INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
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CONSULTATIVE COMMITTEE

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SERIES X: DATA COMMUNICATION NETWORKS:
INTERWORKING BETWEEN NETWORKS,
MOBILE DATA TRANSMISSION SYSTEMS,
INTERNETWORK MANAGEMENT

Interworking between Networks

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

Reedition of CCITT Recommendation X.300 published in the Blue Book, Fascicle VIII.6 (1988)

NOTES

1 CCITT Recommendation X.300 was published in Fascicle VIII.6 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

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

Recommendation X.300

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

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

The CCITT,

considering

(a) that Recommendation X.1 defines the international user classes of service in public data networks (PDNs) and integrated services digital network (ISDN);

(b) that Recommendation X.2 defines the international user services and facilities in PDN and ISND;

(c) that Recommendation X.10 defines the different categories of access of data terminal equipments (DTEs) to the different data transmission services provided by PDNs and ISDN;

(d) that Recommendation X.96 defines call progress signals including those used in conjunction with international user facilities;

(e) that Recommendations X.20, X.20 *bis*, X.21, X.21 *bis*, X.25, X.28, X.29, X.30, X.31 and X.32 already specify the detailed procedures applicable to different types of DTE/DCE interfaces on PDNs and ISDNs;

(f) that Recommendations X.61, X.70, X.71 and X.75 already specify the detailed procedures applicable to call control between two PDNs on the same type;

(g) that PDNs and ISDNs are used to support telecommunication services and CCITT defined services (e.g. Telematic services);

(h) that Recommendation X.200 specifies the reference model of open system interconnection (OSI) for CCITT Applications;

(i) that Recommandation X.213 defines the connection-mode network service definition of OSI for CCITT applications;

(j) that Recommendation X.301 gives the description of the general arrangements for call control within a subnetwork and between subnetworks for the provision of data transmission services;

(k) that Recommendation X.302 describes the general arrangements for call control within a subnetwork and between subnetworks for the provision of data transmission services;

(l) that Recommendation X.305 describes the functionalities of subnetworks relating to the support of the OSI connection-mode network service;

(m) that interworking with common chanel signalling network (CCSN) needs to be considered, in view of the requirements for transferring operational information between Administrations;

(n) the need that DTEs can communicate through different networks, and through different interworking conditions between networks;

(o) the need for general principles and arrangements for interworking between public networks and between public networks and other public networks for the provision of data transmission services;

(p) the need for the provision of data transmission services, in particular:

– for certain user facilities and network utilities for communication through the national networks between the internationally defined data terminal equipment interface protocols and international inter-exchange control and signalling procedures;

– for certain internationally defined network utilities for international operation of public networks;

– for compatibility and uniformity in the principles for realization of international user facilities and network utilities in the public networks;

unanimously recommends

that general principles for interworking between public networks and between public networks and other networks, and that the necessary elements:

– for realization of interworking between different networks providing data transmission services, and

– for realization of international user facilities and network utilities for data transmission services,

be in accordance with the principles and procedures specified in this Recommendation.

CONTENTS

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 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, 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 CCITT 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 arrangemenets 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.

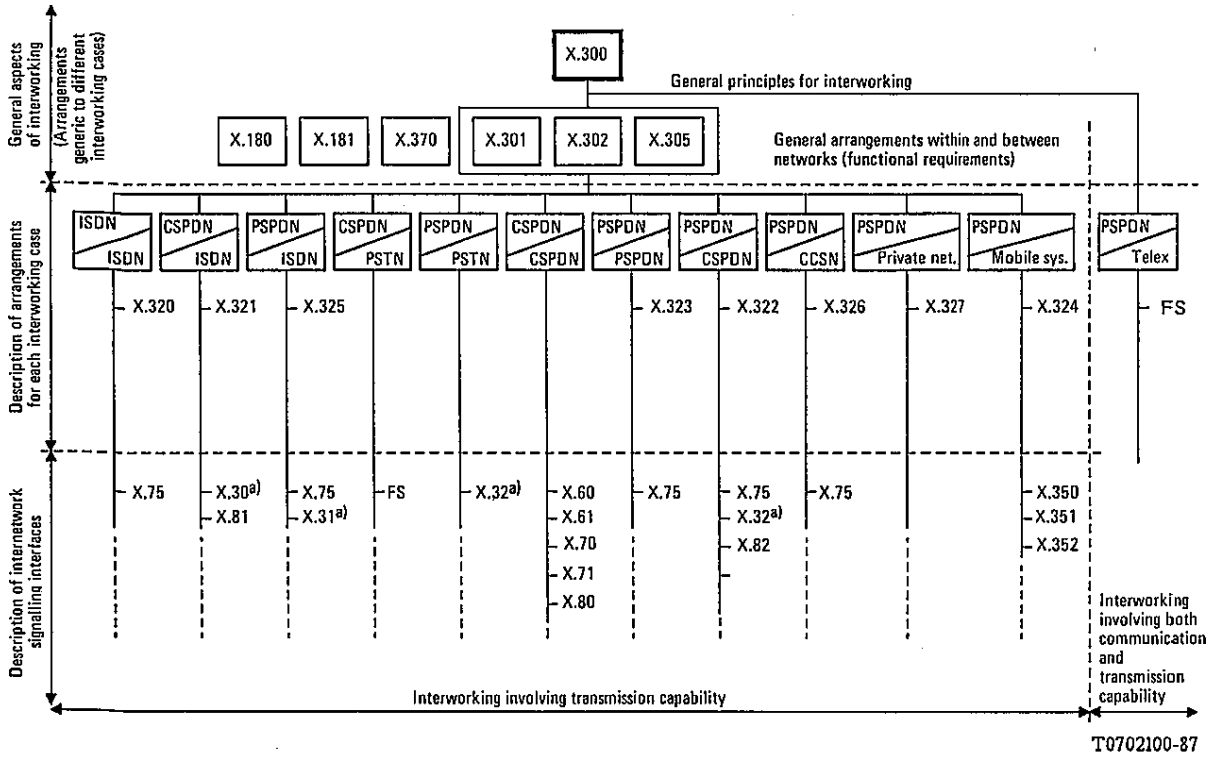
Note – This does not imply that any individual public network is required to implement all the mechanisms related to the OSI connection-mode Network Service.

0.6 This Recommendation is one of a family of interworking Recommendations. Figure 0-1/X.300 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.



a) This Recommendation is considered mainly a user interface.

FS For further study

FIGURE 0-1/X.300

Framework of X-Series Recommendations in relation with interworking

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 8348/Ad 1 is for further study.
- to define the principles for realization of international user facilities and network utilities for data transmission services.

2 References

I.112 Vocabulary of terms for ISDNs,

I.210 Principles of Telecommunication services supported by an ISDN,

I.230 Series Bearer Services supported by an ISDN,

I.240 Series Teleservices supported by an ISDN,

I.250 Series	Definitions and description of Supplementary Services,
I.340	ISDN connection types,
I.411	ISDN user-network interfaces - Reference Configurations,
I.420	Basic user-network interface,
I.421	Primatry rate user-network interface,
I.500	General structure of the ISDN interworking Recommendations
I.510	Definitions and general principles for ISDN interworking,
Q.700 Series	Specifications of Signalling System No. 7,
X.1	International user classes of service in public data networks (PDNs) and ISDNs,
X.2	International data transmission services and optional user facilities in PDNs,
X.10	Categories of access for data terminal equipment to public data transmission services,
X.20	Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for start-stop transmission services on PDNs,
X.20 *bis*	Use on PDNs of DTE which is designed for interfacing to asynchronous duplex V-Series modems,
X.21	Interface between DTE and DCE for synchronous operation on PDNs,
X.21 *bis*	Use on PDNs of DTE which is designed for interfacing to synchronous V-Series modems,
X.22	Multiplex DTE/DCE interface for user classes 3-6,
X.25	Interface between DTE and DCE for terminals operating in the packet-mode on PDNs and connected to PDNs by dedicated circuit,
X.28	DTE/DCE Interface for a start-stop mode DTE accessing the packet assembly/disassembly (PAD) facility in a PDN situated in the same country,
X.29	Procedures for the exchange of control information and user data between PAD facility and a packet-mode DTE or another PAD,
X.30/I.461	Support of X.21, X.21 *bis* and X.20 *bis* based DTEs by an ISDN,
X.31/I.462	Support of packet-mode terminal equipment by an ISDN,
X.32	Interface between DTE and DCE for terminals operating in the packet-mode and accessing a PSPDN through a PSTN or an ISDN or a CSPDN.
X.60	Common channel signalling for circuit switched data applications,
X.61	Signalling System No. 7 - Data user part,
X.70	Terminal and transit control signalling system for start-stop services on international circuits between anisochronous data networks,
X.71	Decentralized terminal and transit control signalling system on international circuit between synchronous data networks,
X.75	Packet switched signalling system between public networks providing data transmission services,
X.80	Interworking of interexchange signalling systems for a circuit switched data services,
X.81	Interworking between an ISDN and a CSPDN,
X.82	Detailed arrangements for interworking between CSPDNs and PSPDNs based on Recommendation T.70.
X.96	Call progress signals in PDNs,
X.180	Administrative arrangements for international closed user groups (CUGs),
X.181	Administrative arrangements for the provision of international permanent virtual circuit service,
X.200	Reference model for Open Systems Interconnection (OSI) for CCITT applications,
X.210	Open systems interconnection (OSI) - layer service conventions,
X.213	Network service definition for OSI for CCITT applications,

X.301 Description of the general arrangements for call control within a subnetwork and between subnetworks for the provision of data transmission services,

X.302 Description of the general arrangements for internal network utilities within a subnetwork and between subnetworks for the provision of data transmission services,

X.305 Functionalities of subnetworks relating to the support of the OSI connection-mode network service,

X.320 General arrangements for interworking between ISDNs for the provision of data transmission services,

X.321(I.540) General arrangements for interworking between CSPDNs and ISDNs for the provision of data transmission services,

X.322 General arrangements for interworking between PSPDNs and CSPDNs for the provision of data transmission services,

X.323 General arrangements for interworking between PSPDNs,

X.324 General arrangements for interworking between PSPDNs and public mobile systems for the provision of data transmission services,

X.325(I.550) General arrangements for interworking between PSPDNs and ISDNs for the provision of data transmission services,

X.326 General arrangements for interworking between PSPDNs and CCSN for the provision of data transmission services,

X.327 General arrangements for interworking between PSPDNs and private networks for the provision of data transmission services,

X.350 General requirements for data transmission in the international public mobile satellite systems,

X.351 Special requirements to be met for packet assembly/dissassembly (PAD) facilities located at or in association with coast earth stations in the public mobile satellite service,

X.352 Interworking between PSPDNs and the public mobile satellite data transmission system,

X.370 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 & 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 (Note)	
h)	Public data network (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 CCITT Service)	I.112
m)	Teleservice	I.112
n)	Terminal adaptator	I.411

Note – this term is contained in the Blue Book (Volume I.3).

3.2 *Terminology defined in this Recommendation*

This section provides concepts and definitions additional to those defined in other Recommendations. Some concepts and terms provided in this section are defined by using Figures 3-1/X/300 and 3-2/X.300, 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).

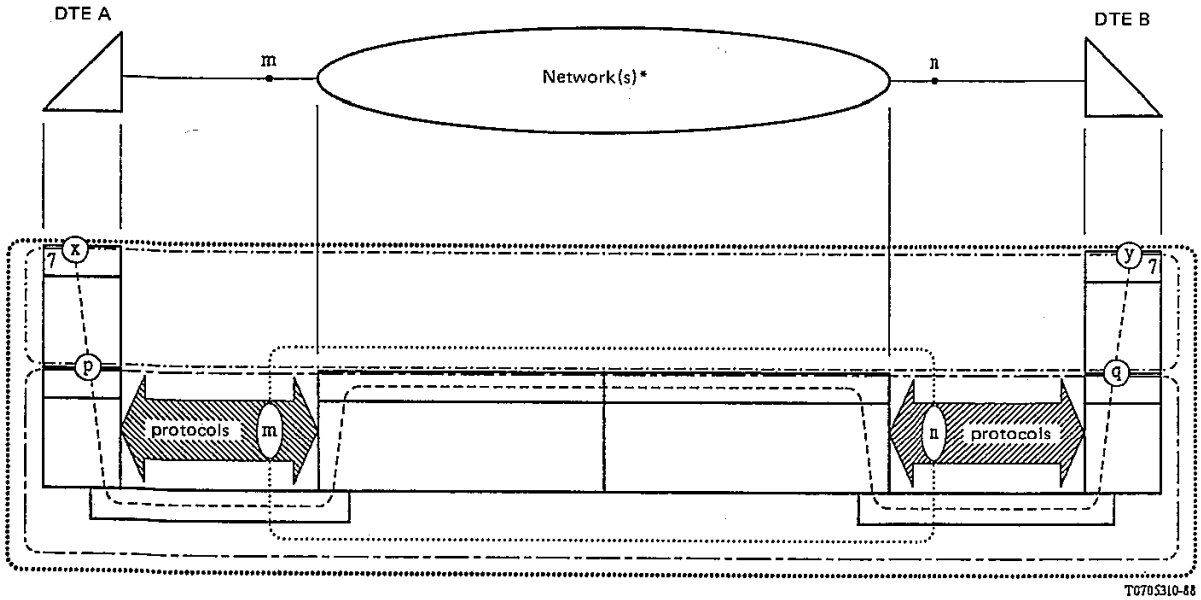
3.2.2 **application interworking function**

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.)



Telecommunication capability: All functionality within the box.
Application service (Note 1): The service offered by telecommunication capability, visible at points x, y. (Application service = the service offered by (communication capability + transmission capability)).

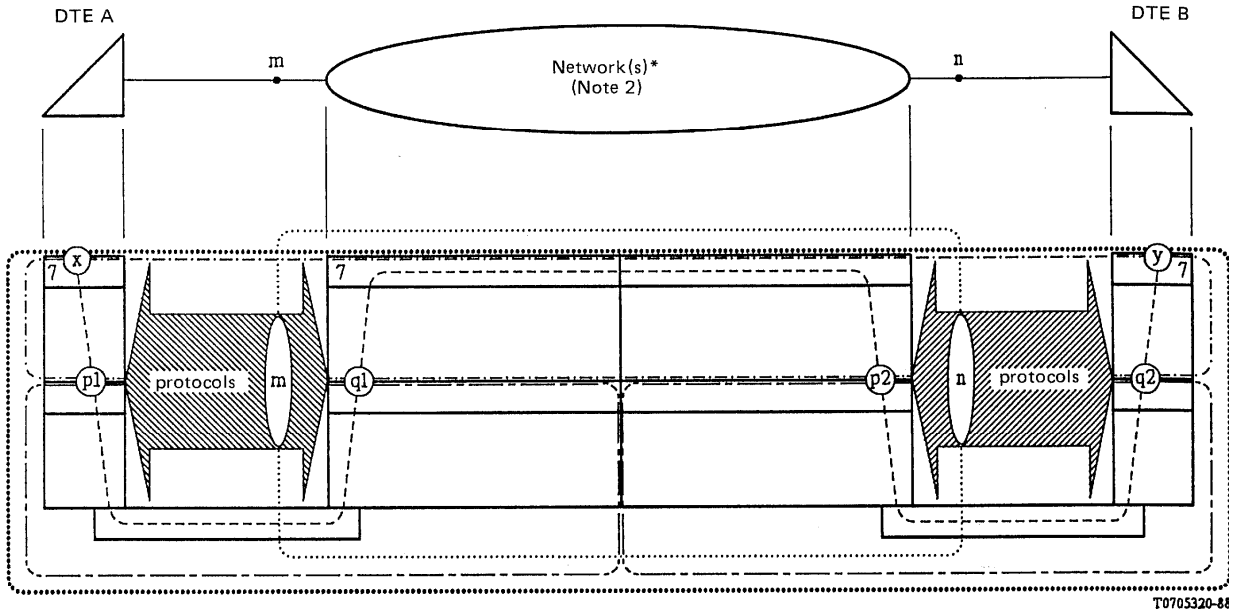
Communication capability: All functionality within the box.

Transmission capability: All functionality within the box.
Subnetwork service: The service offered by transmission capability, visible at points p, q.

Subnetwork functionality: All functionality within the box.
Data transmission service: 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:	All functionality within the box.
	Application service (Note 1):	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:	All functionality within the box.
	Subnetwork service:	The service offered by transmission capability, visible at point (p1, q1), or (p2, q2).
	Application-relay functionality:	All functionality within the box (for further study).
	Application-relay service:	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 1 application interworking function is involved.

FIGURE 3-2/X.300

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

3.2.4 *Application-relay functionality*

(For further study.)

3.2.5 **CCITT service**

(*Note* – This concept is assumed to be equivalent to telecommunication service).

Services defined in CCITT Recommendations, to be marketed to the users by Administrations. Different types of CCITT services may be marketed as follows:

a) Data transmission services, as defined in Recommendation X.1 and X.2 (i.e. circuit switched 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 service, users may establish a privately defined application.

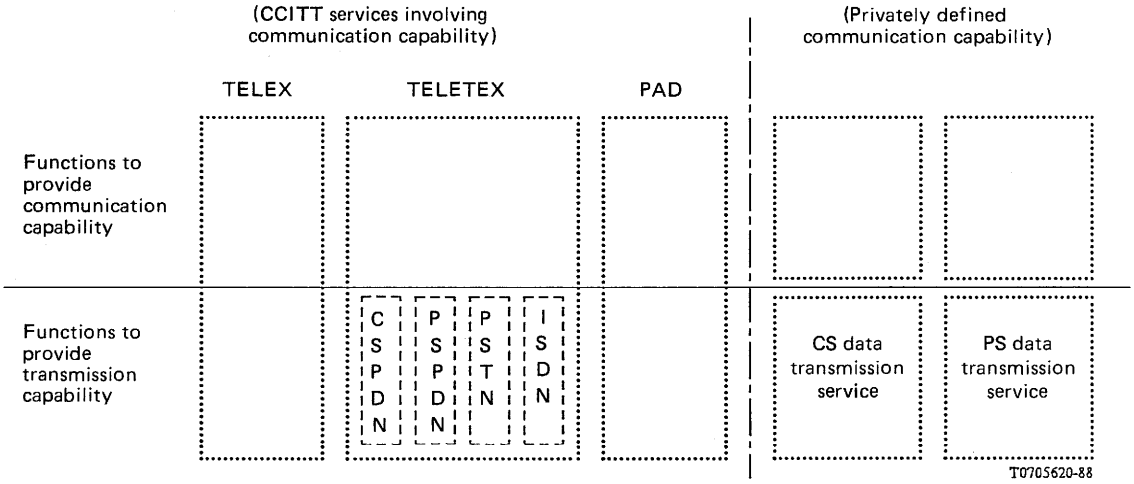


FIGURE 3-3/X.300

Examples of CCITT 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 CCITT, 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, RPOA or any private network operator to satify 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 prupose 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 addresing) 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 furthersections 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/X.300 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.

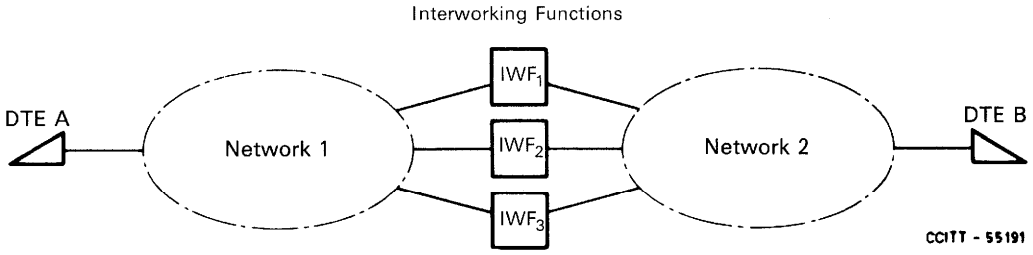


FIGURE 3-4/X.300

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 port 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 ofswitch(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 the I.230-Series related to transmission capability only, while others also relate to communication capability. The exact lists in each category is not subject of this Recommendation.

3.2.22 **telecommunication capability**

The combined functionality of the communication capability and the transmission capability.

3.2.23 Table 3-1/X.300 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 section 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/X.300 and 3-3/X.300 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>

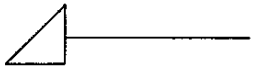
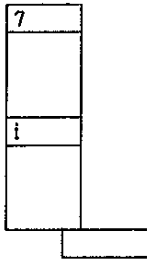
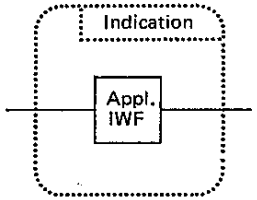
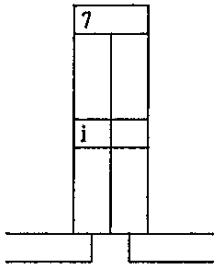
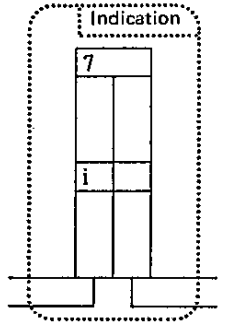
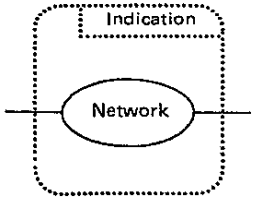
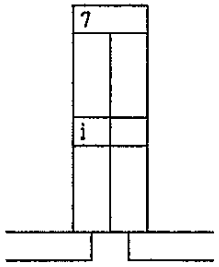
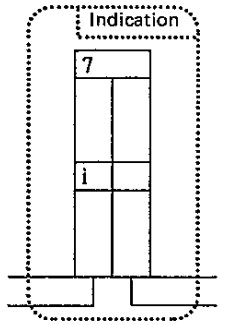
<subnetwork type III> ::= <III>

4 Abbreviations

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
PM	Packet handler
TA	Terminal adaptor
TE	Terminal equipment

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			

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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	Switch or exchange	Subnetwork	Indication: Switch or exchange	i(note)	Indication: i(note)
b)	Real network	Network	Subnetwork	Indication: Network	i(note)	Indication: i(note)
c)	Interworking function	IWF	Subnetwork	Indication: IWF	i(note)	Indication: i(note)
d)	Network* involving transmission capability only	Any combination of a) and/or b) and/or c)	Subnetwork	Indication: Any combination of a) and/or b) and/or c)	Any combination of a) and/or b) and/or c)	Any combination of a) and/or b) and/or c)

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Note – Height may also be used to indicate degree of functionality. Where "i" may be used to indicate a specific layer(s).

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

This section 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 § 5.5, in particular the "note" in § 5.5.2).

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 *Integrated services digital network (ISDN)*

5.3.1 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).

5.3.2 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.

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).

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

5.4 *Public switched telephone network (PSTN)*

5.4.1 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.

5.4.2 The data transmission services which should be considered through the PSTN for interworking with PDNs depend on the exact interworking situation (see also § 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.

5.5 *Common channel signalling network (CCSN)*

5.5.1 The purpose of a common channel signalling network (CCSN) is to control signalling for another network (e.g. ISDN, CSPDN).

The controlled network may interwork with another PDN, as illustrated in Figure 5-1/X.300. Such an interworking is not considered as interworking between CCSN and PDN in this Recommendation.

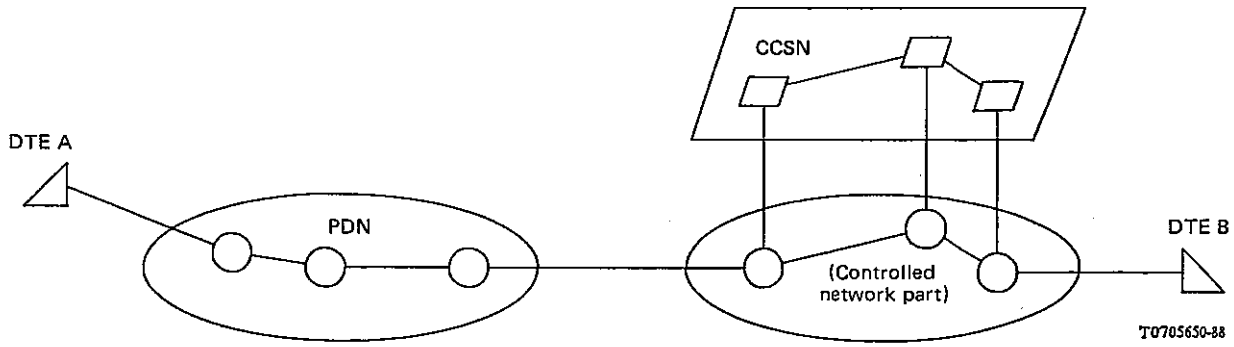


FIGURE 5-1/X.300

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

5.5.2 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/X.300. 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.

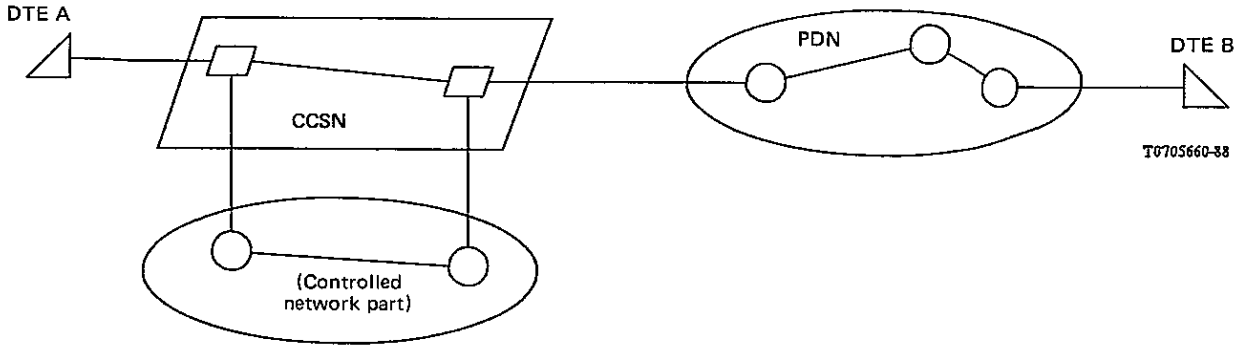


FIGURE 5-2/X.300

Interworking between PDN and CCSN

5.5.3 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 provisin of the OSI connection- mode network service.

5.6 *Public Mobile systems*

5.6.1 *Public Mobile satellite data transmission systems*

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

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

5.6.1.3 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.

5.6.2 *Public land mobile networks (PLMNs)*

5.6.2.1 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.

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

5.6.2.3 CSPDNs may be used to access PLMNs in the same way as defined in § 5.6.2.1 using protocols providing error correction and flow control. This point is for further study.

5.6.3 *Other mobile systems*

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

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

This section 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/X.300 and 6-2/X.300.

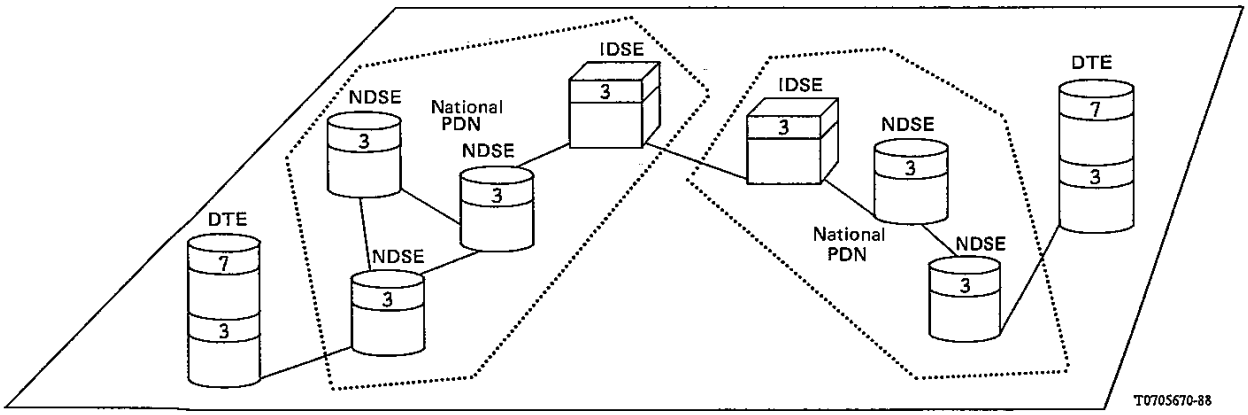


FIGURE 6-1/X.300

Example of an international PDN configuration with interworking

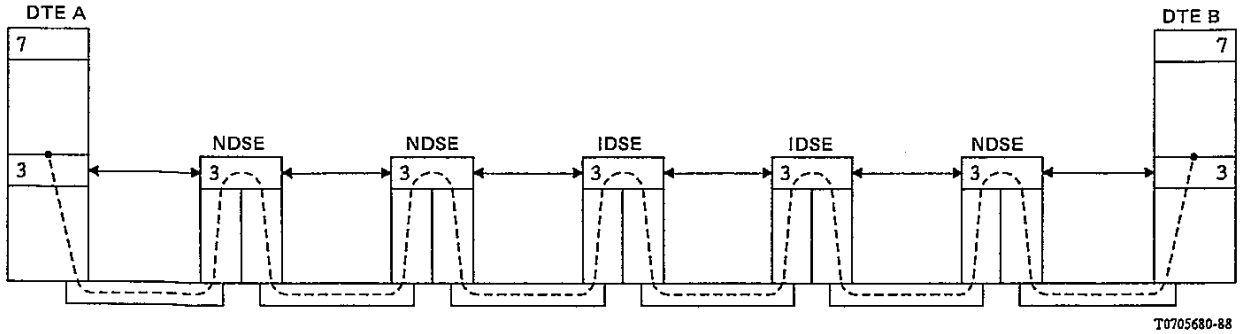


FIGURE 6-2/X.300

Intermediate nodes 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 the following Figure 6-3/X.300 (giving two equivalent representations of intermediate systems involved in the call).

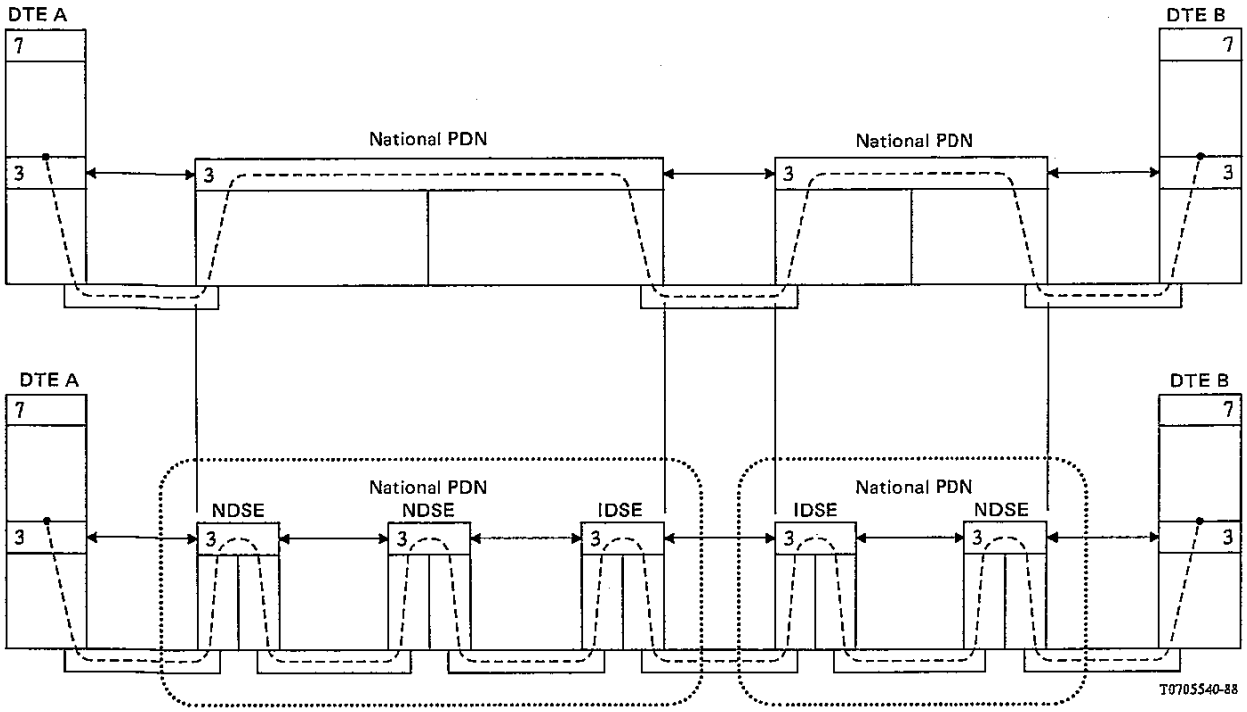


FIGURE 6-3/X.300

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)) . . . This can be graphically represented as shown in Figure 6-4/X.300.

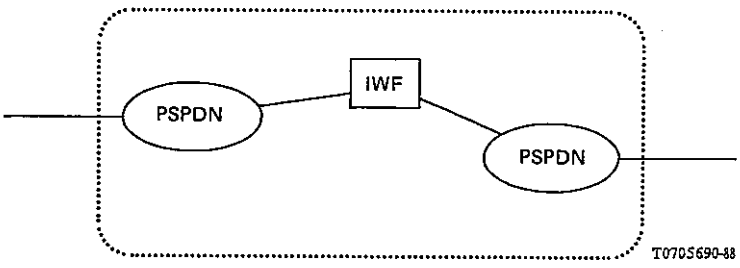


FIGURE 6-4/X.300

Example of a graphical representation of interconnected networks

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

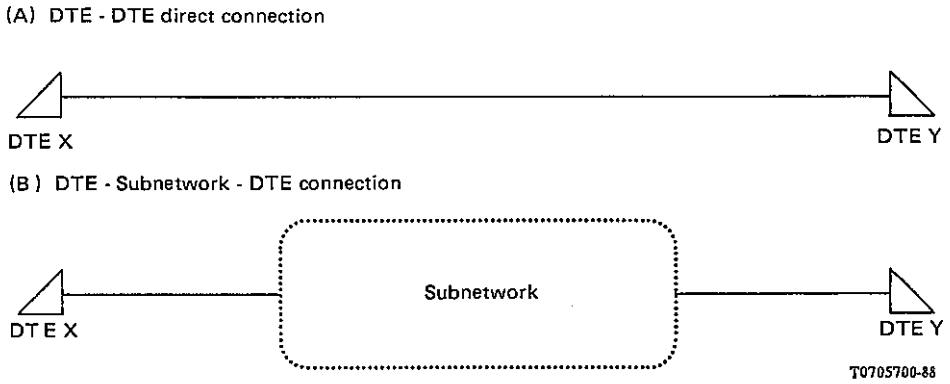
a) two end DTEs; then a single subnetwork is involved in the connection,

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/X.300).

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

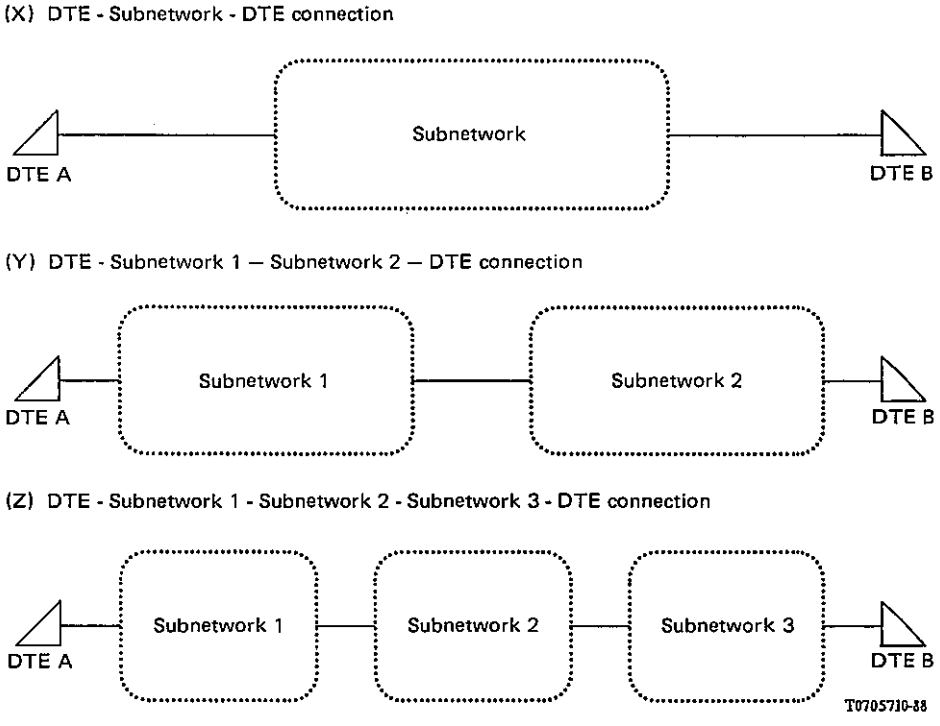
6.1.1.5 From the viewpoint of end users, there are two basic situations:



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), . . .

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 case (Y) et (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 the Figure 6-5/X.300:

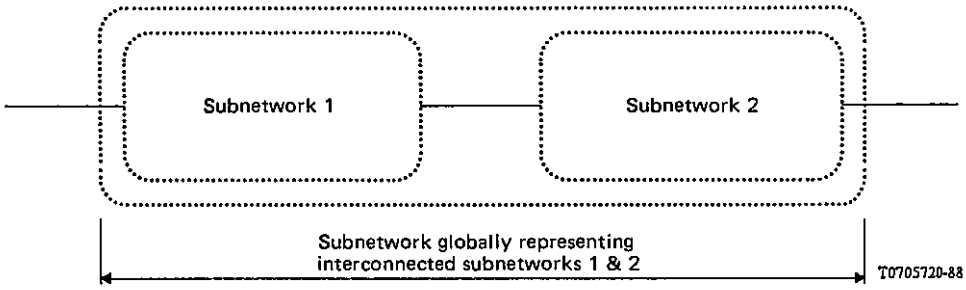


FIGURE 6-5/X.300

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/X.300, this subnetwork is labeled 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:

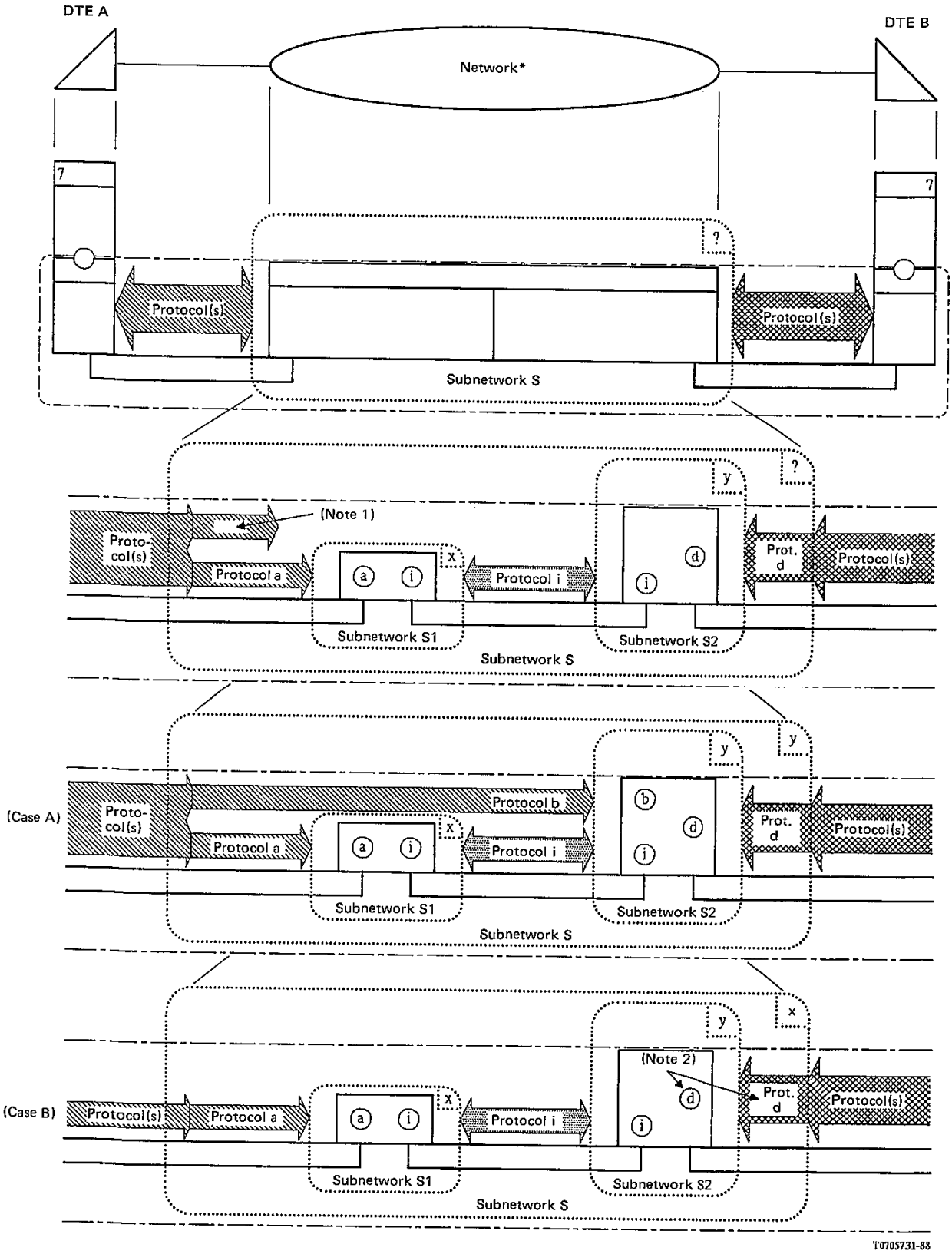
a) Network interworking is based upon the functionality of subnetwork S2. This implies the need for convergence protocol transparently for subnetwork S1. This possibility is outlined in more detail in § 6.1.2.1.

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/X.300, 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).



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

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/X.300. Figure 6-7/X.300 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/X.300, 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.

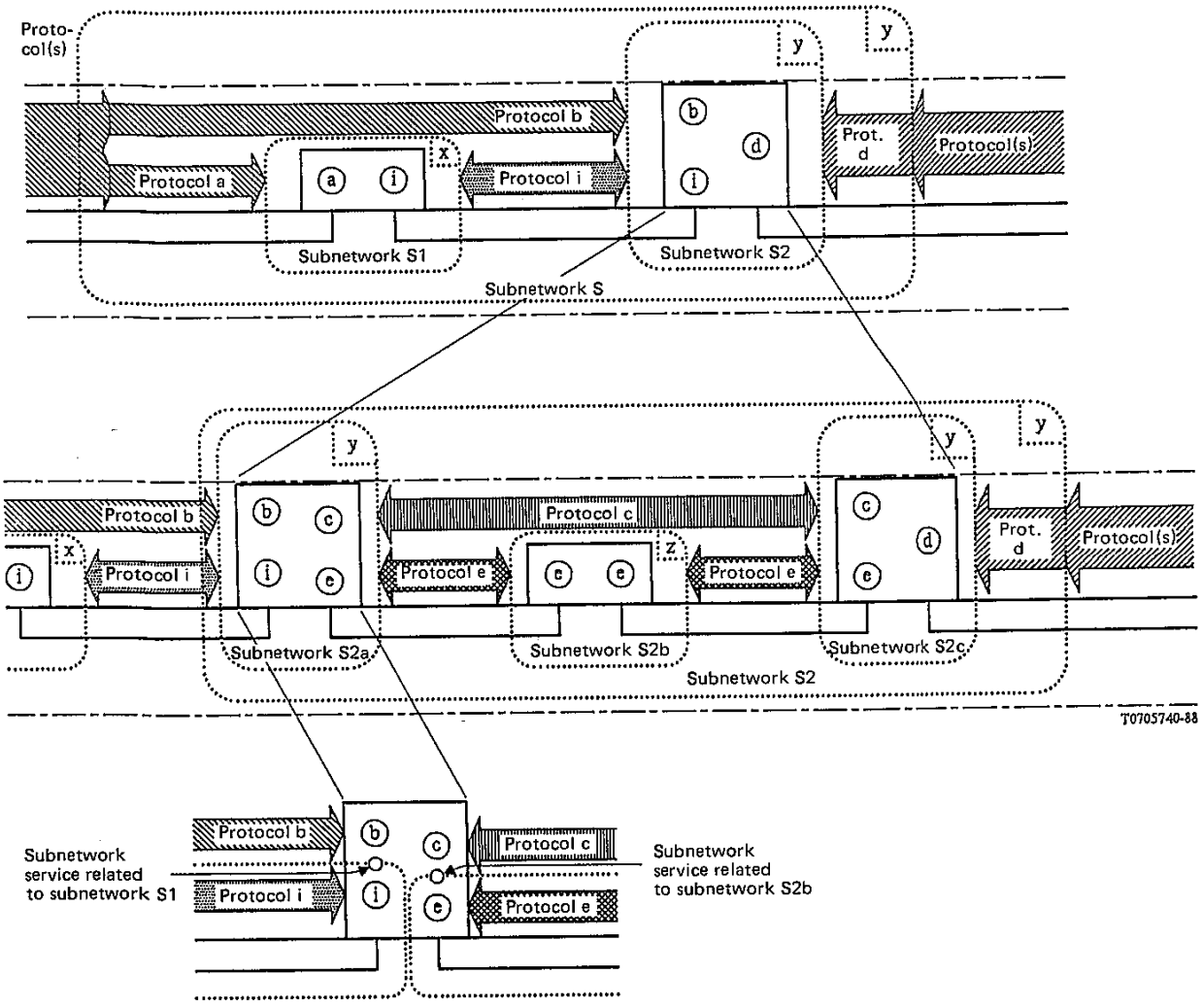


FIGURE 6-7/X.300

Repeated decomposition of subnetworks and participation of different subnetwork services

Figure 6-8/X.300 illustrates the relationship between protocols to access a subnetwork, a convergence protocol, and subnetwork services in an end system.

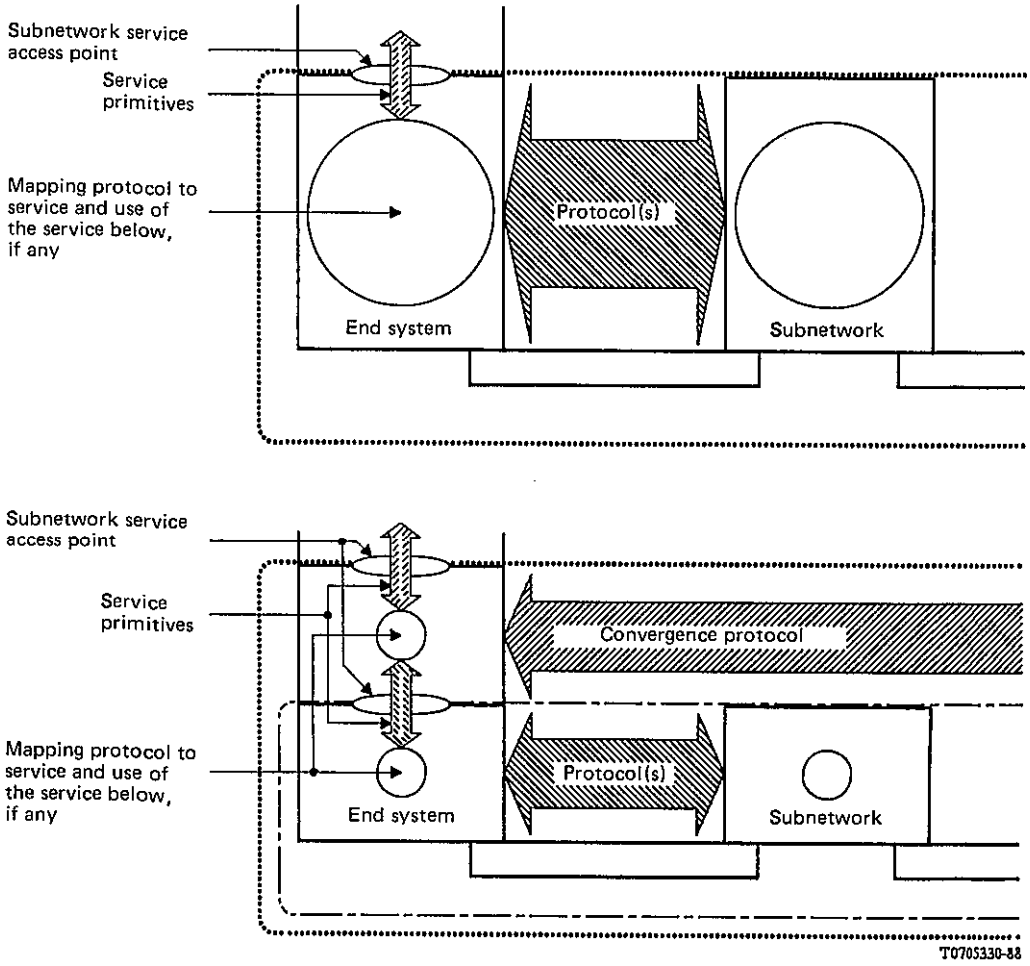


FIGURE 6-8/X.300

Protocol and service mapping in end systems

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.

6.2 *Categories of interworking*

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

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/X.300.

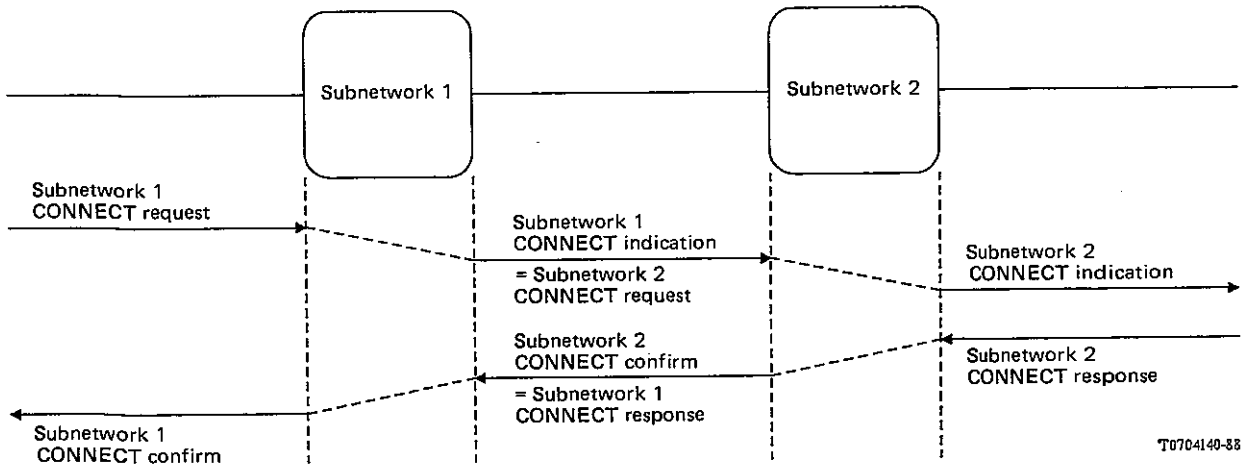


FIGURE 6-9/X.300

Interworking by call control mapping

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.

6.2.2 *Interworking by port access*

Interworking by port access is abstractly shown in Figure 6-10/X.300.

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 section 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.

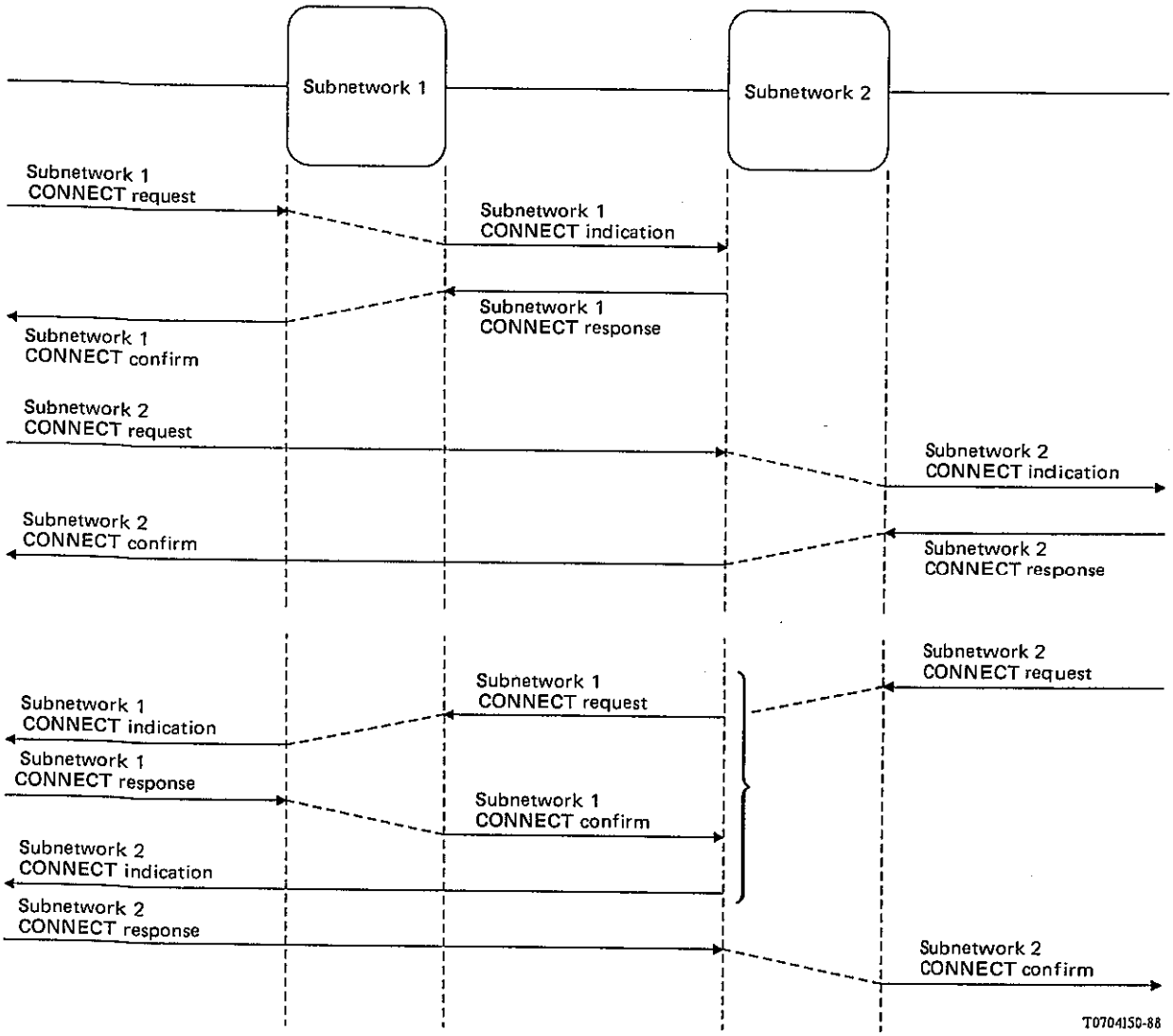


FIGURE 6-10/X.300

Interworking by port access

6.3.1 *Identification of subnetwork types*

Section 6.1 defines how communication may involve subnetworks with different functionalities. In this section, some particular subnetwork functionalities are considered, which are labeled as subnetwork types. The functionalities of the respective subnetwork types are given in Table 6-1/X.300. The functionalities are expressed in relation to the CCITT 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.

TABLE 6-1/X.300

Identification of subnetwork types

Phase of the call / Subnetwork Type	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.

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 § 5 of this Recommendation. The abstract functionality of these networks corresponds to subnetwork types as indicated in Table 6-2/X.300.

TABLE 6-2/X.300

Abstracts functionality of different networks

Network	CSPDN	PSPDN	ISDN(cs)	ISDN(ps)	PSTN	PLMN	MSS	Private networks
Subnetwork Type	III (Note 1)	I	II (Note 2)	I	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.

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/X.300 illustrates the resulting subnetwork type when interconnecting two subnetworks.

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/X.300 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 § 8.

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 communication 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/X.300. Exact arrangements for such convergence are defined in Recommendation X.305.

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

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*

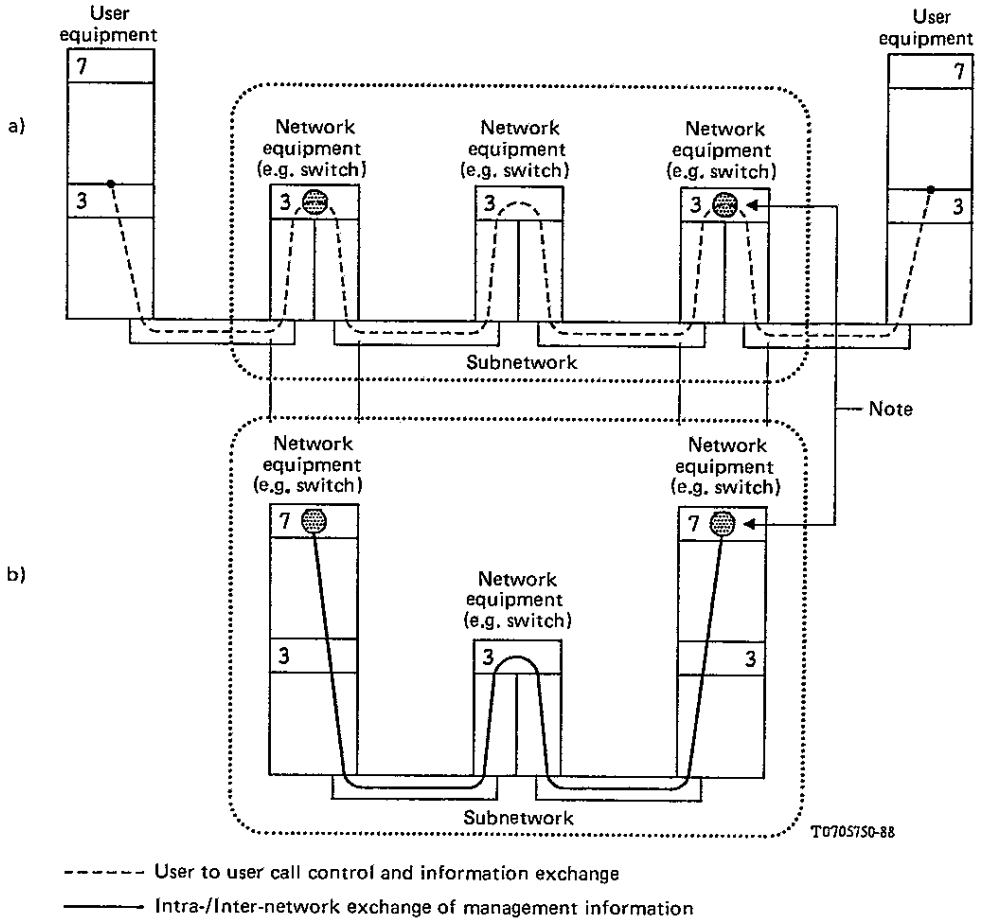
Management information for the control of user calls, internal network management, or inter-network exchange of such information, may be provided by the same and/or separate entities exchanging a user requested call control, and user to user information. Figures 6-11/X.300 and 6-12/X.300 illustrate such 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.

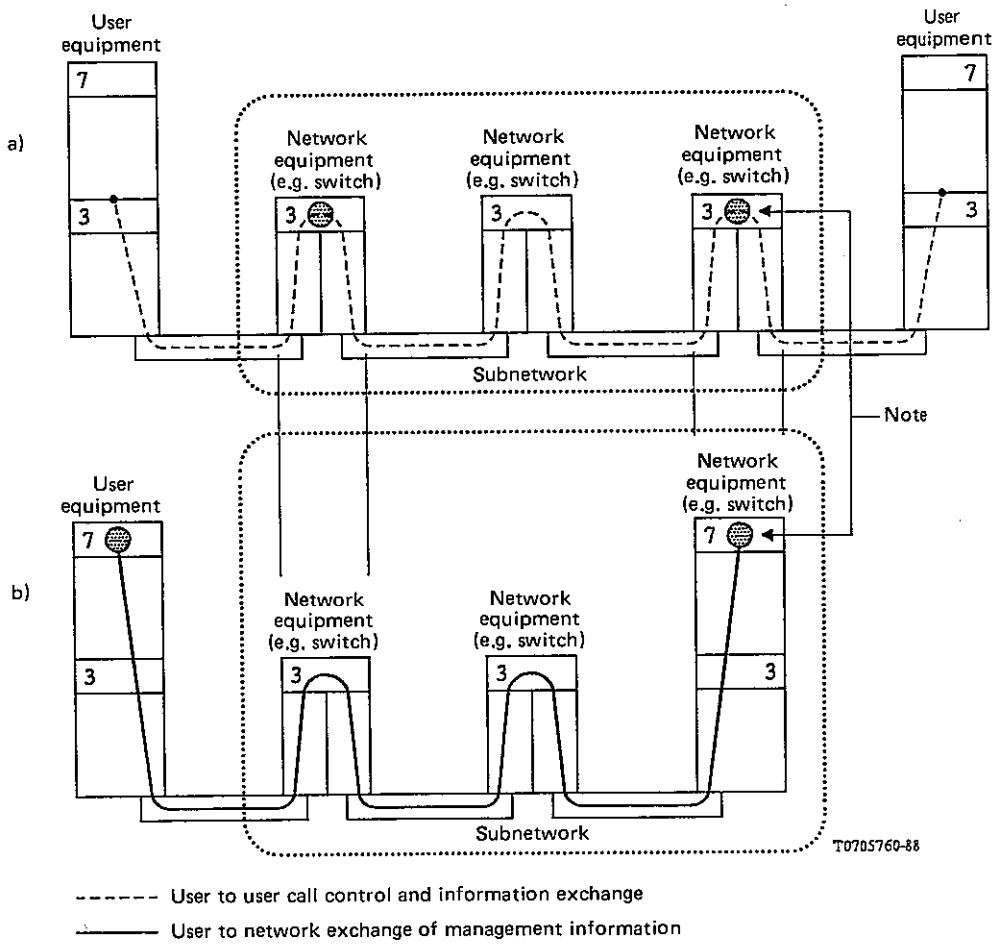
Detailed arrangements for exchange of management information is subject of separate Recommendations (e.g., Recommendation X.370 and Q.700-series Recommendations).



Note – Two entities co-operating 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 co-operating 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

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., CCITT services involving communication capabilities defined by CCITT.

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 CCITT services which are designed in accordance with Recommendation X.200 (reference model of OSI for CCITT 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 CCITT defined services (e.g., Telematic services).

7 Principles interworking involving both transmission and communication capability

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

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 the following Figures 7-1/X.300 and 7-2/X.300.

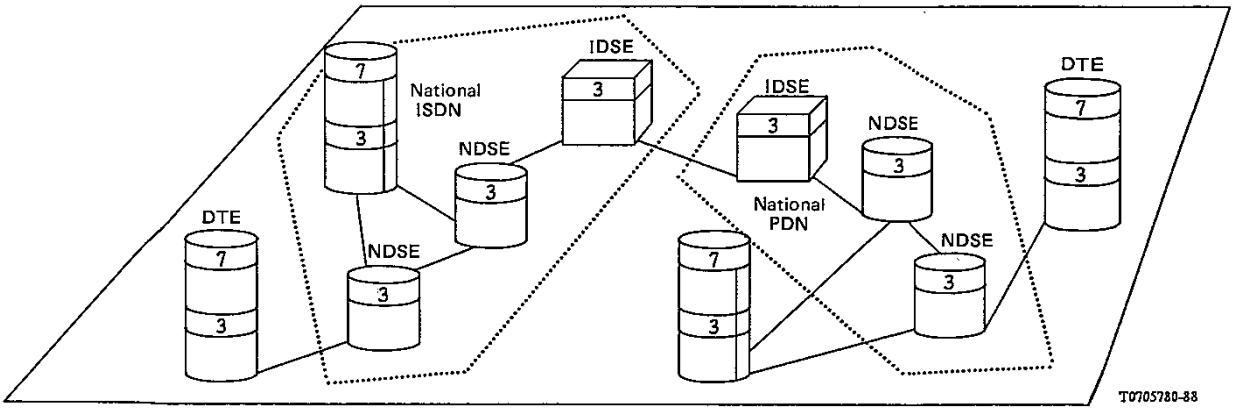


FIGURE 7-1/X.300

Example of interworking involving communication capability

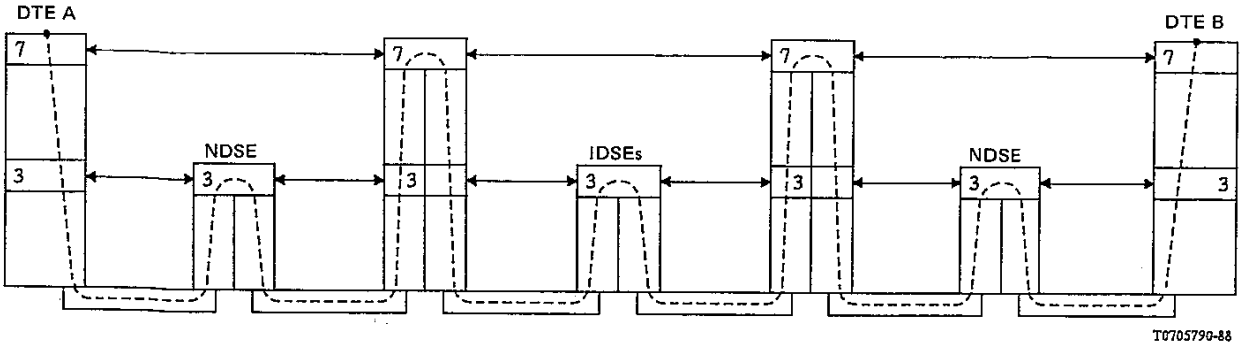


FIGURE 7-2/X.300

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 the following Figure 7-3/X.300 (giving two equivalent representations of intermediate systems involved in the call).

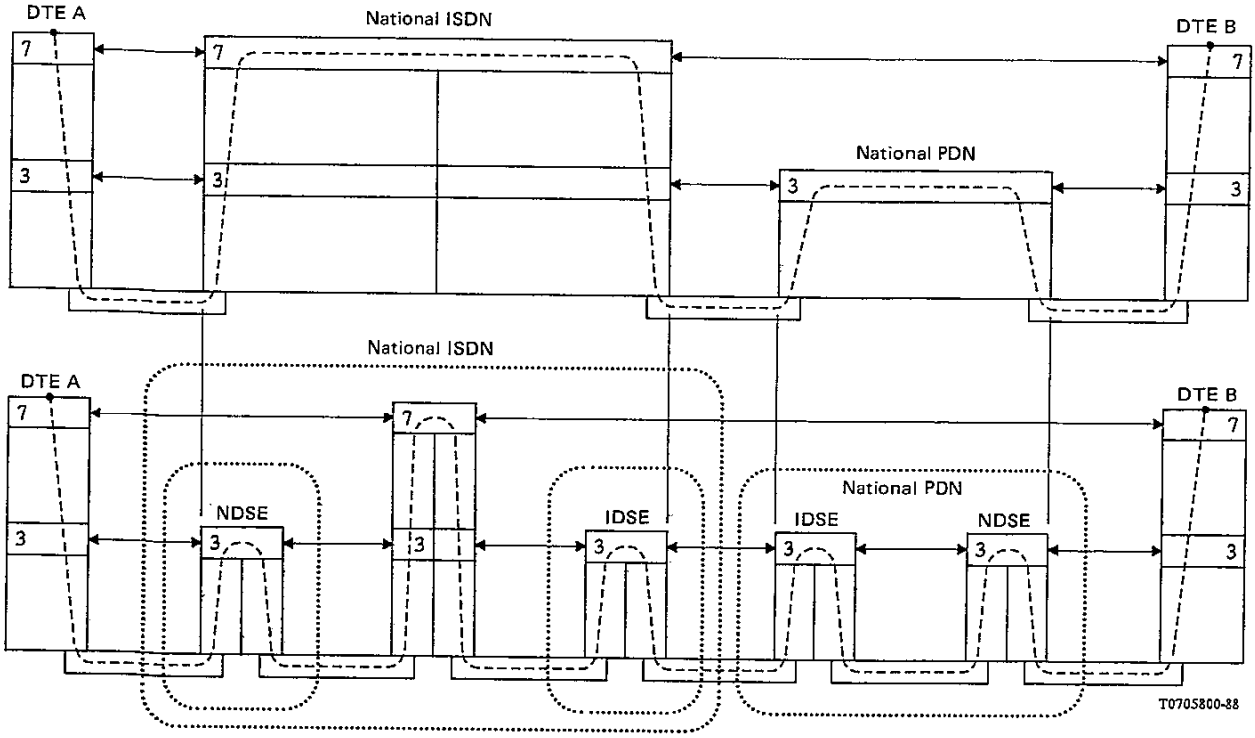


FIGURE 7-3/X.300

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/X.300.

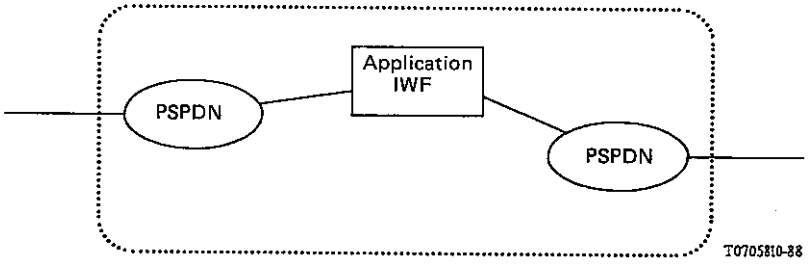


FIGURE 7-4/X.300

Example of a graphical representation of an application relay system

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,

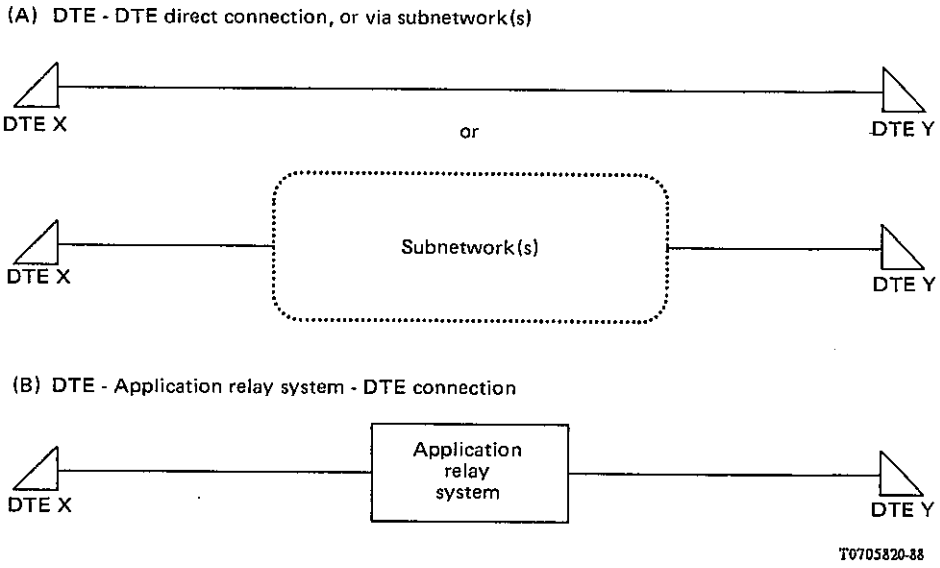
b) one end DTE and another application relay system; then at least two application relay systems are involved in the connection,

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/X.300.)

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.

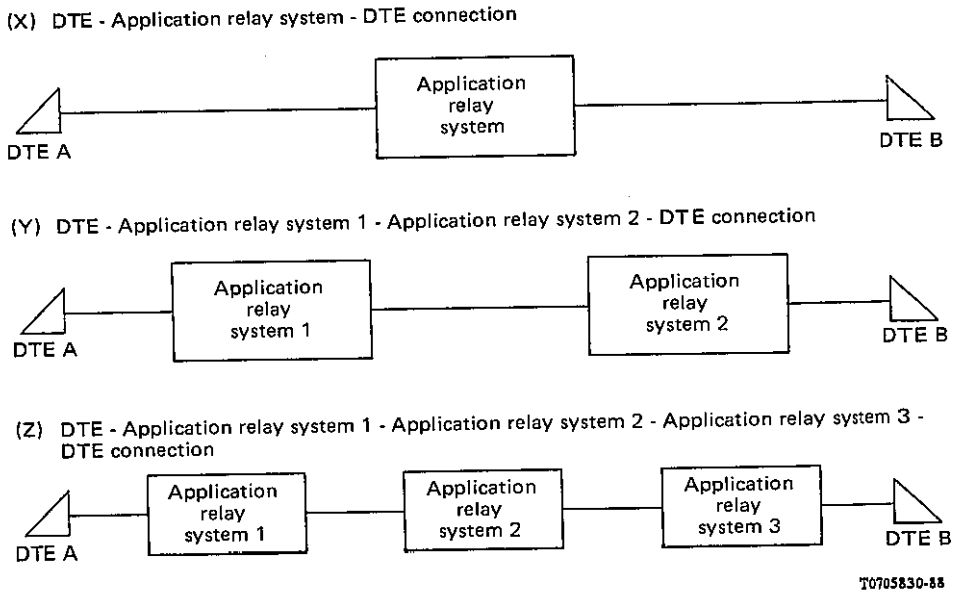
7.1.1.5 From the viewpoint of end users, there are two basic situations:



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 . . .

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:



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/X.300:

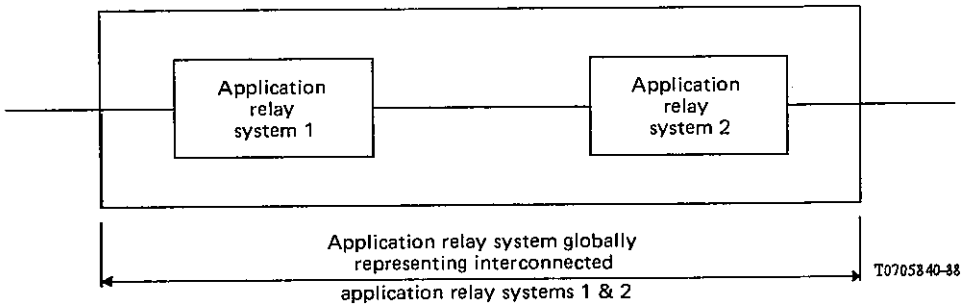


FIGURE 7-5/X.300

Global representation of application relay systems

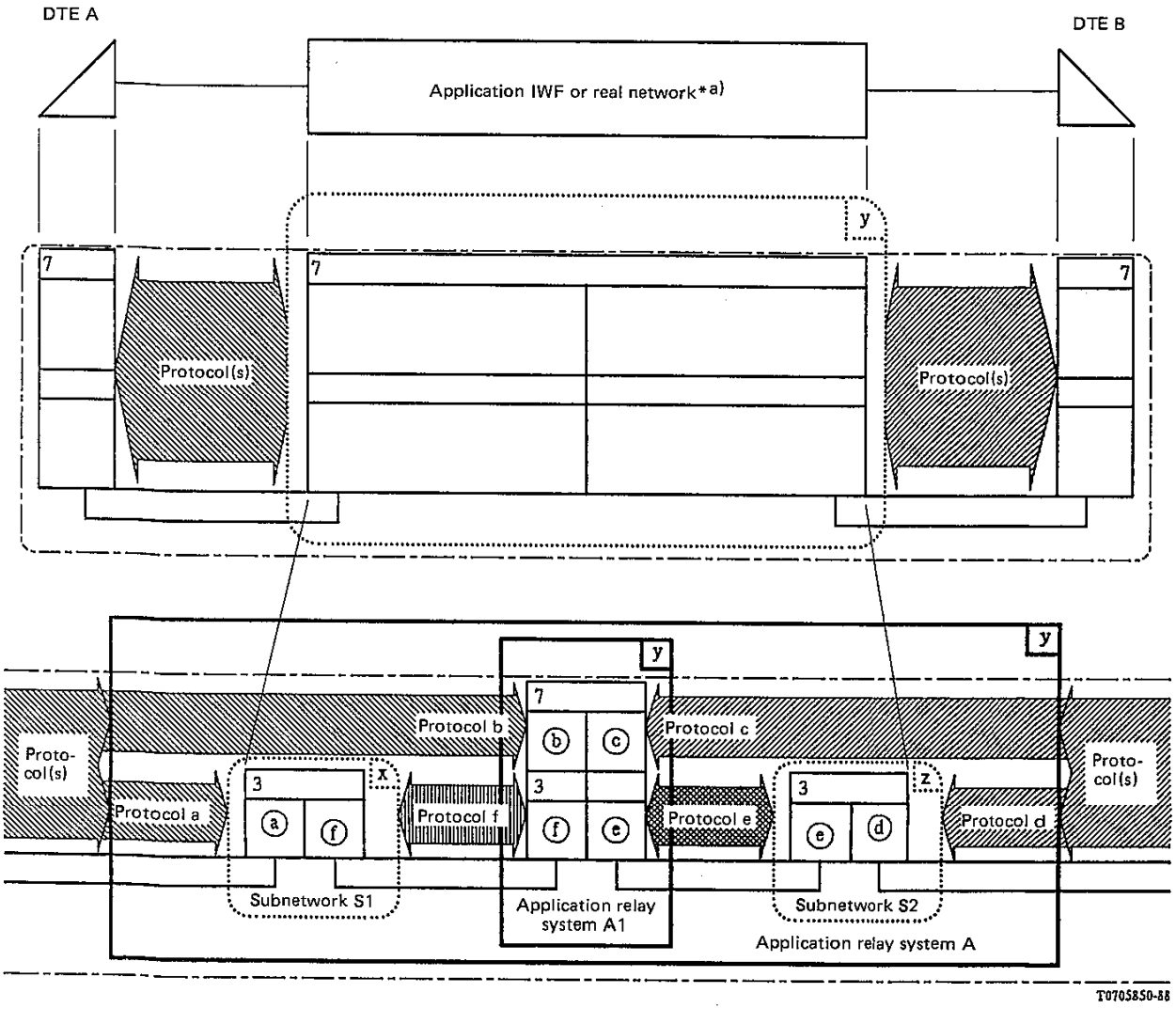
7.1.2 *Decomposition of application relay systems with respect to protocols and services*

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/X.300. 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 be accessed 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.



a) Or combinations of a least 1 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

7.2 *Categories of interworking*

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

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/X.300.

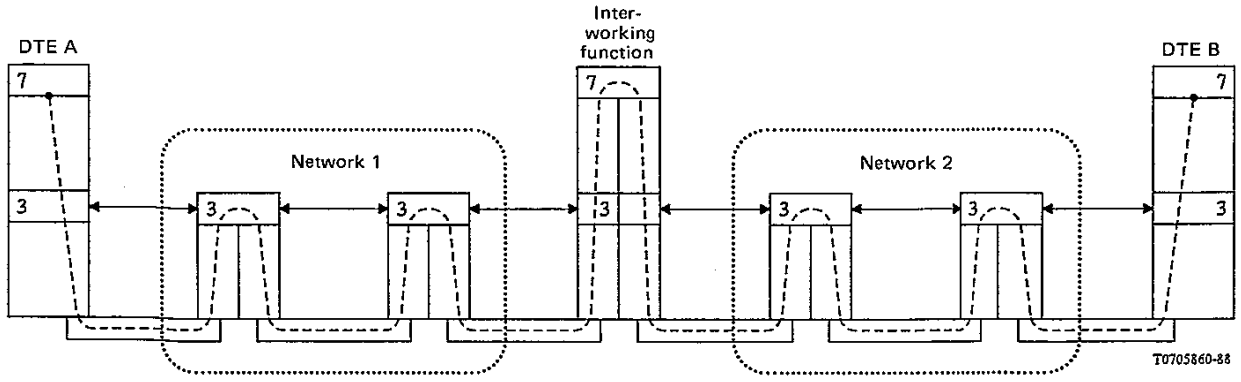


FIGURE 7-7/X.300

Interworking function at the application layer

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/X.300 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.

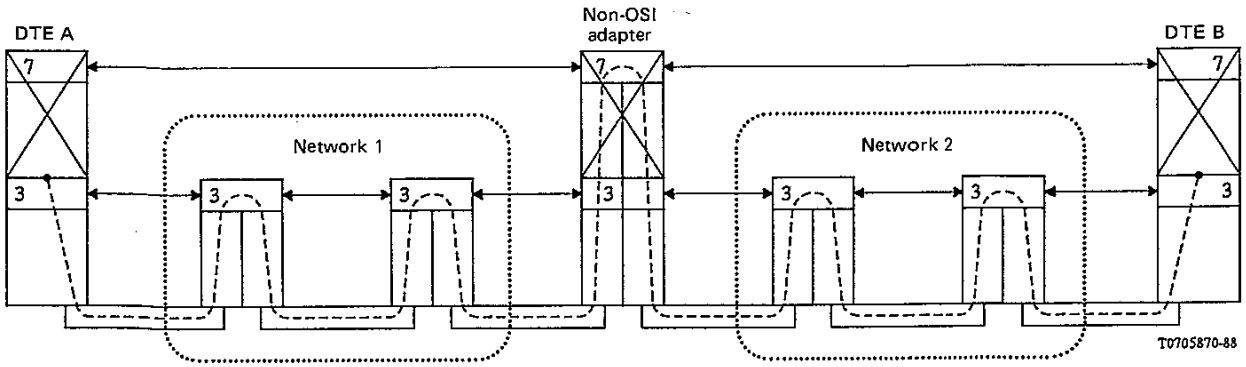


FIGURE 7-8/X.300

Interworking by call control mapping via a non-OSI adapter

7.2.3 *Interworking by port access via a non-OSI adapter*

In this method, network 1 is used to established a physical connection between DTE A and a non-OSI adapter, on a temporary basis, as shown in Figure-7-9/X.300.

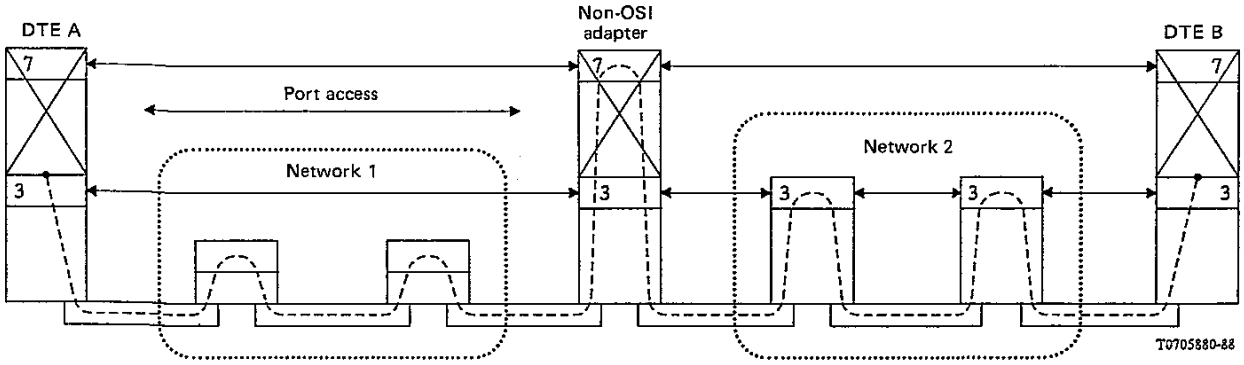


FIGURE 7-9/X.300

Interworking by port access via a non-OSI adapter

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.)

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 CCITT 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 section describes the different conditions for interworking between networks mentioned in § 5, on the basis of the categories of interworking described in § 6.

8.1 *General*

Table 8-1/X.300 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/X.300 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 CCITT telex services, are for further study.

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/X.300.

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.

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/X.300.

TABLE 8-1/X.300

Conditions for interworking

		PSPDN	CSPDN	ISDN: PS Bearer requested	ISDN: CS Bearer requested	CCSN	PSTN	Mobile data systems	Private networks
PSPDN		See X.323							
CSPDN		See X.322, X.28, X.32, X.82 Notes 1, 2	Note 3						
ISDN	PS Bearer requested	Note 4	Note 4	Note 4					
ISDN	CS Bearer requested	Note 4	Note 4	Note 4	Note 4				
CCSN		See X.326	FS	FS	FS	Note 5			
PTSN		See X.28, X.32 Notes 1, 2	FS	FS	FS	Note 5	Note 5		
Mobile data systems		See X.324	Note 6	FS	FS	Note 5	Note 5	FS	
Private networks		See X.327	FS	Note 7	FS	Note 6	Note 6	Note 6	Note 6

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.

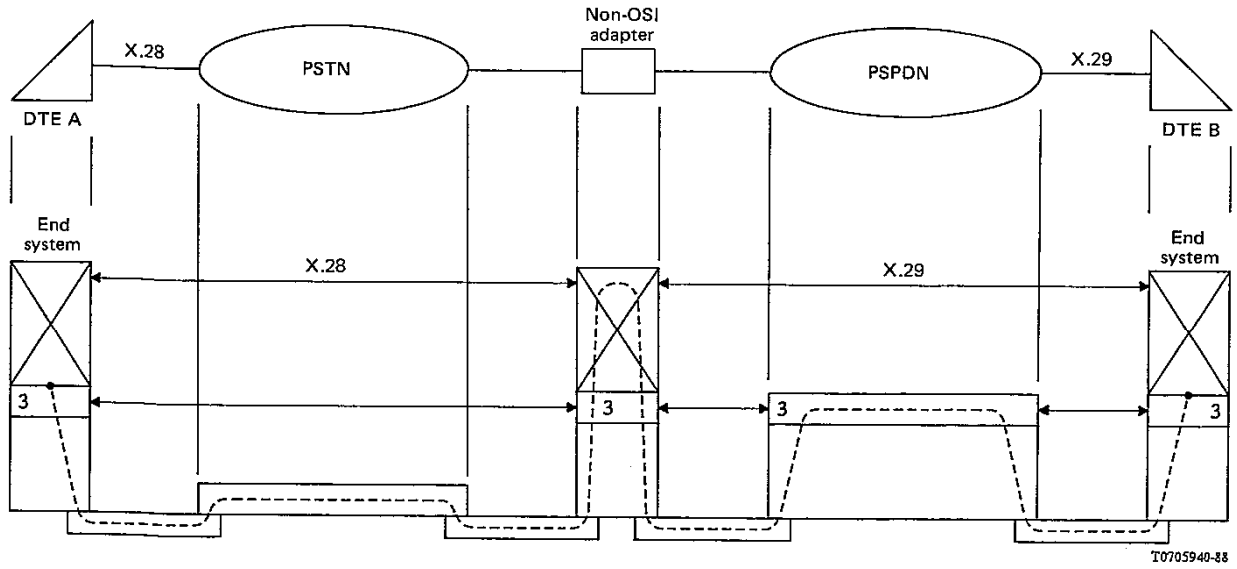


FIGURE 8-1/X.300

Direct interworking via a non-OSI adapter

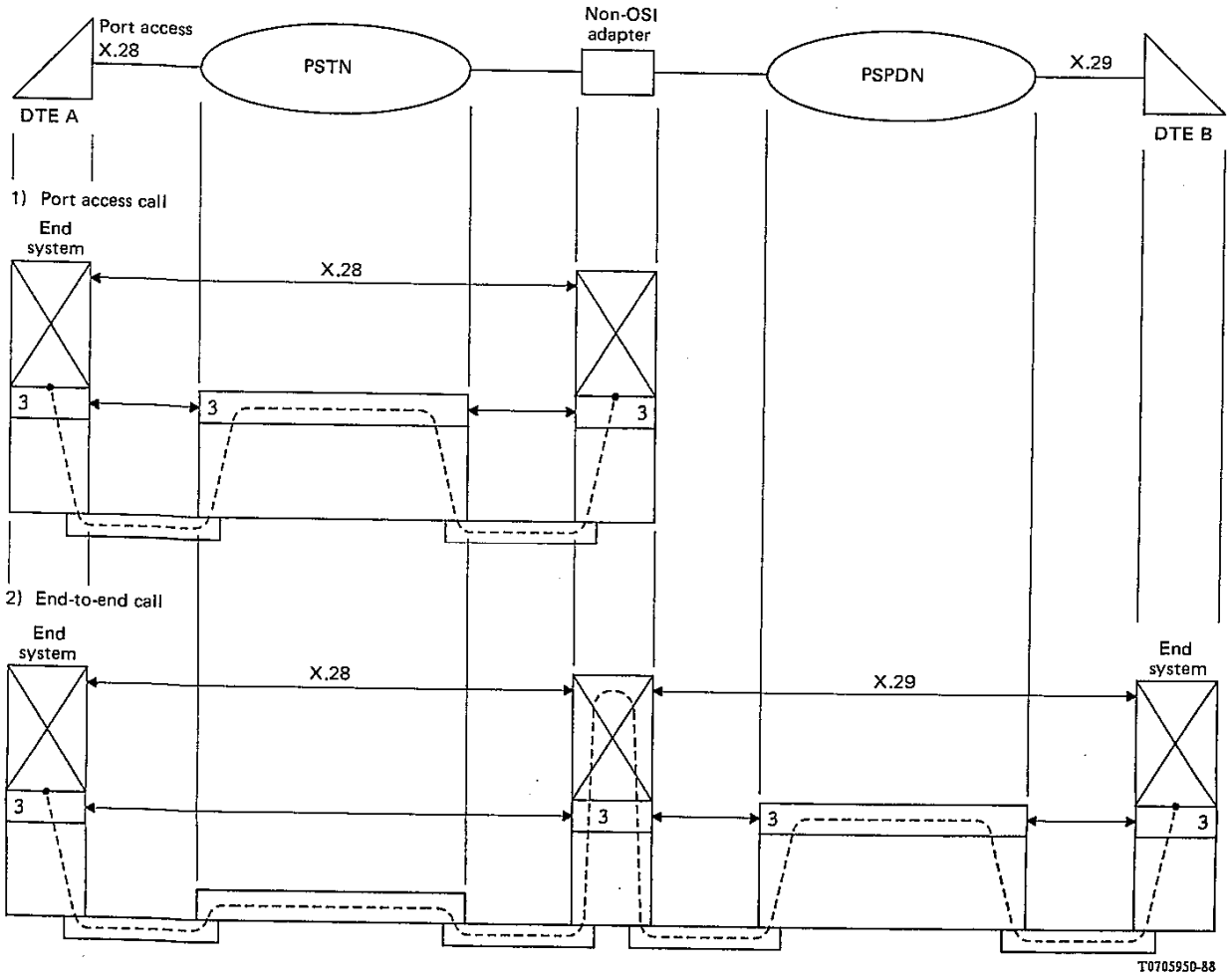


FIGURE 8-2/X.300

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

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.

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 and packet-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 and X.31 for circuit-mode and packet-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 Recommandation X.325);

iii) ISDN where a circuit switched bearer is requested - PSPDN (see Recommandation 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.

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/X.300), a configuration can be decomposed as illustrated in Figure 8-3/X.300, Case b. Thus, the arrangements for interworking will be given in the appropriate subsections of this Recommendations, as based on this decomposition.

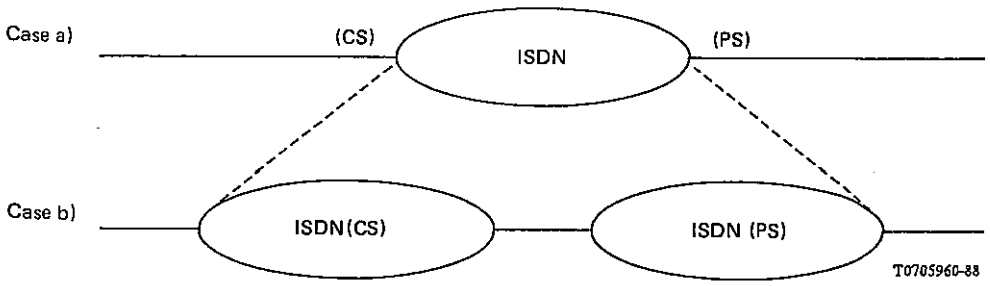


FIGURE 8-3/X.300

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 Recommendation X.30 for circuit-mode and X.31 for circuit-mode and packet-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.

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

ANNEX A

(to Recommendation X.300)

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 §§ A1, A2, A3 and A4 respectively.

Note – The typing of subnetworks in this section 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 § 6.

A.1.2 Networks that correspond to the functionality of Type I subnetwork are PSPDN and ISDN(PS). Figure A-1/X.300 illustrates the PSPDN example.

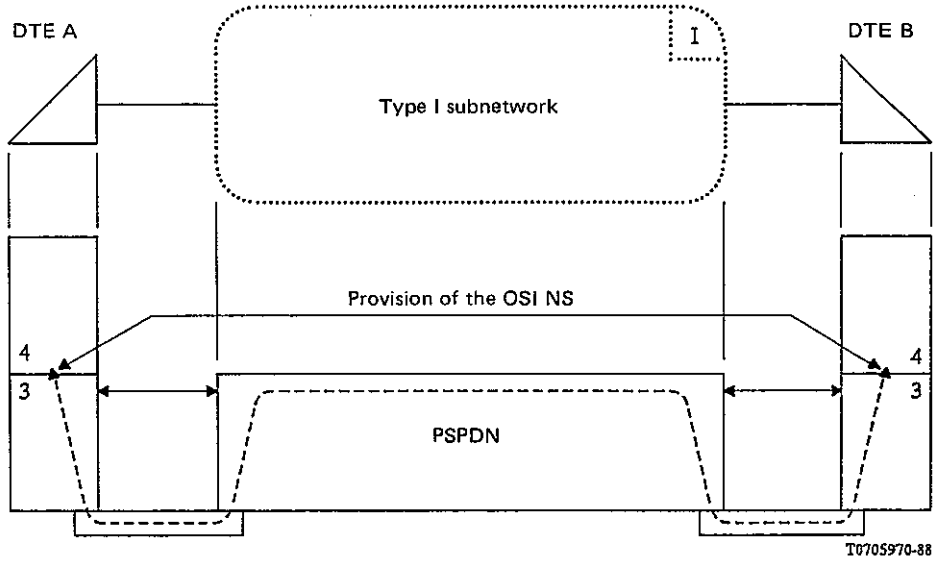
A.2 *Type II subnetwork*

A.2.1 Type II subnetworks operate during phases of a connection as defined in § 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/X.300.

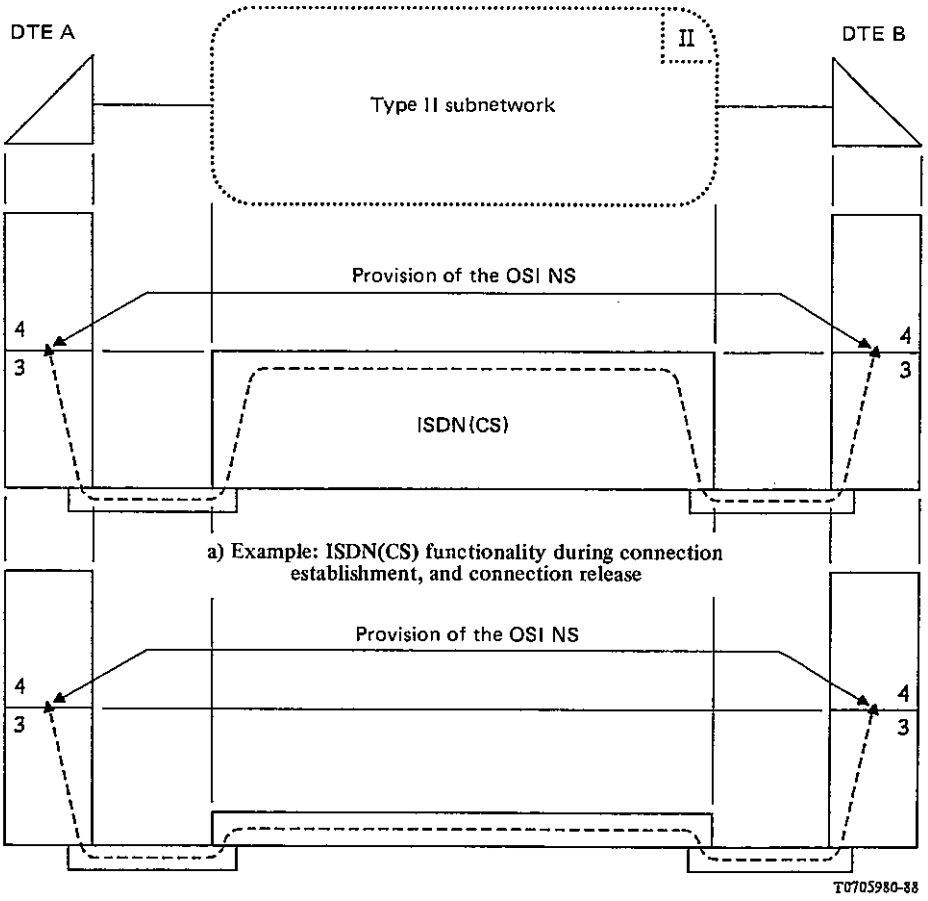
Note 1 – Details of this correspondence are under study.

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/X.300



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

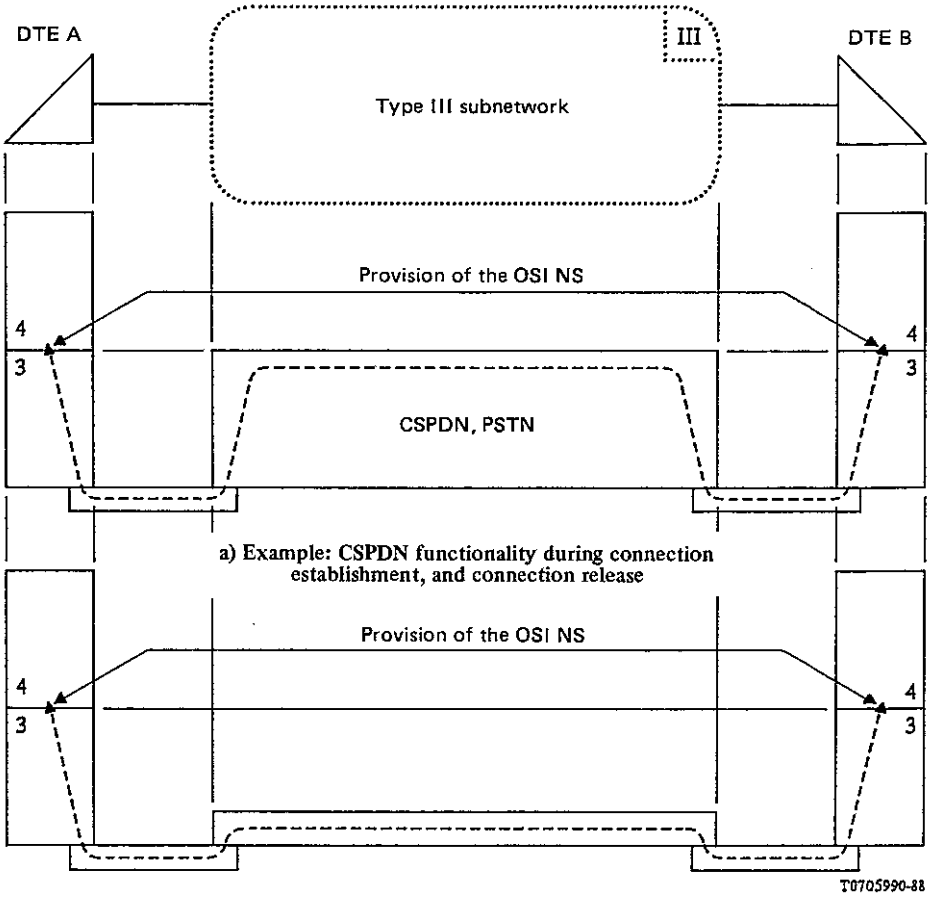
b) Example: ISDN(CS) functionality during data transfer

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 § 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/X.300 illustrates this example.



b) Example: CSPDN functionality during data transfer

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 § 6.

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

ANNEX B

(To Recommendation X.300)

Examples of subnetwork compositions

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

B1: Type I – Type II interconnection;

B2: Type I – Type III interconnection;

B3: Type II – Type III interconnection;

B4: Type IV – Type I interconnection.

Other combinations with Type IV subnetworks are given within B1 and B2 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 B1-1/X.300). This is performed by means of an appropriate IWF. In this case, the functionality of subnetwork S also corresponds to Type I.

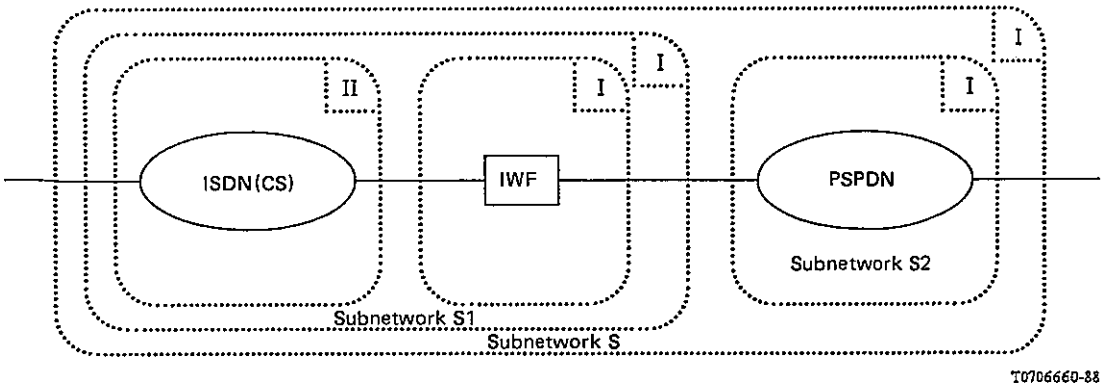


FIGURE B1-1/X.300

According to § 6.1.2 b) the functionality of subnetwork S1 may be of Type II (see Figure B1-2/X.300). This is performed by means of an appropriate interworking function. In this case, the functionality of subnetwork S also corresponds to Type II.

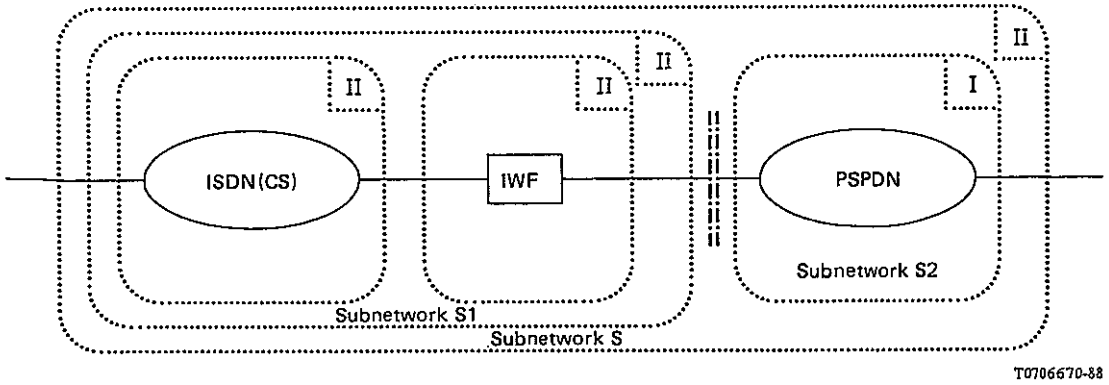


FIGURE B1-2/X.300

According to § 6.1.2 c), the functionality of subnetwork S1 cannot be assigned to any one of the subject types (see Figure B1-3/X.300). Its uses is subject to bilateral agreement.

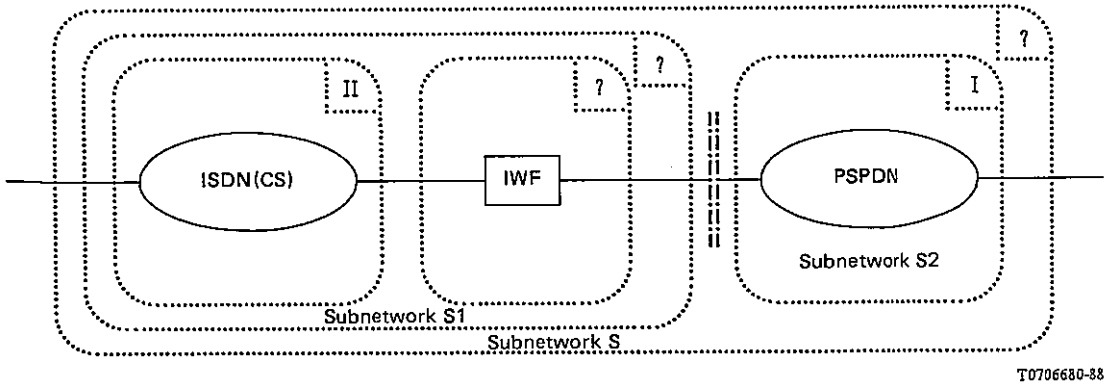


FIGURE B1-3/X.300

B.2 *Type I – Type III interconnetion*

According to § 6.1.2 a) the functionality of subnetwork S1 may be of Type I (see Figure B2-1/X.300). This is performed by means of an appropriate IWF. In this case the functionality of subnetwork S also corresponds to Type I.

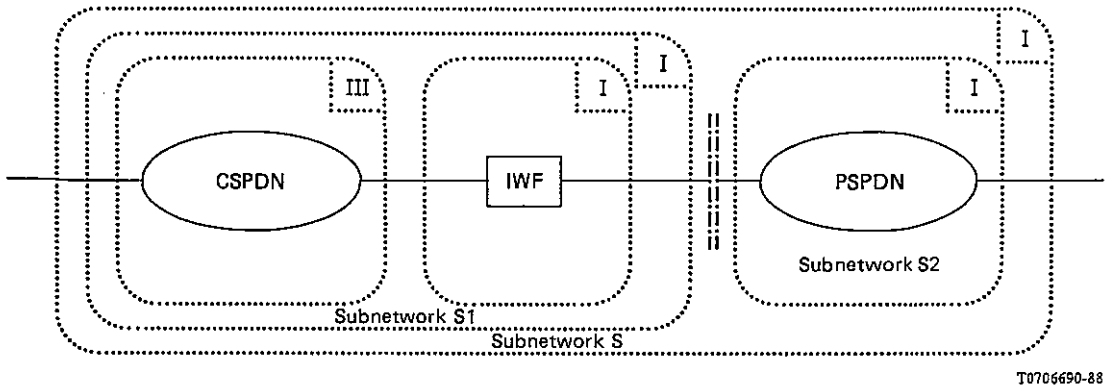


FIGURE B2-1/X.300

According to § 6.1.2 b) the functionality of subnetwork S1 may be of Type III (see Figure B2-2/X.300). This is performed by means of an appropriate IWF. In this case, the functionality of subnetwork S also corresponds to Type III.

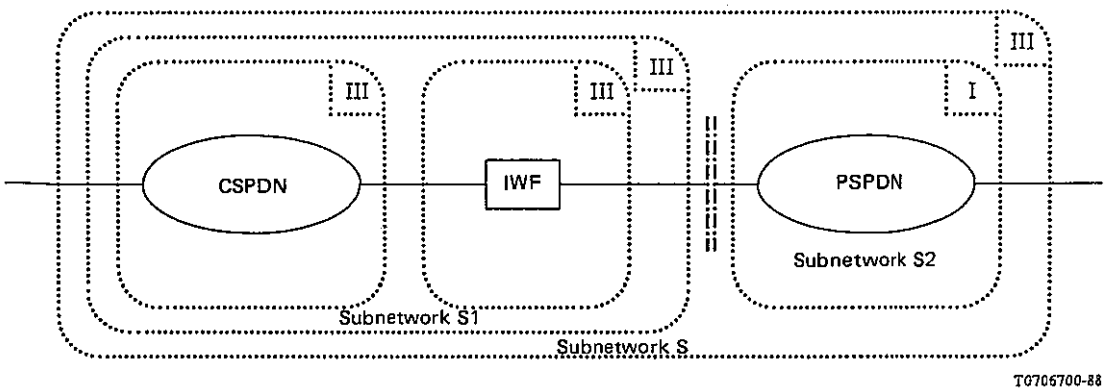


FIGURE B2-2/X.300

According to § 6.1.2 c) the functionality of subnetwork S1 cannot be assigned to one of the subnetwork types (see Figure B2-3/X.300). Its use is subject to bilateral agreement.

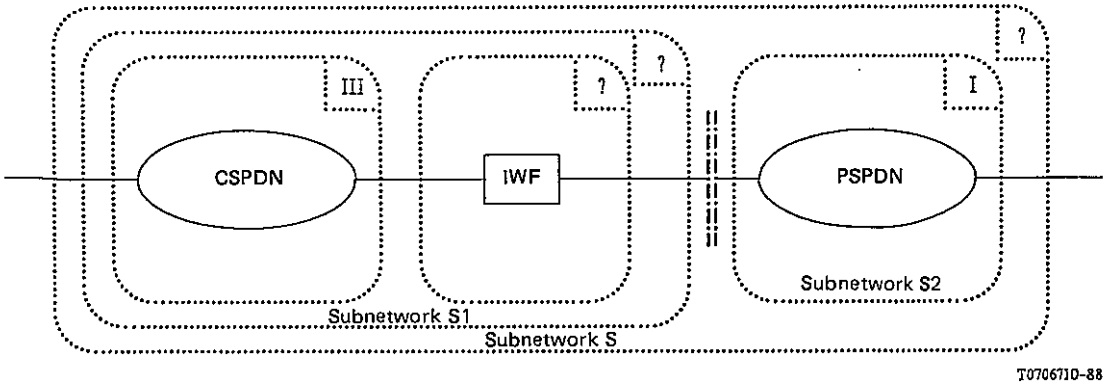


FIGURE B2-3/X.300

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 B3-1/X.300). This performed by means of an appropriate IWF. In this case, the functionality of subnetwork S also corresponds to Type II.

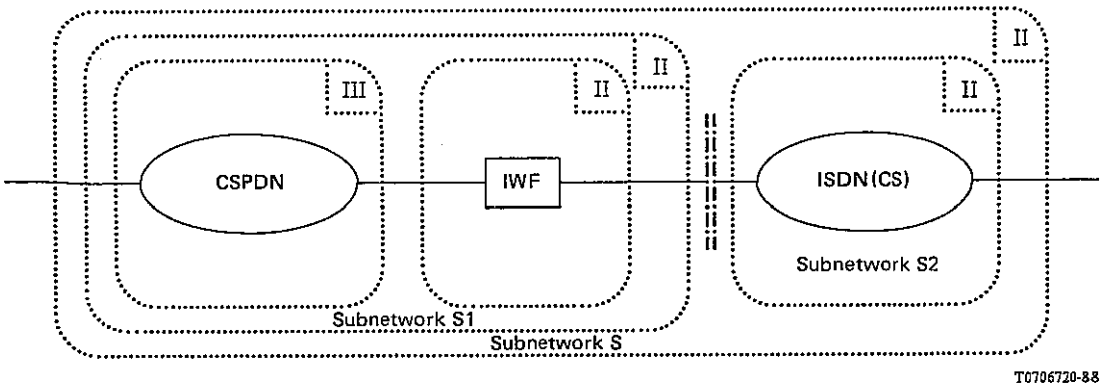


FIGURE B3-1/X.300

According to § 6.1.2 b) the functionality of subnetwork S1 may be of Type III (see Figure B3-2/X.300). This is performed by means of an appropriate IWF. In this case the functionality of subnetwork S also corresponds to Type III.

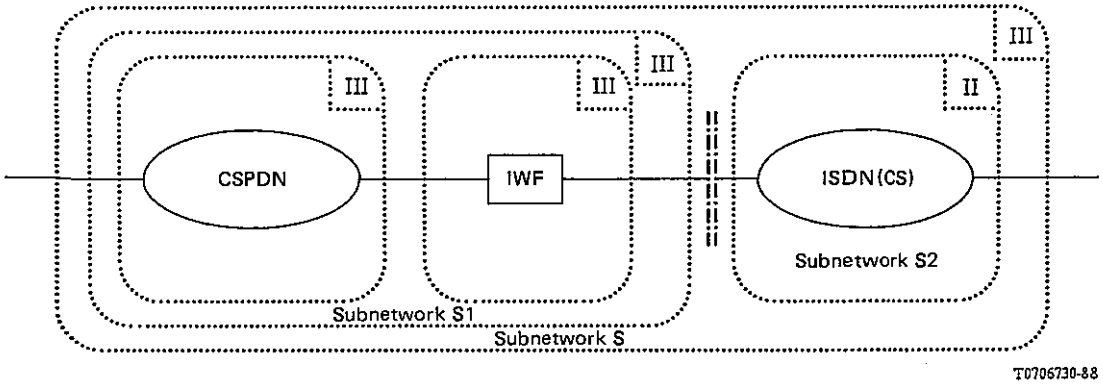


FIGURE B3-2/X.300

According to § 6.1.2 c) the functionality of subnetwork S may be of Type IV (see Figure B3-3/X.300). This is performed by means of an appropriate IWF.

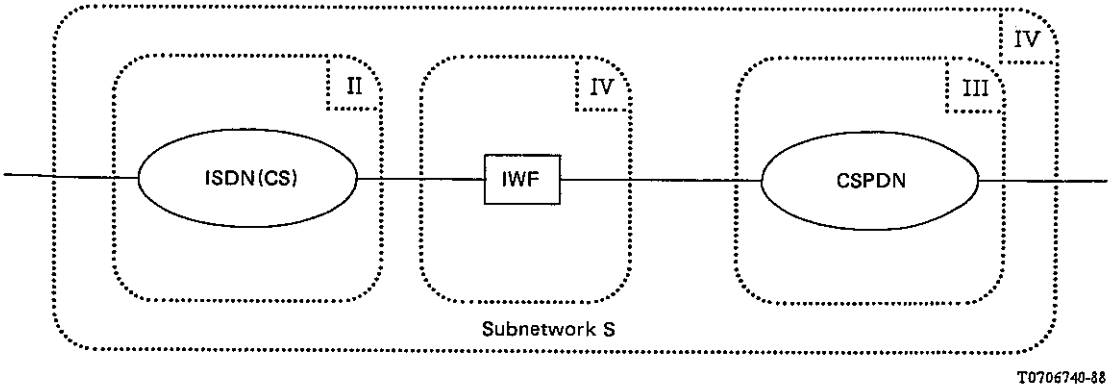


FIGURE B3-3/X.300

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

B.4 *Type IV – Type I interconnection*

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

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