SERIES RECOMMENDATIONS
INTEGRATED SERVICES DIGITAL NETWORK

GENERAL STRUCTURE	
Terminology	I.110–I.119
Description of ISDNs	I.120–I.129
General modelling methods	I.130–I.139
Telecommunication network and service attributes	I.140–I.149
General description of asynchronous transfer mode	I.150–I.199
SERVICE CAPABILITIES	
Scope	I.200–I.209
General aspects of services in ISDN	I.210–I.219
Common aspects of services in the ISDN	I.220–I.229
Bearer services supported by an ISDN	I.230–I.239
Teleservices supported by an ISDN	I.240–I.249
Supplementary services in ISDN	I.250–I.259
OVERALL NETWORK ASPECTS AND FUNCTIONS	
Network functional principles	I.310–I.319
Reference models	I.320–I.329
Numbering, addressing and routing	I.330–I.339
Connection types	I.340–I.349
Performance objectives	I.350–I.359
Protocol layer requirements	I.360–I.369
General network requirements and functions	I.370–I.399
ISDN USER-NETWORK INTERFACES	
Application of I-series Recommendations to ISDN user-network interfaces	I.410–I.429
Layer 1 Recommendations	I.430–I.439
Layer 2 Recommendations	I.440–I.449
Layer 3 Recommendations	I.450–I.459
Multiplexing, rate adaption and support of existing interfaces	I.460–I.469
Aspects of ISDN affecting terminal requirements	I.470–I.489
INTERNETWORK INTERFACES	I.500–I.599
MAINTENANCE PRINCIPLES	I.600–I.699
B-ISDN EQUIPMENT ASPECTS	
ATM equipment	I.730–I.739
Transport functions	I.740–I.749
Management of ATM equipment	I.750–I.759
Multiplexing aspects	I.760–I.769

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T I.570

Public/private ISDN interworking

Summary

Recommendation ITU-T I.570 focuses on the aspect of private networks connection to a public integrated services digital network (ISDN) with ISDN user part (ISUP). This Recommendation presents public/private ISDN interworking reference configurations, scenarios for public/private ISDN interworking, service interworking and interworking requirements at point of interconnection.

History

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Table of Contents

	Page
1 Scope.....	1
2 References.....	1
3 Definitions	2
3.1 Terms defined elsewhere	2
3.2 Terms defined in this Recommendation.....	2
4 Abbreviations and acronyms	2
5 Conventions	2
6 Reference configurations	3
7 Scenarios for public/private ISDN interworking.....	4
8 Service interworking.....	5
8.1 Introduction	5
8.2 Service provision concept.....	6
8.3 Public/private ISDN configurations	7
8.4 Interworking requirements	8
9 Interworking requirements at point of interconnection	10
Bibliography.....	11

Recommendation ITU-T I.570

Public/private ISDN interworking

1 Scope

Recognizing that the ITU-T Recommendations on integrated services digital networks (ISDNs) apply to public ISDNs and may also apply to private ISDNs, there is a need to ensure smooth service interworking across public and private ISDNs such that the services provided are transparent to the user across the public and private network components. This Recommendation aims to provide general principles and guidelines for the interworking of public and private ISDNs.

The following objectives are envisaged in the development of Recommendations on public/private ISDN interworking:

- 1) The provision of common compatible functionality to provide common ISDN services;
- 2) The provision of end-to-end (TE1-type) ISDN terminal connectivity as well as terminal interchangeability;
- 3) A common overall ISDN transmission plan.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T E.164] Recommendation ITU-T E.164 (2010), *The international public telecommunication numbering plan.*
- [ITU-T E.166] Recommendation ITU-T E.166/X.122 (1998), *Numbering plan interworking for the E.164 and X.121 numbering plans.*
- [ITU-T I.112] Recommendation ITU-T I.112 (1993), *Vocabulary of terms for ISDNs.*
- [ITU-T I.210] Recommendation ITU-T I.210 (1993), *Principles of telecommunication services supported by an ISDN and the means to describe them.*
- [ITU-T I.230] Recommendation ITU-T I.230 (1988), *Definition of bearer service categories.*
- [ITU-T I.240] Recommendation ITU-T I.240 (1988), *Definition of teleservices.*
- [ITU-T I.411] Recommendation ITU-T I.411 (1993), *ISDN user-network interfaces – Reference configurations.*
- [ITU-T I.412] Recommendation ITU-T I.412 (1988), *ISDN user-network interfaces – Interface structures and access capabilities.*
- [ITU-T I.510] Recommendation ITU-T I.510 (1993), *Definitions and general principles for ISDN interworking.*
- [ITU-T I.520] Recommendation ITU-T I.520 (1993), *General arrangements for network interworking between ISDNs.*

- [ITU-T Q.764] Recommendation ITU-T Q.764 (1999), *Signalling System No.7 – ISDN User Part signalling procedures.*
- [ITU-T Q.931] Recommendation ITU-T Q.931 (1998), *ISDN user-network interface layer 3 specification for basic call control.*
- [ITU-T Q.1902.4] Recommendation ITU-T Q.1902.4 (2001), *Bearer independent call control protocol (Capability Set 2): Basic call procedures.*
- [ITU-T X.75] Recommendation ITU-T X.75 (1996), *Packet-switched signalling system between public networks providing data transmission services.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

- 3.1.1 customer equipment:** [ITU-T I.112], item 430.
- 3.1.2 customer network:** [ITU-T I.411]
- 3.1.3 network:** [ITU-T I.112], item 305.
- 3.1.4 user:** [ITU-T I.112], item 401.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

- 3.2.1 public network:** A network which provides services to the general public.
- 3.2.2 private network:** A network which provides services to a specific set of users only.
- 3.2.3 mixed public/private ISDN:** An overall ISDN which consists of any concatenation of public and private networks. The user perspective of the services offered by a mixed public/private ISDN is common and consistent across the public and private network components of the mixed network.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ISDN	Integrated Services Digital Network
ISPBX	Integrated Services Private Branch Exchange
ISUP	ISDN User Part
IWF	Interworking Function
LAPD	Link Access Procedure D-channel
SS7	Signalling System No. 7
TE	Terminal Equipment
VPN	Virtual Private Network

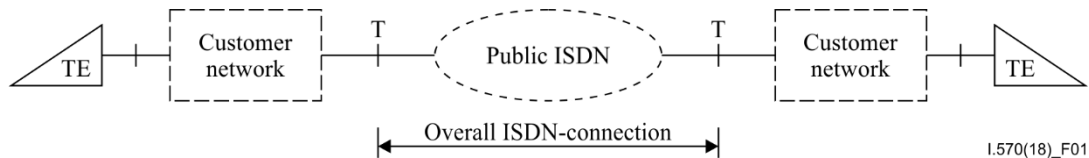
5 Conventions

None.

6 Reference configurations

The functional groups and reference configurations for the customer network are described in [ITU-T I.411], while the interface structures to be used at reference points S and T are described in [ITU-T I.412].

Figure 1 illustrates this overall division of functions involved in a communication across the ISDN.



NOTE 1 – The functional group customer network is described in [ITU-T I.411].

NOTE 2 – If the customer network is null (i.e., null NT2) the ISDN connection can be considered to end at coincident S and T reference points.

NOTE 3 – If the customer network is an ISPBX-based network, providing the same ISDN connection types according to [b-ITU-T I.430] as the public ISDN does, the ISDN connection ends at the S reference point as shown in Figure 2.

Figure 1 – General ISDN reference configuration



NOTE 1 – This reference configuration applies to the case where the customer network consists only of ISPBXs. The case in which "IS-CENTREXs" are included is for further study.

NOTE 2 – Other configurations are possible where the call is asymmetrical, or terminates in or involves high layer functions.

NOTE 3 – The terms "customer equipment" and "public ISDN" do not presuppose a particular regulatory situation in any country and are used purely for technical reasons. The connection type concept is defined in [b-ITU-T I.340].

Figure 2 – Overall ISDN reference configuration for a mixed ISPBX/public ISDN scenario

Public/private ISDN interconnection at Nx reference point will be regarded as ISDN-to-ISDN interworking. The definitions and general principles of ISDN interworking are described in [ITU-T I.510]. Figure 3 shows the general reference configuration of the private ISDN connecting to the public ISDN at the Nx reference point.

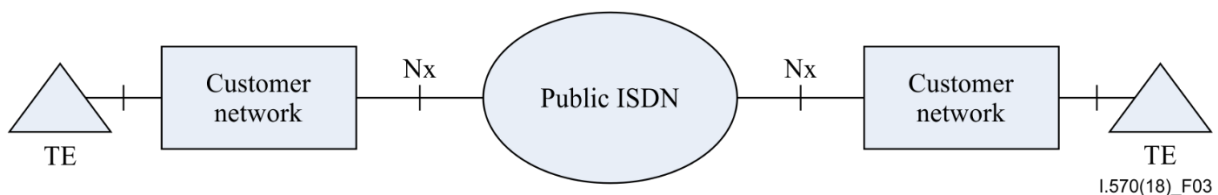


Figure 3 – General reference configuration of the private ISDN connecting to the public ISDN at the Nx reference point scenario

Figure 4 shows overall reference configuration for a mixed ISPBX/private ISDN connecting to the public ISDN at the Nx reference point. S reference point is provided to the TE by ISPBX/private ISDN.

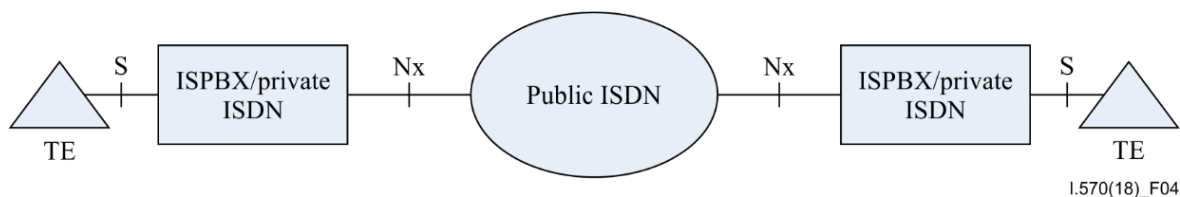


Figure 4 – Overall reference configuration for a mixed ISPBX/private ISDN connect to the public ISDN at the Nx reference point scenario

7 Scenarios for public/private ISDN interworking

In the overlay scenario, the connection, which is established through the public ISDN, is treated as a private ISDN-to-private ISDN link (link B in Figure 5). Signalling and/or user information which is carried on link B is transparent to the public ISDN.

In this case, the services available to a terminal equipment (TE) are those offered by the private ISDN, as if they were provided via link A.

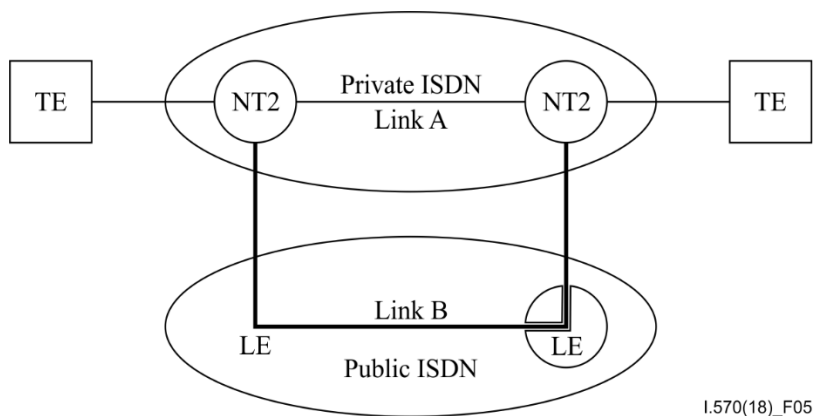


Figure 5 – Overlay scenario

For the concatenated case (see Figure 6), interworking is required at the user-network access of the public ISDN, i.e., at links 1 and 3. In this case, the services provided to a TE are realized by the cooperation of functions and capabilities provided by both the public and private network.

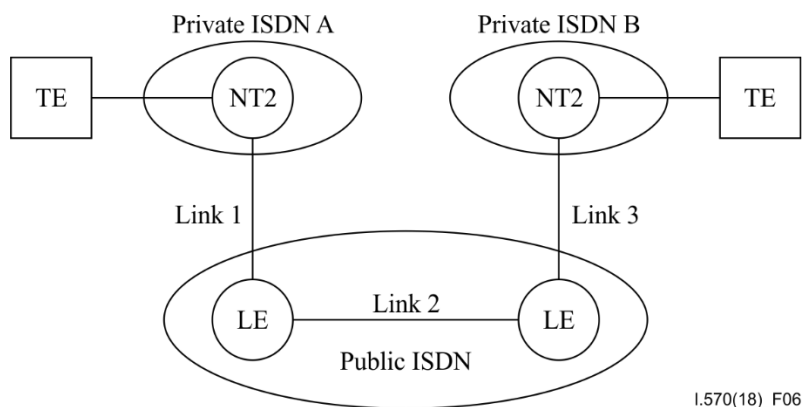


Figure 6 – Concatenation scenario

Figure 7 shows a concatenated case where the private ISDN interworks with the public ISDN at the Nx reference point, i.e., at link 1 and link 3. In this case, the services provided to a TE are realized by the private network. The private and public network are interworked at Nx reference point where Signalling System No. 7 (SS7) is used to carry the information handled at the interworking function (IWF).

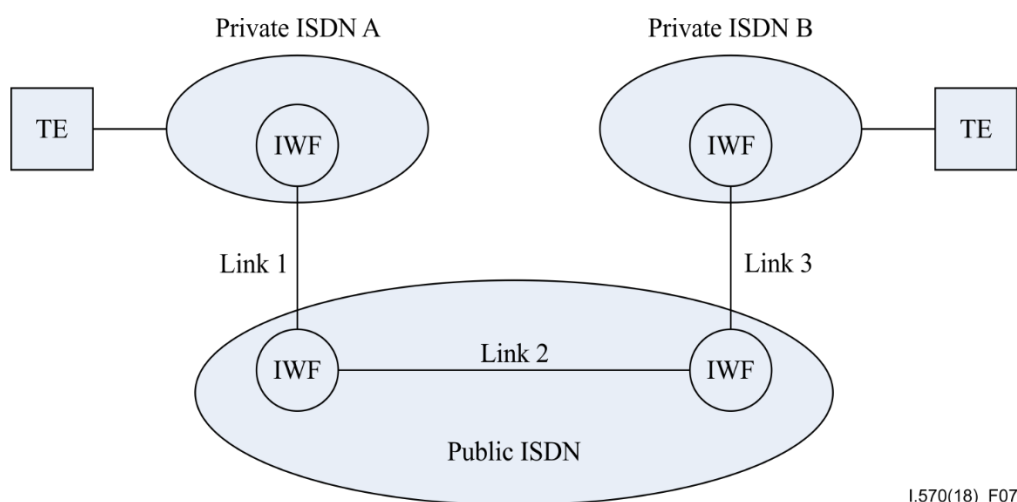


Figure 7 – Concatenation scenario for interworking with ISUP/BICC

The functionality of an overlay scenario may be achieved by upgrading a concatenation scenario by means of virtual private network (VPN) features. Virtual private ISDNs may support features such as uniform numbering plan, specialized routing, account codes and extension dialling. Also the efficiency of user information transfer may be improved e.g., by the provision of A-law/ μ -law conversion, echo cancellation, etc. The VPN concept and its relationship to the overlay and concatenation scenarios require further study.

NOTE – The overlay scenario (Figure 5) is not currently addressed in clauses 8 and 9.

8 Service interworking

8.1 Introduction

The following public/private ISDN interworking principles are identified:

- i) In a mixed public/private ISDN, the stage 1 service descriptions should provide views of the service for both the S and T reference points and these views may be different. Where S and T reference points are coincident, one view of the service applies. Additional requirements for the service definition at the T reference point, if any, should be separately identified.
- ii) For each service, several scenarios may be possible for the actual physical location of logical functionality to the public ISDN. The range of scenarios supported by the public ISDN needs to be identified (by stage 2 service descriptions).
- iii) For some services and a particular private ISDN, the specific scenarios that are applicable with respect to physical allocation of functionality should be negotiated and agreed to between the public ISDN and the private ISDN at subscription time. For other services, additional signalling capabilities shall provide the necessary information.

Service-specific requirements are defined and described in the ITU-T I.200-series of Recommendations.

8.2 Service provision concept

8.2.1 Service interworking at S/T reference point

Service interworking aspects between public ISDNs and private ISDNs shall be specified at the T reference point. Basic bearer services and bearer capabilities as used in the context of teleservices and supplementary services may be supported independently by the private and public ISDN.

Where calls pass through a public and a private ISDN:

- both networks will be involved in the provision of basic services,
- both networks will share their involvement in the provision of supplementary services.

The degree of involvement for each ISDN varies, depending on the basic or supplementary service concerned.

The involvement of public and private ISDNs shall be indicated in each service description by one of the following categories:

- *Local*: if only one ISDN is involved. This can be with or without notification to the remote party and both ISDNs shall be capable of conveying such notifications.
A local involvement can also occur in both networks simultaneously. For example, the invocation of the public ISDN service by the private ISDN at the T reference point can enable the private ISDN to offer the service at the S reference point. This is classified "double".
- *Cooperative*: if both ISDNs are involved. This case requires cooperation between both ISDNs, whose functions will be complementing each other.

Depending on the actual routing of a call, some services need to be classified in both categories.

As a consequence of the cooperation between the public and private ISDN in providing common services in mixed private/public calls, the information exchanged at the T reference point between two ISDNs may be different from what is exchanged between terminals and either ISDN at the S and S and T coincident reference points.

Therefore, the service descriptions of the public ISDN shall, where appropriate, take into account these two types of customer configurations.

8.2.2 Service interworking at Nx reference point

Bearer services and teleservices to be supported by ISDN interworking at Nx reference point are defined in [ITU-T I.510]. End-to-end communication may require:

- interworking at lower layers;
- interworking at higher layers;
- interworking at both lower and higher layers.

NOTE – Bearer service in the ISDN, as defined in [ITU-T I.210] and [ITU-T I.230], provides the user with the possibility of gaining access to various forms of communication.

Teleservice, as defined in [ITU-T I.210] and [ITU-T I.240], provides the full capacity for communication through terminal and network lower and higher layer functions.

8.3 Public/private ISDN configurations

8.3.1 Configurations for public/private ISDN interconnection at S/T reference point

Conceptually, there is a single connection at the T reference point between a public and a private ISDN. However, in practice, there can be more than one instance of a T reference point (see Figure 8) because:

- a private ISDN can be connected to more than one public ISDN;
- a private ISDN exchange can be connected to more than one public ISDN exchange;
- a public ISDN exchange can be connected to more than one private ISDN exchange.

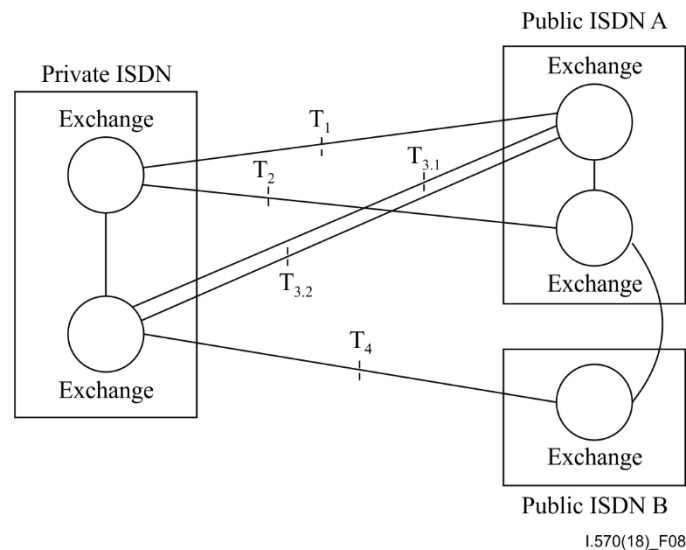


Figure 8 – Example of a public/private ISDN configuration

NOTE 1 – Unless explicitly stated otherwise, the termination of the accesses of one private ISDN exchange on different local exchanges of the public ISDN shall not be assumed.

If the grade of service for intercommunication between a public and a private ISDN requires more than one basic and/or primary rate access to be provided, public ISDNs shall offer the possibility to combine the B- and D-channels of these accesses to one or more trunk group(s)¹, see T_{3.1} and T_{3.2} in Figure 8.

NOTE 2 – The possibility of more than one trunk group between two exchanges is useful for a number of operational and management purposes, e.g., to reserve certain accesses for particular purposes. The description of these purposes is outside the scope of this Recommendation.

As a subscription option, single or multiple collective number(s) shall be assigned to a trunk group. From a numbering point of view all B- and D-channels of an entire trunk group may form one or multiple bundles.

8.3.2 Configurations for public/private ISDN interconnection at Nx reference point

Public/private ISDN interconnection at Nx reference point will be regarded as ISDN-to-ISDN interworking in the context of the ITU-T I.500-series of Recommendations.

Connection types applicable in [ITU-T I.520]:

- Type A: ISDN circuit mode – ISDN circuit mode;

¹ The term "trunk group" refers to trunks of private ISDN exchanges, not local exchanges of the public ISDN.

- Type B: ISDN packet mode – ISDN packet mode;
- Type C: ISDN packet mode – ISDN circuit mode.

Signalling system No. 7 will be utilized when type A is applied to an interworking configuration. ITU-T X.75 interexchange signalling will be applied when type B is deployed to an interworking configuration. Signalling to be utilized will depend on the different interworking configuration when type C is applied.

The functionalities required for bearer service interworking are contained in ISDN-to-ISDN internetwork interfaces. The functions and other requirements for the ISDN-ISDN interface were identified in [ITU-T I.520].

8.4 Interworking requirements

8.4.1 Numbering

8.4.1.1 Use of numbering plans

The public ISDN shall employ the ISDN numbering plan for the ISDN era, see [ITU-T E.164]. The private ISDN can employ either an ITU-T E.164 format plan or a private numbering plan or both numbering plans. An ITU-T E.164 format plan should be used by the private ISDN when the private ISDN interworks with the public ISDN at the Nx reference point with signalling system No. 7.

For calls to/from a public ISDN, numbers of the ITU-T E.164 plan are normally used (Note). In addition, numbers of other ITU-T specified numbering plans, e.g., of the ITU-T X.121 numbering plan, may appear in certain interworking situations. Interworking between numbering plans is defined in [ITU-T E.166]. Arrangements other than those defined therein will be subject to subscription arrangements supported by the public ISDN.

NOTE – Numbers in an "unknown" numbering plan may also be used, in particular when a prefix or an escape code is present, (see [ITU-T Q.931] for a definition and use of "unknown" numbering plan). In this case, the number must be organized according to the public network dialling plan.

If the public ISDN supports private numbering plans and the private ISDN subscribes to a service that makes use of such plans, numbers of a private ISDN's numbering plan may appear at the T reference point.

8.4.1.2 Screening and non-screening arrangement

Public and private ISDNs shall be responsible for the correctness of identification numbers, i.e., they shall determine identities within their respective domains, or at least, verify identity numbers offered them by their terminals. Any interchange of identification numbers, which might be used in the context of supplementary services, will be subject to applicable screening arrangements between the public and private ISDN.

If identification numbers (e.g., calling line, connected line, forwarding numbers, etc.) are offered by a private ISDN to a public ISDN, one of the following two arrangements applies:

a) Screening arrangement

As a standard connection arrangement, the public ISDN may apply screening of identification numbers offered by a private ISDN. If the identification number provided by the private ISDN is valid and the check is successful, this number is used by the network. If the check is unsuccessful, the public ISDN will assign the default ITU-T E.164 number for the private ISDN.

b) Non-screening arrangement

Based on subscription to a special connection arrangement, the public ISDN will not apply screening of identification numbers offered by a private ISDN. The public ISDN shall then

only accept national or international ISDN numbers. If a national ISDN number is received, the public ISDN shall, if so applicable, alter it according to a possibly different hierarchical numbering range, e.g., to an international number (addition of country code). If an international ISDN number is received, the public ISDN shall not alter it.

8.4.2 Access between public and private ISDNs

For the purpose of this Recommendation, only access aspects relating to interworking between public and private ISDNs are discussed. Any other usage, e.g., for private networking over tie-lines via semi-permanent connections, is outside the scope of this Recommendation.

8.4.2.1 Access types

Basic, primary rate access and/or access with signalling system No. 7 shall be used for the interconnection of public with private ISDNs.

NOTE – In the case of a private ISDN node being "IS-CENTREX" the interconnection may be implemented differently.

8.4.2.2 Activation/deactivation

It shall be possible to arrange that the public ISDN does not deactivate basic rate accesses when no calls are in progress.

NOTE – Continuous operation of the access allows maintenance of synchronization in the private network (where internal calls might still be going on) and avoids time delays for resynchronization when mixed private/public calls are to be established.

8.4.2.3 Supply of reference clock

It shall be up to the private network operator to define which of the individual accesses shall be used as a reference access for providing the public ISDN clock to the private ISDN. This definition can also include which other accesses are to be used for this purpose in the case that the reference access fails.

8.4.3 Channel selection principle

For both directions of call setup (see Figure 8), the selection of a distinct B- or D-channel of a trunk group for user information transfer shall be based on the requested bearer capabilities (i.e., the acceptance of a call request by the requested ISDN does not imply that terminal characteristics like high layer compatibilities are met).

If in either direction of call setup no resources are available for further progressing the call, the setup request shall be rejected and an indication of congestion shall be given to the requesting party.

8.4.4 Circuit selection principle

Similar to the channel selection principle, the selection of a circuit of a trunk group for user information transfer shall be based on the requested transmission medium.

If in either direction of call initialling, no resources are available for further progressing the call, the initial request shall be rejected and an indication of congestion shall be given to the requesting party.

The procedures and protocols of circuit selection are defined in [ITU-T Q.1902.4] and [ITU-T Q.764].

8.4.5 Transfer of call control information for connection at the T reference point

Call control information relating to user information transfer over the B- or D-channels of a given access shall be conveyed on the D-channel belonging to the same access (access associated signalling). Within that D-channel call control information can be conveyed in a point-to-point or point-to-multipoint mode of operation. In the case of point-to-point mode of operation, a single,

predetermined layer 2 connection shall carry all call control information, including requests for the establishment of calls. At least, the point-to-point mode of operation shall be supported by all ISDNs.

NOTE – This does not preclude that for non-signalling applications, e.g., the transfer of packet data, connections need to be established on a D-channel which uses non-predetermined data links and that consequently signalling procedures for the determination of data link identifiers are needed.

9 Interworking requirements at point of interconnection

Private ISDNs can connect to the public ISDN at reference point T. The procedures and protocols applicable at reference point T are as defined in the ITU-T Q.920- and ITU-T Q.930-series of Recommendations.

In order that link access procedure D-channel (LAPD) can be applicable for communication in a mixed public/private network situation, the user side and network side must be designated to the adjacent link entities. In a mixed public/private network situation, the public network assumes the network side and the private network assumes the user side.

Private ISDNs can connect to the public ISDN at reference point Nx. If both private and public ISDNs provide circuit mode bearer services, BICC/ISUP should be used. The procedures and protocols of BICC/ISUP are as defined in the ITU-T Q.1902- and ITU-T Q.760-series Recommendations.

Other points of interconnection to the public ISDN from private ISDNs are for further study.

Bibliography

- [b-ITU-T I.340] Recommendation ITU-T I.340 (1988), *ISDN connection types*.
- [b-ITU-T I.430] Recommendation ITU-T I.430 (1995), *Basic user-network interface – Layer 1 specification*.

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