INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

X.300

(10/96)

SERIES X: DATA NETWORKS AND OPEN SYSTEM COMMUNICATION

Interworking between networks – General

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.300

(Previously CCITT Recommendation)

ITU-T X-SERIES RECOMMENDATIONS

DATA NETWORKS AND OPEN SYSTEM COMMUNICATION

PUBLIC DATA NETWORKS	X.1–X.199
Services and facilities	X.1–X.19
Interfaces	X.20–X.49
Transmission, signalling and switching	X.50–X.89
Network aspects	X.90–X.149
Maintenance	X.150–X.179
Administrative arrangements	X.180–X.199
OPEN SYSTEM INTERCONNECTION	X.200–X.299
Model and notation	X.200–X.209
Service definitions	X.210–X.219
Connection-mode protocol specifications	X.220–X.229
Connectionless-mode protocol specifications	X.230–X.239
PICS proformas	X.240–X.259
Protocol Identification	X.260–X.269
Security Protocols	X.270–X.279
Layer Managed Objects	X.280–X.289
Conformance testing	X.290–X.299
INTERWORKING BETWEEN NETWORKS	**X.300–X.399**
General	**X.300–X.349**
Satellite data transmission systems	X.350–X.399
MESSAGE HANDLING SYSTEMS	X.400–X.499
DIRECTORY	X.500–X.599
OSI NETWORKING AND SYSTEM ASPECTS	X.600–X.699
Networking	X.600–X.629
Efficiency	X.630–X.649
Naming, Addressing and Registration	X.650–X.679
Abstract Syntax Notation One (ASN.1)	X.680–X.699
OSI MANAGEMENT	X.700–X.799
Systems Management framework and architecture	X.700–X.709
Management Communication Service and Protocol	X.710–X.719
Structure of Management Information	X.720–X.729
Management functions	X.730–X.799
SECURITY	X.800–X.849
OSI APPLICATIONS	X.850–X.899
Commitment, Concurrency and Recovery	X.850–X.859
Transaction processing	X.860–X.879
Remote operations	X.880–X.899
OPEN DISTRIBUTED PROCESSING	X.900–X.999

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.300 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.

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 principles and detailed arrangements for the interworking of different networks in order to provide a data transmission service. This Recommendation also specifies, in a general network context, the necessary interaction between elements of user interfaces, interexchange signalling systems and other network functions for the support of data transmission services, telematic services and the OSI connection-mode network service where appropriate. In addition, it defines the principle for realization of international user facilities and network utilities for data transmission services.

0 Introduction

0.1 The rapid evolution of data transmission services has resulted in a large number of international standards in this field. The increasing complexity of the totality of these standards creates a need to rationalize common aspects in order to achieve a coherent relationship between these standards.

0.2 Data transmission services and user facilities may be provided by different types of public networks such as, PDNs and Integrated Services Digital Networks (ISDN) (see also Recommendations I.500 and I.510). As a result, there may be a demand to interconnect these networks in order for a DTE on one network to communicate in a uniform way with a DTE on the same network, or with a DTE on another network of the same type, or with a DTE on a network of another type.

0.3 The internetwork signalling between the various types of networks can be of the type defined by Recommendations such as, X.70, X.71, X.75, or of the common channel signalling type such as, Recommendation X.61.

In particular, at an internetwork signalling interface, network utilities may be exchanged between the networks involved. These network utilities may be handled by different types of networks.

0.4 In addition, as a part of the scope of Recommendation X.200 (Reference Model of Open Systems Interconnection for ITU-T applications) is to enable different users to communicate with each other by encouraging the implementation of compatible communication features, the use of this reference model is expected to be encouraged in future user terminal designs.

0.5 As defined by this reference model, one of the major functions of the network layer is to establish a network-connection between network-service users (within end systems). This may involve the concatenation of dissimilar networks.

Therefore, the arrangements and procedures for internetwork signalling between PDNs and other public networks should provide the user with the capability to operate data transmission services, telematic services and the OSI connection-mode network service over the connections derived over either one network, or over concatenated networks.

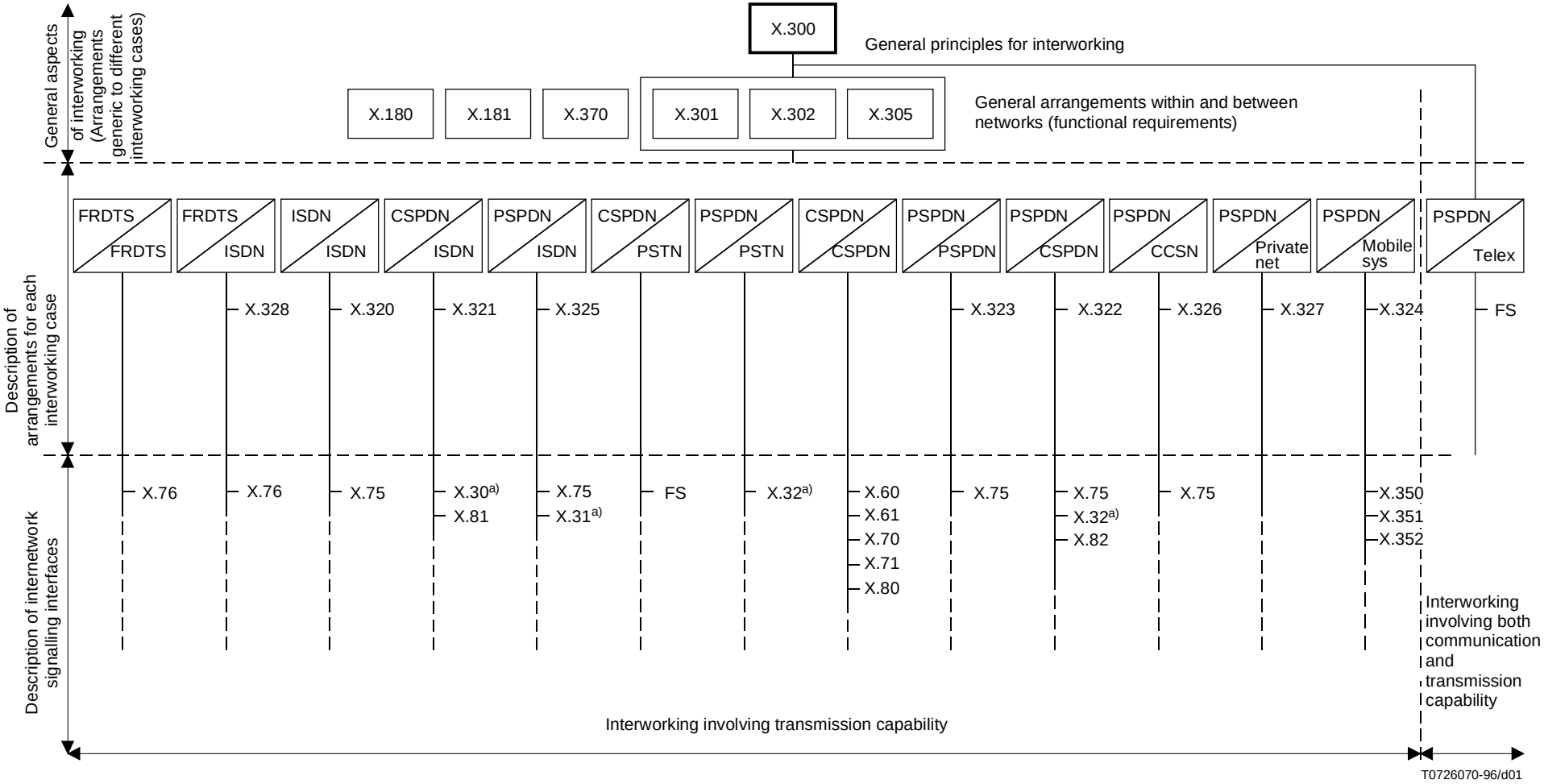
NOTE – This does not imply that any individual public network is required to implement all the mechanisms related to the OSI connection-mode network service.

0.6 This Recommendation is one of a family of interworking Recommendations. Figure 0-1 gives a summary of the relevant interworking Recommendations, which are grouped under three main categories:

a) general aspects of interworking;

b) description of each interworking case;

c) description of internetwork signalling interfaces.



FS For further study
FRDTS Frame Relay Data Transmission Service

a) This Recommendation is considered mainly a user interface.

FIGURE 0-1/X.300

Framework of X-Series Recommendations in relation with interworking

Recommendation X.300

GENERAL PRINCIPLES FOR INTERWORKING BETWEEN PUBLIC NETWORKS AND BETWEEN PUBLIC NETWORKS AND OTHER NETWORKS FOR THE PROVISION OF DATA TRANSMISSION SERVICES

(Former Recommendation X.87, Geneva, 1980; amended at Malaga-Torremolinos, 1984 and Melbourne, 1988; revised in 1996)

1 Scope and field of application

1.1 Interworking between more than two networks is included in the scope of this Recommendation.

1.2 The scope of this Recommendation is:

- To define principles and detailed arrangements for the interworking of different networks in order to provide a data transmission service.
- To specify, in a general network context, the necessary interaction between elements of user interfaces, interexchange signalling systems and other network functions; for the support of data transmission services, telematic services and the OSI connection-mode network service where appropriate.

  NOTE – The support for OSI connectionless-mode network service as defined in ISO/IEC 8348/Amd.1 is for further study.
- To define the principles for realization of international user facilities and network utilities for data transmission services.

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.

- ITU-T Recommendation I.112 (1993), *Vocabulary of terms for ISDNs*.
- ITU-T Recommendation I.210 (1993), *Principles of telecommunication services supported by an ISDN and the means to describe them*.
- I.230-Series Recommendations, *Integrated services digital network – Service capabilities – Bearer services supported by an ISDN*.
- I.240-Series Recommendations, *Integrated services digital network – Service capabilities – Teleservices supported by an ISDN*.
- I.250-Series Recommendations, *Integrated services digital network – Service capabilities – Supplementary services in ISDN*.
- CCITT Recommendation I.340 (1988), *ISDN connection types*.
- ITU-T Recommendation I.411 (1993), *ISDN user-network interfaces – Reference configurations*.
- CCITT Recommendation I.420 (1984). *Basic user-network interface.*
- CCITT Recommendation I.421 (1984), *Primary rate user-network interface*.
- ITU-T Recommendation I.500 (1993), *General structure of the ISDN interworking Recommendations*.
- ITU-T Recommendation I.510 (1993), *Definitions and general principles for ISDN interworking*.

– Q.700-Series Recommendations, *Switching and signalling – Specifications of Signalling System No. 7*.

– 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*.

– CCITT 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*.

– CCITT 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*.

– CCITT Recommendation X.21 (1992), *Interface between data terminal equipment and data circuit-terminating equipment for synchronous operation on public data networks*.

– CCITT 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*.

– CCITT 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 (1993), *DTE/DCE interface for a start-stop mode Data Terminal Equipment accessing the Packet Assembly/Disassembly (PAD) facility in a Public Data Network situated in the same country*.

– ITU-T Recommendation X.29 (1993), *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/I.461 (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/I.462 (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*.

– CCITT Recommendation X.60 (1988), *Common channel signalling for circuit switched data applications*.

– CCITT Recommendation X.61 (1988), *Signalling System No. 7 – Data user part*.

– CCITT Recommendation X.70 (1988), *Terminal and transit control signalling system for start-stop services on international circuits between anisochronous data networks*.

– CCITT 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*.

– CCITT Recommendation X.80 (1988), *Interworking of interexchange signalling systems for circuit switched data services*.

– CCITT Recommendation X.81 (1988), *Interworking between an ISDN circuit-switched and a Circuit-Switched Public Data Network (CSPDN)*.

– CCITT Recommendation X.82 (1988), *Detailed arrangements for interworking between CSPDNs and PSPDNs based on Recommendation T.70*.

– ITU-T Recommendation X.96 (1993), *Call progress signals in public data networks*.

– CCITT Recommendation X.180 (1988), *Administrative arrangements for international Closed User Groups (CUGs)*.

– CCITT Recommendation X.181 (1988), *Administrative arrangements for the provision of international permanent virtual circuits (PVCs)*.

– ITU-T Recommendation X.200 (1994), *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*.

– ITU-T Recommendation X.210 (1993), *Information technology – Open Systems Interconnection – Basic Reference Model: Conventions for the definition of OSI services*.

– ITU-T Recommendation X.213 (1995), *Information technology – Open Systems Interconnection – Network service definition*.

– 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 the OSI connection-mode network service*.

– ITU-T Recommendation X.320 (1966), *General arrangements for interworking between Integrated Services Digital Networks (ISDNs) for the provision of data transmission services*.

– ITU-T Recommendation X.321/I.540 (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.322 (1988), *General arrangements for interworking between Packet Switched Public Data Networks (PSPDNs) and Circuit Switched Public Data Networks (CSPDNs) for the provision of data transmission services*.

– CCITT Recommendation X.323 (1988), *General arrangements for interworking between Packet Switched Public Data Networks (PSPDNs)*.

– 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/I.550 (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*.

– CCITT Recommendation X.326 (1988), *General arrangements for interworking between Packet Switched Public Data Networks (PSPDNs) and Common Channel Signalling Network (CCSN)*.

– ITU-T Recommendation X.327 (1993), *General arrangements for interworking between Packet Switched Public Data Networks (PSPDNs) and private data networks for the provision of data transmission services*.

– CCITT Recommendation X.350 (1988), *General interworking requirements to be met for data transmission in international public mobile-satellite systems*.

– CCITT Recommendation X.351 (1988), *Special requirements to be met for Packet Assembly/Disassembly facilities (PADs) located at or in association with coast earth stations in the public mobile-satellite service*.

– CCITT Recommendation X.352 (1988), *Interworking between Packet Switched Public Data Networks (PSPDNs) and public maritime mobile satellite data transmission systems*.

– CCITT Recommendation X.370 (1988), *Arrangements for the transfer of internetwork management information*.

3 Definitions

3.1 Terminology defined in other Recommendations

This Recommendation makes use of the following concepts and terms defined in other Recommendations.

Concept or term	Recommendation
a) Bearer service (see also 3.2.8, Data transmission service);	I.112 and I.210
b) Exchange;	I.112
c) Integrated services digital network;	I.112
d) Maritime satellite data transmission system;	X.350
e) OSI network layer;	X.200
f) OSI network service;	X.200
g) Packet assembly/disassembly (see Note);	
h) Public data network (see Note);	
i) Public land mobile network;	Q.70
j) Service provider;	X.210
k) Service user;	X.210
l) Telecommunication service (see also 3.2.5, ITU-T service);	I.112
m) Teleservice;	I.112
n) Terminal adaptor.	I.411

NOTE – This term is contained in the *Blue Book* (Volume I.3).

3.2 Terminology defined in this Recommendation

This subclause provides concepts and definitions additional to those defined in other Recommendations. Some concepts and terms provided in this subclause are defined by using Figures 3-1 and 3-2, which form part of their definition (for graphical conventions, see 3.3).

3.2.1 application relay system: The functional abstraction of an application Interworking Function (IWF).

3.2.2 application interworking function: A collection of processes that intervenes in an information flow also associated with applications, relating protocol(s) that access this collection to protocol(s) that exit this collection.

An IWF, that also acts upon information related to that application.

3.2.3 application relay service

(For further study.)

3.2.4 application relay functionality

(For further study.)

3.2.5 ITU-T service:

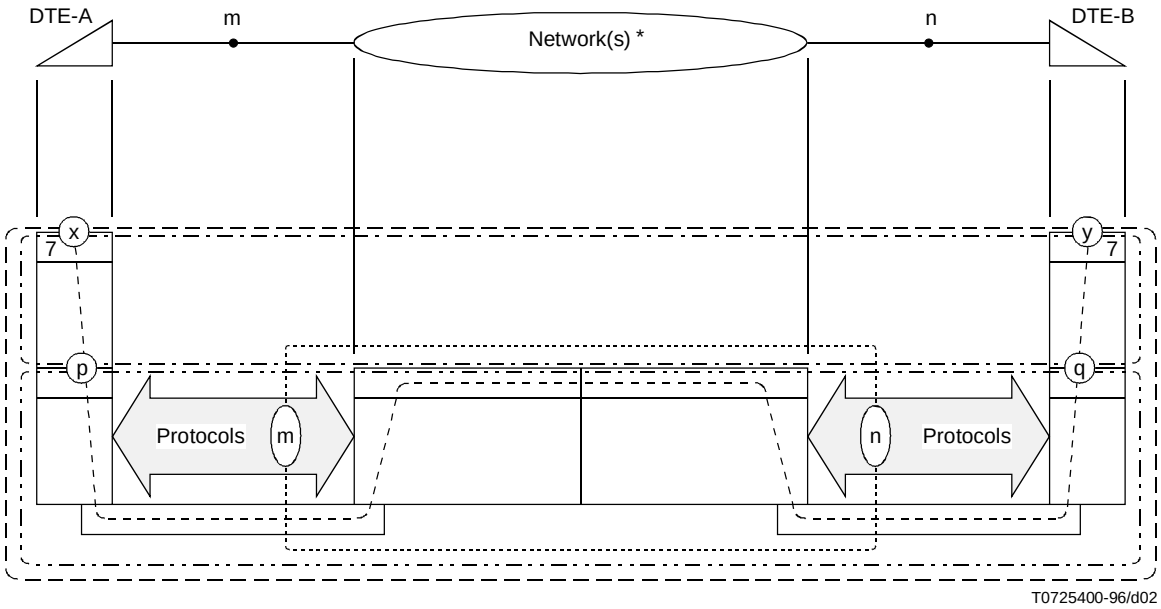
(NOTE – This concept is assumed to be equivalent to telecommunication services.)

Services defined in ITU-T Recommendations may be offered to the users by Administrations. Different types of ITU-T services may be categorized as follows:

a) data transmission services, as defined in Recommendations X.1 and X.2 (i.e. circuit switched, frame relay and packet switched data transmission services and leased circuit services);

b) services involving additional functions, on top of those functions providing transmission capability (e.g. PAD, Telex, Teletex).

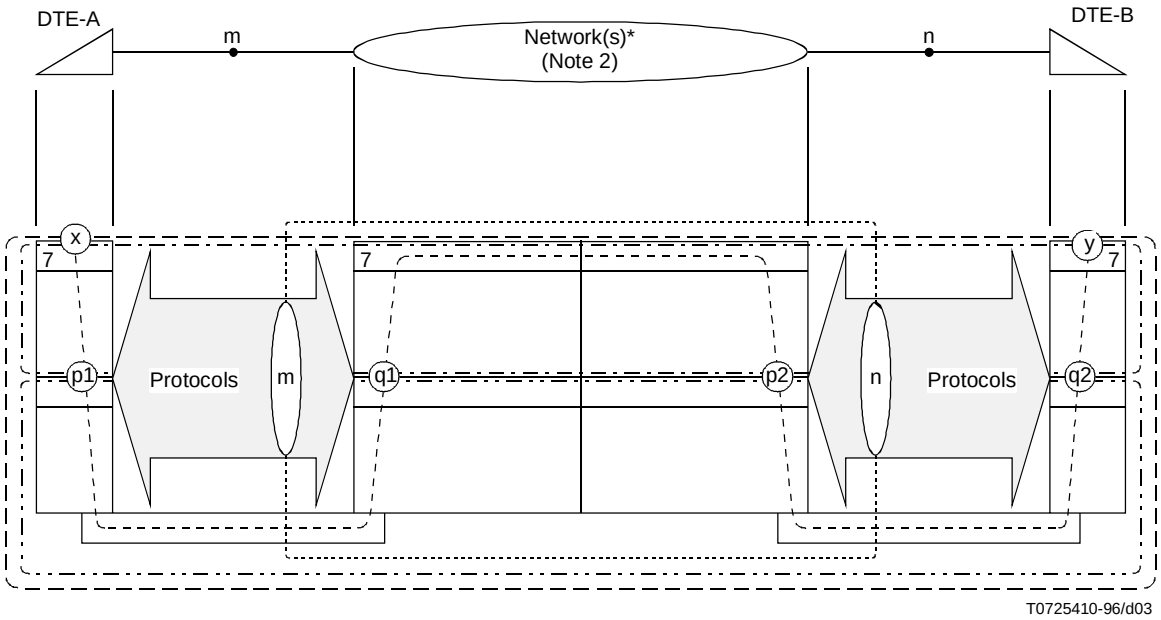
On top of data transmission services, users may establish a privately defined application.



Telecommunication capability: Application service (Note 1):	All functionality within the box. The service offered by telecommunication capability, visible at points x, y. [Application service = the service offered by (communication capability + transmission capability).]
Communication capability:	All functionality within the box.
Transmission capability: Subnetwork service:	All functionality within the box. The service offered by transmission capability, visible at points p, q.
Subnetwork functionality: Data transmission service:	All functionality within the box. The service visible at points m, n.

FIGURE 3-1/X.300

Relationship between terms for interworking involving transmission capability and data transmission service of networks* only



Telecommunication capability: Application service (Note 1):	All functionality within the box. The service offered by telecommunication capability, visible at points x, y. [Application service = the service offered by (communication capability + transmission capability).]
Communication capability:	All functionality within the box.
Transmission capability: Subnetwork service:	All functionality within the box. The service offered by transmission capability, visible at points (p1, q1), or (p2, q2).
Application-relay functionality: Application-relay service:	All functionality within the box (for further study). The service provided by application-relay functionality, visible at points m, n (for further study).

NOTE 1 – Teleservice relates to application service as shown in the I.240-Series Recommendations.

NOTE 2 – At least one application interworking function is involved.

FIGURE 3-2/X.300

Relationship between terms for interworking involving communication capability and teleservice (see Note 1)

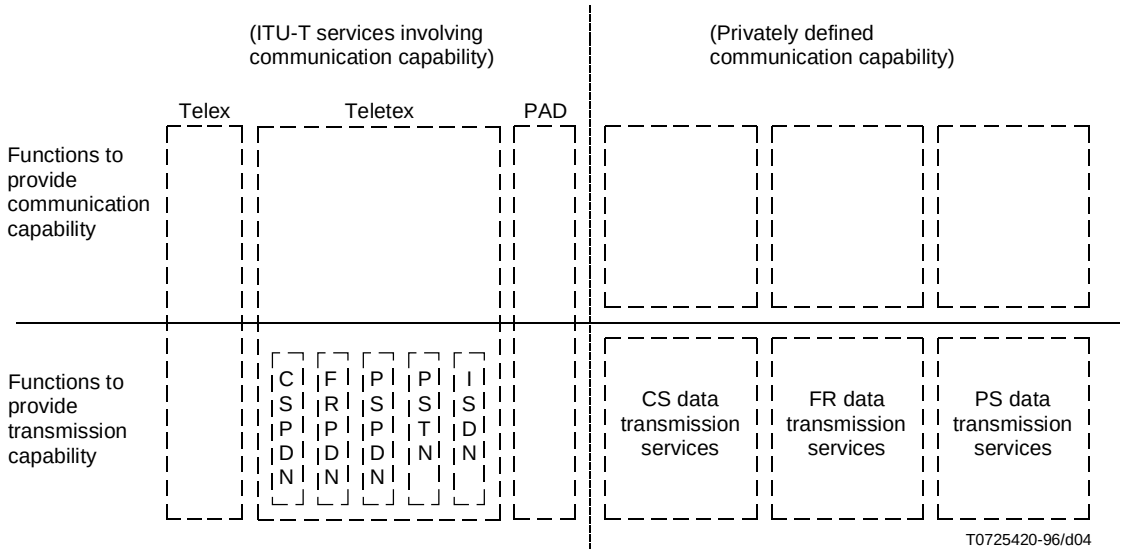


FIGURE 3-3/X.300

Examples of ITU-T services

3.2.6 communication capability: A communication capability consists of the means of communication between systems, related to functions above transmission capability. A communication capability may be defined by ITU-T, it may also be privately defined by users themselves.

3.2.7 convergence protocol: A protocol that is used on top of a subnetwork service (transparent for the related subnetwork), in order to construct another subnetwork service. This protocol may be active during all, or only some of the call related to the constructed subnetwork service.

3.2.8 data transmission service: Data transmission service is that service offered by an Administration, ROA or any private network operator to satisfy a telecommunication requirement and is composed of technical attributes as seen by the customer and other attributes associated with the service provision, e.g. operational. Use of the technical attributes requires mechanisms to access subnetworks as defined in Recommendation X.1 (circuit switched service, packet switched service and leased circuit service) and I.230-Series Recommendations and Recommendation X.10, as far as the purpose of transparent transmission is concerned.

NOTE – This concept is assumed to be equivalent to the bearer service.

3.2.9 end system: The functional abstraction of a real end system.

3.2.10 interworking by call control mapping: Technique of interworking where all call control (including addressing) information carried by the protocol(s) used for switching by the one subnetwork is mapped into the call control (including address) information carried by the protocol(s) used for switching by the other subnetwork.

3.2.11 interworking by port access: Technique of interworking where all call control (including addressing) information carried by the protocol(s) used for switching by the one subnetwork is used to select/address the interworking point. Subsequently, a convergence protocol is used over this subnetwork carrying all call control (including addressing) information that will be mapped into the addressing information carried by the protocols used for switching by the other subnetwork.

3.2.12 interworking function

3.2.12.1 The Interworking Functions (IWFs) considered in this Recommendation are functional entities involved for the establishment of a call between two end systems, whenever two networks are involved between those two end systems.

NOTE 1 – The description of IWFs in examples given in further clauses of this Recommendation does not make any assumption on the implementation of such functions: either within one network involved, or as a separate piece of equipment. Also several IWFs between two networks may be combined into one single piece of equipment.

NOTE 2 – An IWF may be involved in cases where two dissimilar networks are involved, or in cases where two networks of the same type are involved.

NOTE 3 – An IWF only acts for the transparent transfer of information (independent of any application).

NOTE 4 – An Access Unit (AU), Packet Handler (PH) or ISDN terminal adapter may also be considered an IWF.

3.2.12.2 In some cases of interconnection between two networks, several IWFs may be involved. However, for a given communication between two end systems, only one of those IWFs is involved.

3.2.12.3 Figure 3-4 illustrates an example of interworking between two networks by means of IWFs. There may be other cases, where more than two networks would be involved, possibly with more IWFs.

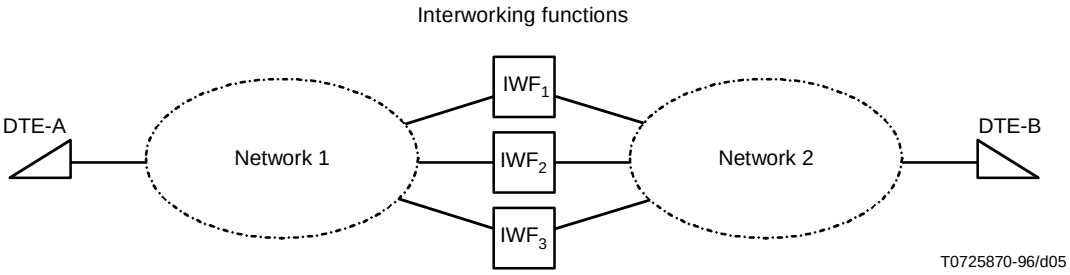


FIGURE 3-4/X.300

Example of interworking between two networks by means of interworking functions

3.2.13 network (Expansion of definition in Recommendation I.112): A set of nodes and links that provide connections between two or more defined ports to facilitate telecommunication between them. In particular, a network can for one particular instance of communication:

a) act for transparent transfer of information only (independent of any application); or

b) also act upon the information related to the application itself.

3.2.14 network*: Any combination of switch(es) or exchange(s), and/or networks, and/or IWFs.

3.2.15 real application relay system: Any combination of networks*, networks, and application IWFs where at least one network and/or application IWF also acts upon the information related to that application.

3.2.16 real end system: A DTE or TE having the capability to communicate, and serving as origination or destination of an instance of communication related to its application(s), and which is not an intermediate system or subnetwork.

3.2.17 **subnetwork**: A functional abstraction of a set of one or more intermediate systems which provide relaying and through which end systems may establish network connection, only related to the lower three layers of the OSI model (see Recommendation X.200).

3.2.18 **subnetwork functionality**: Functionalities residing within a subnetwork are related to the ways the subnetwork supports connections through it. These functionalities may differ in each type of subnetwork depending on the call control and data transfer phases.

3.2.19 **subnetwork service**: A service supported by the protocols used in a subnetwork for an instance of communication. This service is the same at the service access points.

3.2.20 **subnetwork type**: A subnetwork with a functionality defined on the capability to support the OSI connection-mode network service. The term is only valid in this specific context.

3.2.21 **transmission capability**: Transmission capability consists of all the necessary mechanisms required through a subnetwork (or subnetworks interworking) for the transparent transfer of data between users' equipment or application intermediate system, including the related mechanism within the end systems. This includes all mechanism required to access subnetworks, as defined in the I.230-Series Recommendations and Recommendation X.10, as far as the purpose of transparent transmission of information is concerned. It may also include special management functions; such functions are for further study.

NOTE – It is understood that some optional user facilities/supplementary services as defined in Recommendation X.2 and I.230-Series Recommedations relate to transmission capability only, while others also relate to communication capability. The exact lists in each category are not subject to this Recommendation.

3.2.22 **telecommunication capability**: The combined functionality of the communication capability and the transmission capability.

3.2.23 Table 3-1 provides a relationship to some of the terms defined above.

TABLE 3-1/X.300

Relative relationship of real and abstract objects used in this Recommendation

	Objects related to transmission capability only for one instance of communication	Objects related to communication capability only for one instance of communication
Real world objects	• Network • Interworking Function (IWF)	• Network • Application IWF • Real application relay system
Abstract elements	• Subnetwork	• Application relay system

3.3 Graphical conventions

This subclause defines the relationship between some terms used in this Recommendation and their graphical representation as used in this Recommendation. In addition, it defines the relationship between some terms related to real world objects and the terms related to their abstraction for a particular instance of communication. Tables 3-2 and 3-3 summarize the symbols and objects covered in this Recommendation.

The graphical indication of a subnetwork functionality corresponds to the particular subnetwork types as allocated in this Recommendation. The graphical indication will be expressed in Roman numbers as follows (using Backus-Naur Form):

<indication> ::= <subnetwork type I>|<subnetwork type II>|<subnetwork type III>

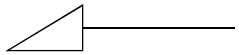
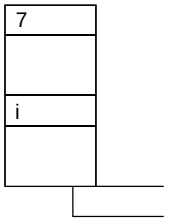
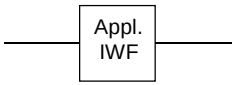
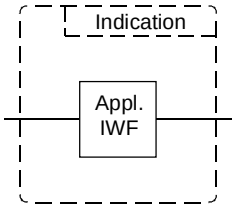
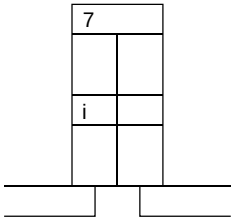
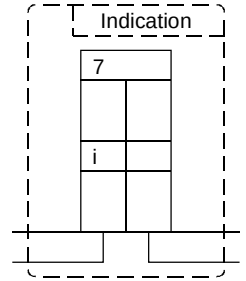
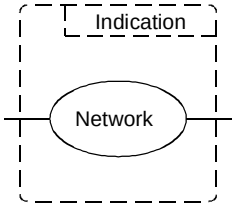
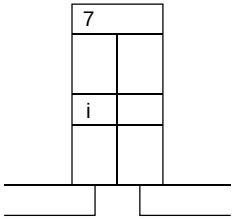
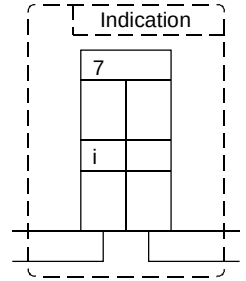
<subnetwork type I> ::= <I>

<subnetwork type II> ::= <II>

<subnetwork type III> ::= <III>

TABLE 3-2/X.300

Correspondence between real world objects involving both transmission capability and communication capability, their abstract elements, and graphical conventions for one particular instance of communication

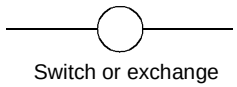
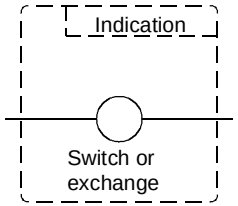
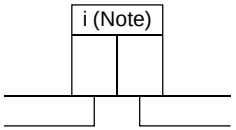
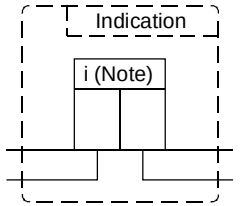
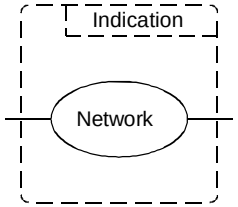
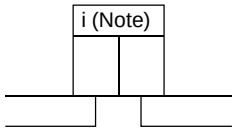
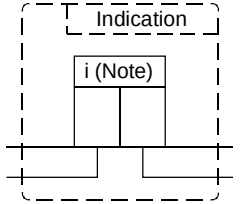
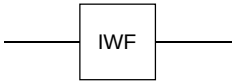
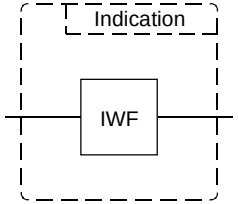
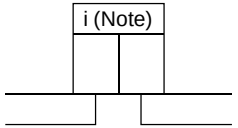
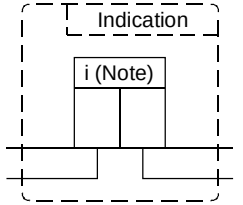
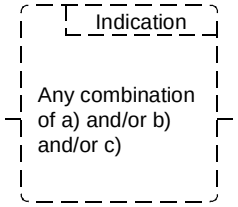
Real world object	Graphical representation of real world object	Corresponding abstract element	Graphical representation of real world object with indication of abstract element functionality	Graphical representation of abstract element	Graphical representation of abstract element with indication of abstract element functionality
a) Real end system (i.e. DTE or TE)		End system	Not applicable		Not applicable
b) Application interworking function		Application relay system			
c) Network		Application relay system			

T0725430-96/d06

NOTE – "i" may be used to indicate a specific layer(s) (for example, "7" present denotes that an application process is present).

TABLE 3-3/X.300

Correspondence between real world objects involving transmission capability only, their abstract elements and graphical conventions for one particular instance of communication

	Real world object	Graphical representation of real world object	Corresponding abstract element	Graphical representation of real world object with indication of abstract element functionality	Graphical representation of abstract element	Graphical representation of abstract element with indication of abstract element functionality
a)	Switch or exchange		Subnetwork			
b)	Real network		Subnetwork			
c)	Interworking function		Subnetwork			
d)	Network* involving transmission capability only	Any combination of a) and/or b) and/or c)	Subnetwork		Any combination of a) and/or b) and/or c)	Any combination of a) and/or b) and/or c)

T0725440-96/d07

NOTE – Height may also be used to indicate degree of functionality. Where "i" may be used to indicate a specific layers.

4 Abbreviations

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

AU	Access Unit
CCSN	Common Channel Signalling Network (SS No. 7)
SS No. 7	Signalling System No. 7
CS	Circuit Switched
CSPDN	Circuit Switched Public Data Network
DCE	Data Circuit-terminating Equipment
DSE	Digital Switching Exchange
DTE	Data Terminal Equipment
IDSE	International Data Switching Exchange
ISDN	Integrated Services Digital Network
IWF	Interworking Function
NDSE	National Data Switching Exchange
NS	Network Service
OSI	Open Systems Interconnection
PAD	Packet Assembler/Dissembler
PDN	Public Data Network
PLMN	Public Land Mobile Network
PS	Packet Switched
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network
PH	Packet Handler
TA	Terminal Adapter
TE	Terminal Equipment

5 Networks to be interconnected and data transmission services to be offered

This clause lists the networks considered in this Recommendation for provision of data transmission services, and indicates where appropriate, the extent to which those networks provide support for the full capability of the OSI connection-mode network service at the DTE/DCE interface.

International data transmission services may be provided through the interworking of different types of networks, as follows:

- Public Data Networks (PDNs);
- Integrated Services Digital Network (ISDN);
- Public Switched Telephone Network (PSTN);
- mobile networks or systems;
- private networks.

NOTE 1 – Other services, not related to data transmission services, may also be provided by interworking involving PDNs. In particular, the requirements for a PDN when interworking with the public telex network in respect of CCITT telex service are defined in Recommendation X.340.

NOTE 2 – Common Channel Signalling Network (CCSN) is also considered in this Recommendation, for interworking with PDNs, and to provide a means of data transmission of operational information (see also 5.6, in particular the Note in 5.6.2).

5.1 Packet Switched Public Data Network (PSPDN)

5.1.1 The Packet Switched Public Data Networks (PSPDNs) are considered in this Recommendation.

5.1.2 The data transmission services and user facilities offered through the PSPDNs are described in Recommendations X.1 and X.2, and are the packet switched data transmission services.

5.1.3 The categories of access for DTEs to the data transmission services offered through PSPDNs are specified in Recommendation X.10.

5.1.4 In addition to data transmission services and telematic services, PSPDNs can be used to support OSI applications.

5.2 Circuit Switched Public Data Network (CSPDN)

5.2.1 The Circuit Switched Public Data Networks (CSPDNs) are considered in this Recommendation.

5.2.2 The data transmission services and user facilities offered through the CSPDNs are described in Recommendations X.1 and X.2, and are:

- either synchronous data transmission services; or
- asynchronous data transmission services.

5.2.3 The categories of access for DTEs to the data transmission services offered through CSPDNs are specified in Recommendation X.10.

5.2.4 In addition to data transmission services and telematic services, a CSPDN can be used to support OSI applications.

NOTE – The extent to which CSPDNs provide support for the full capability of the OSI connection-mode network service, is for further study. It is intended to reflect the result of this study in the present Recommendation, when appropriate.

5.3 Frame Relay Public Data Network (FRPDN)

5.3.1 The Frame Relay Public Data Networks (FRPDNs) are considered in this Recommendation.

5.3.2 The data transmission services and user facilities offered through the FRPDNs are described in Recommendations X.1 and X.2 and are frame relay data transmission services.

5.3.3 The categories of access for DTEs to the data transmission services offered through FRPDNs are specified in Recommendation X.1.

5.3.4 In addition to data transmission services and telematic services, FRPDNs can be used to support OSI applications, when appropriate.

NOTE – The extent to which FRPDNs provide support for the full capability of the OSI connection-mode network service, is for further study. It is intended to reflect the result of this study in the present Recommendation, when appropriate.

5.4 Integrated Services Digital Network (ISDN)

5.4.1 The Integrated Services Digital Network (ISDN) is considered in this Recommendation for the interworking for the provision of data transmission services.

NOTE – One objective of the ISDN is to provide data transmission services currently provided through PDNs (see I.230-Series Recommendations).

5.4.2 The data transmission services related to ISDN considered in this Recommendation are described in Recommendation X.1 and are:

a) circuit-switched data transmission services;

b) packet-switched data transmission services;

c) frame relay data transmission services.

NOTE – In addition, other types of data transmission services may have to be considered for interworking with the ISDN for new applications (e.g. telemetry).

5.4.3 The categories of access for DTEs to the data transmission services on ISDN are described in Recommendation X.10.

5.5 Public Switched Telephone Network (PSTN)

5.5.1 The Public Switched Telephone Network (PSTN) is considered in this Recommendation for the interworking for the provision of data transmission services.

NOTE – PSTN with or without enhanced signalling capability (e.g. calling line identification capability) should be considered for interworking.

5.5.2 The data transmission services which should be considered through the PSTN for interworking with PDNs depend on the exact interworking situation (see also clause 8). Depending on the interworking situation, such data transmission services are either based on synchronous or asynchronous data transmission services or based on packet-switched data transmission services which are expected to be equivalent to the OSI connection-mode network service.

5.6 Common Channel Signalling Network (CCSN)

5.6.1 The purpose of a Common Channel Signalling Network (CCSN) is to control signalling for another network (e.g. ISDN and CSPDN).

The controlled network may interwork with another PDN, as illustrated in Figure 5-1. Such an interworking is not considered as interworking between CCSN and PDN in this Recommendation.

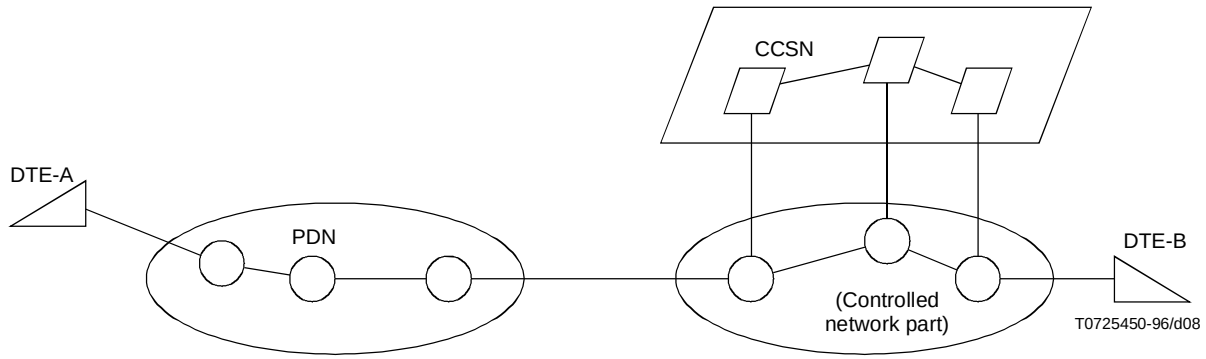


FIGURE 5-1/X.300

Interworking between PDN and a network controlled by a CCSN (not between PDN and CCSN)

5.6.2 For the transmission of operational information between Administrations, CCSN and PDN may also need to interwork at the same level, to provide a means of data transmission between operational centres and/or terminals for those Administrations, as illustrated in Figure 5-2. Such an interworking is to be considered as interworking between CCSN and PDN (see Note).

NOTE – This does not preclude consideration of the interworking between PDNs and common channel signalling networks for the transfer of user data. The provision of this capability is for further study.

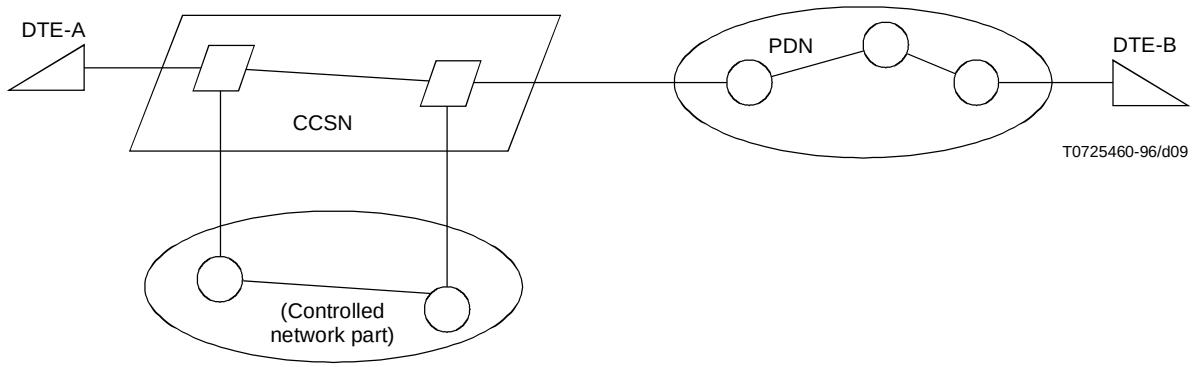


FIGURE 5-2/X.300

Interworking between PDN and CCSN

5.6.3 A CCSN, for the interworking with a PDN and for the transmission of operational information, should be considered, in association with any appropriate interworking function, for the provision of the OSI connection-mode network service.

5.7 Public mobile systems

5.7.1 Public mobile satellite data transmission systems

5.7.1.1 The general interworking requirements for data transmission in public mobile-satellite systems are defined in Recommendation X.350.

5.7.1.2 The requirements for interworking between PSPDNs and the public mobile-satellite service using a PAD are given in Recommendation X.351.

5.7.1.3 The requirements for interworking by call control mapping between packet switched public data networks (PSPDNs) and public mobile satellite data transmission systems are defined in Recommendation X.352.

5.7.2 Public Land Mobile Networks (PLMNs)

5.7.2.1 Interworking between PSPDNs and PLMNs employing analogue radio transmission techniques may be obtained through IWFs designed in accordance with Recommendation X.32. In this case, the telephone channels of the public mobile system are used as access circuits to the IWF. The PLMN may also be interconnected with the PSPDN via switched circuit of the PSTN.

5.7.2.2 Interworking between PSPDNs and ISDNs and PLMNs with access capabilities equivalent to that of the ISDN is for further study.

5.7.2.3 CSPDNs may be used to access PLMNs in the same way as defined in 5.7.2.1 using protocols providing error correction and flow control. This point is for further study.

5.7.3 Other mobile systems

Interworking with public mobile systems in cases other than those given above is for further study.

5.8 Private networks

Private networks are considered for interworking with PSPDNs and ISDNs for the provision of data transmission services (see Recommendation X.327).

NOTE – Interworking with CSPDNs is for further study.

6 Principles for interworking involving transmission capabilities only

The different categories of interworking may involve different levels of functions:

a) in some cases only the functions related to the transparent transfer of information between two DTEs through the network(s) (transmission capability);

b) also, in other cases, additional functions built upon those related to the transparent transfer of information (communication capability).

This clause describes the basic concepts and principles related to cases mentioned in a).

6.1 Composition and decomposition of subnetworks

Consideration of the different conditions for interworking involving transmission capability only requires the development of appropriate concepts for the different types of networks which may be involved. In particular, the concept of subnetwork and of different types of subnetworks, are intended to assist in developing an appropriate framework for studying the interworking between networks.

6.1.1 Concept of subnetwork

6.1.1.1 The corresponding entities cooperate, as indicated in the example of the following Figures 6-1 and 6-2.

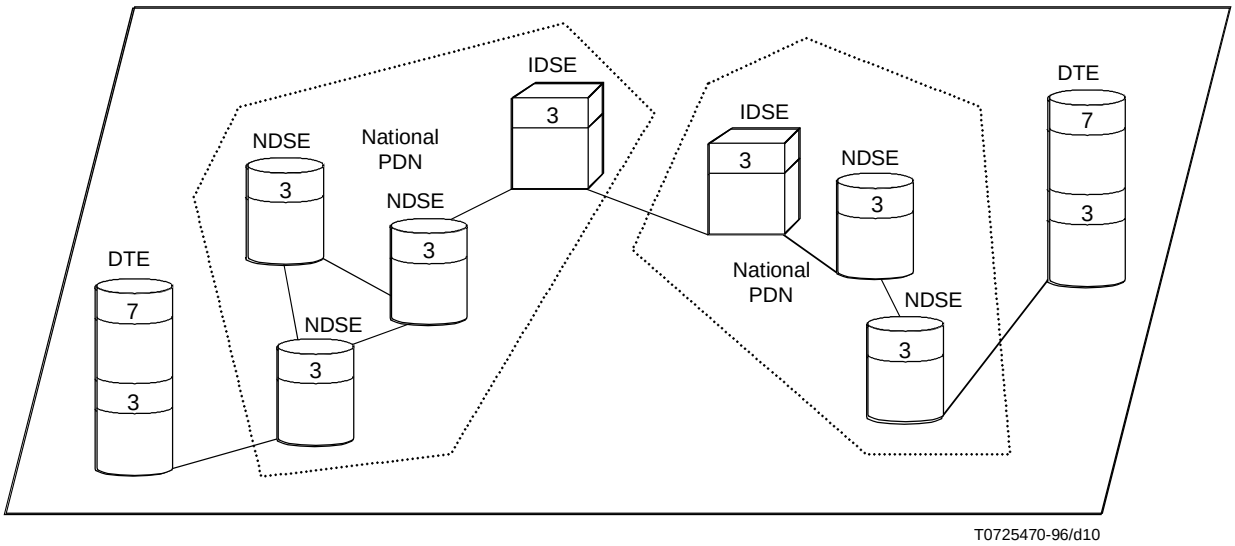


FIGURE 6-1/X.300

Example of an international PDN configuration with interworking

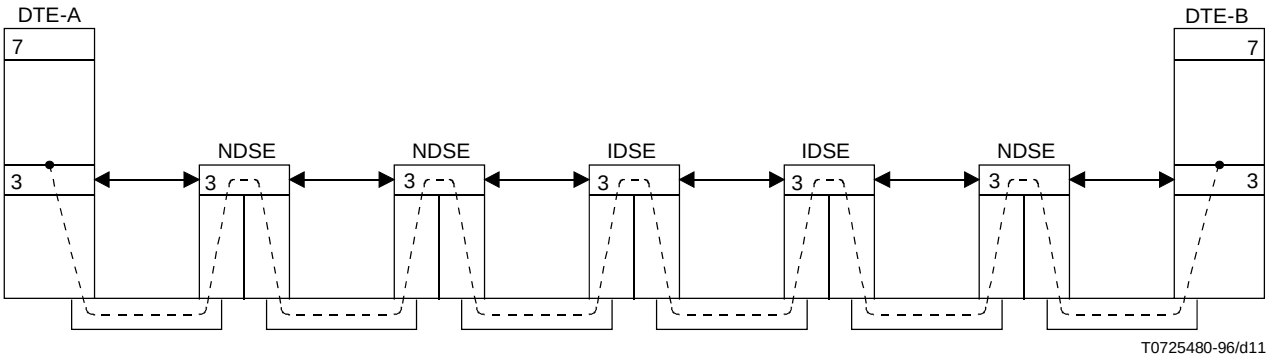


FIGURE 6-2/X.300

Intermediate modes for a network connection

6.1.1.2 It is not always necessary to consider individual intermediate systems involved in a given call. For example, it is not necessary to consider individual NDSEs of a national PDN, since the question of protocols between such NDSEs is a national matter. Also the question of protocols between an NDSE and an IDSE in the same national PDN is a national matter. Therefore, and for the purpose of studying interworking arrangements between networks, it may be of interest to consider those DSEs which are in the same national PDN as only one intermediate abstract system involved in the call, as indicated in Figure 6-3 (giving two equivalent representations of intermediate systems involved in the call).

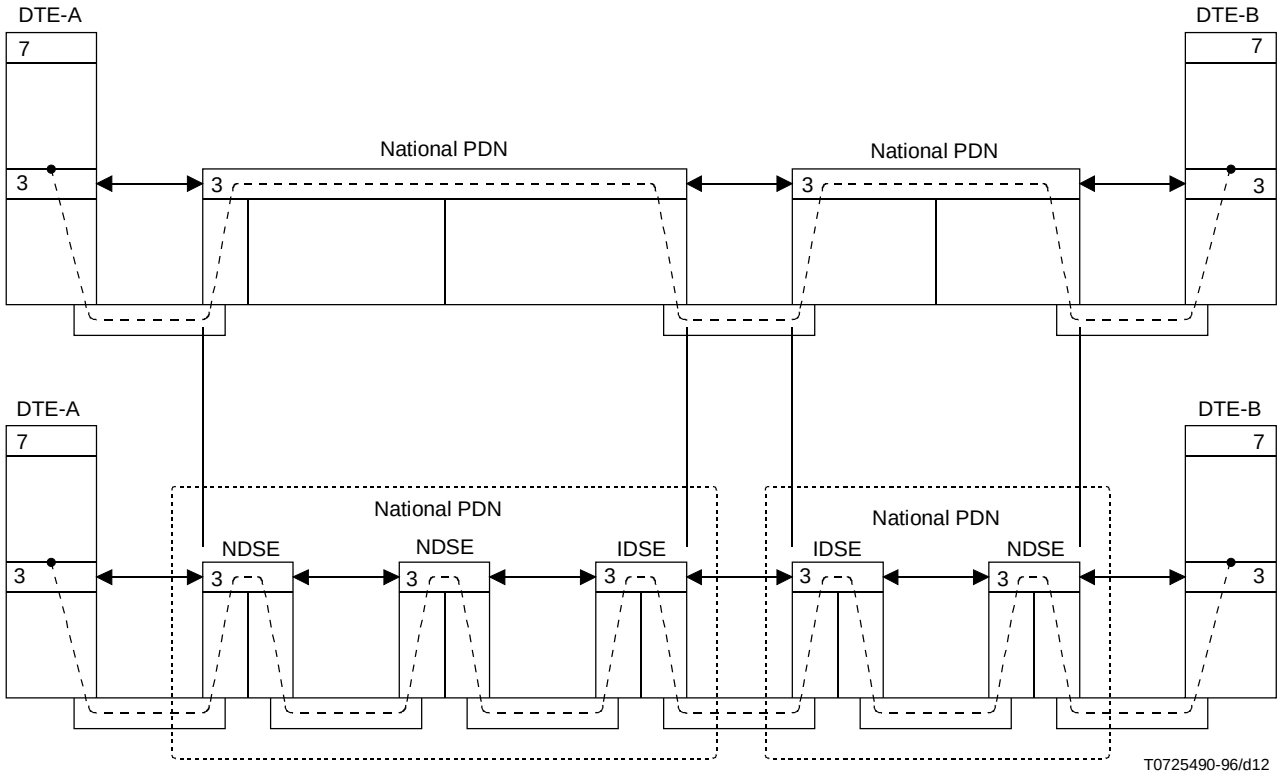


FIGURE 6-3/X.300

Two equivalent representations of intermediate systems involved in a call

6.1.1.3 A subnetwork may contain various combinations of network equipment, including public network(s), interworking function(s) [IWF(s)], etc. This can be graphically represented as shown in Figure 6-4.

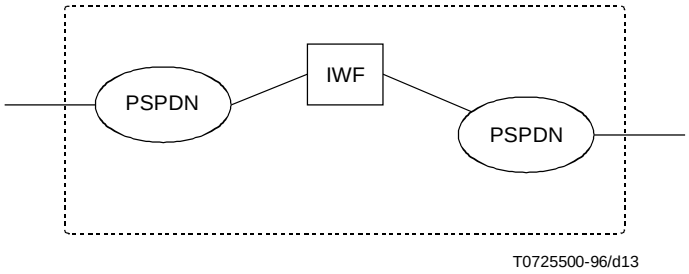


FIGURE 6-4/X.300

Example of a graphical representation of interconnected networks

6.1.1.4 A subnetwork may be used to represent the interconnection of:

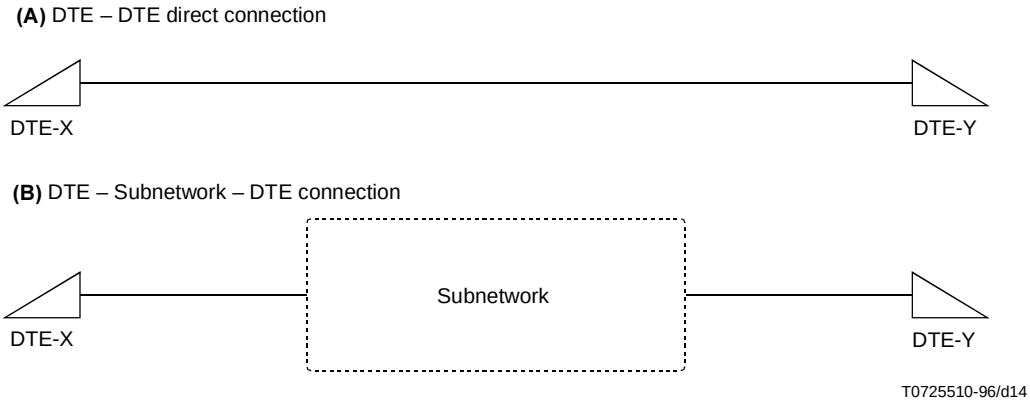
a) two end DTEs, then a single subnetwork is involved in the connection;

b) one end DTE and another subnetwork, then at least two subnetworks are involved in the connection;

c) two other subnetworks, then the subnetwork is involved as a transit subnetwork, it may consist of a single IWF, or be an actual transit network (see Figure 6-4).

The same collection of equipment, considered as a subnetwork, may be used in one or more of these cases a) to c) above.

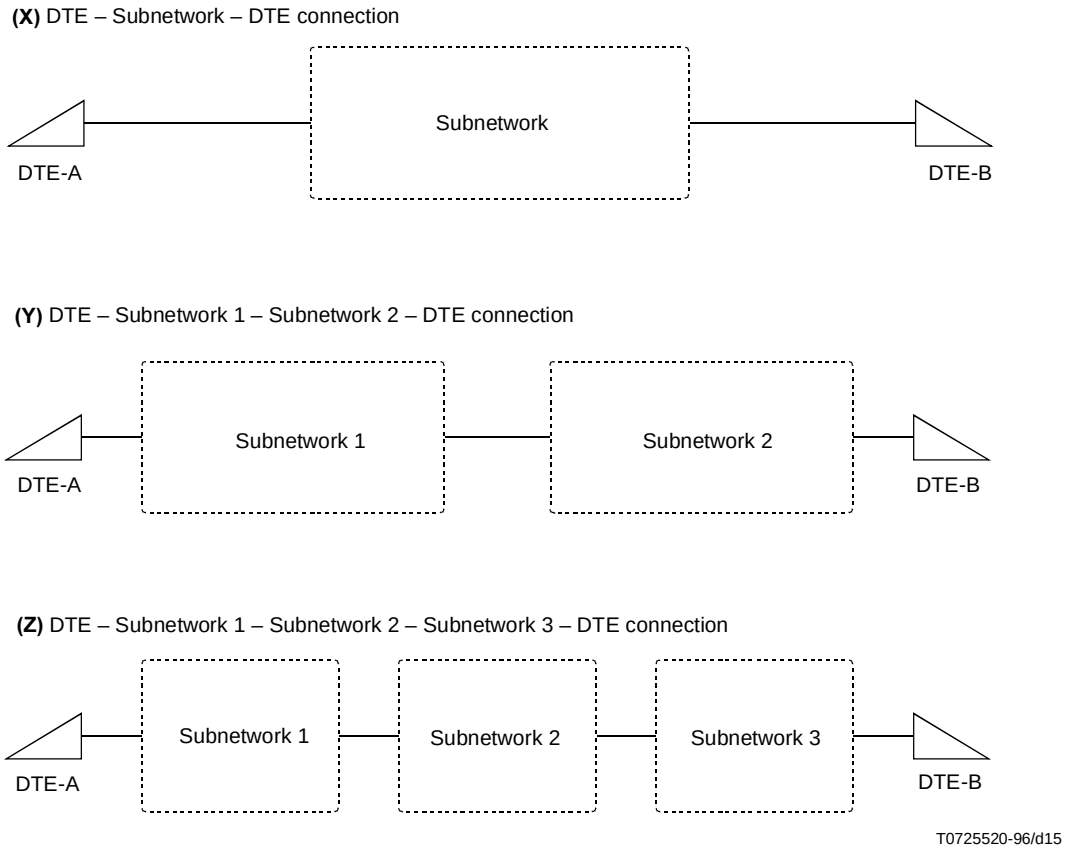
6.1.1.5 From the viewpoint of end users, there are two basic situations:



In case (B), there is no need, from the users' viewpoint, to consider the exact subnetwork configuration. The subnetwork may for example be: a single network, two interconnected networks (via an IWF or not), etc.

Also in case (B), the protocols at DTE-X and DTE-Y interfaces may be different.

6.1.1.6 From the viewpoint of network providers, there are different configurations to consider:



In cases (Y) and (Z), an IWF may be involved in any one of the subnetworks used. In case (Z), the intermediate subnetwork may consist of a single IWF.

The procedure used at DTE-A interface should not be dependent on the subnetwork(s) used on the connection with the corresponding DTE-B.

6.1.1.7 Following the cases in 6.1.1.5 and 6.1.1.6 above, a given network equipment configuration may be considered as a single subnetwork, or several distinct interconnected subnetworks, depending on the viewpoint needed for consideration. This is illustrated in Figure 6-5:

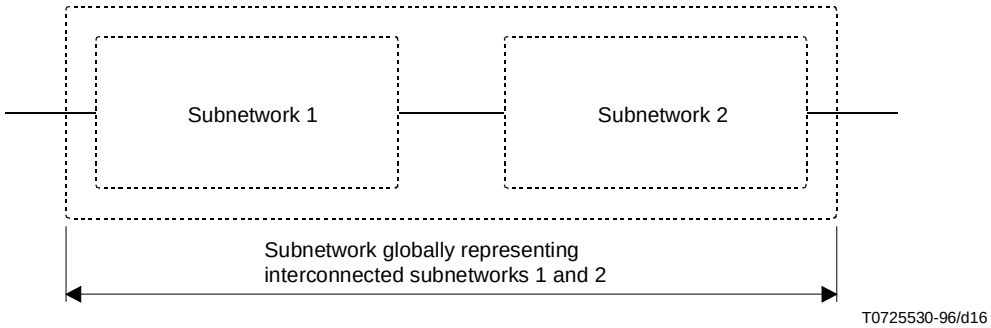


FIGURE 6-5/X.300

Global representation of subnetworks

6.1.2 Decomposition of subnetworks with respect to protocols and services

In the case that end-systems are interconnected via subnetworks, from the end-system point of view, only one subnetwork needs to be considered (i.e. the subnetwork composed of all subnetworks between end-systems).

In Figure 6-6, this subnetwork is labelled subnetwork S. Subnetwork S may be composed out of subnetworks S1 and S2. Subnetwork S1 may be accessed using protocol "a". Subnetwork S2 may be accessed using protocol "d". The functional capabilities of subnetwork S2 are assumed to be more comprehensive than those of subnetwork S1.

For network interworking between subnetworks S1 and S2, different concepts may apply:

a) Network interworking is based upon the functionality of subnetwork S2. This implies the need for convergence protocol transparently for subnetwork S1. This possibility is outlined in more detail in 6.1.2.1.

b) Network interworking is based upon the functionality of subnetwork S1. This implies that specific elements of protocol "d" cannot be mapped to corresponding elements of protocol "a" used between DTE-A and subnetwork S1. This case is described in 6.1.2.2.

c) In many practical cases of subnetwork interconnection, network interworking may correspond to a functional level, which is between the functional levels performed by subnetworks S1 and S2. In this case, there is a need for either an enhancement of subnetwork S1 or a convergence protocol transparent to subnetwork S1. The functional level on which network interworking takes place, however, is lower than the functional level performed by subnetwork S2. This case is not described in more detail, since it is between the possibilities defined in 6.1.2.1 and 6.1.2.2 and does not need additional clarification.

The concept which has to be chosen for network interworking is dependent on the requirements of the services to be supported by the interworking arrangements. A specific application or service may in cases a), b) and c) above require an additional convergence protocol transparent to subnetworks S1 and S2. An example of this case is the support of telematic services by means of circuit-switched data transmission services.

6.1.2.1 In this case, subnetwork S (see Figure 6-6, case A) is accessed by protocols (a + b) or by protocol (d). Decomposition of subnetwork S however, reveals two participating subnetworks S1 and S2. Subnetwork S2 uses protocol (d) and can also be accessed by protocols (i + b). Subnetwork S1 can be accessed by protocol (a) and also by (i).

The full functionality of subnetwork (y) actually resides in subnetwork S2. Subnetwork S1 does not provide functionality (y) but does provide a different functionality (x). The means to make up for the difference in functionality is provided by protocol (b), transparently for subnetwork S1.

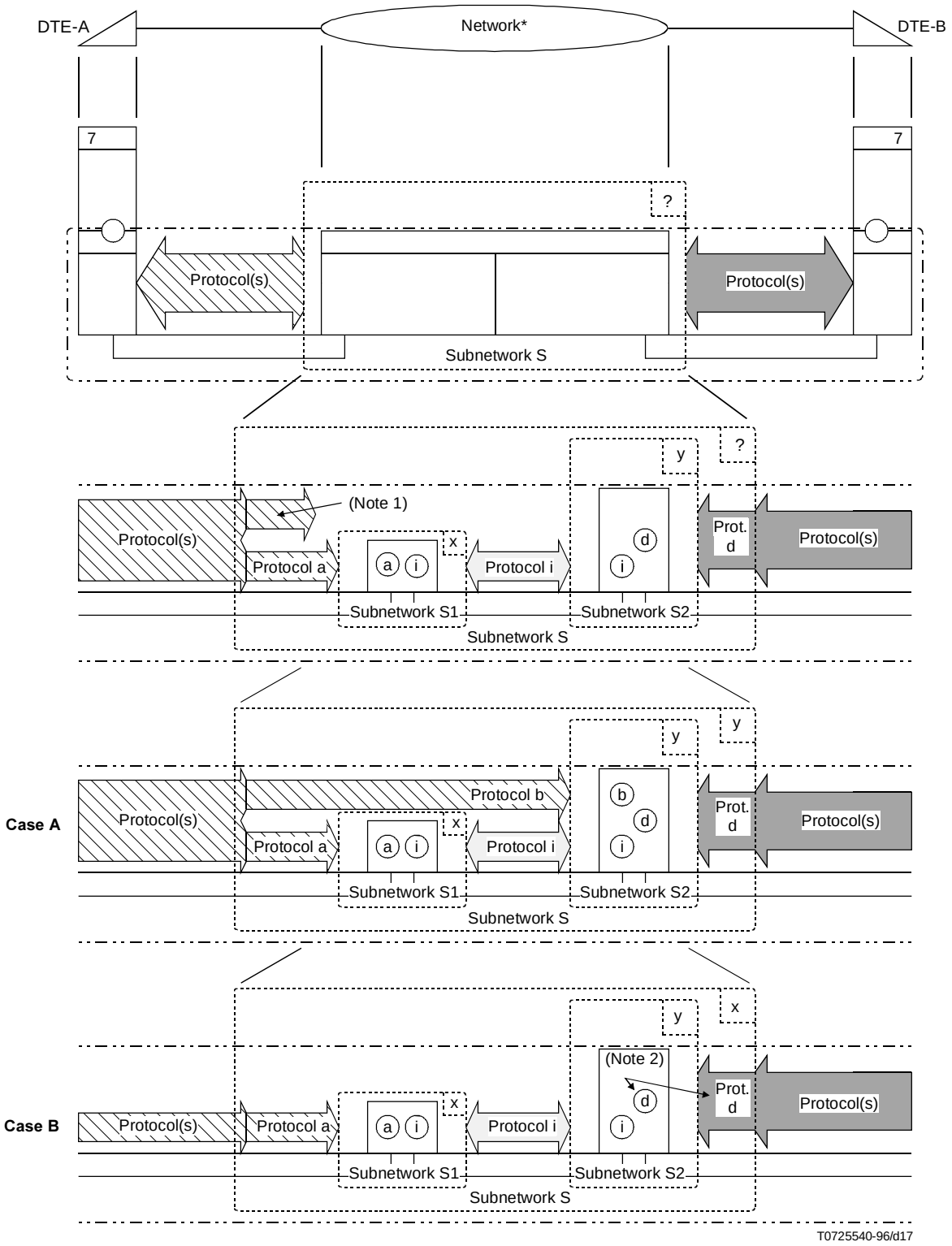
The operation of decomposition can be repeated as often as appropriate and desirable, as necessary for the specification of interconnected systems. Such repetition is illustrated in Figure 6-7. Figure 6-7 also illustrates how different subnetwork services (related to the subnetwork functionality) play a role. In general the following applies:

[Subnetwork service (x) + convergence protocol] = subnetwork service (y)

6.1.2.2 Figure 6-6, case B shows network interworking on the basis of the functionality of subnetwork S1.

A number of elements of protocol "d" cannot be mapped to corresponding elements of protocol "a" used between DTE-A and subnetwork S1. Therefore, these elements of protocol "d" are not available to the resulting data transmission service. The overall functionality of subnetwork S is equivalent to the functional level performed by subnetwork S1. The loss of elements of protocol "d" when the functionality of subnetwork S is on the level of subnetwork S1 may result in a loss of service features for this communication from DTE-B point of view.

The applicability of this concept of subnetwork decomposition assumes that the dominant attributes of the service offered at each side of the communication are retained and that only those service features are lost which are not essential for the required data transmission services.



NOTE 1 – Depending on the use of case A or case B, this protocol is available or not.

NOTE 2 – Not all elements of protocol "d" can be mapped to corresponding elements of protocol "a" used between DTE-A and subnetwork S1.

FIGURE 6-6/X.300

Decomposition of subnetworks

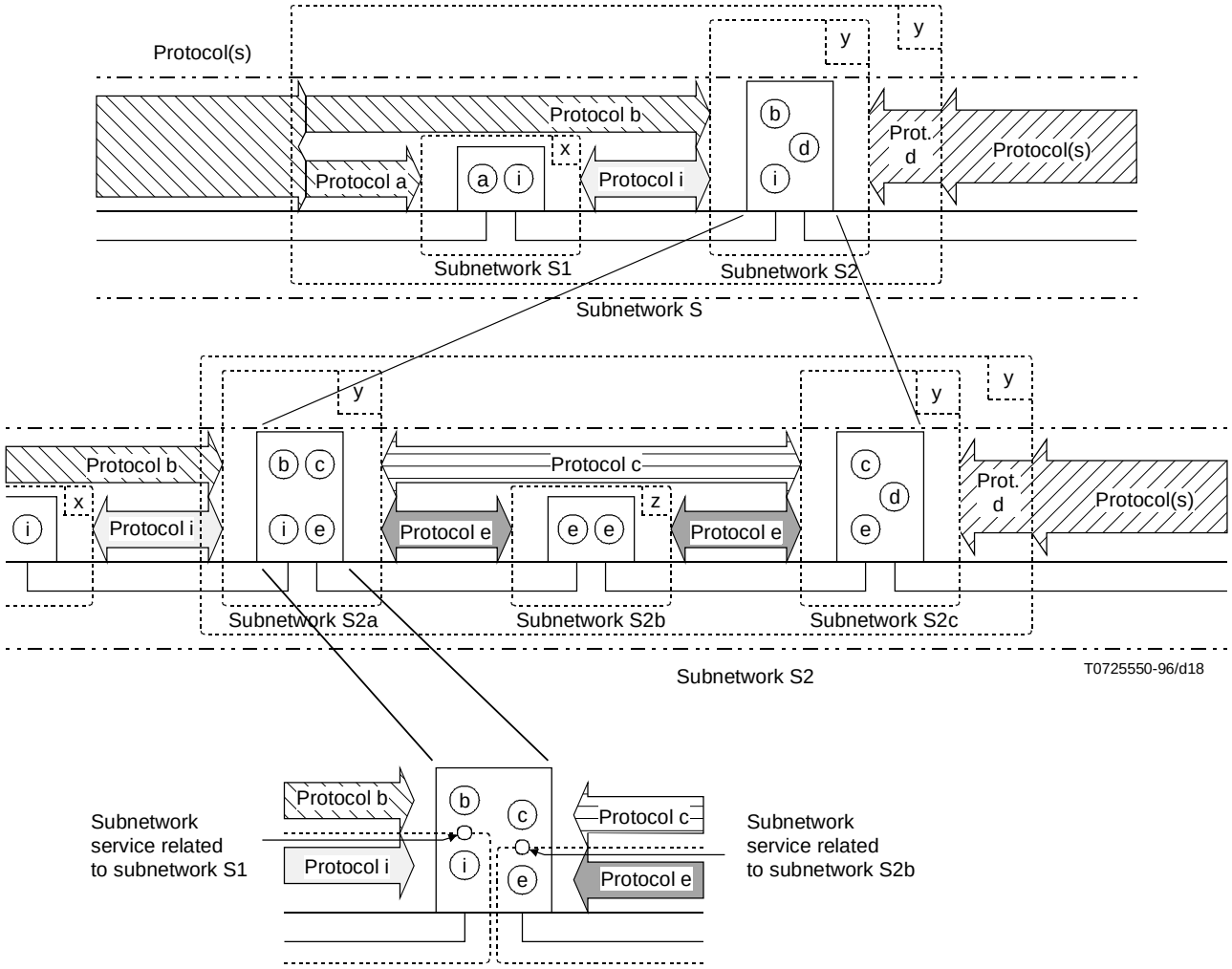


FIGURE 6-7/X.300

Repeated decomposition of subnetworks and participation of different subnetwork services

Figure 6-8 illustrates the relationship between protocols to access a subnetwork, a convergence protocol, and subnetwork services in an end system.

6.1.3 Principles for interworking between subnetworks

Interworking between subnetworks should be based on considerations on the functionality of the subnetworks concerned. In such interworking, it is not necessary to consider any individual intermediate system involved in a given network connection. Each network should be considered globally, in association with any appropriate interworking functions whenever it is necessary. For the purpose of interworking between two networks, the pieces of network equipment will be represented as interconnected subnetworks.

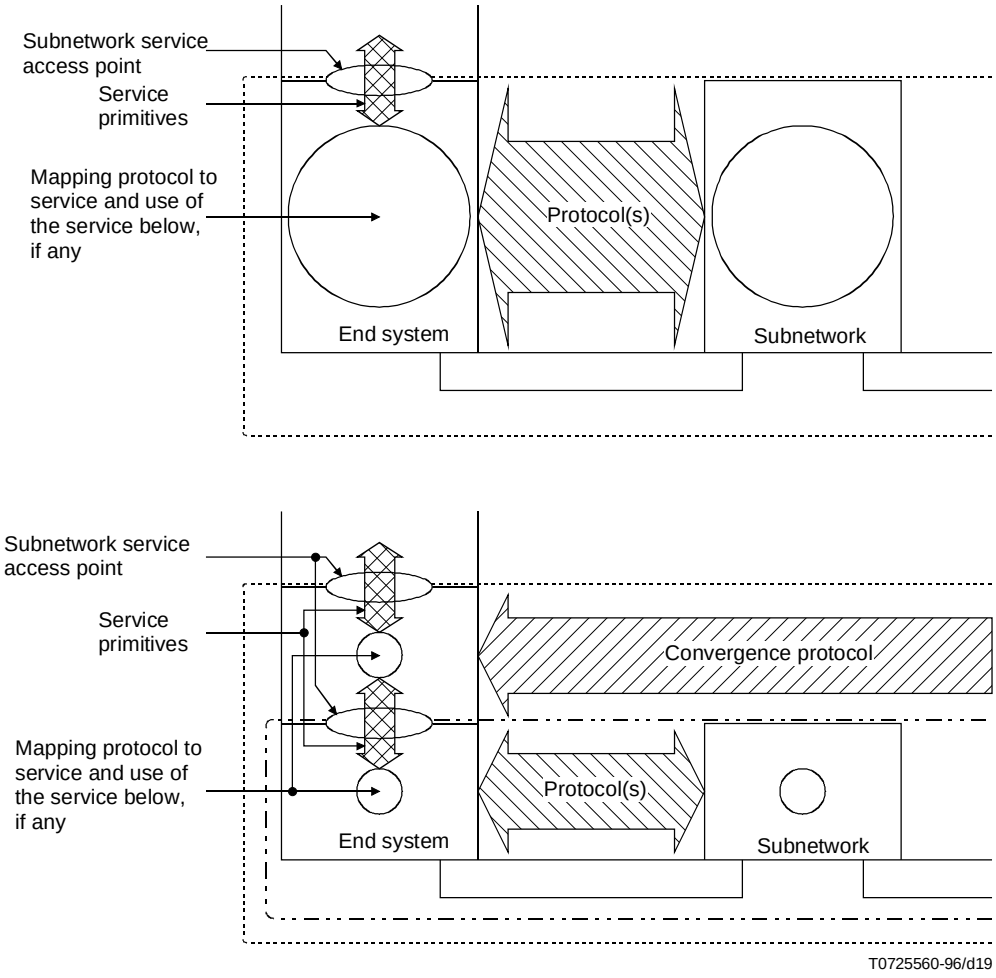


FIGURE 6-8/X.300

Protocol and service mapping in end systems

6.2 Categories of interworking

This subclause describes the categories of interworking that involve functions related to the transmission capability only (see also clause 3). Two different categories of interworking between two networks have to be considered in this subclause:

a) interworking by call control mapping;

b) interworking by post access.

NOTE – The arrows used in the figures of 6.2 indicate in a generic way exchange of information that occurs at the interface of the subnetwork. Their purpose is not to represent the Network Service (NS) primitives conveyed through the horizontal abstract interface between the network layer and the transport layer.

6.2.1 Interworking by call control mapping

Interworking by call control mapping is abstractly shown in Figure 6-9.

Possible examples of this type of interworking includes interworking between CSPDNs using X.71, interworking between PSPDN and ISDN using X.75 and interworking between CSPDN and PSPDN in the case where the call control information of the CSPDN is mapped into the call control information of the PSPDN.

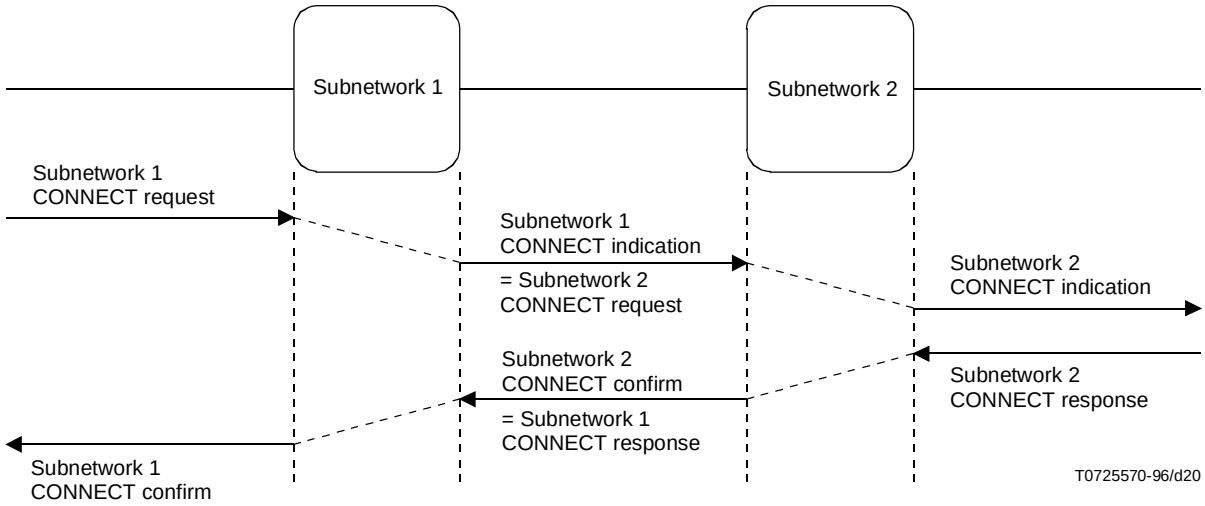


FIGURE 6-9/X.300

Interworking by call control mapping

6.2.2 Interworking by port access

Interworking by port access is abstractly shown in Figure 6-10.

Possible examples of this type of interworking includes interworking between PSTN and PSPDN where first a connection (switched or hot-line) through the PSTN is established to a port of the PSPDN, after which procedures are operated over this connection for establishment of a connection through the PSPDN.

6.3 Categorization of subnetworks with respect to the support of the OSI-NS

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

Other types of subnetworks supporting other services and applications are for further study.

6.3.1 Identification of subnetwork types

Subclause 6.1 defines how communication may involve subnetworks with different functionalities. In this subclause, some particular subnetwork functionalities are considered, which are labelled as subnetwork types. The functionalities of the respective subnetwork types are given in Table 6-1. The functionalities are expressed in relation to the ITU-T recommended subnetwork service (defined in Recommendation X.213) in the different phases of a call.

The identification of the particular subnetwork types does neither imply any requirement for enhancing such networks for OSI, nor restrict the use of such subnetworks to OSI. The identification rather intends to provide a general basis, and still allows use by any applications.

For further details on the identification of subnetwork types, see Annex A.

6.3.2 Relations between networks and subnetwork types

Networks are considered in clause 5. The abstract functionality of these networks corresponds to subnetwork types as indicated in Table 6-2.

For example of subnetwork types, see Annex B.

6.3.3 Interconnection of subnetwork types

Different types of subnetworks are defined in 6.3.1. Table 6-3a illustrates the resulting subnetwork type when interconnecting two subnetworks.

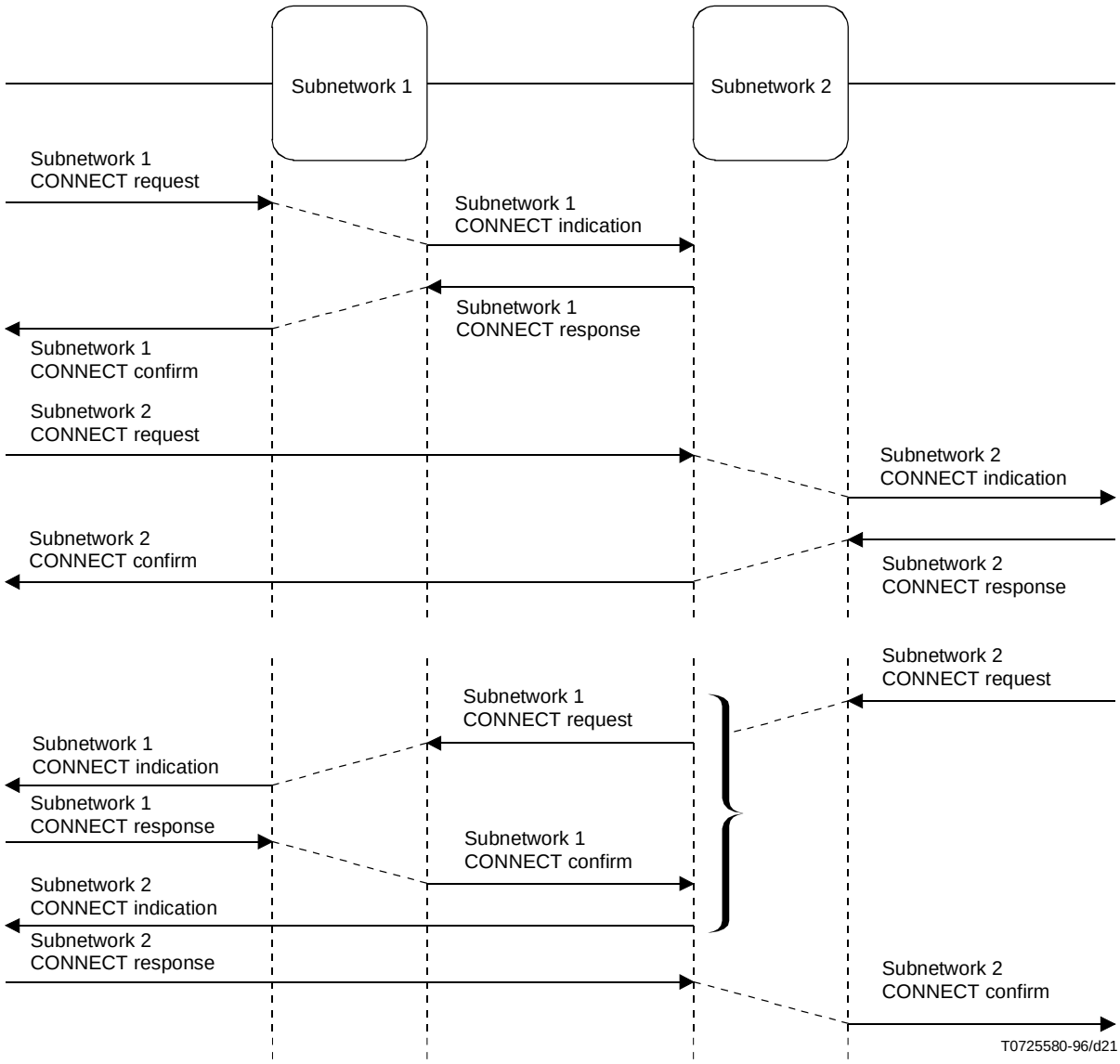


FIGURE 6-10/X.300

Interworking by port access

TABLE 6-1/X.300

Identification of subnetwork types

Subnetwork type \ Phase of the call	Connection establishment phase	Data transfer phase	Connection release phase
Subnetwork Type I	M	M	M
Subnetwork Type II	M	P	M
Subnetwork Type III	S	P	S
Subnetwork Type IV	M or S	F	M or S

M All mandatory elements required for the provision of the OSI Network Service are signalled through the subnetwork by means of its signalling capability.

P The functionality of the subnetwork corresponds to that of a physical connection.

S A subset of all mandatory elements required for the provision of the OSI Network Service are signalled through the subnetwork by means of its signalling capability.

F Some form of packetizing or framing is operated by the subnetwork, without providing all mandatory elements required for the support of the OSI Network Service.

TABLE 6-2/X.300

Abstracts functionality of different networks

Network	CSPDN	PSPDN	FRPDN	ISDN (cs)	ISDN (ps)	ISDN (fr)	PSTN	PLMN	MSS	Private networks
Sub-network type	III (Note 1)	I	IV	II (Note 2)	I	IV	III	FS	I	FS

FS For further study.

NOTE 1 – Further study is under way on how CSPDNs could be enhanced to subnetwork type II functionality.

NOTE 2 – Details of this correspondence are under study.

TABLE 6-3a/X.300

Resulting subnetwork types when interconnecting two subnetworks

	I	II	III	IV
I	I	I / IV	I / IV	I / IV
II	I / IV	II	II / III	IV
III	I / IV	II / III	III	IV
IV	I / IV	IV	IV	IV

Different categories of interworking are defined in 6.2. Different types of subnetworks are identified in 6.3.1. Table 6-3b defines how the different categories are applied when interconnecting the identified subnetworks.

Detailed interworking arrangements concerning the different cases in terms of networks are defined in clause 8.

TABLE 6-3b/X.300

Categories of interworking considering interconnection of subnetworks

	Subnetwork Type I	Subnetwork Type II	Subnetwork Type III	Subnetwork Type IV
Subnetwork Type I	Interworking by call control mapping	Interworking by call control mapping or by port access	Interworking by call control mapping or by port access	Interworking by call control mapping or by port access
Subnetwork Type II	Interworking by call control mapping or by port access	Interworking by call control mapping	Interworking by call control mapping or by port access	Interworking by call control mapping or by port access
Subnetwork Type III	Interworking by call control mapping or by port access	Interworking by call control mapping or by port access	Interworking by call control mapping	Interworking by call control mapping or by port access
Subnetwork Type IV	Interworking by call control mapping or by port access	Interworking by call control mapping or by port access	Interworking by call control mapping or by port access	Interworking by call control mapping

6.3.4 Use of subnetwork types

A certain subnetwork implies a subnetwork service end systems. When a certain subnetwork service is available in end systems, any implementation in the end systems outfitted and capable to use a subject, or all of this subnetwork service can successfully communicate through the subnetwork.

For example, suppose two end systems communicate through a Type III subnetwork (e.g. interconnection of PSTNs). Given the possibilities of the inherent subnetwork service, widely differing applications, from character-mode to OSI, could communicate through this subnetwork.

End systems designed in accordance with OSI must, in order to be open to each other, support the standardized subnetwork service for OSI: the OSI connection-mode NS.

A certain subnetwork implies a subnetwork service in end systems. When a certain subnetwork service is available in end systems, convergence to the OSI connection-mode NS will be in accordance with Table 6-4. Exact arrangements for such convergence are defined in Recommendation X.305.

TABLE 6-4/X.300

Use of different subnetwork types to provide the OSI connection-mode NS

Phase of the OSI-NS connection / Subnetwork type	Connection establishment phase	Data transfer phase	Connection release phase
Subnetwork Type I	No convergence protocol required	No convergence protocol required	No convergence protocol required
Subnetwork Type II	No convergence protocol required	Convergence protocol required	No convergence protocol required
Subnetwork Type III	Convergence protocol required	Convergence protocol required	Convergence protocol required
Subnetwork Type IV	Convergence protocol required[a)]	Convergence protocol required	Convergence protocol required[a)]

[a)] If this subnetwork does not provide all the mandatory elements of the OSI Network Service in this phase.

6.4 Relationships with respect to management

Management information for the control of user calls, internal network management, or internetwork exchange of such information, may be provided by the same and/or separate entities exchanging a user requested call control, and user-to-user information. Figures 6-11 and 6-12 illustrate such situations. The network can be decomposed into two or more logical entities:

a) entities exchanging user-to-user information and, in some cases, user call control information; and/or

b) separate entities providing exchange of management information.

Example: PSTN with Signalling System No. 7. The Signalling System No. 7 uses layered protocols to exchange call control and management information outside of user information flow.

Detailed arrangements for exchange of management information is the subject of separate Recommendations (e.g. Recommendation X.370 and Q.700-Series Recommendations).

6.5 Basic principles in relation with service indication parameters

6.5.1 PDNs and ISDN will be used for the support of various telematic services, i.e. ITU-T services involving communication capabilities defined by ITU-T.

6.5.2 The mechanisms to be used to satisfy any requirement related to service indications, e.g. compatibility checking, should in particular accommodate the case of those ITU-T services which are designed in accordance with Recommendation X.200 (reference model of OSI for ITU-T applications) and other Recommendations applicable to OSI protocols at layers 4 to 7.

6.5.3 The equipment involved in realizing the transmission capability will only act upon the parameters related to this transmission capability.

6.5.4 The parameters related to the communication capability will not be seen by the equipment realizing the transmission capability, and will be coded independently from the parameters defining the transmission capability.

6.5.5 For efficient handling through the network, parameters of each category may be conveyed globally in one or several profiles.

6.5.6 In a call request, a facility/utility can only be considered in the context of OSI, as an element of protocol at the network layer (layer 3). It cannot be considered as an element of protocol at layers higher than the network layer.

NOTE – Through a PSPDN, a call request packet can contain user data conveying elements of protocol related to the communication capability (i.e. at layers higher than the network layer). Similarly, through an ISDN, a SETUP message can contain user information.

6.5.7 A facility/utility may also contain information related to ITU-T defined services (e.g. telematic services).

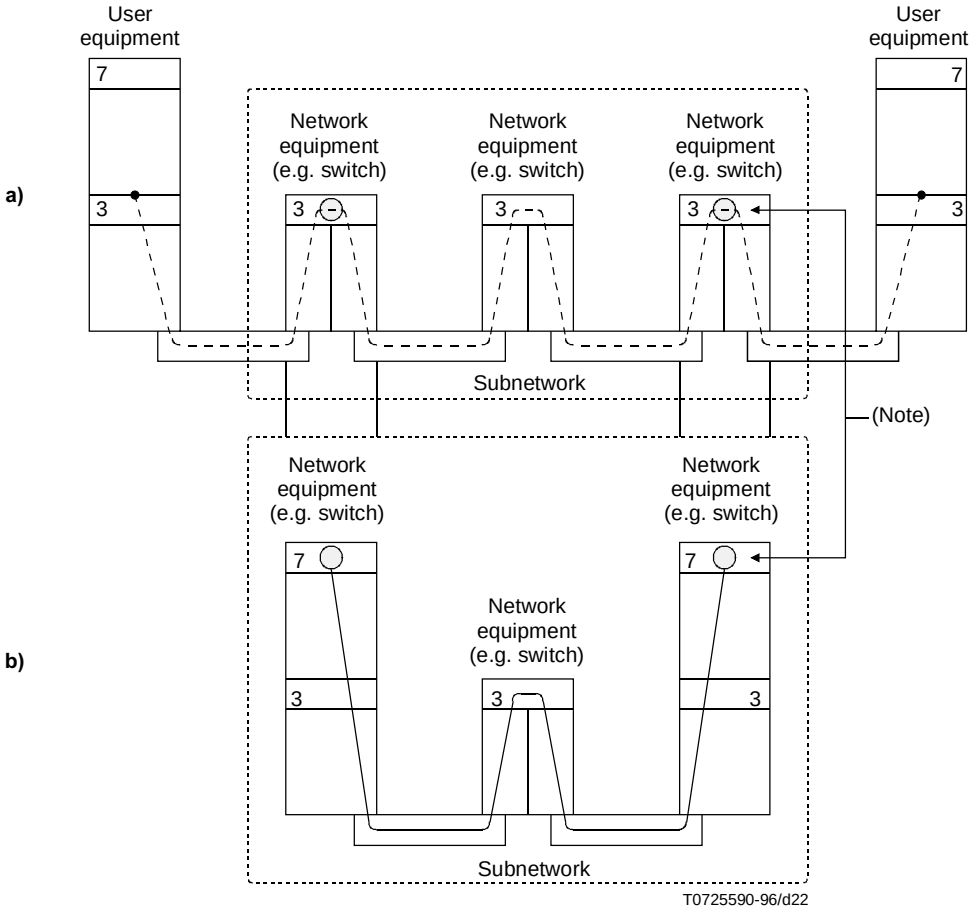
7 Principles interworking involving both transmission and communication capabilities

The different categories of interworking may involve different levels of functions:

a) in some cases only the functions related to the transparent transfer of information between two DTEs through the network(s) (transmission capability);

b) in other cases also additional functions built upon those related to the transparent transfer of information (communication capability).

This clause describes the basic concepts and principles related to cases mentioned in b).



User-to-user call control and information exchange

Intra/Internetwork exchange of management information

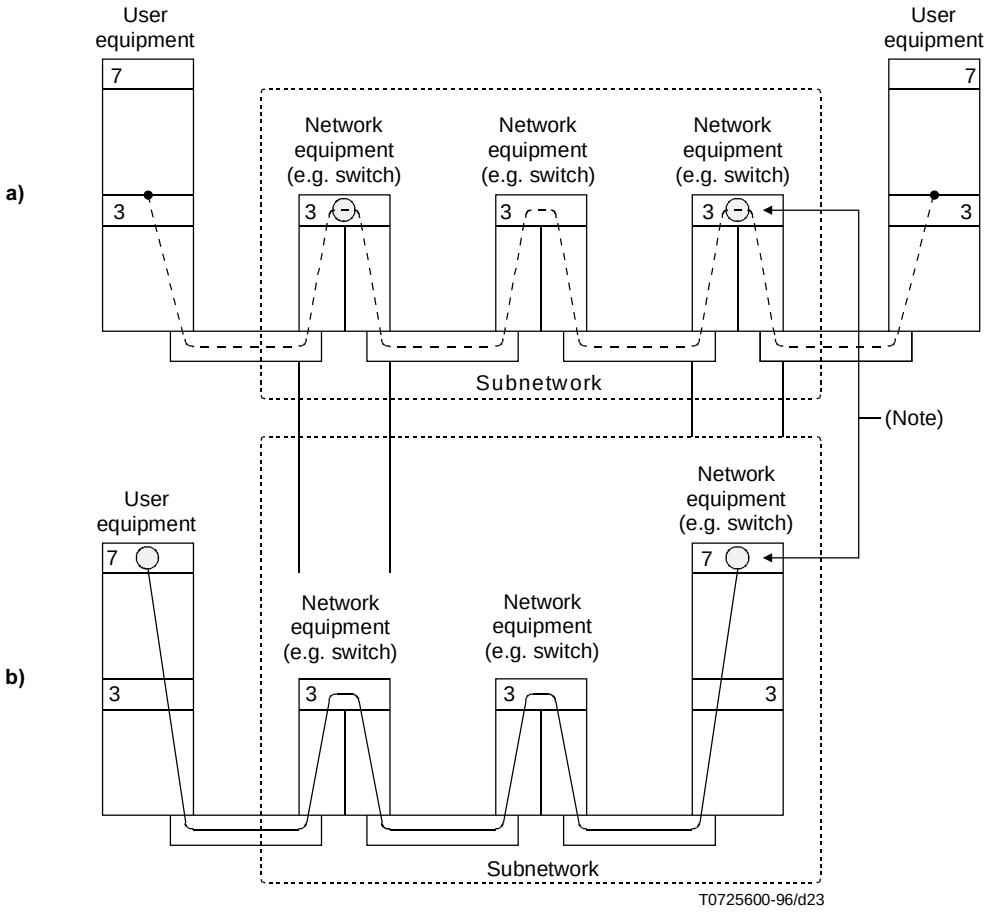
NOTE – Two entities cooperating for control of user-to-user calls, and for the exchange of management information are engaged in a dual functionality. Consequently, the same two entities:

a) on the one hand, exchange call control and user-to-user information;

b) on the other hand, exchange management information; for this purpose, specific protocols may be established.

FIGURE 6-11/X.300

Transfer of management information between network equipment by application layer protocol



NOTE – Two entities cooperating for control of user-to-user calls, and for the exchange of management information are engaged in a dual functionality. Consequently, the same two entities:

a) on the one hand, exchange call control and user-to-user information;

b) on the other hand, exchange management information; for this purpose, specific protocols may be established.

FIGURE 6-12/X.300

Transfer of management information between user and network by application layer protocol

7.1 Composition and decomposition of application relay systems

7.1.1 Concept of application intermediate system

7.1.1.1 The corresponding entities cooperate, as indicated in the example of Figures 7-1 and 7-2.

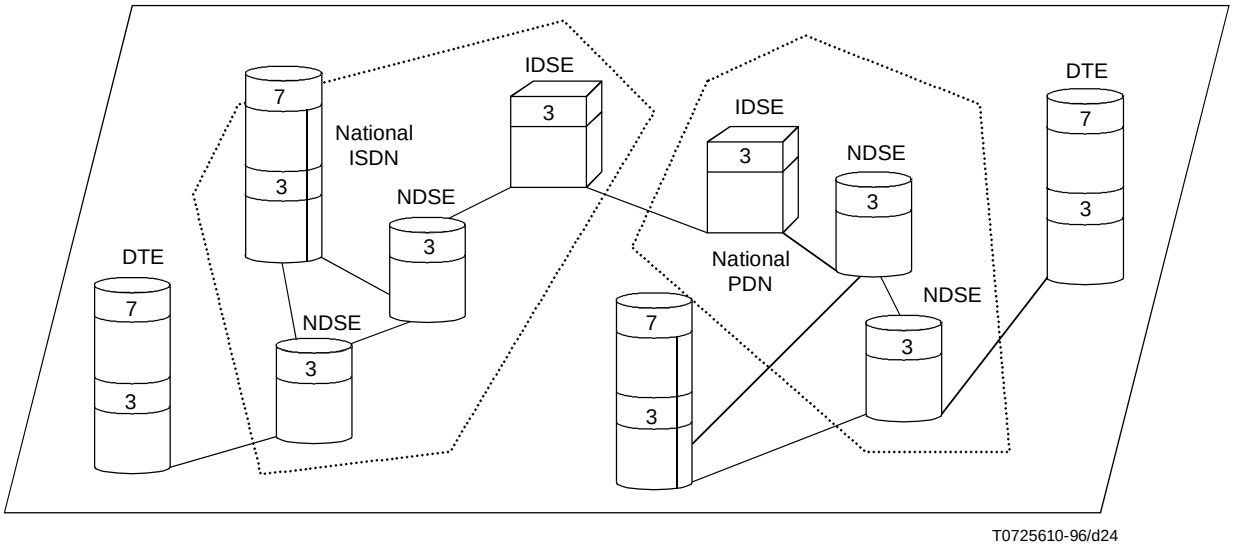


FIGURE 7-1/X.300

Example of interworking involving communication capability

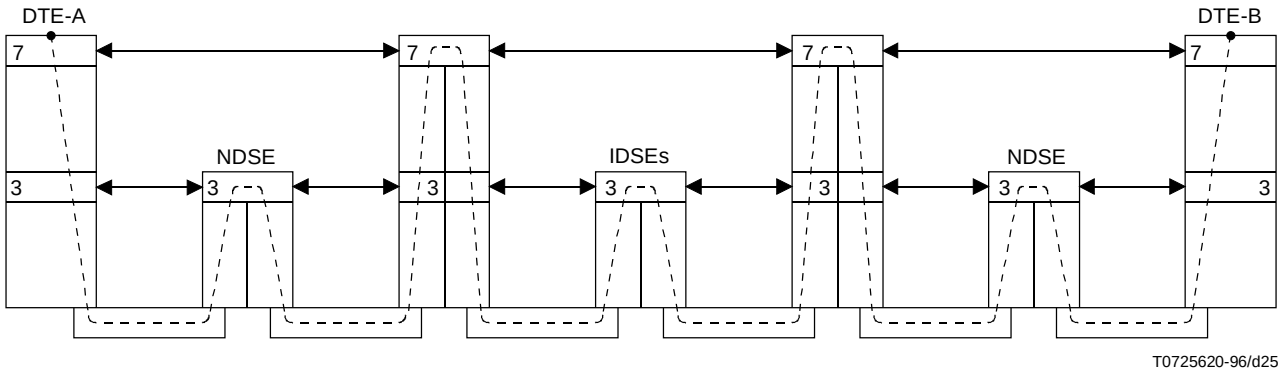


FIGURE 7-2/X.300

Intermediate nodes for an application connection and relation with network connections

7.1.1.2 Similar to the subnetwork case, it is not always necessary to consider individual intermediate systems involved in a given call. Therefore, and for the purpose of studying interworking arrangements between real networks, it may be of interest to consider those combinations of intermediate systems as only one intermediate abstract system involved in the call, as indicated in Figure 7-3 (giving two equivalent representations of intermediate systems involved in the call).

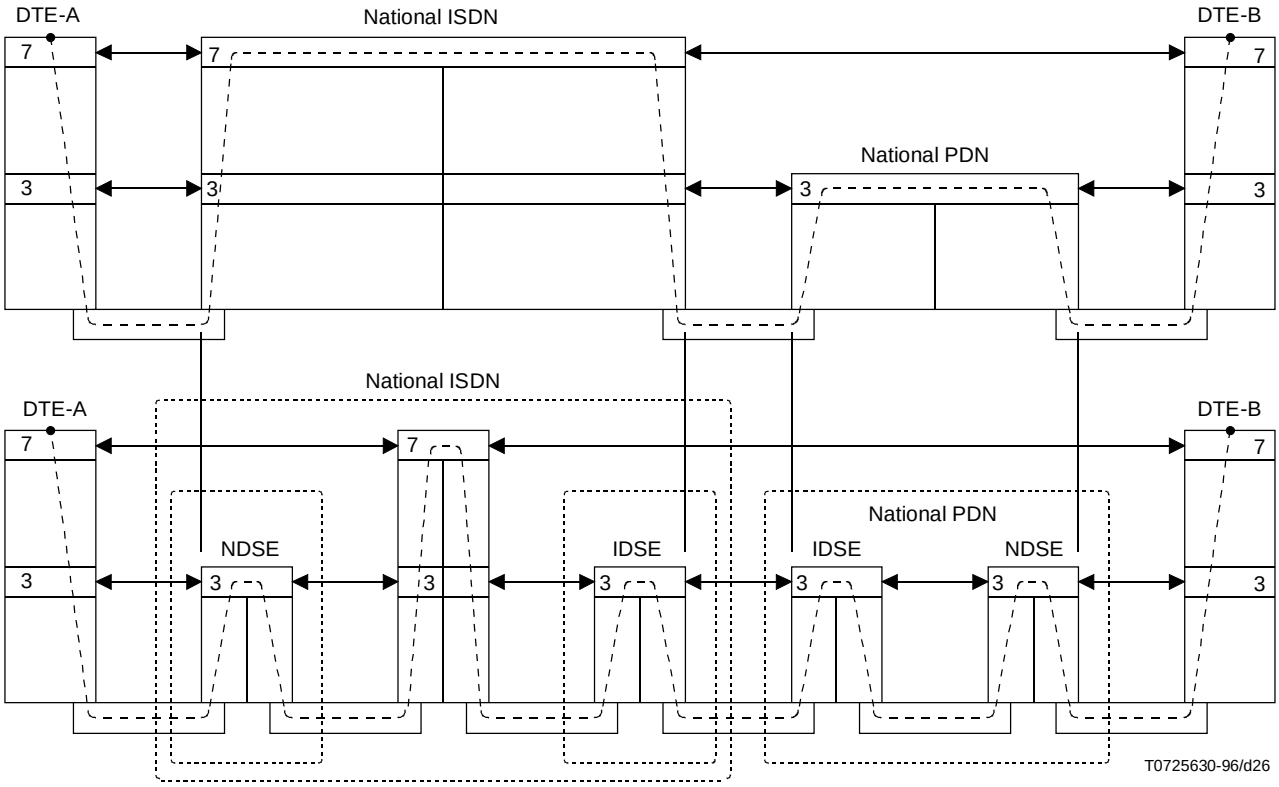


FIGURE 7-3/X.300

Two equivalent representations of intermediate systems involved in a call

7.1.1.3 An application relay system may contain various combinations of equipment, including different real application interworking units and networks*. There is always at least one real application IWF. This can be graphically represented as shown in Figure 7-4.

7.1.1.4 An application relay system may be used to represent the interconnection of:

a) two end DTEs; then a single application relay system is involved in the connection;

b) one end DTE and another application relay system; then at least two application relay systems are involved in the connection;

c) two other application relay systems; then the application relay system is involved as a transit application relay system; it may consist of a single application IWF, or be an actual transit network consisting of more application IWFs (see Figure 7-4);

d) end systems and/or application relay systems can also be interconnected by subnetworks rather than by direct interconnection.

The same collection of equipment, considered as an application relay system, may be used in one or more of these cases a) to d) above.

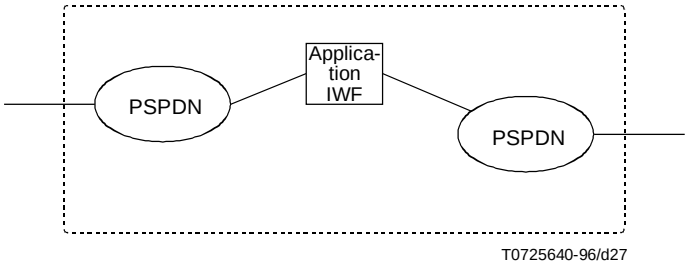
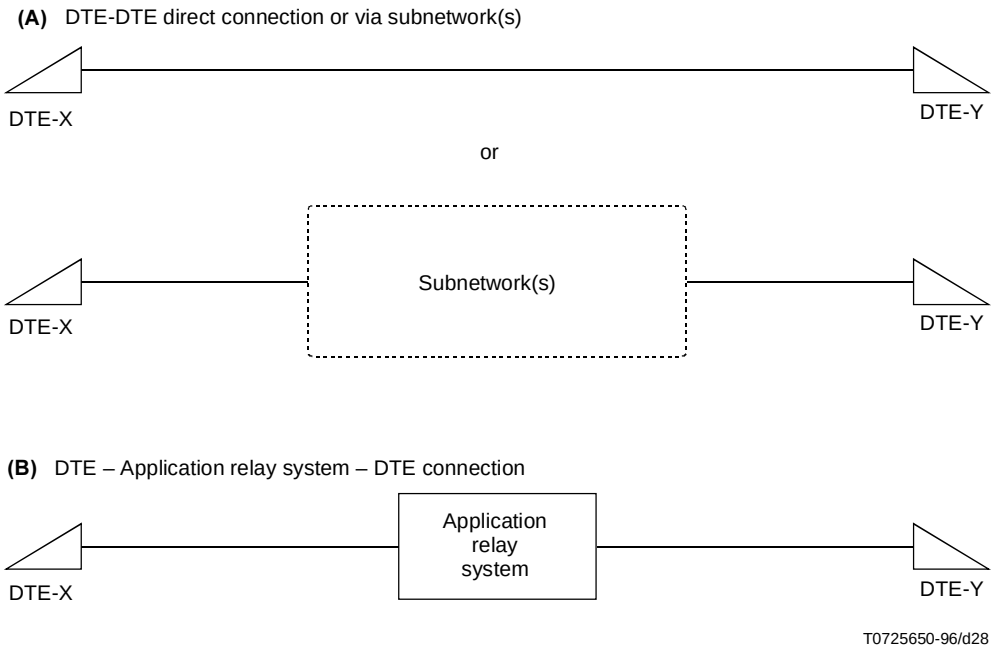


FIGURE 7-4/X.300

Example of a graphical representation of an application relay system

7.1.1.5 From the viewpoint of end users, there are two basic situations:

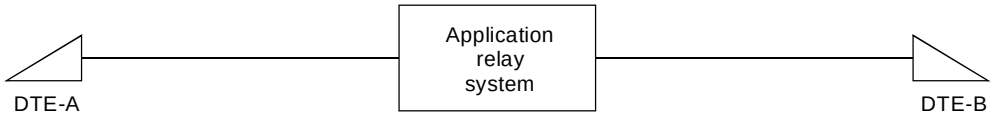


In case (B), there is no need, from the users' viewpoint, to consider the exact application relay system configuration. The application relay system may, for example, be: a single application IWF, two interconnected application IWFs, etc.

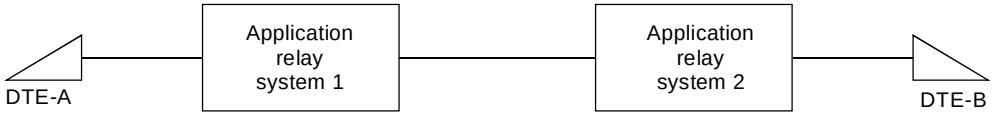
Also in case (B), the protocols at DTE-X and DTE-Y interfaces may be different.

7.1.1.6 From the viewpoint of network providers, there are different configurations to consider:

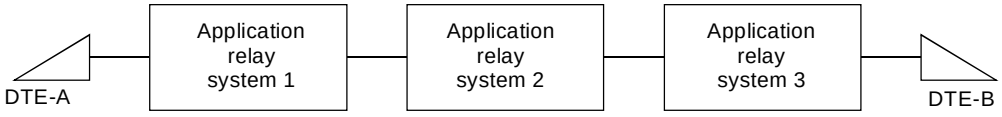
(X) DTE – Application relay system – DTE connection



(Y) DTE – Application relay system 1 – Application relay system 2 – DTE connection



(Z) DTE – Application relay system 1 – Application relay system 2 – Application relay system 3 – DTE connection

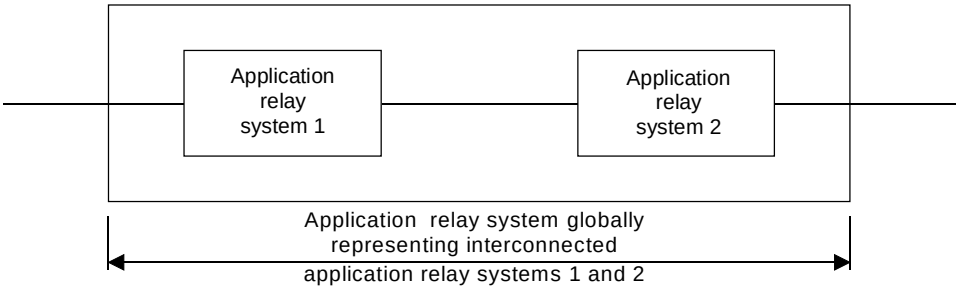


T0725660-96/d29

In cases (Y) and (Z), an application IWF may be involved in any one of the application relay systems used. In case (Z), the relay application relay system may consist of a single application IWF. In all cases application relay systems and DTEs may mutually communicate directly or via a subnetwork.

The procedure used at DTE-A interface should not be dependent on the application relay system(s) used on the connection with the corresponding DTE-B.

7.1.1.7 Following the cases in 7.1.1.5 and 7.1.1.6 above, a given equipment configuration may be considered as a single application relay system, or several distinct interconnected application relay systems, depending on the viewpoint needed for consideration. This is illustrated in Figure 7-5:



T0725670-96/d30

FIGURE 7-5/X.300

Global representation of application relay systems

7.1.2 Decomposition of application relay systems with respect to protocols and services

In the case that end-systems are interconnected via application relay systems and subnetworks, from the end-system point of view, only one application relay system needs to be considered (i.e. the application relay system composed of all application relay systems and subnetworks between end-systems).

To access this application relay system, a particular set of protocols is required. From the conceptual point of view, the relating of these protocols at particular places within that one application relay system is of no concern to the end-system.

This observation is shown in Figure 7-6. In this example, application relay system A is accessed by protocols (a + b) or by protocols (c + d). Decomposition of application relay system A, however, reveals two participating subnetworks S1 and S2. Subnetwork S2 uses protocol (d) and can also access protocol (e). Subnetwork S1 can be accessed by protocols (a) and also by (f). Application relay system A1 can be accessed by protocols (b + f) or by (c + e).

The full functionality of application relay system A actually resides in application relay system A1.

7.2 Categories of interworking

This subclause describes the categories of interworking that involve functions related to the communication capability. Three different categories of interworking are identified in this subclause:

a) interworking at higher layers of OSI;

b) interworking by call control mapping via a non-OSI adapter;

c) interworking by port access via a non-OSI adapter.

7.2.1 Interworking at higher layers of OSI

In such a category of interworking, an interworking function is involved, which acts with functions at layers up to and including the application layer, as illustrated in Figure 7-7.

In this case, two different network layer connections are established, with the IWF acting as an application layer relay between those two network layer connections.

7.2.2 Interworking by call control mapping via a non-OSI adapter

Figure 7-8 illustrates this type of interworking, where DTE-A and DTE-B are communicating via a non-OSI adapter, with the possibility for DTE-A to indicate directly the address of DTE-B.

7.2.3 Interworking by port access via a non-OSI adapter

In this method, network 1 is used to establish a physical connection between DTE-A and a non-OSI adapter, on a temporary basis, as shown in Figure-7-9.

7.2.4 Examples of non-OSI adapter(s)

An example of a non-OSI adapter is X.28 PAD.

7.3 Identification of application relay system types

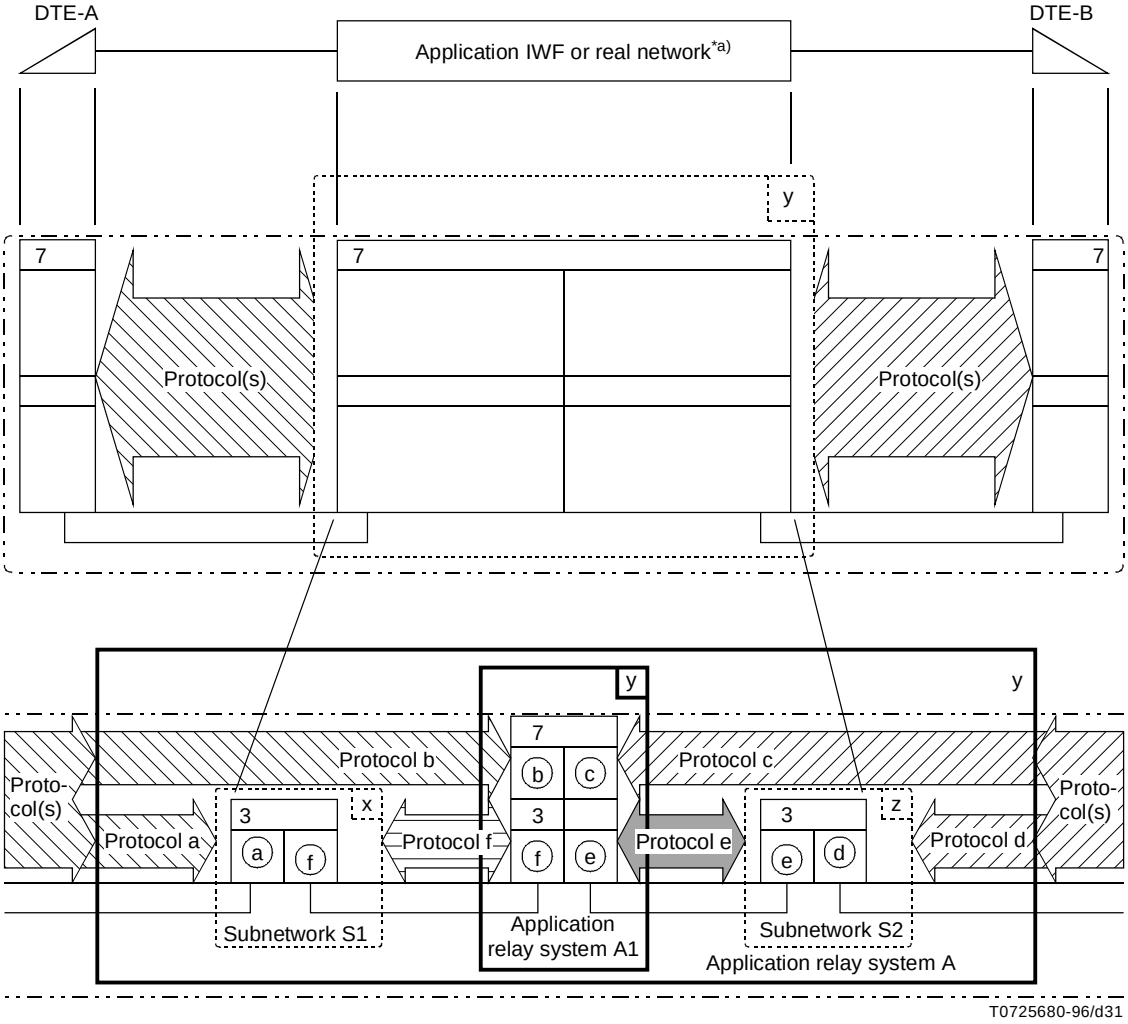
(For further study.)

7.4 Relation between application IWF, networks and application relay system types

(For further study.)

7.5 Interconnection of application relay system types

(For further study.)



a) Or combinations of at least one application IWF with any real subnetwork.

NOTE – Decomposition may also result in any combination of (depending on real world objects) n-subnetworks and m-application relay systems, where $n \geq 0$ and $m \geq 1$.

FIGURE 7-6/X.300

Decomposition of application IWFs and real networks

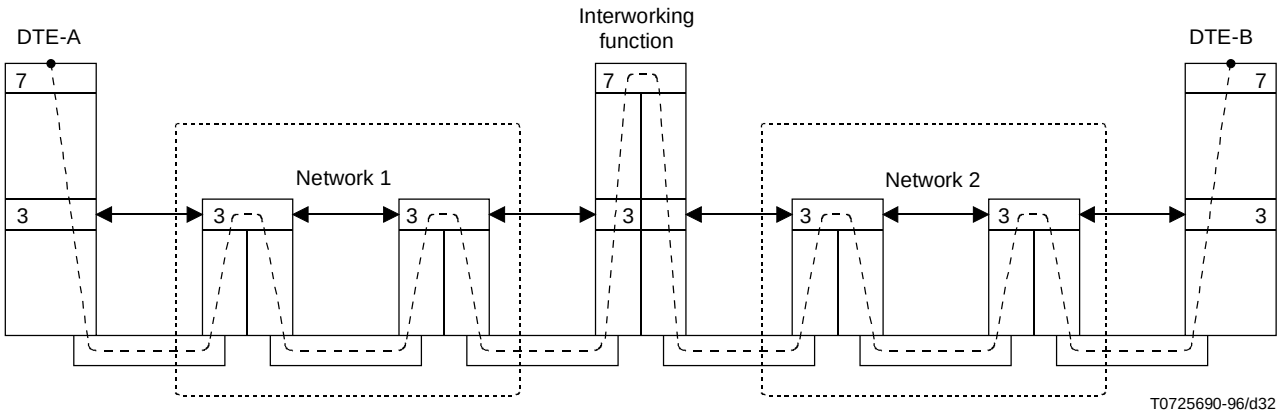


FIGURE 7-7/X.300

Interworking function at the application layer

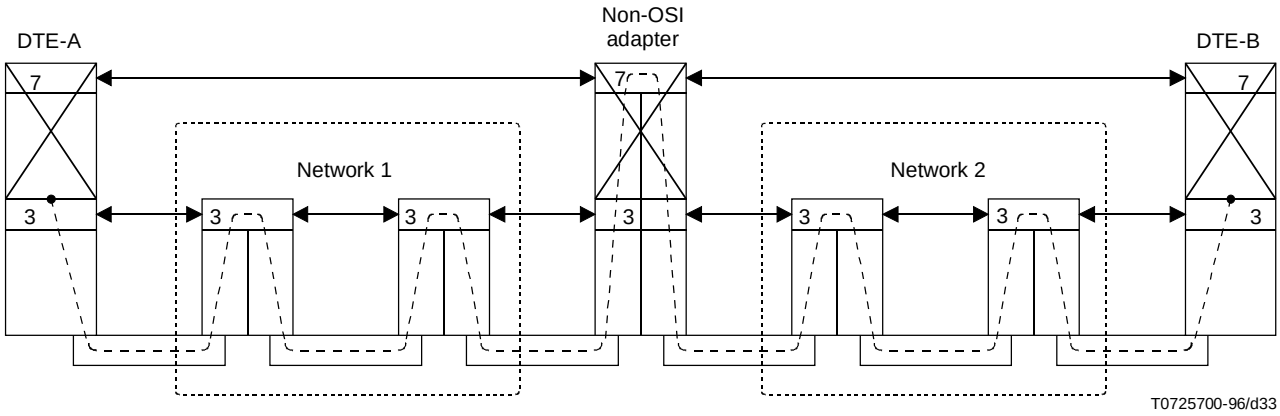


FIGURE 7-8/X.300

Interworking by call control mapping via a non-OSI adapter

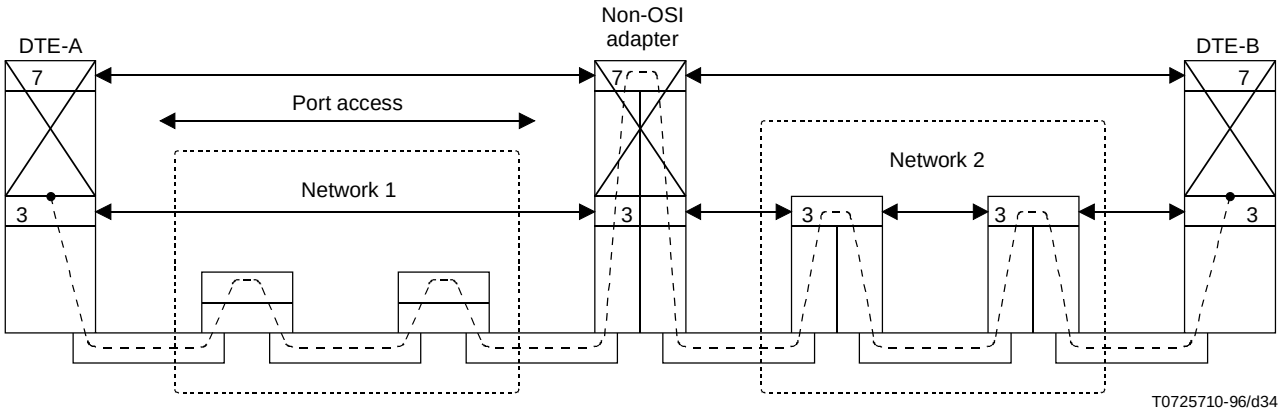


FIGURE 7-9/X.300

Interworking by port access via a non-OSI adapter

7.6 Use of application relay system types

7.6.1 All applications

(For further study.)

7.6.2 OSI applications

(For further study.)

7.7 Relationships with respect to management

(For further study.)

7.8 Relationships with the Reference Model of OSI for ITU-T applications

(For further study.)

7.9 Basic principles in relation with service indication parameters

(For further study.)

8 Description of the different interworking conditions

This clause describes the different conditions for interworking between networks mentioned in clause 5, on the basis of the categories of interworking described in clause 6.

8.1 General

Table 8-1 describes the conditions for interworking, between either two public networks or one public network and another network to provide data transmission services. In cases where more than two networks are involved in a given connection, Table 8-1 applies as appropriate at each interworking between two networks.

NOTE – Conditions for interworking between two public networks or between one public network and another network to provide services not related to data transmission services are not presently described. In particular, the requirements for a PDN, when interworking with the public telex network in respect to ITU-T telex services, are for further study.

TABLE 8-1/X.300

Conditions for interworking

PSPDN		Rec. X.323									
CSPDN		Recs. X.322, X.28, X.32, (Notes 1, 2)	(Note 3)								
FRDTS		FS	FS	FS							
ISDN	PS Bearer requested	Rec. X.325 (Note 4)	Rec. X.321 (Note 4)	Rec. X.328	Rec. X.320 (Note 4)						
	CS Bearer requested	Rec. X.325 (Note 4)	Rec. X.321 (Note 4)	Rec. X.328	Rec. X.320 (Note 4)	Rec. X.320 (Note 4)					
	FR Bearer requested	Rec. X.325 (Note 4)	Rec. X.321 (Note 4)	Rec. X.328	Rec. X.320 (Note 4)	Rec. X.320 (Note 4)	Rec. X.320 (Note 4)				
CCSN		Rec. X.326	FS	FS	FS	FS	FS	(Note 5)			
PTSN		Recs. X.28, X.32 (Notes 1, 2)	FS	FS	FS	FS	FS	(Note 5)	(Note 5)		
Mobile data systems		Rec. X.324	(Note 6)	FS	FS	FS	FS	(Note 5)	(Note 5)	FS	
Private networks		Rec. X.327	FS	FS	(Note 7)	FS	FS	(Note 6)	(Note 6)	(Note 6)	(Note 6)
					PS bearer requested	CS bearer requested	FR bearer requested			Mobile data systems	Private networks
		PSPDN	CSPDN	FRDTS	ISDN			CCSN	PSTN		

FS Further study required

NOTE 1 – For interworking between start-stop DTEs on either the PSTN or CSPDN and PSPDN, see Recommendation X.28. See also 8.2 in the case of PSTN.

NOTE 2 – For interworking between packet-mode DTEs on either the CSPDN or PSTN and PSPDN, see Recommendation X.32.

NOTE 3 – Interworking between CSPDNs through existing X-Series Recommendations X.61, X.70, X.71 and X.80, for the provision of synchronous or asynchronous data transmission services.

NOTE 4 – See also 8.3.

NOTE 5 – This interworking, if required, is out of the scope of the present Recommendation.

NOTE 6 – Consideration of this interworking in the present Recommendation is for further study.

NOTE 7 – Recommendation X.31 applies in the case of a private network providing a packet switched data transmission service.

8.2 Interworking via a non-OSI adapter between PSTN and PSPDN

8.2.1 Direct interworking via a non-OSI adapter

In this interworking method, a PSTN can offer a non-OSI adapter which provides, e.g. PAD function. Moreover, a PSTN can provide direct interworking non-OSI adapter routing selection to indicate directly the address of DTE-B.

In the outgoing access from PSTN to PSPDN, a calling DTE originates a PSTN call request indicating the address of a called DTE connected to the PSPDN, so that the PSTN can provide the called DTE address to the non-OSI adapter. Therefore no separate X.28 call request procedure is required.

A possible interworking arrangement between PSTN and PSPDN is illustrated in Figure 8-1.

In this interworking:

a) arrangement between a non-OSI adapter in PSTN and PSPDN is based on Recommendation X.75;

b) non-OSI adapter provides conversion between a conventional telephone signalling and X.75 during call set-up phase;

c) during data transfer phase, the protocols defined in Recommendations X.28 and X.29 are used in PSTN and PSPDN, respectively.

NOTE – The condition for using X.75 as mentioned in a) and b) above are for further study.

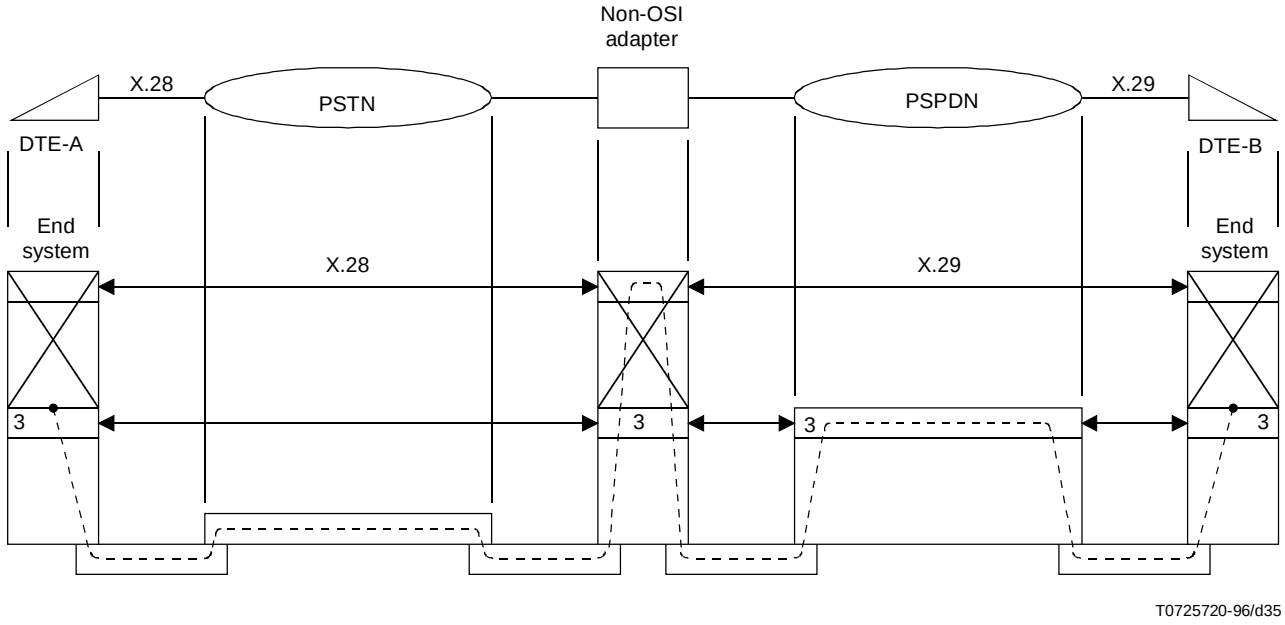


FIGURE 8-1/X.300

Direct interworking via a non-OSI adapter

8.2.2 Interworking via a non-OSI adapter based on the port access method

In the outgoing access from PSTN to PSPDN, a calling DTE originates an X.28 “call request” to a non-OSI adapter indicating the address of a called DTE connected to the PSPDN, after establishing a PSTN connection with the non-OSI adapter, this means a two-stage call request procedure.

In the outgoing access from PSPDN to PSTN, a calling DTE originates an X.29 call request indicating the address of a called DTE connected to the PSTN.

In this interworking method, a PSPDN can offer the non-OSI adapter which provides, e.g. PAD function.

A possible interworking arrangement between PSTN and PSPDN is illustrated in Figure 8-2.

In this interworking arrangement:

a) non-OSI adapter (X.3 PAD) provides conversion between X.28 and X.29 DTE/DCE interfaces;

b) the X.28 DTE/DCE interface protocol is used to set up the call from the non-OSI adapter to the called DTE-B;

c) the X.29 DTE/DCE interface protocol is used to set up the call from the DTE-B to DTE-A;

d) during data transfer phase, the protocols defined in Recommendations X.28 and X.29 are used at the DTE/DCE interfaces in PSTN and in PSPDN, respectively.

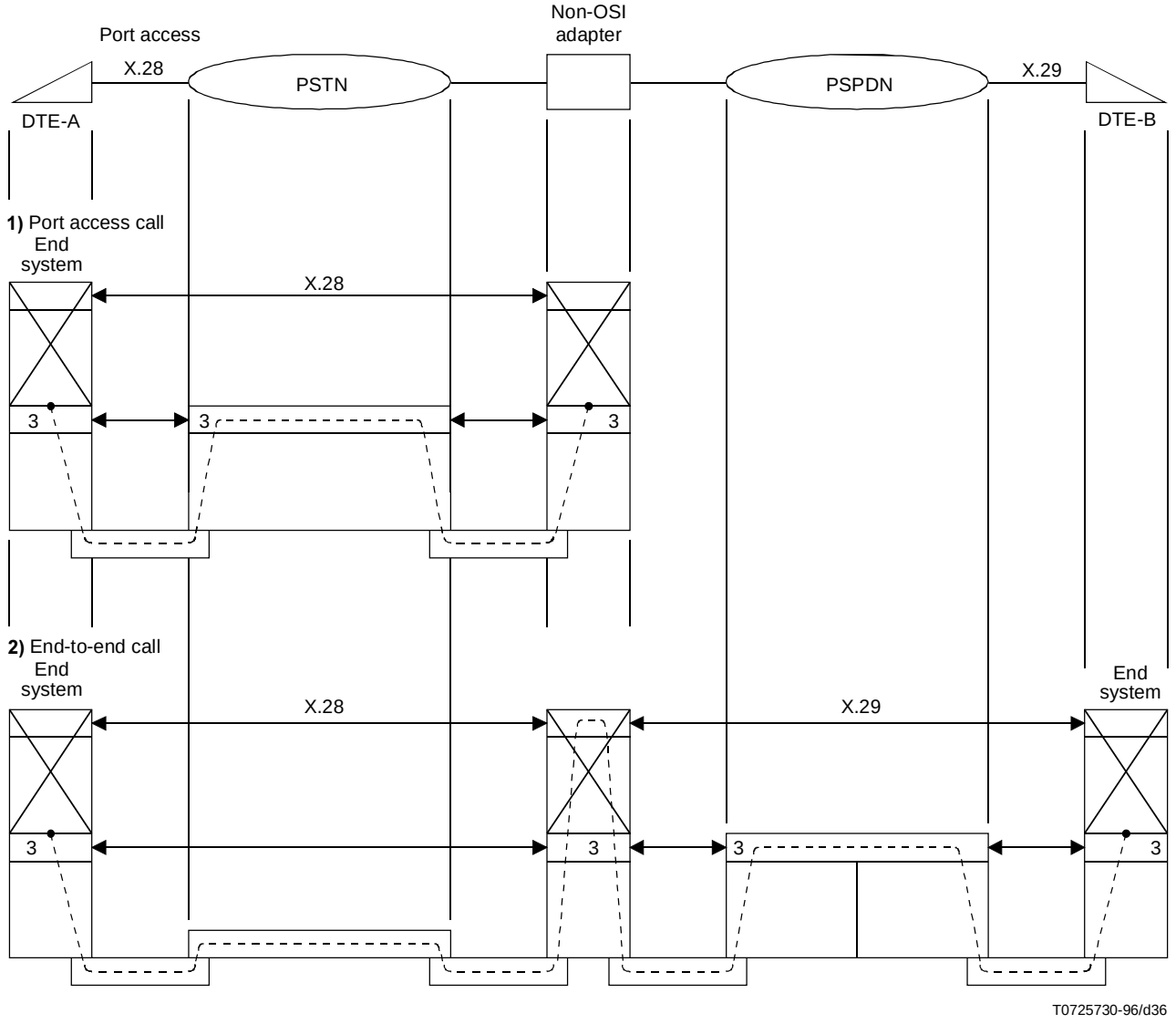


FIGURE 8-2/X.300

Interworking via a non-OSI adapter based on port access between PSTN and PSPDN

8.3 Interworking involving ISDN for the provision of data transmission services

8.3.1 Interworking between ISDN and PDNs

For interworking situations between ISDN and PDNs, the ISDN connection types as defined in Recommendation I.340 have to be considered. In particular, the data transfer phase of circuit-mode, packet-mode and frame-mode services must be clearly distinguished. The scenarios for connection of terminals supporting these modes to ISDN are described in Recommendations X.30 for circuit-mode, X.31 for circuit-mode and packet-mode and X.33 for frame-mode.

Various different cases of interworking are considered that are based on interworking by call control mapping of OSI (see 6.2.1) or on interworking by port access (see 6.2.2):

i) ISDN where a circuit-switched bearer is requested – CSPDN (see Recommendation X.321).

ii) ISDN where a packet-switched bearer is requested – PSPDN (see Recommendation X.325).

iii) ISDN where a circuit-switched bearer is requested – PSPDN (see Recommendation X.325).

Both the cases of "access to the data transmission services provided by PSPDNs (PSPDN services)" and "an ISDN virtual circuit bearer service" according to Recommendation X.31 must be considered.

Both interworking by call control mapping and interworking by port access must be considered.

iv) ISDN where a packet-switched bearer is requested – CSPDN (see Recommendation X.321).

In this case only ISDN virtual circuit bearer service according to Recommendation X.31 is applicable.

v) ISDN where a frame-mode bearer is requested – CSPDN (see Recommendation X.321).

vi) ISDN where a frame-mode bearer is requested – PRPDN (see Recommendation X.325).

vii) ISDN where a circuit-switched bearer is requested – FRPDN (see Recommendation X.328).

viii) ISDN where packet-switched bearer is requested – FRPDN (see Recommendation X.328).

ix) ISDN where a frame-mode bearer is requested – FRPDN (see Recommendation X.328).

8.3.2 Interworking between two ISDNs for the provision of data transmission services

When a circuit switched bearer is used to access the ISDN at one interface (CS), and a virtual circuit bearer service is used to access the ISDN at another interface (PS) (see Figure 8-3), a configuration can be decomposed as illustrated in Figure 8-3, case b). Thus, the arrangements for interworking will be given in the appropriate subclauses of this Recommendation as based on this decomposition.

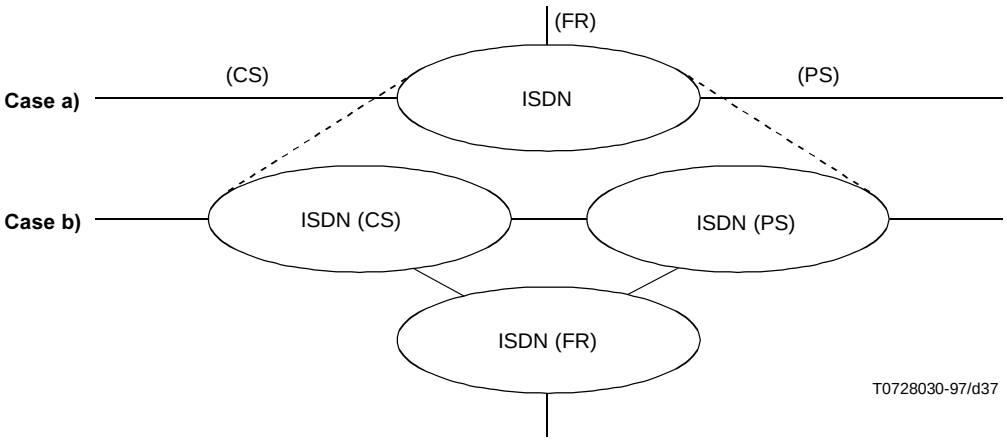


FIGURE 8-3/X.300

For interworking situations between ISDNs, the ISDN connection types as defined in Recommendation I.340 have to be considered. In particular, the information transfer modes of circuit and packet must be clearly distinguished. The scenarios for connection of terminals supporting these modes to ISDN are described in Recommendations X.30 for circuit-mode, X.31 for packet-mode and X.33 for frame-mode services.

Different cases of interworking are considered that are based on interworking by call control mapping (see 6.2.1) or on interworking by port access (see 6.2.2).

i) ISDN/ISDN where on both ISDNs a packet switched bearer is requested; both access to the data transmission services provided by PSPDN (PSPDN services) and ISDN virtual circuit bearer service, as defined in Recommendation X.31, must be considered.

ii) ISDN/ISDN where on both ISDNs a circuit switched bearer is requested.

iii) ISDN/ISDN where on one ISDN a packet switched bearer is requested and on the other ISDN a circuit switched bearer is requested. Both interworking by call control mapping and interworking by port access must be considered.

iv) ISDN/ISDN where on both ISDNs a frame-mode bearer is requested.

v) ISDN/ISDN where on one ISDN a frame-mode bearer is requested and on the other ISDN a circuit switched bearer is requested.

vi) ISDN/ISDN where on one ISDN a packet switched bearer is requested and on the other ISDN a frame-mode bearer is requested.

See Recommendation X.320 for description of these interworking arrangements.

Annex A

Basic categories of subnetworks

In terms of functionality in this Recommendation, four basic categories of subnetworks are considered:

– Type I subnetwork.

– Type II subnetwork.

– Type III subnetwork.

– Type IV subnetwork.

These are described in A.1, A.2, A.3 and A.4 respectively.

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

Other types of subnetworks supporting other services and applications are for further study.

A.1 Type I subnetwork

A.1.1 Type I subnetworks operate during the phases of a connection as defined in clause 6.

A.1.2 Networks that correspond to the functionality of Type I subnetwork are PSPDN and ISDN (PS). Figure A.1 illustrates the PSPDN example.

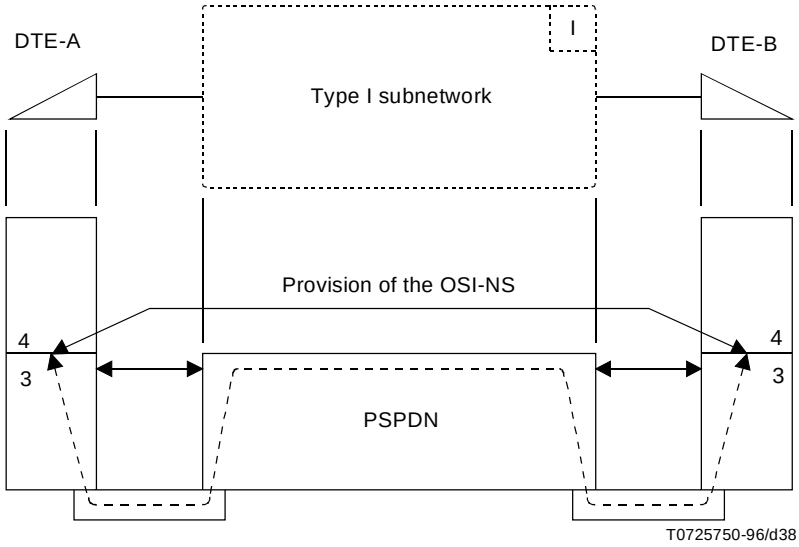
A.2 Type II subnetwork

A.2.1 Type II subnetworks operate during phases of a connection as defined in clause 6.

A.2.2 A network that corresponds to the functionality of Type II subnetwork is ISDN (CS) and is illustrated in Figure A.2.

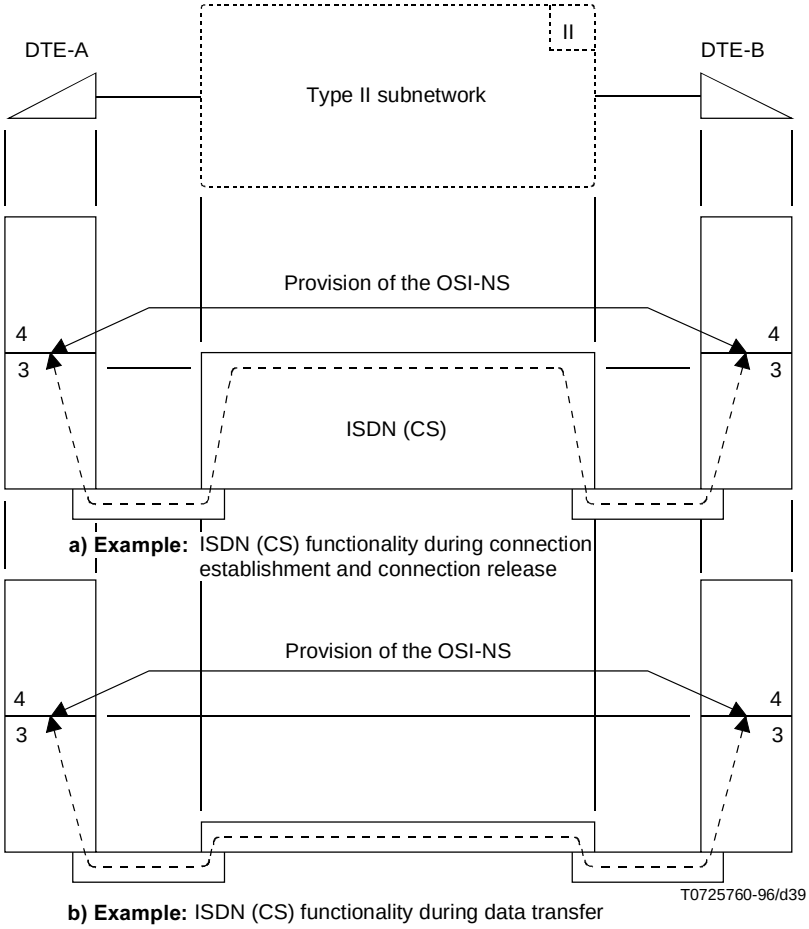
NOTE 1 – Details of this correspondence are under study.

NOTE 2 – Further study is under way on how CSPDNs could be enhanced to contain functionality of this type of subnetwork.



Example: PSPDN functionality for connection establishment, data transfer and connection release

FIGURE A.1/X300



a) Example: ISDN (CS) functionality during connection establishment and connection release

b) Example: ISDN (CS) functionality during data transfer

FIGURE A.2/X.300

A.3 Type III subnetwork

A.3.1 Type III subnetworks operate during the different phases of a connection as defined in clause 6.

A.3.2 Networks that correspond to the functionality of Type III subnetwork are CSPDN and PSTN (for the provision of data transmission services). Figure A.3 illustrates this example.

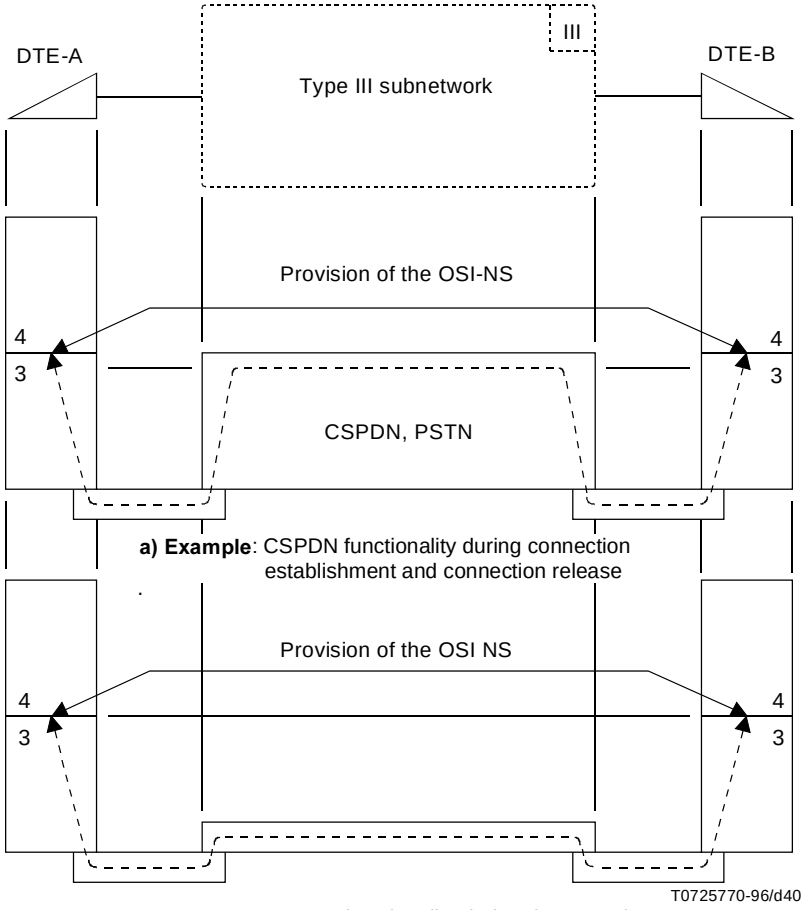


FIGURE A.3/X.300

A.4 Type IV subnetwork

A.4.1 Type IV subnetworks operate during the different phases of a connection as defined in clause 6.

A.4.2 Examples of networks that correspond to the functionality of Type IV subnetworks are for further study.

Annex B

Examples of subnetwork compositions

Subclause 6.3.1 identifies four different types of subnetworks. This annex describes examples of subnetwork compositions and outlines their overall functionality, namely:

B.1: Type I – Type II interconnection.

B.2: Type I – Type III interconnection.

B.3: Type II – Type III interconnection.

B.4: Type IV – Type I interconnection.

Other combinations with Type IV subnetworks are given within B.1 and B.2 as well.

The applicability of these compositions depends on the capabilities of the terminal equipment connected to the subnetworks.

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

Other types of subnetworks supporting other services and applications are for further study.

B.1 Examples of Type I and Type II interconnection

According to 6.1.2 a), the functionality of subnetwork S1 may be of Type I (see Figure B.1). This is performed by means of an appropriate IWF. In this case, the functionality of subnetwork S also corresponds to Type I.

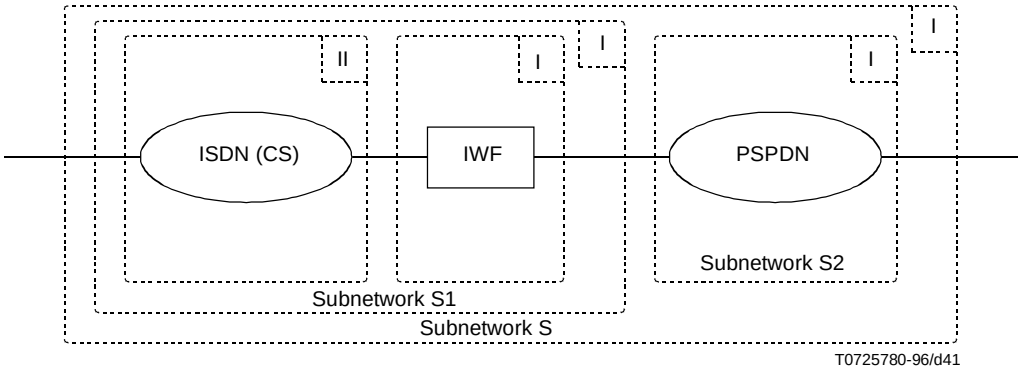


FIGURE B.1/X.300

According to 6.1.2 b), the functionality of subnetwork S1 may be of Type II (see Figure B.2). This is performed by means of an appropriate interworking function. In this case, the functionality of subnetwork S also corresponds to Type II.

According to 6.1.2 c), the functionality of subnetwork S1 cannot be assigned to any one of the subject types (see Figure B.3). Its use is subject to bilateral agreement.

B.2 Type I – Type III interconnection

According to 6.1.2 a), the functionality of subnetwork S1 may be of Type I (see Figure B.4). This is performed by means of an appropriate IWF. In this case, the functionality of subnetwork S also corresponds to Type I.

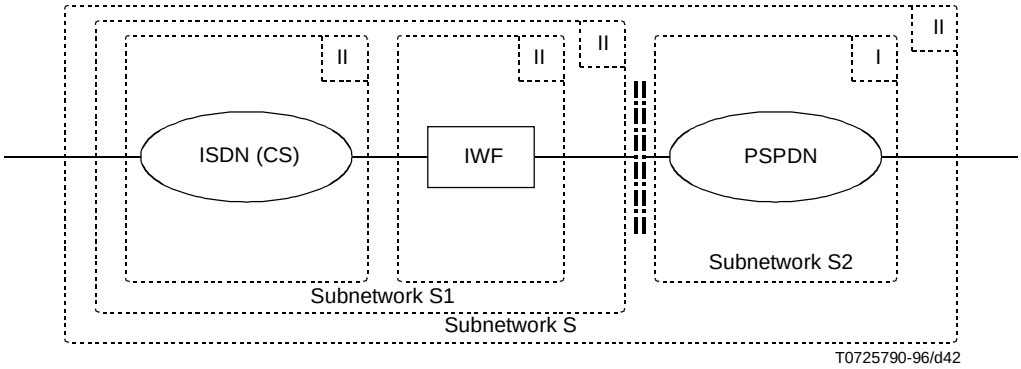


FIGURE B.2/X.300

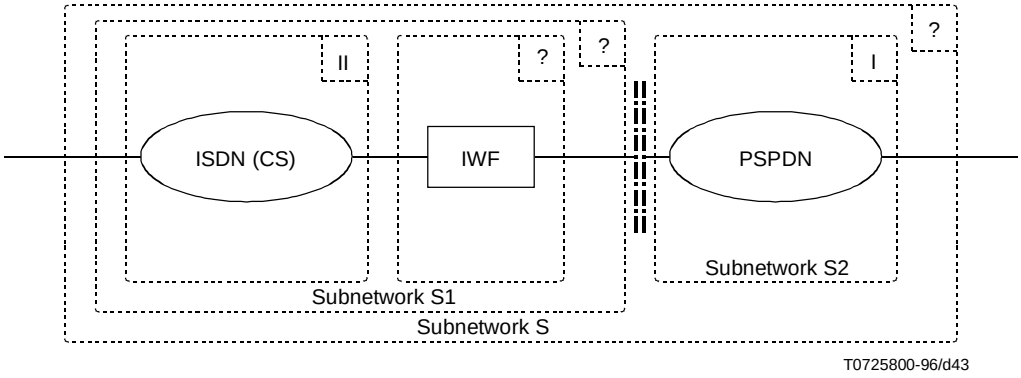


FIGURE B.3/X.300

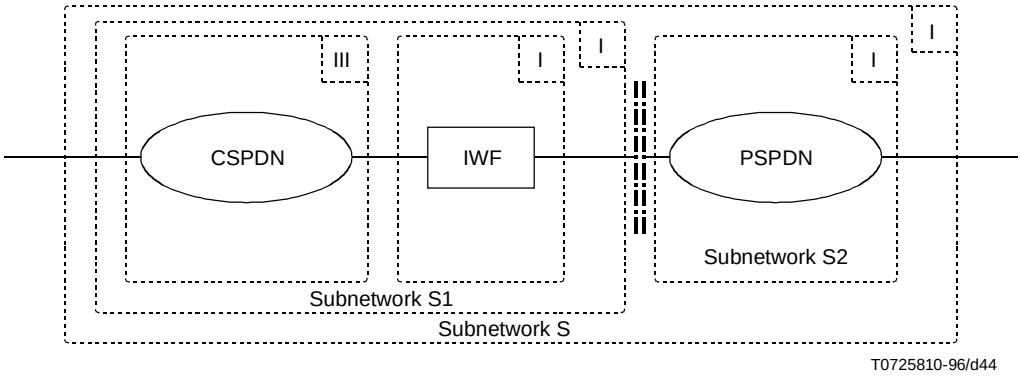


FIGURE B.4/X.300

According to 6.1.2 b), the functionality of subnetwork S1 may be of Type III (see Figure B.5). This is performed by means of an appropriate IWF. In this case, the functionality of subnetwork S also corresponds to Type III.

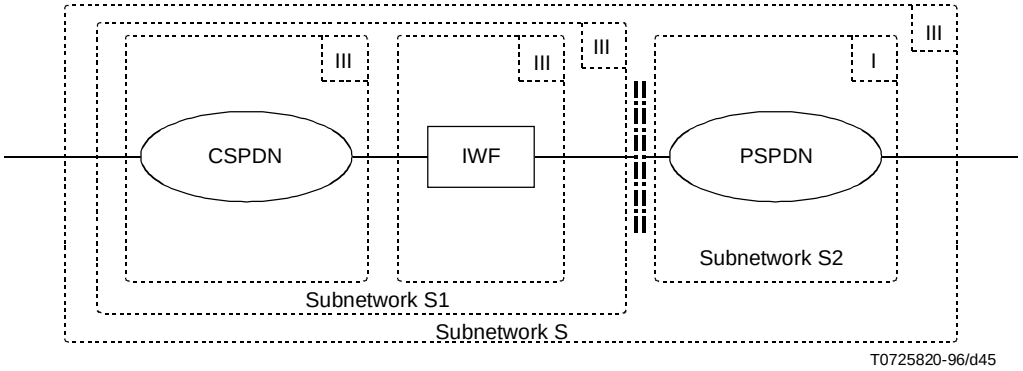


FIGURE B.5/X.300

According to 6.1.2 c), the functionality of subnetwork S1 cannot be assigned to one of the subnetwork types (see Figure B.6). Its use is subject to bilateral agreement.

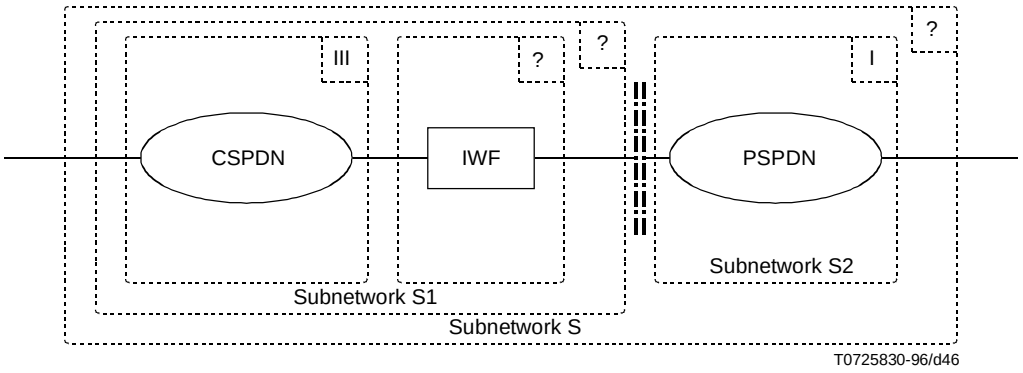


FIGURE B.6/X.300

B.3 Type II – Type III interconnection

According to 6.1.2 a), the functionality of subnetwork S1 may be of Type II (see Figure B.7). This is performed by means of an appropriate IWF. In this case, the functionality of subnetwork S also corresponds to Type II.

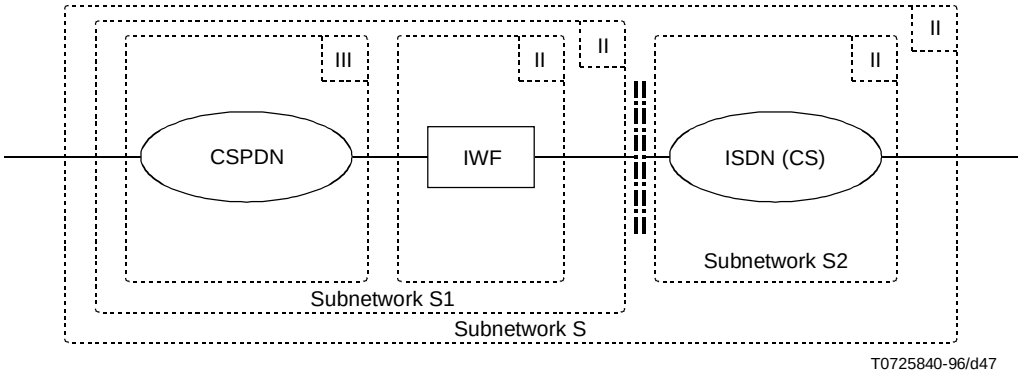


FIGURE B.7/X.300

According to 6.1.2 b), the functionality of subnetwork S1 may be of Type III (see Figure B.8). This is performed by means of an appropriate IWF. In this case, the functionality of subnetwork S also corresponds to Type III.

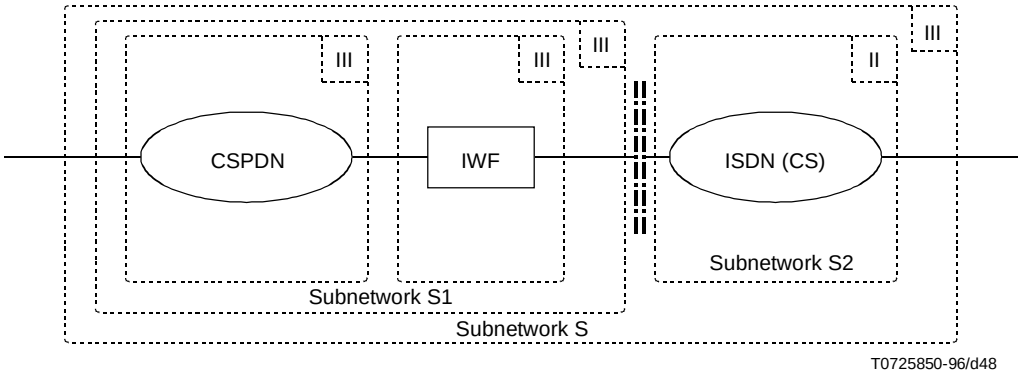


FIGURE B.8/X.300

According to 6.1.2 c), the functionality of subnetwork S may be of Type IV (see Figure B.9). This is performed by means of an appropriate IWF.

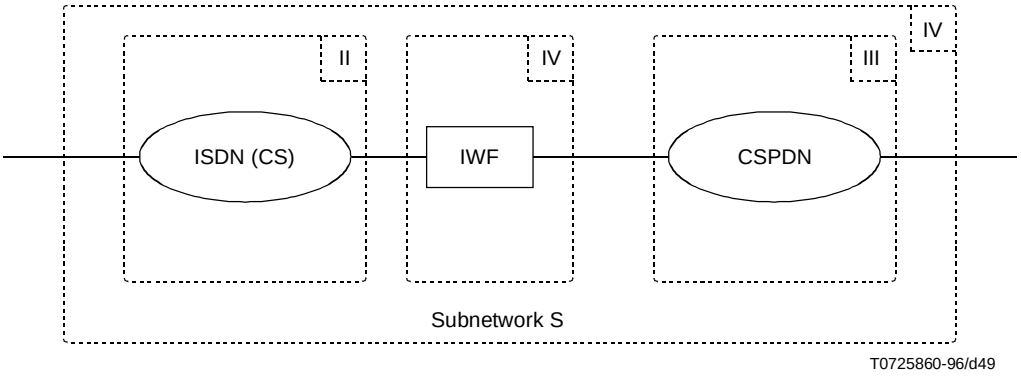


FIGURE B.9/X.300

Type IV subnetwork consisting of ISDN (CS) and CSPDN interconnected via an IWF

B.4 Type IV – Type I interconnection

Examples of interworking arrangements in this interconnection group is for further study.

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