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SERIES X: DATA NETWORKS AND OPEN SYSTEM
COMMUNICATIONS

Public data networks – Services and facilities

Technical characteristics of data transmission services

ITU-T Recommendation X.7

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ITU-T Recommendation X.7

Technical characteristics of data transmission services

Summary

This Recommendation describes the technical characteristics of data transmission services, including leased circuit, circuit switched, packet switched (including ISDN), and frame relay data transmission services. Technical characteristics include access attributes, interfaces and quality of service parameters. This Recommendation also contains definitions of particular optional user facilities and terminology, includes access to frame relay data transmission service via B-ISDN and some optional user facilities for frame relay. This revision includes interworking data transmission services with Internet.

Source

ITU-T Recommendation X.7 was approved on 29 April 2004 by ITU-T Study Group 17 (2001-2004) under the ITU-T Recommendation A.8 procedure.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. 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 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.

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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Technical characteristics of data transmission services

1 Scope

1.1 The X-series ITU-T Recommendations define the wide range of capabilities available in Public Data Networks (PDNs). These capabilities reflect many aspects of using a PDN: available services; user interfaces, including the concepts of *user class of service* and *categories of access*; addressing and routing; performance parameters; status information; optional features that may be available to complement the basic services; and interworking with other networks.

1.2 To use the wide range of capabilities of public data networks effectively and efficiently, users need to be well informed. Numerous ITU-T Recommendations have been developed that define and specify these capabilities. The intent of this Recommendation is to provide a concise, high-level overview of the capabilities available in public data networks and the associated ITU-T Recommendations in which they are discussed. It is suggested that readers of this Recommendation consult the referenced ITU-T Recommendations for further details.

1.3 The scope of this Recommendation is to provide a summary of the family of ITU-T X.1-X.199, X.300-X.399-series Recommendations that discuss technical characteristics of data transmission services in public data networks. Technical characteristics include access attributes, interfaces, and quality of service parameters. The X-series ITU-T Recommendations within the scope of this Recommendation cover the following:

- services and optional user facilities;
- interfaces;
- transmission, signalling and switching;
- network aspects including numbering and routing;
- performance and quality of service aspects; and
- interworking between networks, providing data transmission services.

1.4 In addition to defining the data transmission capabilities available in PDNs as listed above, the X-series ITU-T Recommendations specify many other aspects of data communications which are beyond the scope of this Recommendation. These aspects are:

- X.200-series: Open Systems Interconnection (OSI), including protocol-testing methodology;
- X.400-series: Message Handling Systems;
- X.500-series: Directory;
- X.600-series: OSI Networking and System aspects;
- X.700-series: OSI Management;
- X.800-series: OSI Distributed Applications including Security; and
- X.900-series: Open Distributed Processing.

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 Recommendation E.164 (1997), *The international public telecommunication numbering plan*.
- ITU-T Recommendation E.166/X.122 (1998), *Numbering plan interworking for the E.164 and X.121 numbering plans*.
- ITU-T Recommendation F.69 (1994), *The international telex service – Service and operational provisions of telex destination codes and telex network identification codes*.
- ITU-T Recommendation F.600 (2004), *Service and operational principles for public data transmission service*.
- ITU-T Recommendation I.112 (1993), *Vocabulary of terms for ISDNs*.
- ITU-T Recommendation I.233.1 (1991), *Frame mode bearer services: ISDN frame relaying bearer service*.
- ITU-T Recommendation I.240 (1988), *Definition of teleservices*.
- ITU-T Recommendation I.430 (1995), *Basic user-network interface – Layer 1 specification*.
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- ITU-T Recommendation I.432 (1993), *B-ISDN user-network interface – Physical layer specification*.
- ITU-T Recommendation Q.921 (1997), *ISDN user-network interface – Data link layer specification*.
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- ITU-T Recommendation Q.931 (1998), *ISDN user-network interface layer 3 specification for basic call control*.
- ITU-T Recommendation Q.933 (2003), *ISDN Digital Subscriber Signalling System No. 1 (DSS1) – Signalling specifications for frame mode switched and permanent virtual connection control and status monitoring*.
- ITU-T Recommendation X.1 (2000), *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 (2000), *International data transmission services and optional user facilities in public data networks and ISDNs*.
- ITU-T Recommendation X.3 (2000), *Packet Assembly/Disassembly facility (PAD) in a public data network*.
- ITU-T Recommendation X.5 (1996), *Facsimile Packet Assembly/Disassembly facility (FPAD) in a public data network*.
- ITU-T Recommendation X.6 (1997), *Multicast service definition*.
- ITU-T Recommendation X.8 (1994), *Multi-aspect PAD (MAP) framework and service definition*.

- ITU-T Recommendation X.20 (1988), *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for start-stop transmission services on public data networks.*
- ITU-T Recommendation X.20 bis (1988), *Use on public data networks of Data Terminal Equipment (DTE) which is designed for interfacing to asynchronous duplex V-series modems.*
- ITU-T Recommendation X.21 (1992), *Interface between Data Terminal Equipment and Data Circuit-terminating Equipment for synchronous operation on public data networks.*
- ITU-T Recommendation X.21 bis (1988), *Use on public data networks of Data Terminal Equipment (DTE) which is designed for interfacing to synchronous V-series modems.*
- ITU-T Recommendation X.22 (1988), *Multiplex DTE/DCE interface for user classes 3-6.*
- 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.28 (1997), *DTE/DCE interface for a start-stop mode data terminal equipment accessing the Packet Assembly/Disassembly facility (PAD) in a public data network situated in the same country.*
- ITU-T Recommendation X.29 (1997), *Procedures for the exchange of control information and user data between a Packet Assembly/Disassembly (PAD) facility and a packet mode DTE or another PAD.*
- ITU-T Recommendation X.30 (1993), *Support of X.21, X.21 bis and X.20 bis based Data Terminal Equipments (DTEs) by an Integrated Services Digital Network (ISDN).*
- ITU-T Recommendation X.31 (1995), *Support of packet mode terminal equipment by an ISDN.*
- ITU-T Recommendation X.32 (1996), *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and accessing a packet-switched public data network through a public switched telephone network or an integrated services digital network or a circuit-switched public data network.*
- ITU-T Recommendation X.33 (1996), *Access to packet-switched data transmission services via frame relaying data transmission services.*
- ITU-T Recommendation X.34 (1996), *Access to packet-switched data transmission services via B-ISDN.*
- ITU-T Recommendation X.35 (1993), *Interface between a PSPDN and a private PSDN which is based on X.25 procedures and enhancements to define a gateway function that is provided in the PSPDN.*
- ITU-T Recommendation X.36 (2003), *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for public data networks providing frame relay data transmission service by dedicated circuit.*
- ITU-T Recommendation X.37 (1995), *Encapsulation in X.25 packets of various protocols including frame relay.*
- ITU-T Recommendation X.38 (1996), *G3 facsimile equipment/DCE interface for G3 facsimile equipment accessing the Facsimile Packet Assembly/Disassembly facility (FPAD) in a public data network situated in the same country.*

- ITU-T Recommendation X.39 (1996), *Procedures for the exchange of control information and user data between a Facsimile Packet Assembly/Disassembly (FPAD) facility and a packet mode Data Terminal Equipment (DTE) or another FPAD.*
- ITU-T Recommendation X.45 (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, designed for efficiency at higher speeds.*
- ITU-T Recommendation X.46 (1998), *Access to FRTDS via B-ISDN.*
- ITU-T Recommendation X.48 (1996), *Procedures for the provision of a basic multicast service for Data Terminal Equipments (DTEs) using Recommendation X.25.*
- ITU-T Recommendation X.49 (1996), *Procedures for the provision of an extended multicast service for Data Terminal Equipments (DTEs) using Recommendation X.25.*
- ITU-T Recommendation X.60 (1988), *Common channel signalling for circuit-switched data applications.*
- ITU-T Recommendation X.70 (1988), *Terminal and transit control signalling system for start-stop services on international circuits between anisochronous data networks.*
- ITU-T Recommendation X.71 (1988), *Decentralized terminal and transit control signalling system on international circuits between synchronous data networks.*
- ITU-T Recommendation X.75 (1996), *Packet-switched signalling system between public networks providing data transmission services.*
- ITU-T Recommendation X.76 (2003), *Network-to-network interface between public data networks providing PVC and/or SVC frame relay data transmission service.*
- ITU-T Recommendation X.77 (1997), *Interworking between PSPDNs via B-ISDN.*
- ITU-T Recommendation X.78 (1999), *Interworking procedures between networks providing frame relay data transmission services via B-ISDN.*
- ITU-T Recommendation X.80 (1988), *Interworking of interexchange signalling systems for circuit-switched data services.*
- ITU-T Recommendation X.81 (1988), *Interworking between an ISDN circuit-switched and a Circuit-Switched Public Data Network (CSPDN).*
- ITU-T Recommendation X.82 (1988), *Detailed arrangements for interworking between CSPDNs and PSPDNs based on Recommendation T.70.*
- ITU-T Recommendation X.85/Y.1321 (2001), *IP over SDH using LAPS.*
- ITU-T Recommendation X.86/Y.1323 (2001), *Ethernet over LAPS.*
- ITU-T Recommendation X.87/Y.1324 (2003), *Multiple services ring based on RPR.*
- ITU-T Recommendation X.92 (1988), *Hypothetical reference connections for public synchronous data networks.*
- ITU-T Recommendation X.96 (2000), *Call progress signals in public data networks.*
- ITU-T Recommendation X.110 (2002), *International routing principles and routing plan for public data networks.*
- ITU-T Recommendation X.111 (2003), *Principles for the routing of international frame relay traffic.*
- ITU-T Recommendation X.115 (1995), *Definition of address translation capability in public data networks.*

- ITU-T Recommendation X.116 (1996), *Address translation registration and resolution protocol.*
- ITU-T Recommendation X.121 (2000), *International numbering plan for public data networks.*
- ITU-T Recommendation X.123 (1996), *Mapping between escape codes and TOA/NPI for E.164/X.121 numbering plan interworking during the transition period.*
- ITU-T Recommendation X.124 (1999), *Arrangements for the interworking of the E.164 and X.121 numbering plans for frame relay and ATM networks.*
- ITU-T Recommendation X.125 (1998), *Procedure for the notification of the assignment of international network identification codes for public frame relay data networks and ATM networks numbered under the E.164 numbering plan.*
- ITU-T Recommendation X.130 (1988), *Call processing delays in public data networks when providing international synchronous circuit-switched data services.*
- ITU-T Recommendation X.131 (1988), *Call blocking in public data networks when providing international synchronous circuit-switched data services.*
- ITU-T Recommendation X.134 (1997), *Portion boundaries and packet-layer reference events: basis for defining packet-switched performance parameters.*
- ITU-T Recommendation X.135 (1997), *Speed of service (delay and throughput) performance values for public data networks when providing international packet-switched services.*
- ITU-T Recommendation X.136 (1997), *Accuracy and dependability performance values for public data networks when providing international packet-switched services.*
- ITU-T Recommendation X.137 (1997), *Availability performance values for public data networks when providing international packet-switched services.*
- ITU-T Recommendation X.138 (1997), *Measurement of performance values for public data networks when providing international packet-switched services.*
- ITU-T Recommendation X.139 (1997), *Echo, drop, generator and test DTEs for measurement of performance values in public data networks when providing international packet-switched services.*
- ITU-T Recommendation X.140 (1992), *General quality of service parameters for communication via public data networks.*
- ITU-T Recommendation X.142 (2003), *Quality of service metrics for characterizing frame relay/ATM service interworking performance.*
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- ITU-T Recommendation X.180 (1988), *Administrative arrangements for international Closed User Groups (CUGs)*.
- ITU-T Recommendation X.181 (1988), *Administrative arrangements for the provision of international Permanent Virtual Circuits (PVCs)*.
- ITU-T Recommendation X.223 (1993), *Use of X.25 to provide the OSI connection-mode network service for ITU-T applications*.
- ITU-T Recommendation X.272 (2000), *Data compression and privacy over frame relay networks*.
- 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*.
- ITU-T Recommendation X.371/Y.1402 (2001), *General arrangements for interworking between public data networks and the Internet*.

3 Terminology

This Recommendation defines the following terms:

3.1 call progress signals: Call progress signals provide information relating to the ability to use the data transmission service or the ability to progress a new or existing call.

3.2 categories of access: A DTE can, by various means, access the data transmission services provided by PDNs and ISDNs:

- by a *direct access* from the DTE to the PDN providing the service without an intermediate public switched network of another type (including a PDN, PSTN or ISDN);
- by a *port access* from the DTE to a PDN via an intermediate public network of another type (including a PDN, PSTN or ISDN).

3.3 circuit switched data transmission service: A service requiring the establishment of a circuit switched data connection before data can be transferred between Data Terminal Equipments (DTEs).

3.4 communication service: A communication service consists of the means of communication between persons and/or automatic systems, related to functions above a data transmission capability. Communication service is assumed to be equivalent to *teleservice* defined in ITU-T Recs I.112 and I.240. Communication services include functions of Data Terminal Equipment (DTE). Various communication services may be based on the data transmission service. A communication capability may be defined by ITU-T; it may also be privately defined by users themselves.

3.5 data transmission service: A data service established and operated by an Administration or a Recognized Operating Agency (ROA) provided by means of a public data network. Data transmission service is assumed to be equivalent to the *bearer service* defined in ITU-T Recs I.112 and I.230. Data networks and data transmission services do not include functions of Data Terminal Equipment (DTE). Four types of data transmission services are identified: circuit switched, packet switched, frame relay and leased circuit data transmission service.

3.6 facsimile packet assembly/disassembly facility: A Facsimile Packet Assembly/Disassembly (FPAD) Facility is a facility which offers a Group-3 (G3) facsimile equipment the opportunity to use a packet switched public data network to convey facsimile control and image data to another G3 facsimile equipment or to an application DTE. The FPAD also allows

an application DTE to establish a connection and to send control and image data to a G3 facsimile equipment.

An FPAD has the following functions, among many others:

- assembly of facsimile image data into packets;
- disassembly of the user data field of packets into facsimile image data;
- handling of virtual call set-up and clearing;
- a mechanism for forwarding packets when proper conditions exist;
- a mechanism for transmitting facsimile image data to the G3 facsimile equipment.

3.7 frame relay data transmission service: A service involving the transmission of data in the form of frames on user interface.

3.8 leased circuit data transmission service: A service whereby a circuit (or circuits) of a public network is (are) made available to a user or group of users for its exclusive use.

NOTE – Where only two data circuit-terminating equipments are involved, it is known as a point-to-point facility and where more than two are involved, it is known as a multipoint facility.

3.9 optional user facility: An optional user facility modifies or complements the basic data transmission service found on the basic user facility(ies). Consequently, it cannot be offered to a user as a stand-alone service. It must be offered together or in association with a basic user facility. An optional user facility may be applicable to a number of data transmission services.

3.10 packet assembly/disassembly facility: A Packet Assembly/Disassembly (PAD) Facility is a facility which offers a start/stop-mode DTE the opportunity to use the packet switched public data network to communicate with another start/stop-mode DTE or a packet-mode DTE¹. It has the following functions, among many others:

- assembly of characters into packets;
- disassembly of the user data field of packets into characters;
- handling of virtual call set-up and clearing, resetting and interrupt procedures;
- a mechanism for forwarding packets when proper conditions exist;
- a mechanism for transmitting data characters, including start, stop and parity elements as appropriate to the start/stop-mode DTE.

3.11 packet switched data transmission service: A service involving the transmission and, if necessary, the assembly and disassembly of data in the form of packets.

3.12 permanent virtual circuit: A service of the packet switched virtual circuit services in which a permanent association exists between two DTEs which is identical to the data transfer phase of a virtual call. No call set-up or clearing procedure is possible or necessary.

3.13 permanent virtual circuit: A service of the frame relay public data network in which a permanent association exists between the DTEs. No call set-up or clearing procedure is possible or necessary.

3.14 public data network: A network established and operated by an Administration or an ROA for the specific purpose of providing data transmission services. Circuit switched, packet switched, frame relay and leased circuit data transmission services are feasible within these networks.

¹ With the inclusion of DTEs that use start/stop framing in ITU-T Rec. X.25, the term "packet-mode" DTE is taken to include DTEs that use either synchronous framing or start/stop framing.

3.15 switched virtual circuit: A service of the frame relay public data network in which a call set-up procedure and clearing procedure will determine a period of communication between two DTEs in which users' data will be transferred in the network in the frame mode of operation.

3.16 user class of service (international): An international user class of service is a category of public data transmission service in a certain network in which the data signalling rates, call control signalling rates and other parameters are specified with reference to the services, the interfaces, and the DTE operating mode.

3.17 virtual call: A service of the packet switched virtual circuit services in which a call set-up procedure and a call clearing procedure will determine a period of communication between two DTEs in which users' data will be transferred in the network in the packet mode of operation.

3.18 virtual circuit: A virtual circuit is a bidirectional, transparent transmission path through a packet switched network between logical or physical ports of two DTEs. All users' data will be delivered from the packet network in the same order in which they are received by the network. Inherent in the virtual circuit service is the throughput of user data for each direction of transmission – this can be expressed as a *throughput class* or *user information transfer rate*.

4 Abbreviations

This Recommendation uses the following abbreviations:

ARE	Address Resolution Entity
ATM	Asynchronous Transfer Mode
AU	Access Unit
BCUG	Bilateral Closed User Group
B-ISDN	Broadband ISDN
CIR	Committed Information Rate
CSPDN	Circuit Switched Public Data Network
CUG	Closed User Group
DCC	Data Country Code
DCE	Data Circuit-terminating Equipment
DNIC	Data Network Identification Code
DTE	Data Terminal Equipment
FH	Frame Handler
FPAD	Facsimile Packet Assembly/Disassembly
FRBS	Frame Relaying Bearer Service
FRDTS	Frame Relay Data Transmission Service
FRPDN	Frame Relay Public Data Network
ICRD	Inter-network Call Redirection and Deflection
IP	Internet Protocol
ISDN	Integrated Services Digital Network
IWF	InterWorking Function
LAPS	Link Access Procedure – SDH

MAP	Multi-Aspect Packet assembly/disassembly
MLP	Multi-Link Procedure
NPI	Numbering Plan Identifier
NTN	Network Terminal Number
NUI	Network User Identification
OSI	Open Systems Interconnection
PAD	Packet Assembly/Disassembly
PDN	Public Data Network
PDU	Protocol Data Unit
PH	Packet Handler
PS	Packet Switch
PSDN	Packet Switched Data Network
PSN	Public Switched Network
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network
PVC	Permanent Virtual Circuit
ROA	Recognized Operating Agency
SDH	Synchronous Digital Hierarchy
SLP	Single Link Procedure
SVC	Switched Virtual Circuit
TA	Terminal Adapter
TOA	Type Of Address
VC	Virtual Call

5 Public data transmission services

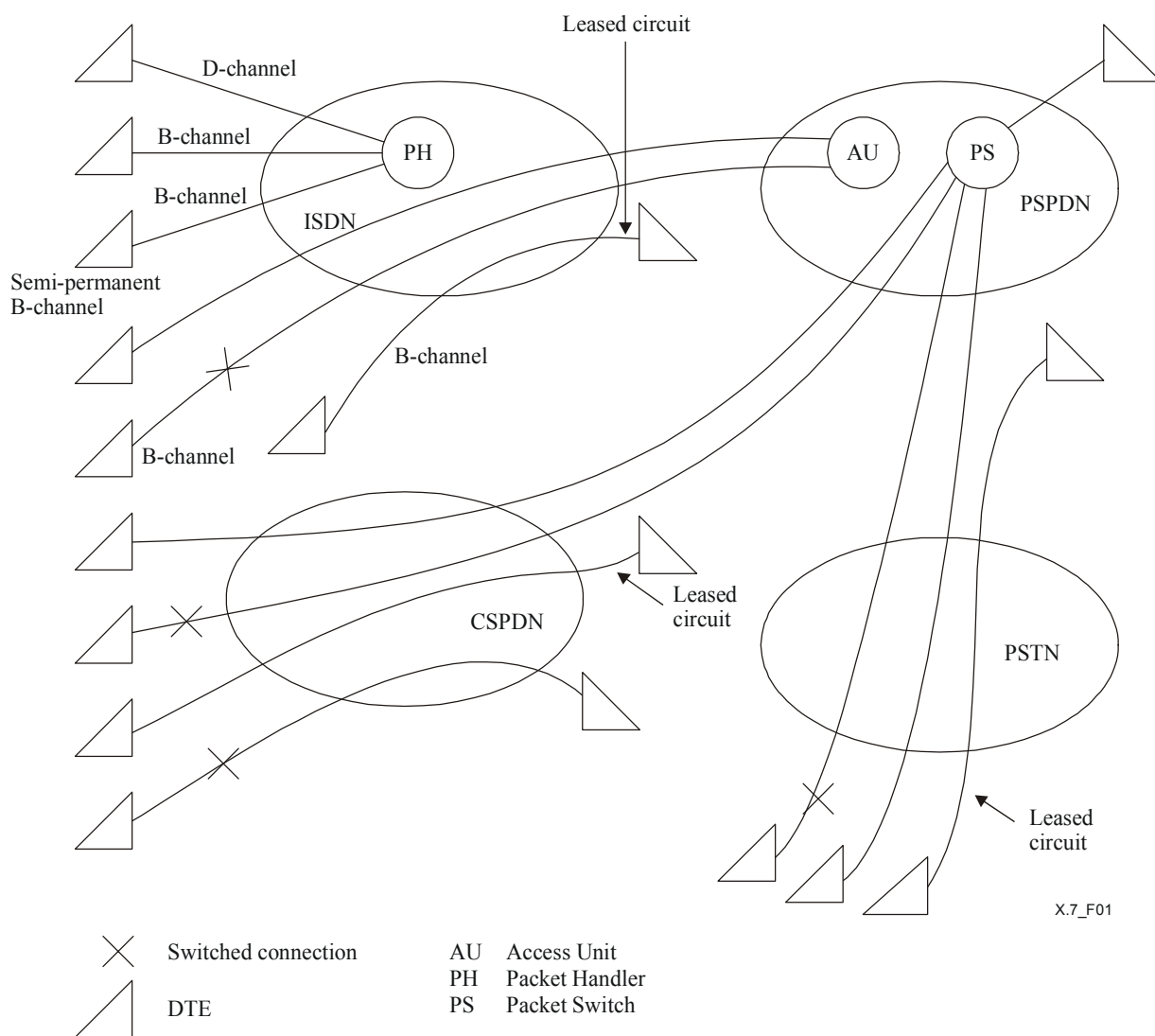
This clause identifies public data networks and ISDNs considered in this Recommendation for the provision of data transmission services and the associated ITU-T Recommendations describing their technical characteristics. The data transmission services are as follows:

- circuit switched data transmission service;
- packet switched data transmission service;
- frame relay data transmission service; and
- leased circuit data transmission service.

For service and operational principles for public data transmission services see ITU-T Rec. F.600.

Figures 1 and 2 depict various networks that provide data transmission services discussed in this Recommendation.

ITU-T Recs X.85/Y.1321, X.86/Y.1323 and X.87/Y.1324 define some additional possibilities for data transmission over telecommunication networks.



X.7_F01

NOTE 1 – Other methods of access to data transmission services, such as ISDN H-Channels and other leased circuit arrangements, are also possible.

NOTE 2 – PADs not shown.

Figure 1/X.7 – Various networks providing circuit switched, packet switched and leased circuit data transmission services

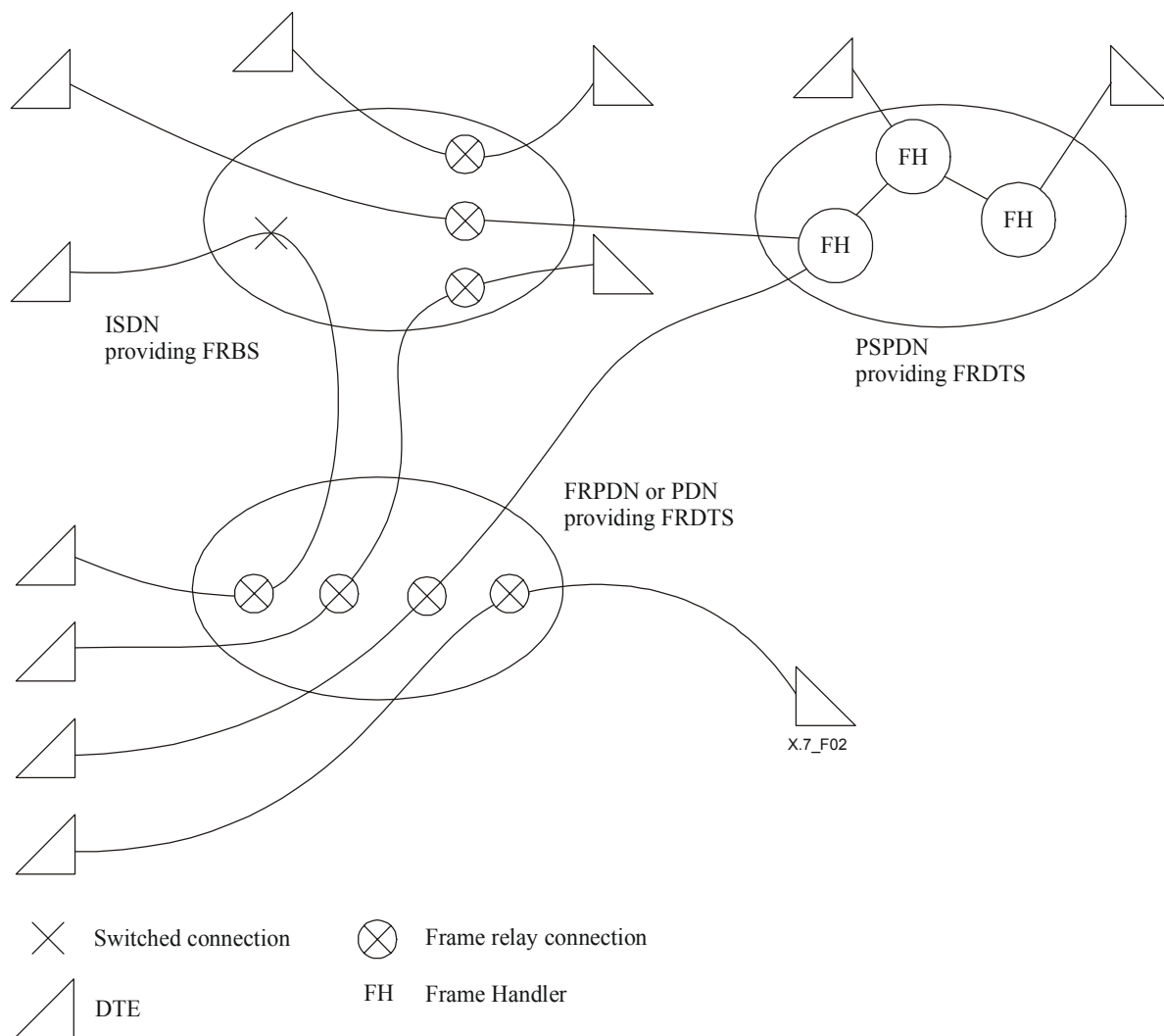


Figure 2/X.7 – Various networks providing Frame Relay Data Transmission Service (FRDTS) and Frame Relaying Bearer Service (FRBS)

5.1 General aspects of data transmission services

5.1.1 Access attributes

ITU-T Rec. X.1 describes user classes of service for data transmission services for Data Terminal Equipments (DTEs) operating in start/stop-mode and for DTEs operating in synchronous-mode. It also describes different categories of access for DTEs accessing various data transmission services.

The data transmission services and optional user facilities offered by public data networks are described in ITU-T Rec. X.2. It also describes which optional user facilities are available with each data transmission service on an international basis. Some of the optional user facilities are available on a per-call basis and others may be assigned for an agreed contractual period. ITU-T Rec. X.2 also discusses DTE services and identification methods when accessing a packet switched data transmission service through a switched connection. Optional user facilities are described below in clause 6.

User services and optional user facilities are further categorized as "E" (for essential) or "A" (for additional). An essential user facility or service should be made available internationally. An additional user facility or service may be available in certain PDNs and may also be available internationally. It must be noted that not all user facilities are available for all user classes of service or categories of access.

5.1.2 Addressing and routing aspects

ITU-T Rec. X.121 describes the International Numbering Plan for PDNs. That Recommendation makes provisions to identify a DTE by an International Data Number of up to 14 digits. An International Data Number can be represented in one of two formats as shown in Figure 3.

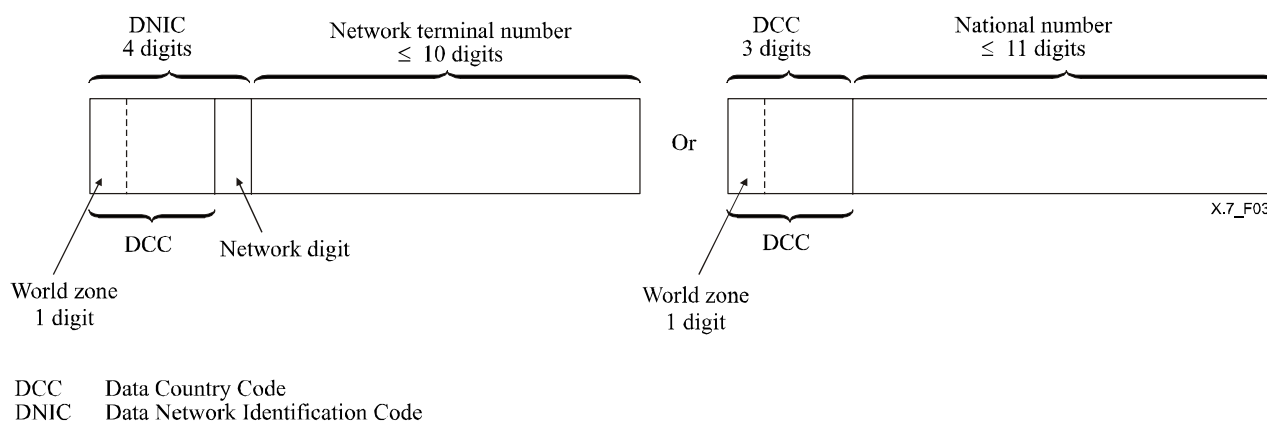


Figure 3/X.7 – International data number X.121 format

In both cases depicted in Figure 3, the first three digits identify a country and are known as a Data Country Code (DCC). The first digit of the DCC identifies the world zone and is a single digit in the range of 2-7 (e.g., 3 represents North America). DCCs are assigned by ITU-T and are recorded in Annex D/X.121. The fourth digit, when used to indicate a specific data network in a country, in conjunction with the DCC together are known as a Data Network Identification Code (DNIC). In this case, the remaining ten digits are used as a network terminal number. Alternatively, when the fourth digit is not used to identify a network, the digits after the DCC are used as a national number.

The first digit of the International Data Number outside of the 2-7 range is used to indicate special cases, e.g., DNICs assigned to public mobile-satellite systems.

Provision is also made for DTEs to be identified by numbers from other numbering plans (i.e., ITU-T Recs E.164 and F.69). ITU-T Rec. X.121 makes allowance for these plans to be identified in address signals carried in PDNs. This is accomplished by defining an *escape digit* to be inserted before the first digit of the non-X.121 number.

Provision is also made for the use of *prefixes* to allow for selection of different types of address formats. Prefixes are not part of the international X.121 format and are not signalled from one network to another.

ITU-T Rec. E.166/X.122 defines the numbering plan interworking between networks using the E.164 numbering plan and networks using the X.121 numbering plan. It illustrates how addresses are carried from one network to another.

Specific aspects of addressing relative to the different data transmission services and use of optional user facilities are discussed below.

ITU-T Rec. X.110 specifies the high level routing principles that should be applied for the establishment of calls across interconnecting PDNs.

ITU-T Rec. X.111 specifies general principles for routing frame relay data traffic across international PDNs. Principles for routing in the case of frame relay and asynchronous transfer mode (ATM) interworking are also provided.