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**ITU-T**

TELECOMMUNICATION  
STANDARDIZATION SECTOR  
OF ITU

**X.328**

(10/96)

SERIES X: DATA NETWORKS AND OPEN SYSTEM  
COMMUNICATION

Interworking between networks – General

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**General arrangements for interworking between  
public data networks providing frame relay data  
transmission services and Integrated Services  
Digital Networks (ISDNs) for the provision of  
data transmission services**

ITU-T Recommendation X.328

(Previously CCITT Recommendation)

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*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.328 was prepared 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.

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## **SUMMARY**

This Recommendation defines general arrangements for the interworking between PDNs providing FRDTS and 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.



**GENERAL ARRANGEMENTS FOR INTERWORKING BETWEEN PUBLIC DATA NETWORKS PROVIDING FRAME RELAY DATA TRANSMISSION SERVICES AND INTEGRATED SERVICES DIGITAL NETWORKS (ISDNs) FOR THE PROVISION OF DATA TRANSMISSION SERVICES**

*(Geneva, 1996)*

## **1 Scope and field of operation**

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 situation.

This Recommendation describes the interworking arrangements between Integrated Services Digital Networks (ISDNs) and Public Data Networks (PDNs) providing Frame Relay Data Transmission Services (FRDTS) 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.

## **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 Recommendations is regularly published.

- CCITT Recommendation E.164 (1991), *Numbering plan for the ISDN era.*
- CCITT Recommendation I.230 (1988), *Definition of bearer service categories.*
- CCITT Recommendation I.233.1 (1991), *Frame mode bearer services: ISDN frame relaying bearer service.*
- ITU-T Recommendation I.372 (1993), *Frame relaying bearer service network-to-network interface requirements.*
- ITU-T Recommendation I.500 (1993), *General Structure of the ISDN Interworking Recommendations.*
- ITU-T Recommendation I.530 (1993), *Network interworking between an ISDN and a Public Switched Telephone Network (PSTN).*
- ITU-T Recommendation I.555 (1993), *Frame relaying bearer service interworking.*
- CCITT Recommendation Q.922 (1992), *ISDN data link layer specification for frame mode bearer services.*
- ITU-T Recommendation Q.931 (1993), *ISDN user-network interface layer 3 specification for basic call control.*
- ITU-T Recommendation Q.933 (1995), *Integrated Services Digital Network (ISDN) Digital Subscriber Signalling System No. 1 (DSS 1) – Signalling specifications for frame mode switched and permanent virtual connection control and status monitoring.*
- 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.25 (1996), *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 Recommendation X.31/I.462 (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.36 (1995)/Amendment 1 (1996), *Switched Virtual Circuit (SVC) signalling and refinements of Permanent Virtual Circuit (PVC) signalling.*
- 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 frame relay data transmission service.*
- ITU-T Recommendation X.121 (1996), *International numbering plan for public data networks.*
- ITU-T Recommendation X.122/E.166 (1996), *Numbering plan interworking for the E.164 and X.121 numbering plans.*
- 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.*
- CCITT Recommendation X.305 (1988), *Functionalities of subnetworks relating to the support of OSI connection-mode network service.*
- ITU-T Recommendation X.320 (1996), *General arrangements for interworking between Integrated Services Digital Networks (ISDNs) for the provision of data transmission services.*
- ITU-T Recommendation X.321 (1996), *General arrangements for interworking between Circuit Switched Public Data Networks (CSPDNs) and Integrated Services Digital Networks (ISDNs) for the provision of data transmission services.*
- CCITT Recommendation X.324 (1988), *General arrangements for interworking between Packet Switched Public Data Networks (PSPDNs) and public mobile systems for the provision of data transmission services.*
- ITU-T Recommendation X.325 (1996), *General arrangements for interworking between Packet Switched Public Data Networks (PSPDNs) and Integrated Services Digital Networks (ISDNs) for the provision of data transmission services.*

### **3 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 mapping;
- f) interworking by port access.



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

- a) circuit switched bearer service;
- b) packet switched virtual circuit bearer service;
- c) frame mode bearer service.

This Recommendation makes use of the following terms defined in Recommendation X.1:

- a) Frame Relay Data Transmission Services;
- b) Frame Relay Public Data Network;
- c) Packet Switched Data Transmission Services;
- d) Packet Switched Public Data Network.

## **4 Abbreviations**

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

CSPDN	Circuit Switched Public Data Network
DTE	Data Terminal Equipment
ISDN	Integrated Services Digital Network
IWF	Interworking Function
FRBS	Frame Relaying Bearer Service
FRDTS	Frame Relay Data Transmission Services
FRPDN	Frame Relay Public Data Network
MSS	Mobile Satellite System
PDN	Public Data Network
PLP	Packet Layer Protocol
PSDTS	Packet Switched Data Transmission Services
PSPDN	Packet Switched Public Data Network
SS No. 7	Signalling System No. 7
TA	Terminal Adaptor
TE	Terminal Equipment

## **5 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.

### **5.1 FRPDN**

The FRPDN provides Frame Relay Data Transmission Services (FRDTS) as defined in Recommendations X.1 and X.2 for the provision of data transmission services. The FRPDN may be accessed by DTEs by the category of access E as defined in Recommendation X.1. In addition, the FRPDN may also be accessed via other networks, e.g. PSPDN, FRPDN (see Recommendation X.76) or ISDN (this Recommendation).

TABLE 1/X.328

**Comparison of general characteristics of FRPDN and ISDN**

General characteristics	FRPDN	ISDN
Data Transmission Service/ Bearer Service	For further study	Rec. X.1, I.230-Series
Optional User Facilities/ Supplementary Services	For further study	Circuit-Mode I.250-Series Packet-Mode X.301 Frame Relay I.233
Categories of access	X.1 category G	X.1 categories S, T, U
Access via other networks		
PSTN	For further study	Rec. I.530
CSPDN	For further study	Rec. X.321 X.1 category B
PSPDN	For further study	Rec. X.325 X.1 categories C, D
FRPDN	Rec. X.76	This Recommendation
MSS	For further study	Rec. X.324
ISDN	This Recommendation	SS No. 7, Rec. X.75, X.1 category Y

**5.2 ISDN**

The ISDN provides Frame Relaying, Packet Switched and/or Circuit Switched Data Transmission Services/Bearer Services as defined in Recommendations X.1, X.2 and in I.230-Series Recommendations.

NOTE 1 – Supplementary services/optional user facilities for the circuit-mode operation on ISDN are specified 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 Bearer Service (FRBS) are specified in Recommendation I.233.1.

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, e.g. PSTN (see Recommendation I.530), CSPDN (see Recommendation X.1, category B and Recommendation X.321), PSPDN (see Recommendation X.325), MSS

(Recommendation X.324), FRPDN (this Recommendation), or ISDN (SS No. 7, Recommendations X.75 and X.1, category Y).

NOTE 2 – In the context of this Recommendation, and for the purpose of provision of data transmission services, the following categories of bearer services defined in the I.230-Series Recommendations are considered.

- 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.

**5.3 Call control between FRPDN and ISDN**

The general arrangements for call control between the FRPDN and the ISDN are as defined in Recommendation X.301. Network utilities used between the FRPDN and the ISDN are as defined in Recommendation X.302 (not visible for user). Supplementary services/optional user facilities for Circuit Switched Data Transmission Services/Bearer Services in the ISDN are specified in the I.250-Series Recommendations. Supplementary services/optional user facilities for Packet Switched Data Transmission Services/Bearer Services in the ISDN are specified in Recommendation X.2. Supplementary services/optional user facilities for Frame Relay Data Transmission Services/Bearer Services in the ISDN, are for further study.

## 5.4 Functionalities of the FRPDN and the ISDN

The functionalities of different types of subnetworks are described in Recommendation X.305. In the case where the ISDN is used to provide a Circuit Switched Data Transmission Service/Bearer Service, the functionality of the PSPDN and the ISDN differ. Therefore, in order to enable interworking, procedures must be operated over the Circuit Switched Bearer Service in the ISDN to achieve functional compatibility. In the case where the ISDN is used to provide a Packet Switched Data Transmission Service/Bearer Service, the functionality of the PSPDN and the ISDN differ. Therefore, in order to enable interworking, procedures must be operated over the Frame Relay Data Transmission Service in the FRPDN to achieve functional compatibility. In the case where the ISDN is used to provide a Frame Relay Data Transmission Service/Bearer Service, the FRPDN and the ISDN are functionally compatible.

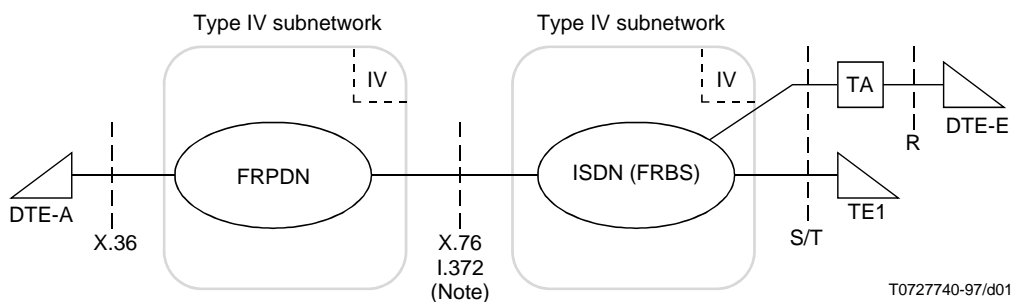
## 6 Specific interworking arrangements

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

- a) Interworking between FRPDN and ISDN where a Frame Relaying Bearer Service is used.
- b) Interworking between FRPDN and ISDN where a Circuit Switched Bearer Service is used:
  - 1) interworking by call-control mapping;
  - 2) interworking by port access.
- c) Interworking between FRPDN and ISDN where a Packet Switched Bearer Service is used:
  - 1) interworking by call-control mapping;
  - 2) interworking by port access.

### 6.1 Interworking between FRPDN and ISDN where a Frame Relaying Bearer Service is requested

The detailed procedures for interworking by call-control mapping are defined in Recommendation X.76 (see Figure 1).



NOTE – A functionally equivalent internal network protocol may be used when FRPDN and ISDN are of the same network provider, or by bilateral agreement.

FIGURE 1/X.328

### Use of an ISDN Frame Relaying Bearer Service ISDN (FRBS)/FRPDN interworking

#### 6.1.1 Transfer of addressing information

ISDNs typically utilize the E.164 numbering plan. FRPDNs may be numbered according to the numbering plans specified in either Recommendation X.121 or Recommendation E.164.

### **6.1.2 Arrangements for facilities related to the QOS of the call**

The interworking arrangements between the FRPDN and the ISDN for facilities related to the QOS of the call should conform to Recommendation X.301.

### **6.1.3 Arrangements for facilities related to charging conditions applying to the call**

For further study.

### **6.1.4 Arrangements for facilities related to specific routing conditions applying to the call**

For further study.

### **6.1.5 Arrangements for facilities related to protection mechanisms requested by the user of a call**

For further study.

### **6.1.6 Arrangements for facilities to convey user data in addition to the normal data flow in the data transfer phase**

The interworking arrangements between the FRPDN and the ISDN for these facilities should conform to Recommendation X.301.

### **6.1.7 Arrangements for other facilities**

For further study.

### **6.1.8 Arrangements for internal network utilities (not visible for users)**

For further study.

## **6.2 Interworking between FRPDN and ISDN where a Circuit Switched Bearer Service is requested**

### **6.2.1 Interworking by call-control mapping**

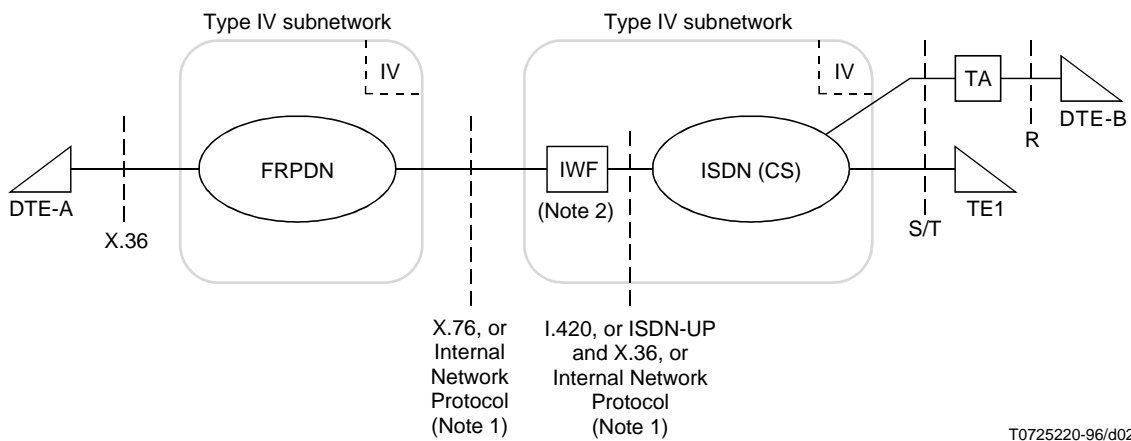
See Figure 2.

In order to enable interworking, procedures must be operated over the ISDN Circuit Switched Bearer Service to achieve functional compatibility. These procedures are for further study. In general, the following applies:

- The call-control procedures in the ISDN (i.e. I.420 or the functionally identical SS No. 7 or a functionally identical internal network protocol) should be mapped in the IWF to the call-control procedures in the FRPDN (i.e. X.76, or a functionally identical internal network protocol). This mapping is for further study.
- The data transfer procedures operated between DTE-A and the IWF over the Frame Relay Data Transmission Services in the FRPDN should be mapped to the data procedures operated between IWF and TE1/DTE-B over the Circuit Switched Bearer Service in the ISDN.

### **6.2.2 Interworking by Port Access**

In order to enable interworking, procedures must be operated over the ISDN Circuit Switched Bearer Service to achieve functional compatibility. These procedures follow Recommendation X.36 (see Figure 3).



NOTE 1 – For international interworking, internal network protocols do not apply.

NOTE 2 – In the case of access to the Frame Relay Data Transmission Services provided by the FRPDN, the IWF logically belongs to the FRPDN.

FIGURE 2/X.328

**Frame Relay Data Transmission Services provided by FRPDN interworking  
by call-control mapping with ISDN where a Circuit Switched Bearer Service  
is requested in the ISDN**

In general, the following applies:

- X.76, or a functionally identical network protocol is operated between the FRPDN and the IWF.
- I.420, or ISDN-UP, or a functionally identical internal network protocol is operated between the ISDN and the IWF, and used to control the Circuit Switched Bearer Service.
- X.36 is operated between the IWF and TE1/DTE-B + TA over the ISDN Circuit Switched Bearer Service.

**“Dialing out” considerations**

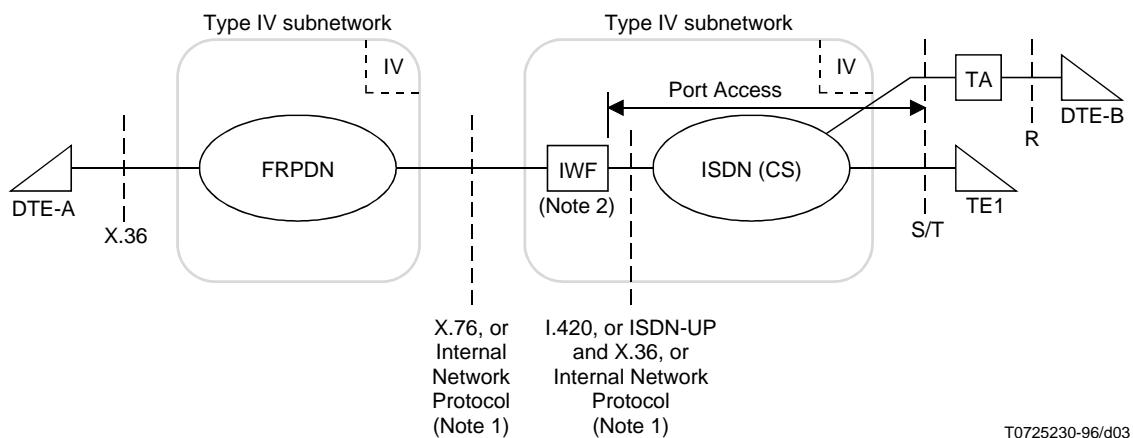
A Circuit Switched Bearer Service will be set up through the ISDN between the IWF and TE1/DTE-B + TA upon receipt of an incoming X.76 set-up message, i.e.:

- The called party number (and called party subaddress, if provided) of the incoming Q.931 set-up message are derived from the X.76 set-up message.
- The bearer capability of the incoming Q.931 set-up message is coded as circuit mode.
- The lower layer compatibility of the incoming Q.931 set-up message may be included to pass compatibility information from the IWF to TE1/DTE-B + TA. This information is derived from the lower layer compatibility information, if present in the X.76 set-up message. If included, the Layer 2 protocol is encoded as Recommendation Q.922 and the Layer 3 protocol is encoded as the Layer 3 protocol utilized by DTE-A.
- After establishment of the Circuit Switched Bearer Service, a Frame Relay switched virtual circuit will be established between the IWF and TE1/DTE-B + TA. The X.76 set-up message will be mapped by the IWF to an incoming X.36 set-up message.
- Subsequent X.76 set-up messages will be mapped by the IWF to incoming X.36 set-up messages.
- Further procedures are as detailed in Recommendations X.36 and X.76.

## “Dialling in” considerations

A Circuit Switched Bearer Service will be set up through the ISDN between TE1/DTE-B + TA and the IWF, i.e.:

- The called party number of the outgoing Q.931 set-up message is the address of the IWF (port address).
- The bearer capability of the outgoing Q.931 set-up message is coded as circuit mode.
- The lower layer compatibility of the outgoing Q.931 set-up message may be included to pass compatibility information from TE1/DTE-B + TA to the IWF. If included, the Layer 2 protocol is encoded as Recommendation Q.922 and the Layer 3 protocol is encoded as the Layer 3 protocol utilized by TE1/DTE-B + TA.
- After establishment of the Circuit Switched Bearer Service, a Frame Relay switched virtual circuit will be established between TE1/DTE-B + TA and the IWF.
- An X.36 set-up message from TE1/DTE-B + TA will be mapped by the IWF to an outgoing X.76 set-up message.
- Further procedures are as detailed in Recommendations X.36 and X.76.



NOTE 1 – For international interworking, internal network protocols do not apply.

NOTE 2 – In the case of access to the Frame Relay Data Transmission Services provided by the FRPDN, the IWF logically belongs to the FRPDN.

FIGURE 3/X.328

### Frame Relay Data Transmission Services provided by FRPDN interworking by Port Access with ISDN where a Circuit Switched Bearer Service is requested in the ISDN

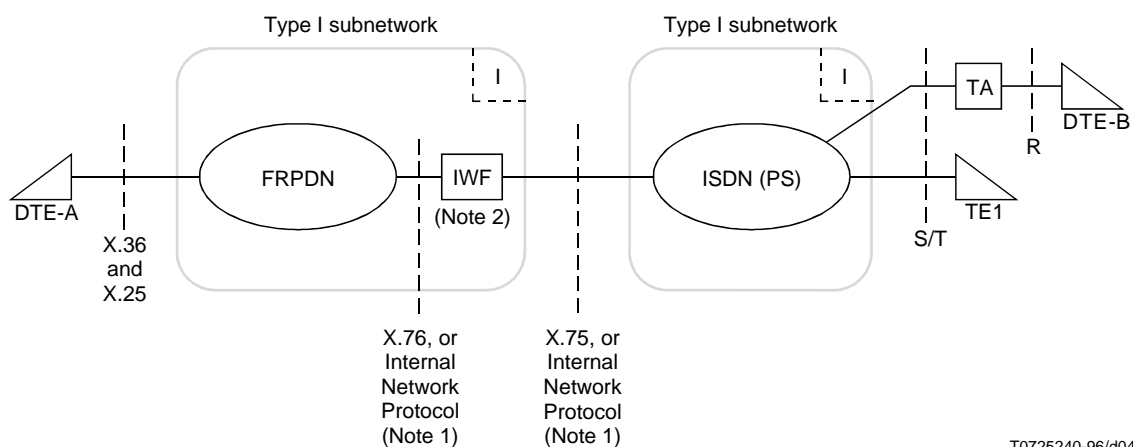
## 6.3 Interworking between FRPDN and ISDN where a Packet Switched Bearer Service is requested

### 6.3.1 Interworking by call-control mapping

This case of interworking by call-control mapping is for further study in Recommendation X.33. In order to enable interworking, procedures must be operated over the FRPDN Frame Relay Data Transmission Service to achieve functional compatibility (see Figure 4). In general, the following applies:

- The call-control procedures in the ISDN (i.e. X.75, or a functionally identical internal network protocol) should be mapped in the IWF to the call-control procedures in the FRPDN (i.e. X.76, or a functionally identical internal network protocol).

- The data transfer procedures operated between DTE-A and the IWF over the Frame Relay Data Transmission Services in the FRPDN should be mapped to the data procedures operated between IWF and TE1/DTE-B (i.e. X.75, or a functionally identical internal network protocol).



NOTE 1 – For international interworking, internal network protocols do not apply.

NOTE 2 – In the case of access to the Packet Switched Bearer Service provided by the ISDN, the IWF logically belongs to the ISDN.

FIGURE 4/X.328

**Frame Relay Data Transmission Services provided by FRPDN interworking by call-control mapping with ISDN where a Packet Switched Bearer Service is requested in the ISDN**

### 6.3.2 Interworking by Port Access

In order to enable interworking, procedures must be operated over the FRPDN Frame Relay Data Transmission Services to achieve functional compatibility. These procedures follow Recommendation X.25 (see Recommendations X.33 and X.1 category Z). Aspects of Recommendation X.32 apply as noted in Recommendation X.33 (see Figure 5).

In general, the following applies:

- X.75, or a functionally identical network protocol is operated between the ISDN and the IWF.
- X.76, or a functionally identical network protocol is operated between the FRPDN and the IWF, and used to control the Frame Relay Data Transmission Services in the FRPDN.
- X.25 is operated between the IWF and DTE-A over the Frame Relay Data Transmission Services in the FRPDN.

#### “Dialing out” considerations

A Frame Relay switched virtual circuit will be set up through the FRPDN between the IWF and DTE-A upon receipt of an incoming X.75 call request packet, i.e.:

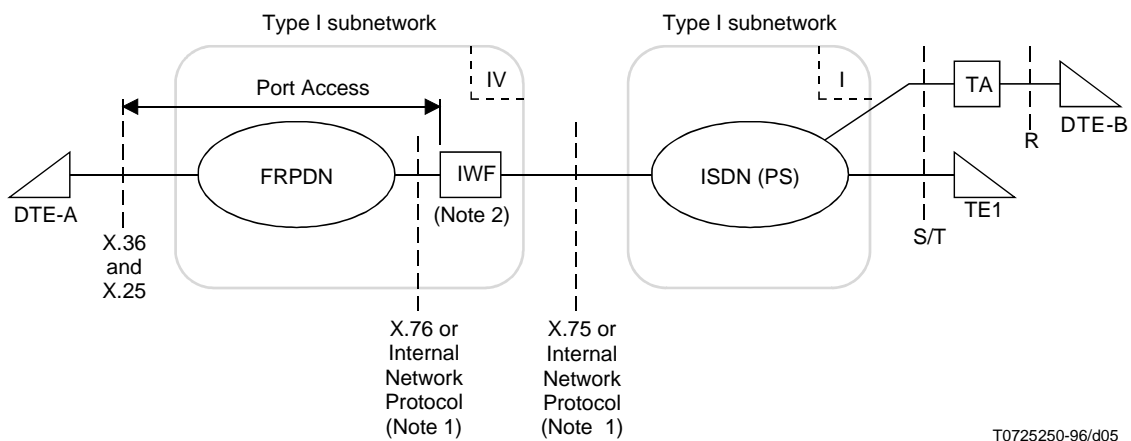
- The called party number (and called party subaddress, if provided) of the incoming X.36 set-up message are derived from the X.75 call request packet.
- The lower layer compatibility of the incoming X.36 set-up message may be included to pass compatibility information from the IWF to DTE-A. If included, the Layer 2 protocol is encoded as Recommendation Q.922 and the Layer 3 protocol is encoded as X.25 Packet Layer Protocol (PLP).

- After establishment of the Frame Relay switched virtual circuit, the X.75 call request packet will be mapped by the IWF to an X.25 incoming call packet.
- Subsequent X.75 call request packets will be mapped by the IWF to X.25 incoming call packets.
- Further procedures are as detailed in Recommendation X.33.

**“Dialling in” considerations**

A Frame Relay switched virtual circuit will be set up through the FRPDN between DTE-A and the IWF, i.e.:

- The called party number of the outgoing X.36 set-up message is the address of the IWF (port address).
- The X.36 lower layer compatibility may be included to pass compatibility information from TE1/DTE-B + TA to the IWF. If included, the Layer 2 protocol is encoded as Recommendation Q.922 and the Layer 3 protocol is encoded as X.25 PLP.
- After establishment of the Circuit Switched Bearer Service, an X.36 set-up message from TE1/DTE-B + TA will be mapped by the IWF to an outgoing X.76 set-up message.
- Further procedures are as detailed in Recommendation X.33.



NOTE 1 – For international interworking, internal network protocols do not apply.

NOTE 2 – In the case of access to the Packet Switched Bearer Service provided by the ISDN, the IWF logically belongs to the ISDN.

FIGURE 5/X.328

**Frame Relay Data Transmission Services provided by FRPDN interworking by Port Access with ISDN where a Packet Switched Bearer Service is requested in the ISDN**



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