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SERIES X: DATA NETWORKS AND OPEN SYSTEM COMMUNICATION

Interworking between networks – General

General arrangements for interworking between integrated services digital networks (ISDNs) for the provision of data transmission services

ITU-T Recommendation X.320

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

FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (ITU). The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation X.320, was revised by ITU-T Study Group 7 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 5th of October 1996.

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NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

CONTENTS

SUMMARY

This Recommendation defines general arrangements for the interworking between ISDNs for the provision of data transmission services. These arrangements are applicable only to the interworking involving transmission capabilities and not to interworking involving communication capabilities as described in Recommendation X.300.

INTRODUCTION

This Recommendation is one of a set of Recommendations produced to facilitate considerations of interworking between networks. It is based on Recommendation X.300 which defines the general principles for interworking between public networks, and between public networks and other networks for the provision of data transmission services. Recommendation X.300 indicates in particular how collections of physical equipment can be represented as "subnetworks" for consideration in interworking situations.

This Recommendation describes the interworking arrangements between ISDNs for the provision of data transmission services.

GENERAL ARRANGEMENTS FOR INTERWORKING BETWEEN INTEGRATED SERVICES DIGITAL NETWORKS (ISDNs) FOR THE PROVISION OF DATA TRANSMISSION SERVICES

(Melbourne, 1988; revised in 1996)

1   Scope

The purpose of this Recommendation is to describe the general arrangements for the interworking between ISDNs for the provision of data transmission services. These arrangements are applicable only to the interworking involving transmission capabilities, and not to interworking involving communication capabilities as described in Recommendation X.300.

> NOTE – The typing of subnetworks in this Recommendation is based on the support for the OSI connection-mode network service and is therefore only valid in this context.

2   References

The following 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; all 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 Recommendation is regularly published.

–   CCITT Recommendation E.164 (1991), *Numbering plan for the ISDN era*.

–   ITU-T Recommendation E.166/X.122 (1996), *Numbering plan interworking for the E.164 and X.121 numbering plans*.

–   I.230-Series Recommendations, *Integrated services digital network – Service capabilities – Bearer services supported by an ISDN*.

–   I.250-Series Recommendations, *Integrated services digital network – Service capabilities – Supplementary services in ISDN*.

–   ITU-T Recommendation I.500 (1993), *General structure of the ISDN interworking Recommendations*.

–   ITU-T Recommendation X.1 (1996), *International user classes of service in, and categories of access to, public data networks and Integrated Services Digital Networks (ISDNs)*.

–   ITU-T Recommendation X.2 (1996), *International data transmission services and optional user facilities in public data networks and ISDNs*.

–   ITU-T Recommendation X.10 (1993), *Categories of access for Data Terminal Equipment (DTE) to public data transmission services*.

–   ITU-T Recommendation X.31 (1995), *Support of packet mode terminal equipment by an ISDN*.

–   ITU-T Recommendation X.33 (1996), *Access to packet switched data transmission services via frame relaying data transmission services*.

–   ITU-T Recommendation X.75 (1996), *Packet-switched signalling system between public networks providing data transmission services*.

–   ITU-T Recommendation X.76 (1995), *Network-to-network interface between public data networks providing the frame relay data transmission service*.

–   ITU-T Recommendation X.121 (1996), *International numbering plan for public data networks*.

–   ITU-T Recommendation X.300 (1996), *General principles for interworking between public networks, and between public networks and other networks for the provision of data transmission services.*

–   ITU-T Recommendation X.301 (1996), *Description of the general arrangements for call control within a subnetwork and between subnetworks for the provision of data transmission services.*

–   CCITT Recommendation X.302 (1988), *Description of the general arrangements for internal network utilities within a subnetwork and intermediate utilities between subnetworks for the provision of data transmission services.*

–   Recommendation X.305 (1988), *Functionalities of subnetworks relating to the support of OSI connection-mode network service.*

3   Terms and definitions

This Recommendation makes use of the following terms defined in Recommendation X.300:

a)   transmission capability;

b)   communication capability;

c)   subnetwork functionality;

d)   data transmission service;

e)   interworking by call control;

f)   interworking by port access.

This Recommendation makes use of the following terms defined in the I.230-Series Recommendations:

a)   circuit switched bearer service;

b)   packet switched virtual circuit bearer service;

c)   frame relaying bearer service.

4   Abbreviations

For the purposes of this Recommendation, the following abbreviations apply:

CNIC	Clearing Network Identification Code
CUG	Closed User Group
CUG/OA	Closed User Group with Outgoing Access
DTE	Data Terminal Equipment
ISDN	Integrated Services Digital Network
IWF	Interworking Function
MSS	Mobile Satellite System
PSPDN	Packet Switched Public Data Network
SS No. 7	Signalling System No. 7
TA	Terminal Adaptor
TE	Terminal Equipment
TNIC	Transit Network Identification Code

5   Conventions

No particular conventions are used.

6 General aspects

This Recommendation, in describing interworking arrangements between two subnetworks for the provision of data transmission services, adheres to the general principles of Recommendation X.300. The environments of these two subnetworks are described in the following subclauses. See also Table 1.

TABLE 1/X.320

General characteristics of ISDN

General characteristic	ISDN
Data transmission service/Bearer service	X.1, I.230-Series
Supplementary services	Circuit-Mode I.250-Series, Packet-Mode X.301 Frame-Mode X.36
Categories of access	X.1 categories S, T, U See also 5.1
Access via other networks PSTN CSPDN PSPDN FRPDN MSS ISDN	 I.530 Recommendations X.321 and X.1 category B Recommendations X.325 and X.1 categories C, D X.328 X.324 SS No.7, X.75, X.76 X.1 category Y, this Recommendation

6.1 ISDN

The ISDN may provide packet switched and/or circuit switched and/or frame relay data transmission services/bearer services as defined in Recommendations X.1, I.230-Series, and X.2.

> NOTE 1 – Supplementary services/optional user facilities for the circuit-mode operation on ISDN are in the I.250-Series Recommendations. Recommendation X.2 applies to ISDN packet switched data transmission services/bearer services. Supplementary services for the frame relaying operation on ISDN are for further study.

For the provision of data transmission services, the ISDN may be accessed by DTEs/TEs by the categories of access S, T, U as defined in Recommendation X.1 and/or the access methods defined in the I.230-Series Recommendations. In addition the ISDN may also be accessed via other networks, i.e. PSTN (see Recommendation I.530), CSPDN (see Recommendation X.1, category B and Recommendation X.321), PSPDN (see Recommendations X.325 and X.1, categories C, D), MSS (see Recommendation X.324), or ISDN (SS No. 7, Recommendations X.75 and X.76, see Recommendation X.1, category Y and this Recommendation).

> NOTE 2 – In the context of this Recommendation, and for the purpose of provision of data transmission services only, the following categories of bearer services defined in the I.230-Series Recommendations are considered. (Others are for further study.):

   a) circuit-mode 64 kbit/s unrestricted, 8 kHz structured;

   b) circuit-mode 64 kbit/s, 8 kHz structured, usable for speech information transfer;

   c) circuit-mode 64 kbit/s, 8 kHz structured, usable for 3.1 kHz audio information transfer;

   d) virtual call and permanent virtual circuit;

   e) frame relaying bearer service.

6.2 Call control between ISDNs

The general arrangements for call control between ISDNs are as defined in Recommendation X.301. Network utilities used between the PSPDN and ISDN are as defined in Recommendation X.302 (not visible for users). Supplementary services/optional user facilities for the circuit-mode operation on ISDNs are as defined in the I.250-Series Recommendations.

NOTE – Supplementary services for the frame relaying operation on ISDN are for further study.

6.3 Functionalities of the ISDN

The functionalities of different types of subnetworks are described in Recommendation X.305. In the case where two ISDNs are used to provide different data transmission services/bearer services of circuit switched, frame relaying or packet switched, the functionality of the two ISDNs differs. Therefore, in order to enable interworking, procedures must be operated over the circuit switched or the frame relaying bearer to achieve functional compatibility. In the case where both ISDNs are used to provide a same data transmission service/bearer service, the ISDNs are functionally compatible.
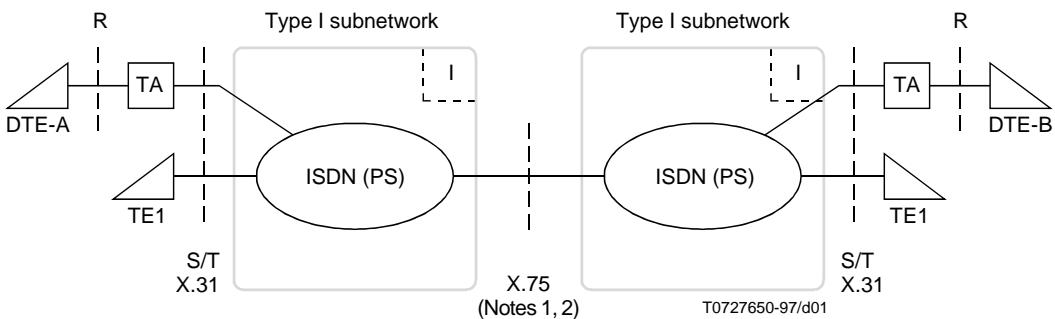
7 Specific interworking arrangements

As described in Recommendation X.300, the following interworking cases should be distinguished:

a) interworking between ISDNs, each using a packet switched bearer;

b) interworking between ISDNs, each using a circuit switched bearer;

c) interworking between ISDNs, each using frame relaying bearer;

d) interworking between ISDNs, where a packet switched bearer is used on one ISDN, and a circuit switched bearer is used on the other:

1) interworking by call-control mapping;

2) interworking by port access;

e) interworking between ISDNs, where a packet switched bearer is used on one ISDN, and a frame relaying bearer is used on the other:

1) interworking by call-control mapping;

2) interworking by port access;

f) interworking between ISDNs, where a circuit switched bearer is used on one ISDN, and a frame relaying bearer is used on the other:

1) interworking by call-control mapping;

2) interworking by port access.

7.1 Interworking between ISDNs, where a packet switched bearer is requested on each

The detailed procedures for interworking by call-control mapping are defined in Recommendation X.75 (see Figure 1). The use of other Recommendations is for further study. In particular, the following applies:

NOTE 1 – The use of other Recommendations is for further study.

NOTE 2 – The use of X.75 applies between the packet handling functions of the ISDNs. These packet handling functions support the ISDN virtual circuit bearer service defined in Recommendation X.31.

FIGURE 1/X.320

**ISDN/ISDN packet-mode interworking where both ISDNs
support the ISDN virtual circuit bearer service**

7.1.1 Transfer of addressing information

ISDNs typically utilize the E.164 numbering plan. The considerations on the transfer of E.164 addressing information in X.75 are given in Recommendation X.301.

7.1.2 Arrangements for facilities related to the QOS of the call

These arrangements are as described in Recommendation X.301.

7.1.3 Arrangements for facilities related to charging conditions applying to the call

These arrangements are as described in Recommendation X.301.

7.1.4 Arrangements for facilities related to specific routing conditions requested by the user of the call

These arrangements are as described in Recommendation X.301.

7.1.5 Arrangements for facilities related to protection mechanisms requested by the user of the call

These arrangements are as described in Recommendation X.301. In particular, for the CUG and CUG/OA facilities the interlock code mechanism described in Recommendation X.180 shall be applied.

7.1.6 Arrangements for facilities to convey user data in addition to the normal data flow in the data transfer phase

These arrangements are as described in Recommendation X.301.

7.1.7 Arrangements for other facilities

These arrangements are as described in Recommendation X.301.

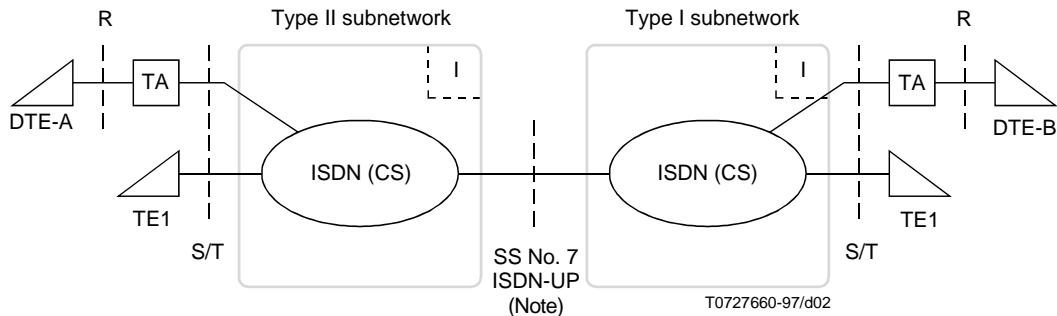### 7.1.8 Arrangements for internal network utilities (not visible for users)

These arrangements are as described in Recommendation X.302. In particular, the mechanisms for network identification are applied as follows:

– the ISDN is identified by the Recommendation X.302 method.

The network identification is then further applied in the TNIC and CNIC utilities of Recommendation X.75.

7.2 Interworking between ISDNs where a circuit switched bearer is requested on each

The detailed procedures for interworking are defined in Signalling System No. 7, ISDN-user part (see Figure 2). In particular, the following applies:

NOTE – In this case of direct interworking between the two ISDNs, the inter-network interface would be achived using Signaling System No. 7, ISDN-UP.

FIGURE 2/X.320

ISDN/ISDN circuit-mode interworking

7.2.1 Transfer of addressing information

ISDNs typically utilize the E.164 numbering plan. The considerations on the transfer of addressing information are given in Recommendation X.301.

7.2.2 Arrangements for facilities related to QOS of the call

These arrangements are as described in Recommendation X.301.

7.2.3 Arrangements for facilities related to changing conditions applying to the call

These arrangements are as described in Recommendation X.301.

7.2.4 Arrangements for facilities related to specific routing conditions requested by the user of the call

These arrangements are as described in Recommendation X.301.

7.2.5 Arrangements for facilities related to protection mechanisms requested by the user of a call

These arrangements are as described in Recommendation X.301.

7.2.6 Arrangements for facilities to convey user data in addition to the normal data flow in the data transfer phase

These arrangements are as described in Recommendation X.301.

7.2.7 Arrangements for other facilities

These arrangements are as described in Recommendation X.301.

7.2.8 Arrangements for internal network utilities

These arrangements are as described in Recommendation X.302.

7.3 Interworking between ISDNs where a frame relaying bearer is used on each

See Figure 3.

NOTE – The use of other Recommendations is for further study.

FIGURE 3/X.320

ISDN/ISDN interworking where both ISDNs support the ISDN FRBS

7.3.1 Transfer of addressing information

ISDNs typically utilize the E.164 numbering plan. The considerations on the transfer of addressing information are given in Recommendation X.301.

7.3.2 Arrangements for facilities related to QOS of the call

These arrangements are as described in Recommendation X.301.

7.3.3 Arrangements for facilities related to changing conditions applying to the call

These arrangements are as described in Recommendation X.301.

7.3.4 Arrangements for facilities related to specific routing conditions requested by the user of the call

These arrangements are as described in Recommendation X.301.

7.3.5 Arrangements for facilities related to protection mechanisms requested by the user of a call

These arrangements are as described in Recommendation X.301. In particular, for the CUG and CUG/OA facilities the interlock code mechanism described in Recommendation X.180 shall be applied.

7.3.6 Arrangements for facilities to convey user data in addition to the normal data flow in the data transfer phase

These arrangements are as described in Recommendation X.301.
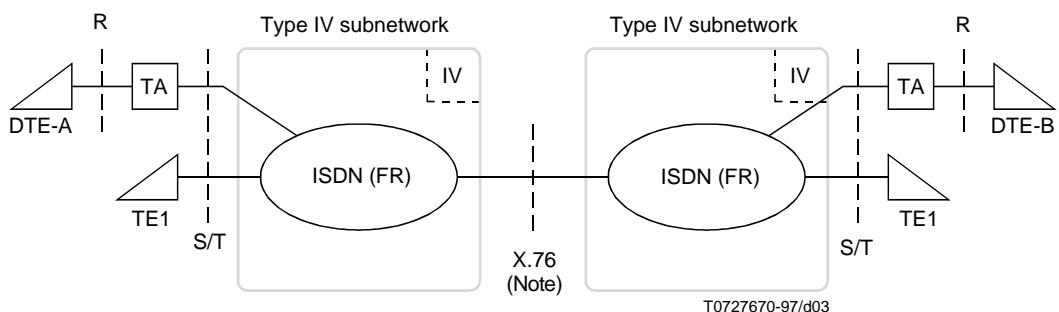
7.3.7 Arrangements for other facilities

These arrangements are as described in Recommendation X.301.
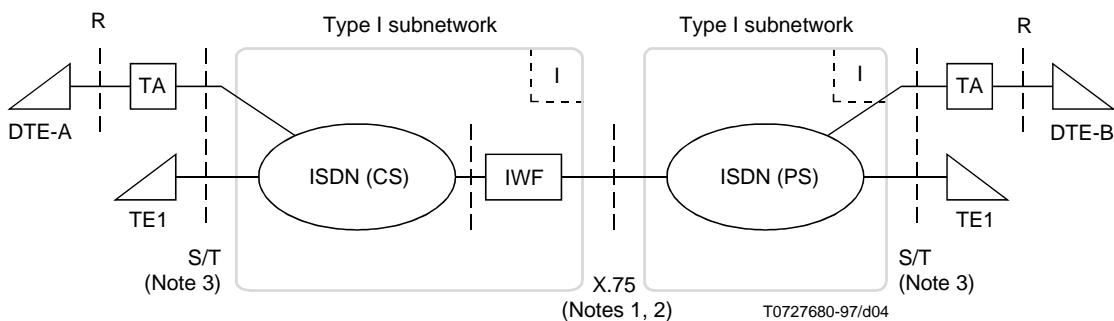
7.3.8 Arrangements for internal network utilities

These arrangements are as described in Recommendation X.302.

7.4 Interworking between ISDNs where a packet switched bearer is used on one, and a circuit switched bearer is used on the other

7.4.1 Interworking by call-control mapping

See Figure 4.

NOTE 1 – The use of other Recommendations is for further study.

NOTE 2 – Recommendations X.75 applies between the packet handling function in the IWF and the packet handling function in the ISDN, where the ISDN virtual circuit bearer is requested as defined in Recommendation X.31.

NOTE 3 – The exact protocols to be used for accessing this subnetwork are for further study.
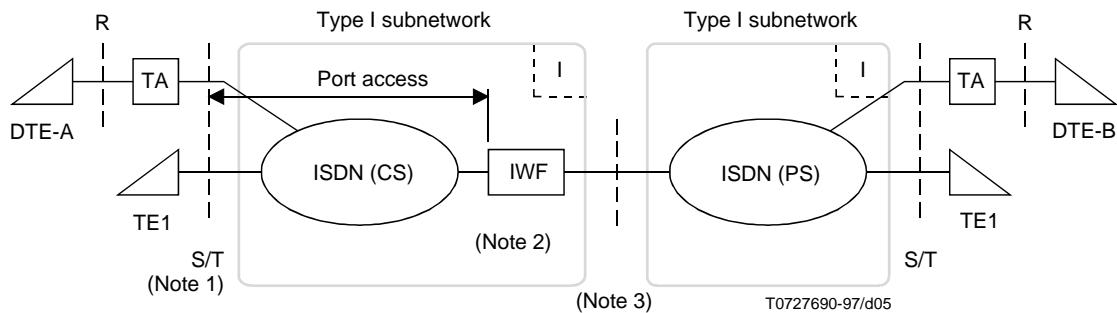
FIGURE 4/X.320

Interworking by call-control mapping

In order to enable interworking, procedures must be operated over the ISDN circuit switched bearer to achieve functional capability. However, these procedures are for further study. In general, the following applies:

–   Call-control arrangements in the circuit-switched case of ISDN (i.e. I.420 or the functionality identical SS No. 7 protocol or a functionally identical internal network protocol) should be mapped in the IWF to the call-control arrangements in the packet switched case of ISDN (i.e. X.75 or a functionally identical internal network protocol). This mapping is for further study.

–   Data transfer arrangements in the packet switched case of ISDN (i.e. X.75 or a functionally identical internal network protocol) should be mapped in the IWF to the procedures operated over the circuit switched bearer between IWF and TE/DTE. This mapping is for further study.

7.4.2 Interworking by port access

See Figure 5.

NOTE 1 – The ISDN terminal or TA (DTE-A) is, in this case, different from a terminal connected to the ISDN supporting the ISDN virtual circuit bearer service as defined in Recommendation X.31.

NOTE 2 – In this case, the IWF logically belongs to the ISDN providing the ISDN virtual circuit bearer service [ISDN (PS)].

NOTE 3 – X.75 or a functionally identical internal network protocol.

FIGURE 5/X.320

ISDN/ISDN interworking where a circuit switched bearer is requested to one ISDN and a virtual circuit bearer service is requested to the other ISDN

In order to enable interworking, procedures must be operated over the ISDN circuit switched bearer to achieve functional compatibility. These procedures follow Recommendation X.25 (see Recommendations X.31 and X.1 access category Y). Aspects of Recommendation X.32 apply as noted in Recommendation X.31.

In general, the following applies:

– X.75, or a functionally identical internal network protocol is operated between the packet switched case of ISDN and IWF.

– I.420, or ISDN-UP, or a functionally identical internal network protocol is operated between the circuit switched case of ISDN and the IWF, and used to control the circuit switched bearer.

– X.25 is operated between the IWF and the DTE/TE over the ISDN circuit switched bearer.

"Dialling out" considerations

A circuit switched bearer will be set up through the ISDN upon receipt of a X.75 call request packet, i.e.:

– The Q.931 called party number (and subaddress, if provided) are derived from the X.75 call request packet.

– The Q.931 bearer capability is coded as circuit mode.

– After establishment of the circuit switched bearer, a link connection will be established and the X.75 call request packet will be mapped by the IWF to an X.25 incoming call packet.

– Further procedures are as detailed in Recommendation X.31.

"Dialling in" considerations

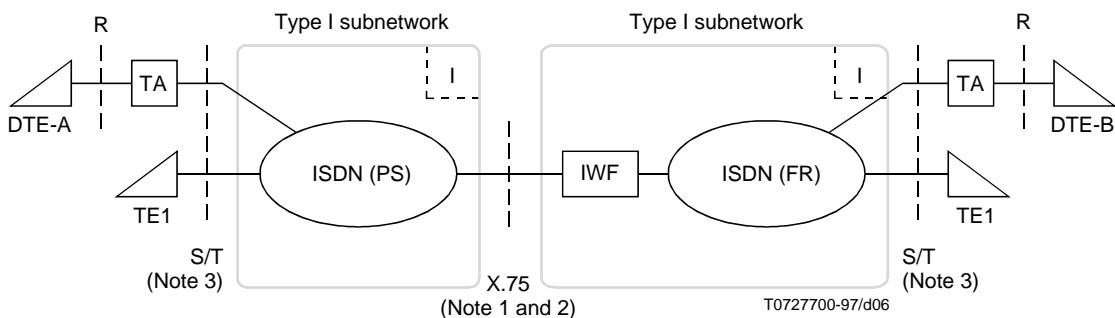A circuit switched bearer will be set up through the ISDN, i.e.:

– The Q.931 called party number is the address of the IWF (port address).

– The Q.931 bearer capability is coded as circuit mode.

– After establishment of the circuit switched bearer, a link connection will be established.

– An X.25 call request packet will be mapped by the IWF to an X.75 call request packet.

– Further procedures are as detailed in Recommendation X.31.

7.5 Interworking between ISDNs, where a packet switched bearer is used on one ISDN, and a frame relaying bearer is used on the other

7.5.1 Interworking by call-control mapping

See Figure 6.

NOTE 1 – Recommendations X.75 applies between the packet handling function in the IWF and the packet handling function in the ISDN

NOTE 2 – The use of other Recommendations is for further study.

NOTE 3 – The exact protocols to be used for accessing this subnetwork are for further study.

FIGURE 6/X.320

ISDN/ISDN interworking where a packet switched bearer is requested to one ISDN and frame relaying bearer service is requested on the other ISDN (interworking by call-control mapping)

In order to enable interworking, procedures must be operated over the ISDN frame relaying bearer to achieve functional capability. However, these procedures are for further study. In general, the following applies:
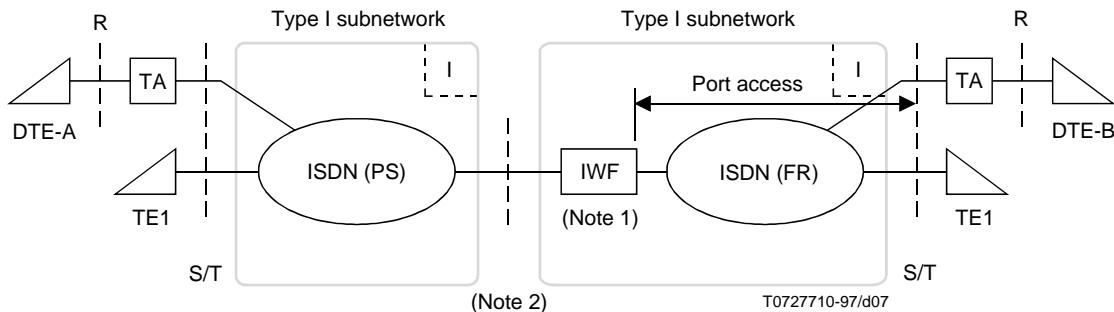
– Call control arrangements in the frame-relaying case of ISDN (Q.933 or the functionality identical internal network protocol) should be mapped in the IWF to the call-control arrangements in the packet switched case of ISDN (i.e. X.75 or functionally identical internal network protocol). This mapping is for further study.

– Data transfer arrangements in the packet switched case of ISDN (i.e. X.75 or a functionally identical internal network protocol) should be mapped in the IWF to the procedures operated over the frame relaying bearer between IWF and TE/DTE. This mapping is for further study.

7.5.2 Interworking by port access

In order to enable interworking, procedures must be operated over the ISDN frame relaying bearer to achieve functional compatibility. These procedures follow Recommendation X.25 (see Figure 7).

In general, the following applies:

– X.75, or functionally identical internal network protocol is operated between the packet switched case of ISDN and IWF.

– Q.933, or functionally identical internal network protocol is operated between the frame-relaying case of ISDN and the IWF, and used to control the frame relaying bearer.

– X.33 is operated between the IWF and the DTE/TE over the ISDN frame relaying bearer.

FIGURE 7/X.320

ISDN/ISDN interworking where a packet switched bearer is requested to one ISDN and a frame relaying bearer service is requested on the other ISDN (interworking by port access)
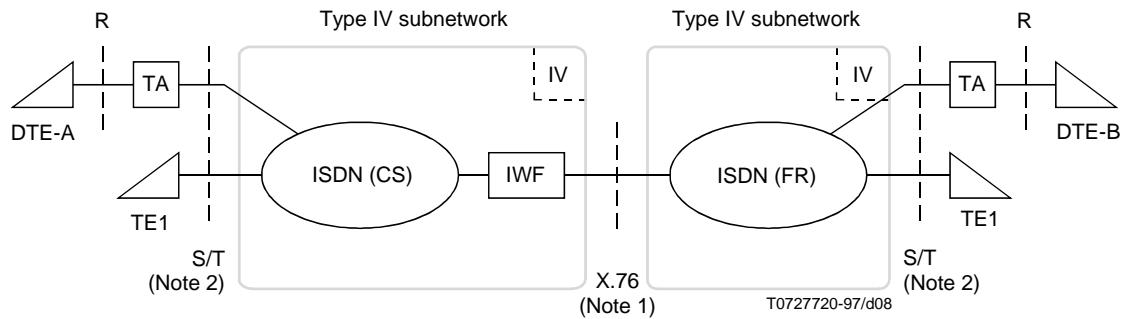
7.6 Interworking between ISDNs, where a circuit switched bearer is used on one ISDN, and a frame relaying bearer is used on the other

7.6.1 Interworking by call-control mapping

See Figure 8.

In order to enable interworking, procedures must be operated over the ISDN circuit switched bearer to achieve functional capability. However, these procedures are for further study. In general, the following applies:

– Call control arrangements in the circuit-switched case of ISDN (i.e. I.420 or the functionality identical SS No. 7 protocol or a functionally identical internal network protocol) should be mapped in the IWF to the call-control arrangements in the frame relaying case of ISDN (i.e. X.76 or functionally identical internal network protocol). This mapping is for further study.

– Data transfer arrangements in the frame relaying case of ISDN (i.e. X.76 or a functionally identical internal network protocol) should be mapped in the IWF to the procedures operated over the circuit switched bearer between IWF and TE/DTE. This mapping is for further study.

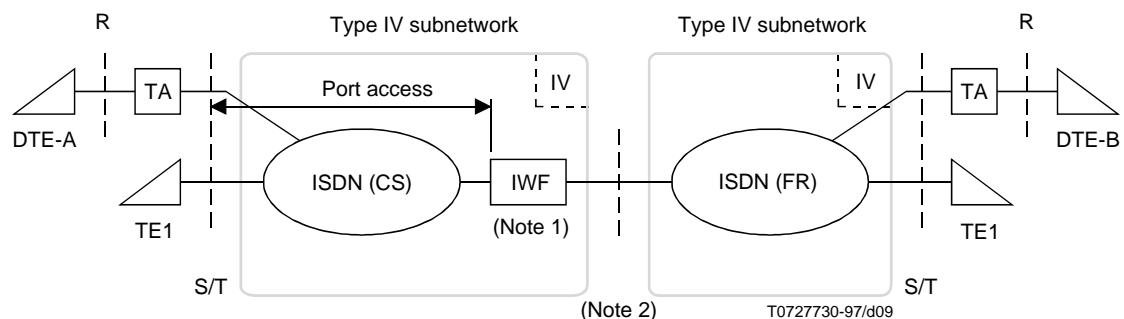NOTE 1 – The use of other Recommendations is for further study.

NOTE 2 – The exact protocols to be used for accessing this subnetwork are for further study.

FIGURE 8/X.320

**ISDN/ISDN interworking where a circuit switched bearer is requested to one ISDN
and a frame relaying bearer service is requested on the other ISDN
(interworking by call-control mapping)**

7.6.2 Interworking by port access

See Figure 9.

NOTE 1 – In this case, the IWF logically belongs to the ISDN providing the ISDN virtual circuit bearer service [ISDN (FR)].

NOTE 2 – X.76 or a functionally identical internal network protocol.

FIGURE 9/X.320

**ISDN/ISDN interworking where a circuit switched bearer is requested to one ISDN
and a frame relaying bearer service is requested on the other ISDN
(interworking by port access)**

In order to enable interworking, procedures must be operated over the ISDN circuit bearer to achieve functional compatibility. These procedure follow Recommendations Q.922 and Q.933.

In general, the following applies:

    –   X.76 or a functionally identical internal network protocol is operated between the frame relaying case of ISDN and IWF.

    –   I.420, or ISDN-UP, or functionally identical internal network protocol is operated between the circuit switched case of ISDN and the IWF, and used to control the circuit switched bearer.

    –   Core aspects of Recommendation Q.922 is operated between the IWF and the DTE/TE over the ISDN circuit switched bearer during data transfer phase.

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