INTERNATIONAL TELECOMMUNICATION UNION

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THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

BLUE BOOK

VOLUME VIII – FASCICLE VIII.6

DATA COMMUNICATION NETWORKS

INTERWORKING BETWEEN NETWORKS, MOBILE DATA TRANSMISSION SYSTEMS, INTERNETWORK MANAGEMENT

RECOMMENDATIONS X.300-X.370

IXTH PLENARY ASSEMBLY
MELBOURNE, 14-25 NOVEMBER 1988

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Recommendations X.300 to X.370

Data communication networks

PRELIMINARY NOTES

1 The Questions entrusted to each Study Group for the Study Period 1989-1992 can be found in Contribution No. 1 to that Study Group.

2 In this Fascicle, the expression "Administration" is used for shortness to indicate both a telecommunication Administration and a recognized private operating agency.

3 The status of annexes and appendices attached to the Series X Recommendations should be interpreted as follows (except where specified:

- an *annex* to a Recommendation forms an integral part of the Recommendation;
- an *appendix* to a Recommendation does not form part of the Recommendation and only provides some complementary explanation or information.

FASCICLE VIII.6

Recommendations X.300 to X.370

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

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SECTION 1

INTERWORKING BETWEEN NETWORKS

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)

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.

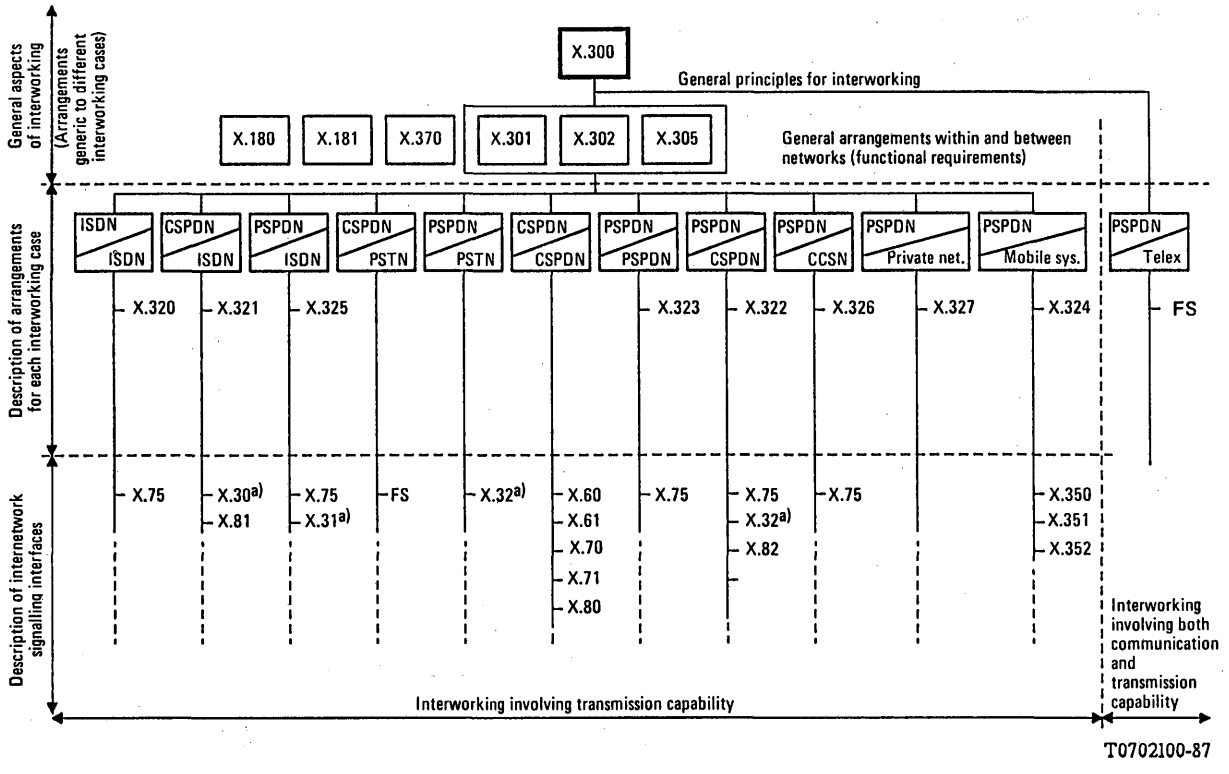
Note – This does not imply that any individual public network is required to implement all the mechanisms related to the OSI connection-mode Network Service.

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).

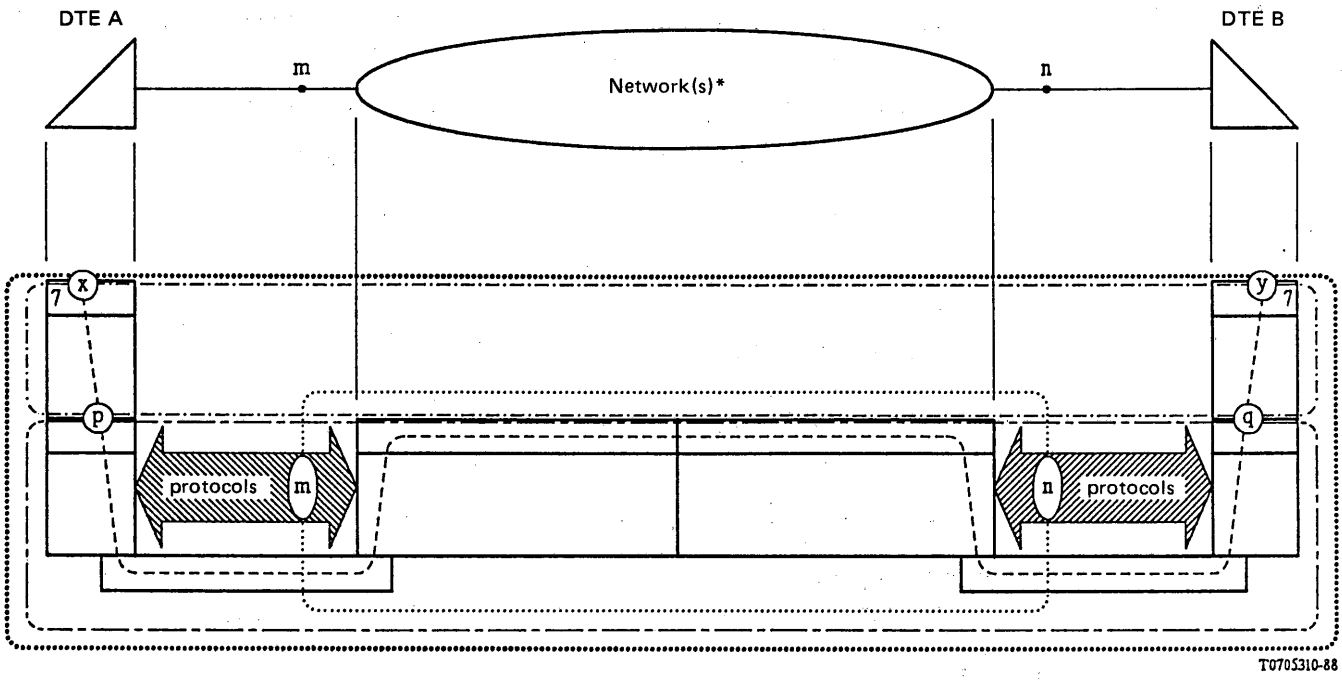
3.2.2 **application interworking function**

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*

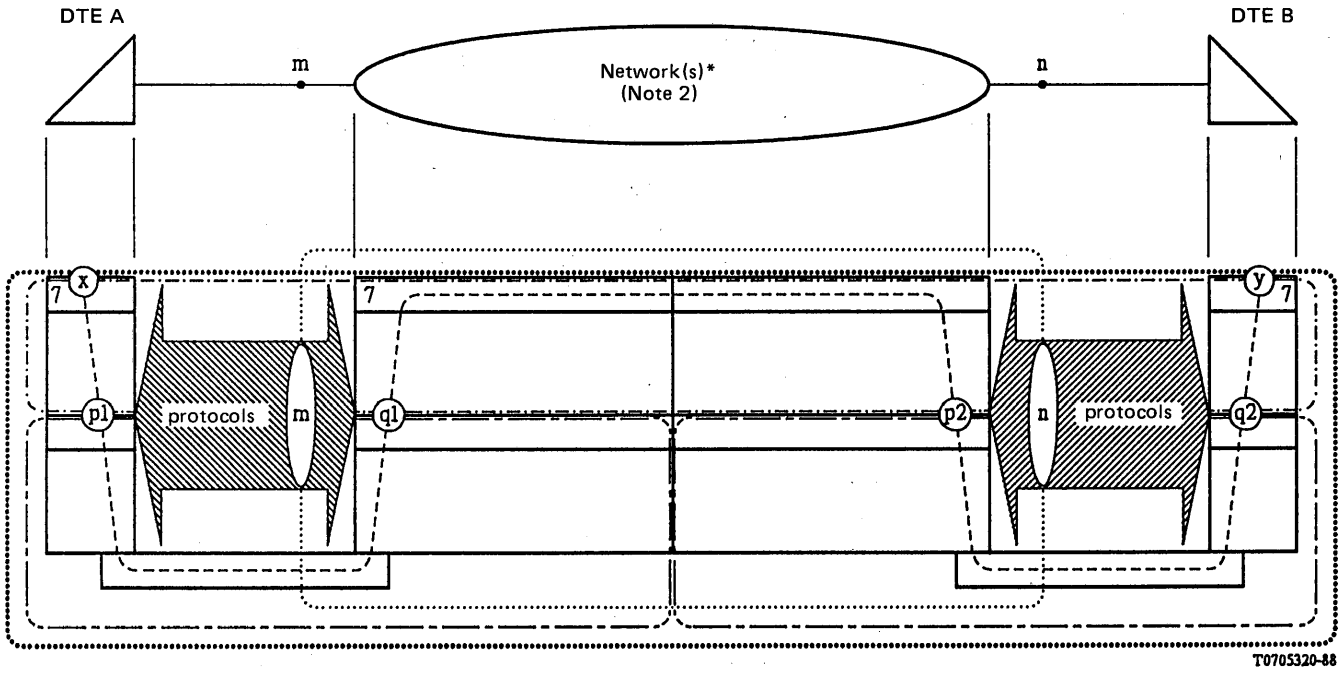
(For further study.)



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.

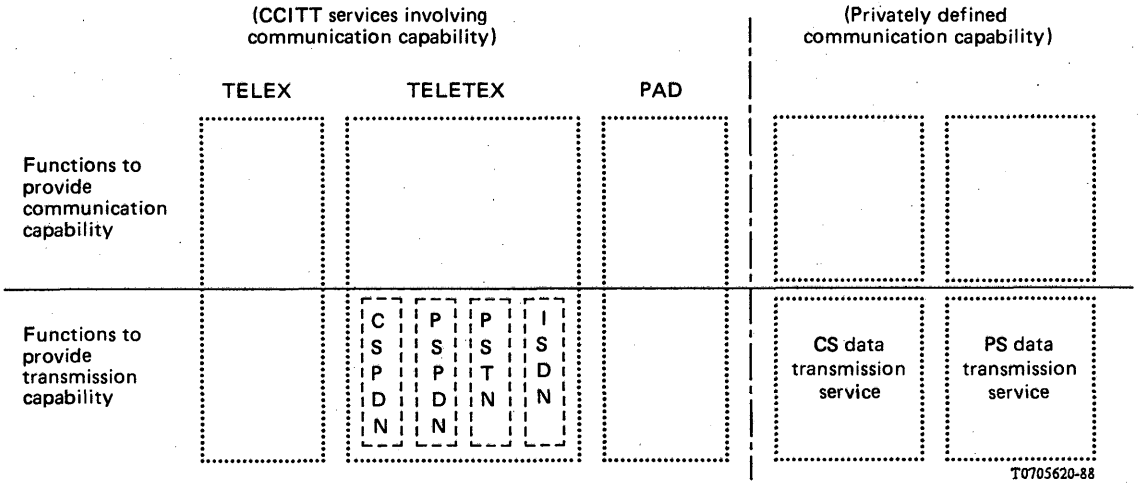


FIGURE 3-3/X.300

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.

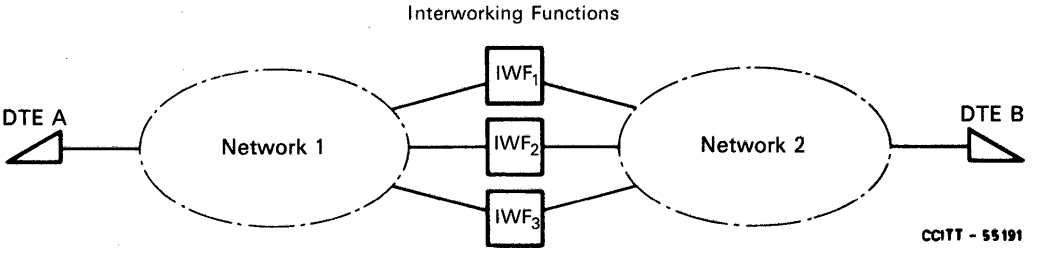


FIGURE 3-4/X.300

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>

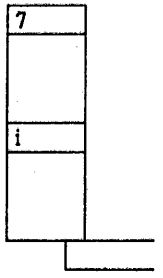
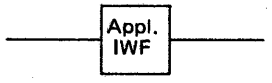
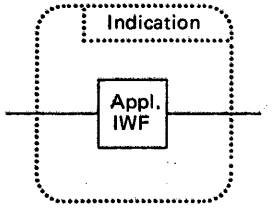
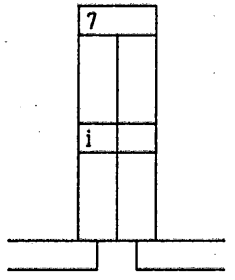
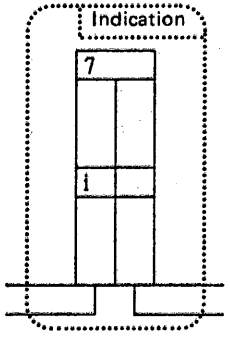
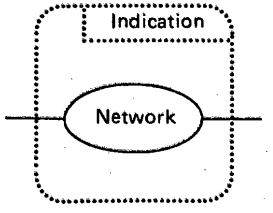
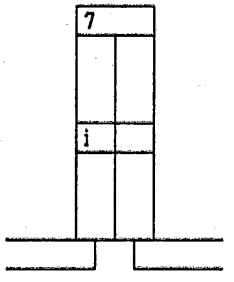
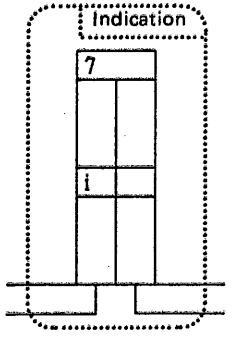
<subnetwork type III> ::= <III>

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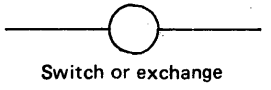
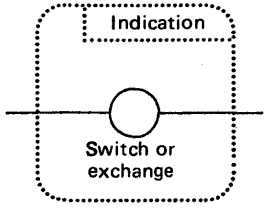
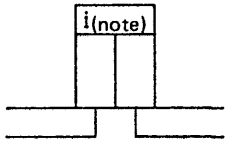
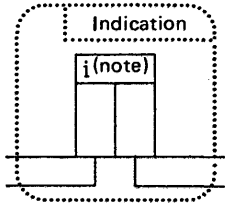
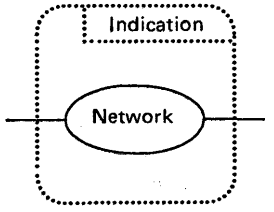
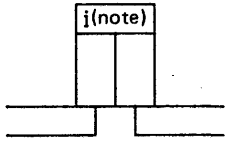
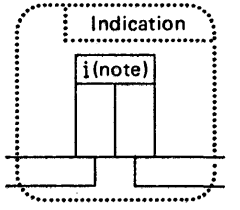
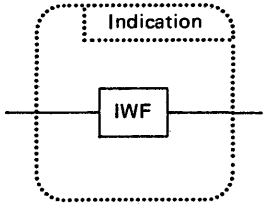
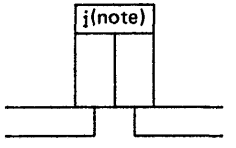
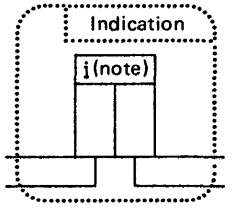
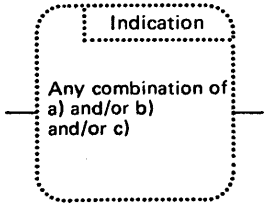
Note – "i" may be used to indicate a specific layer(s) (for example, "7" present denotes that an application process is present).

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		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)

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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.

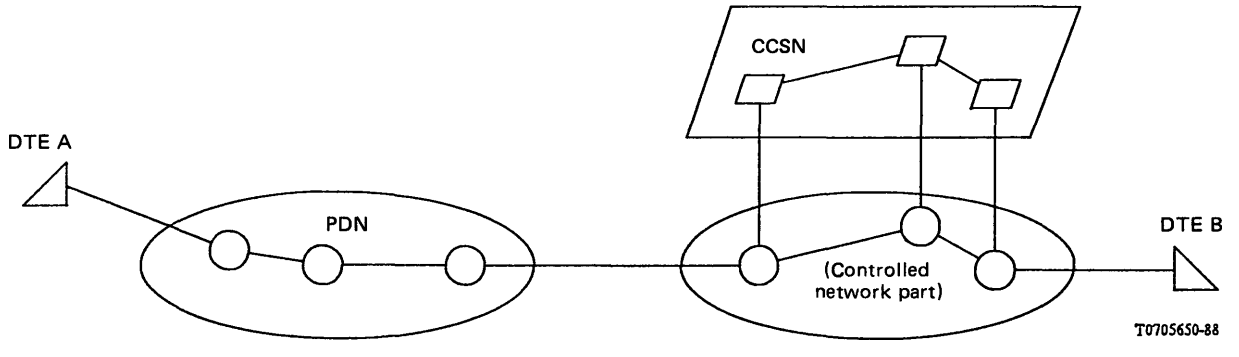


FIGURE 5-1/X.300

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.

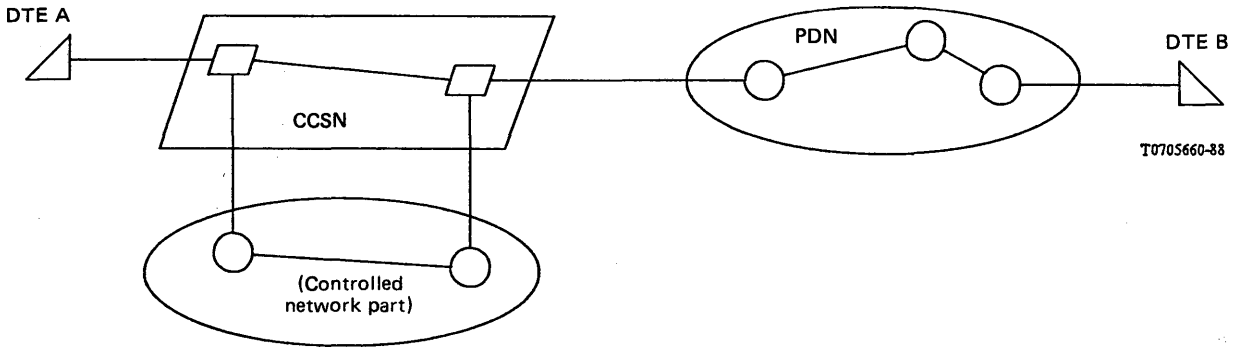


FIGURE 5-2/X.300

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.

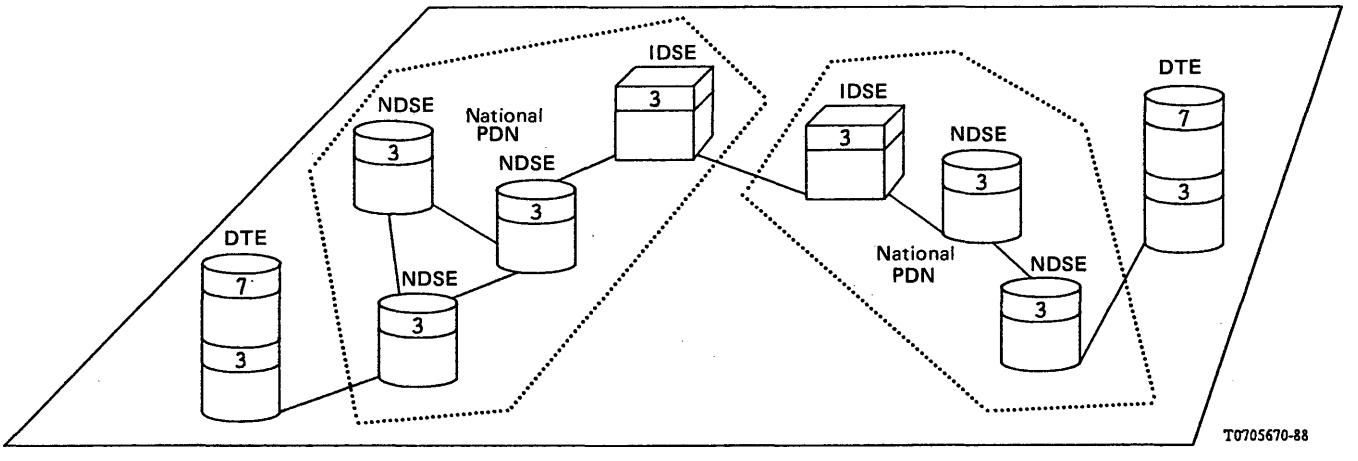


FIGURE 6-1/X.300

Example of an international PDN configuration with interworking

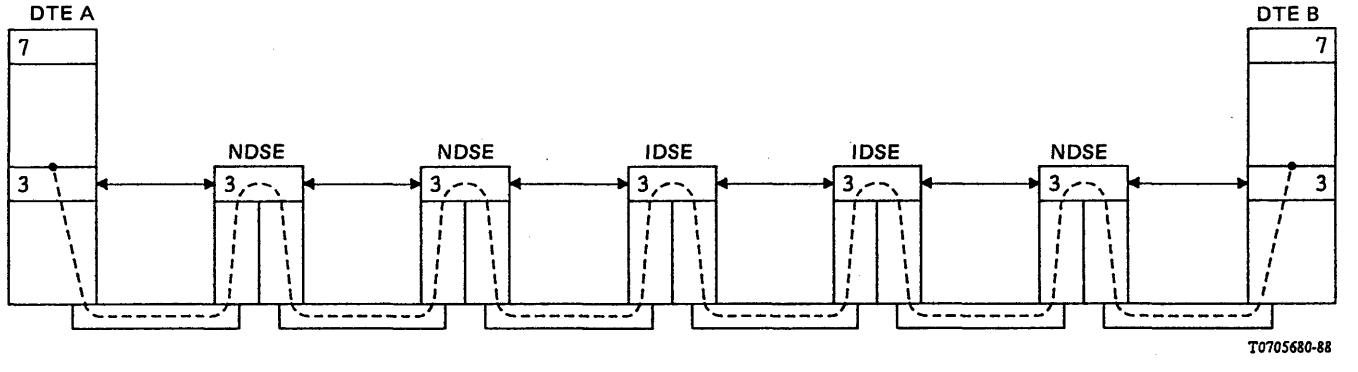


FIGURE 6-2/X.300

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).

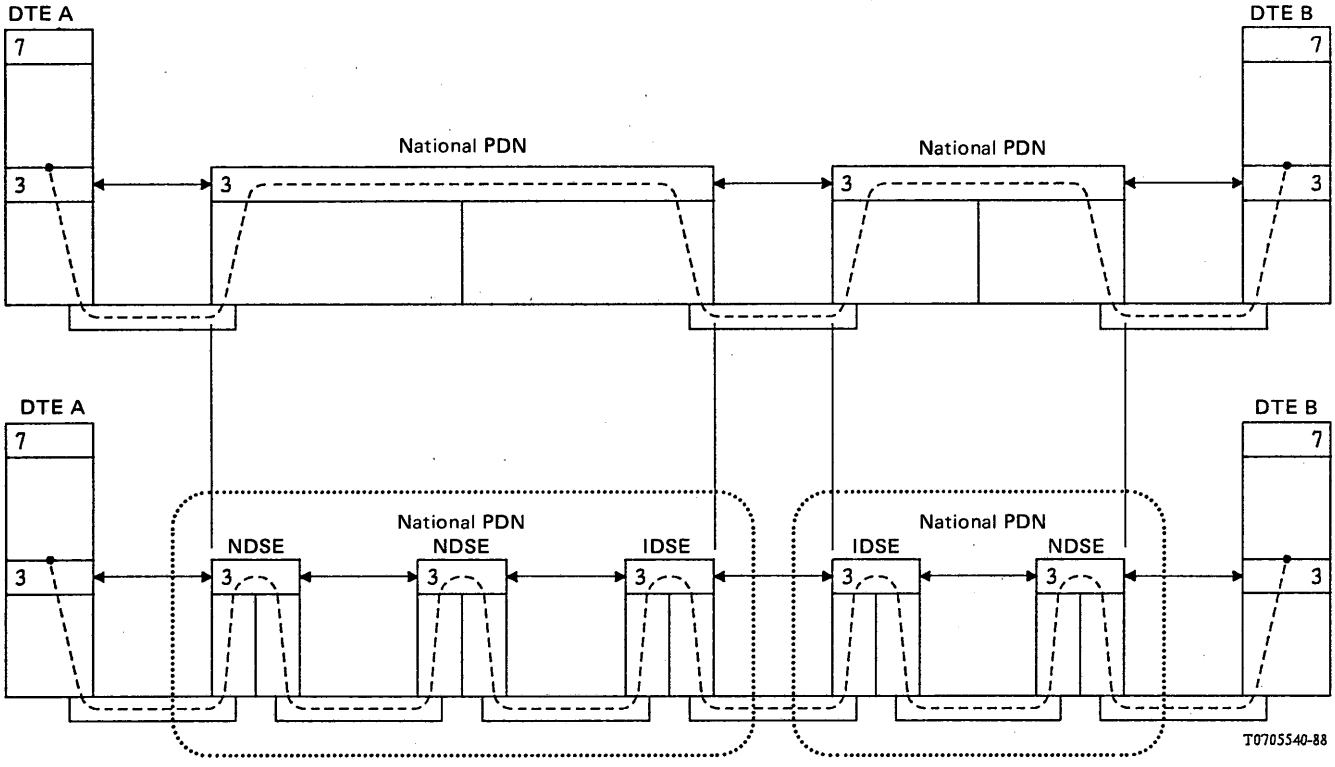


FIGURE 6-3/X.300

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.

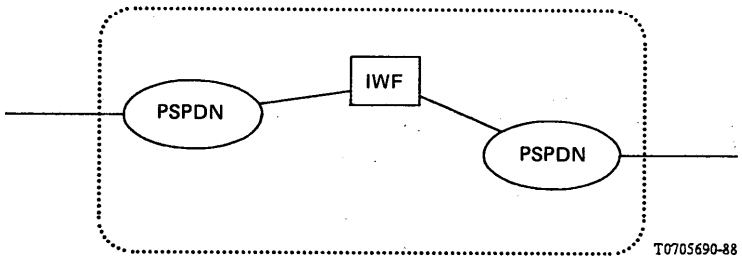


FIGURE 6-4/X.300

Example of a graphical representation of interconnected networks

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

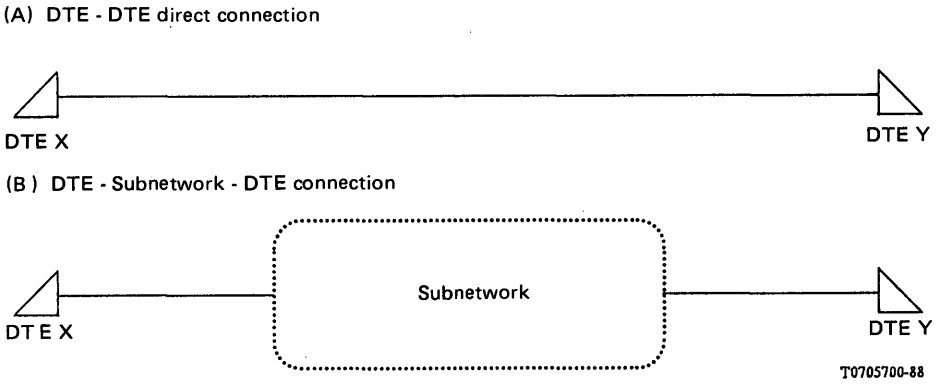
a) two end DTEs; then a single subnetwork is involved in the connection,

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.

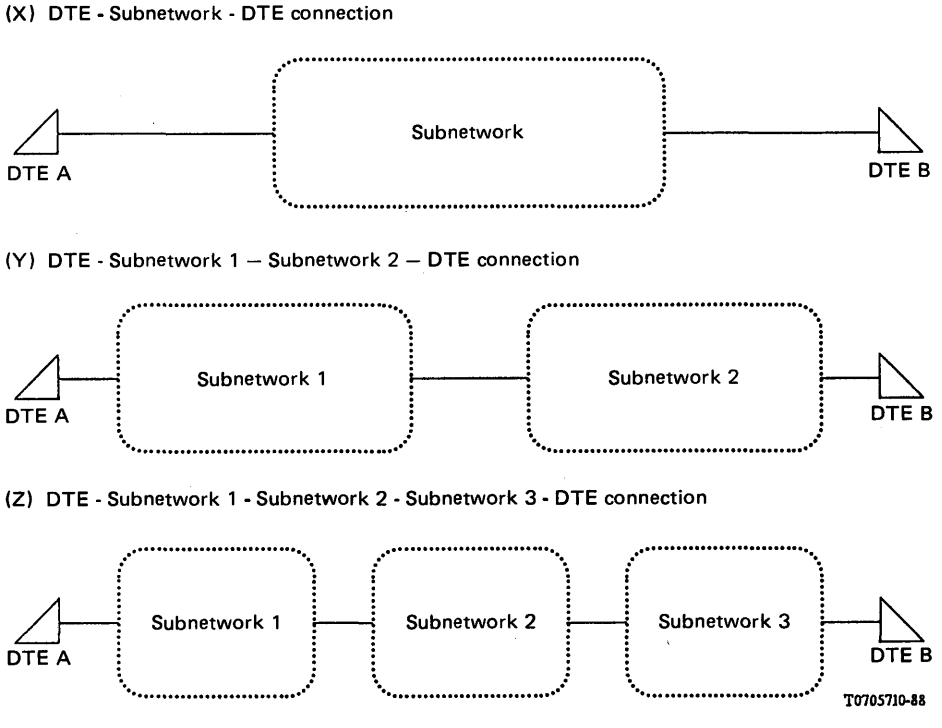
6.1.1.5 From the viewpoint of end users, there are two basic situations:



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:

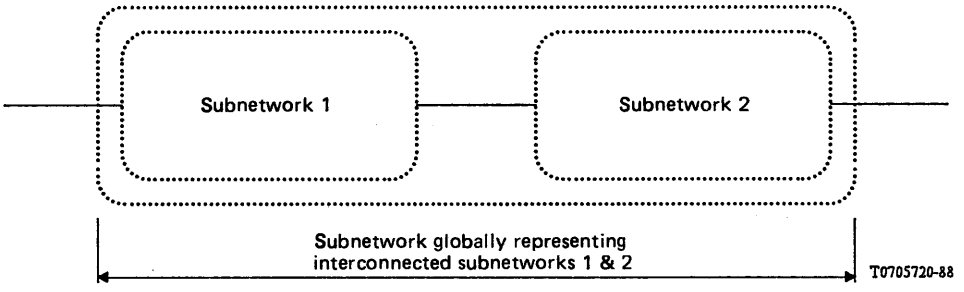


FIGURE 6-5/X.300

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:

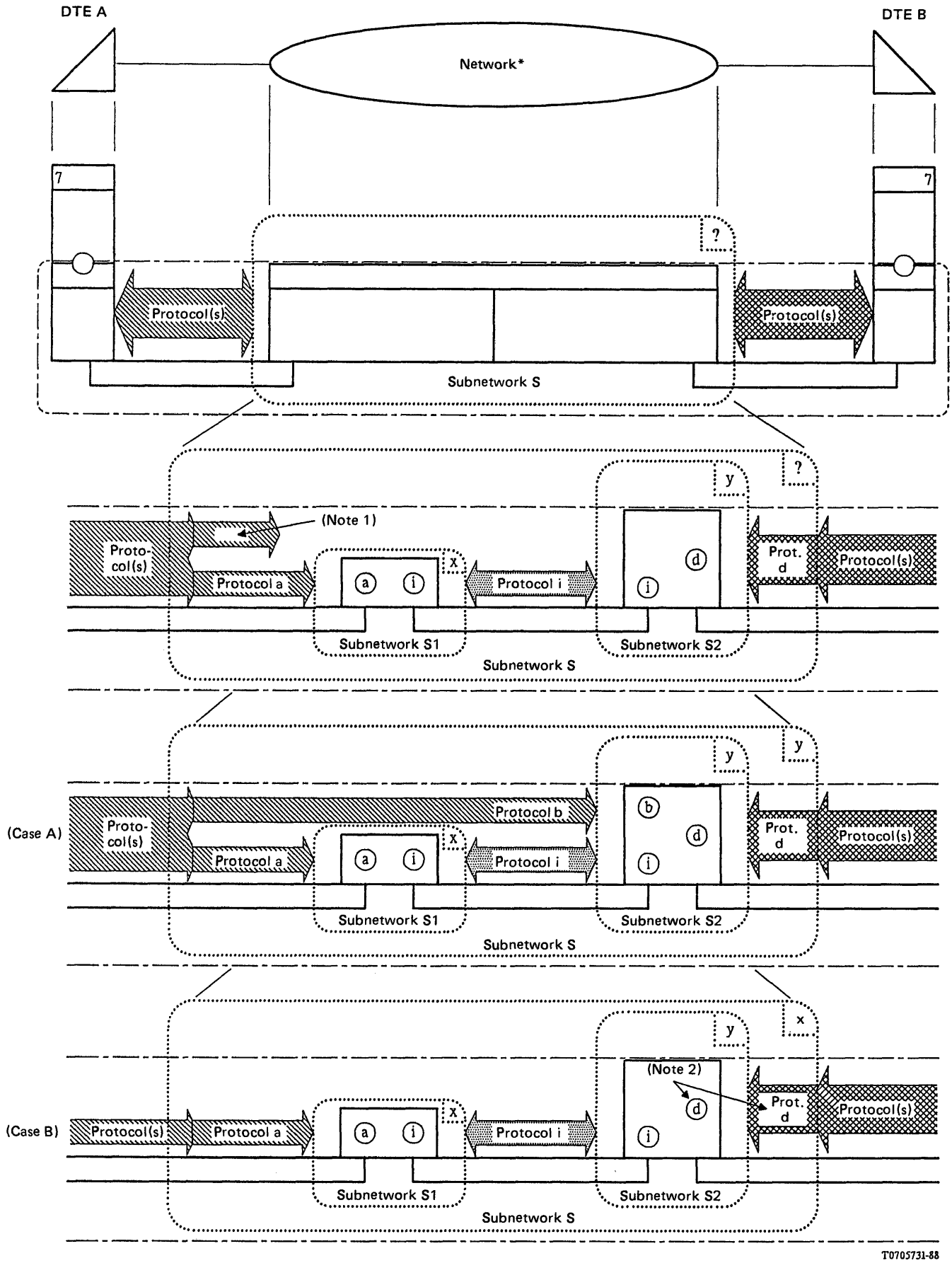
a) Network interworking is based upon the functionality of subnetwork S2. This implies the need for convergence protocol transparently for subnetwork S1. This possibility is outlined in more detail in § 6.1.2.1.

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.

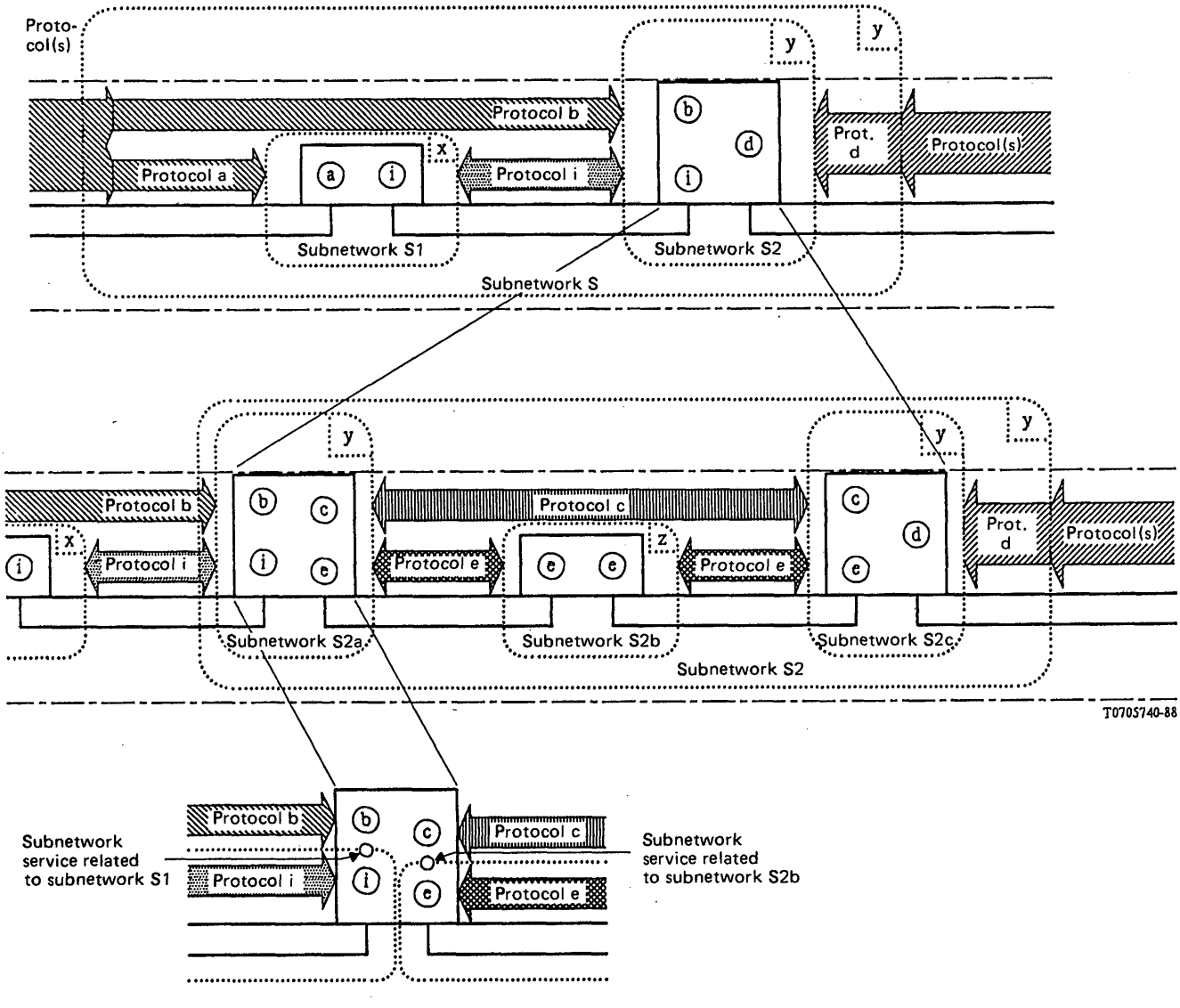


FIGURE 6-7/X.300

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.

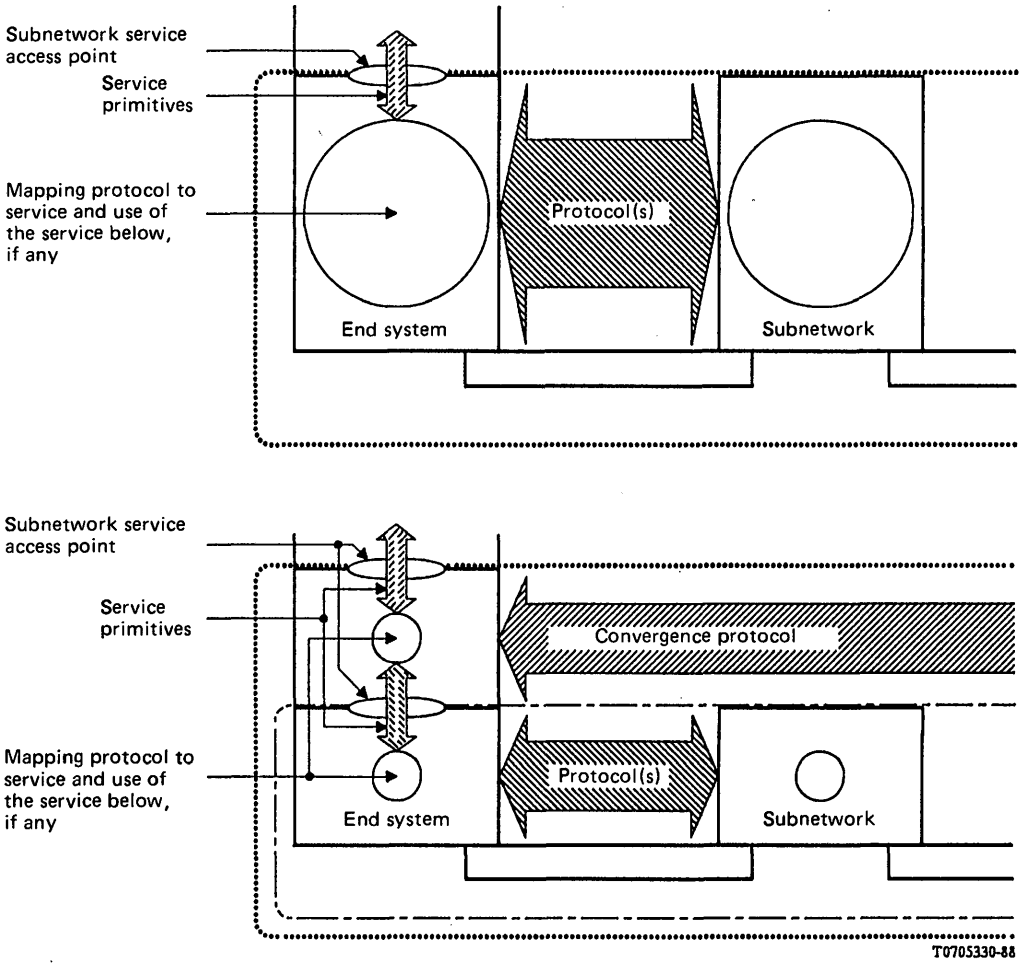


FIGURE 6-8/X.300

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.

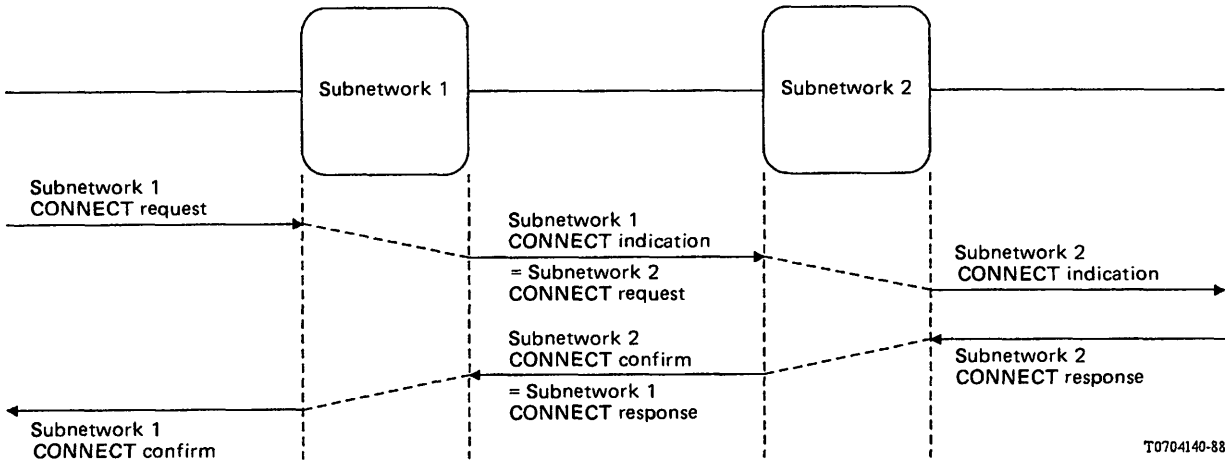


FIGURE 6-9/X.300

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.

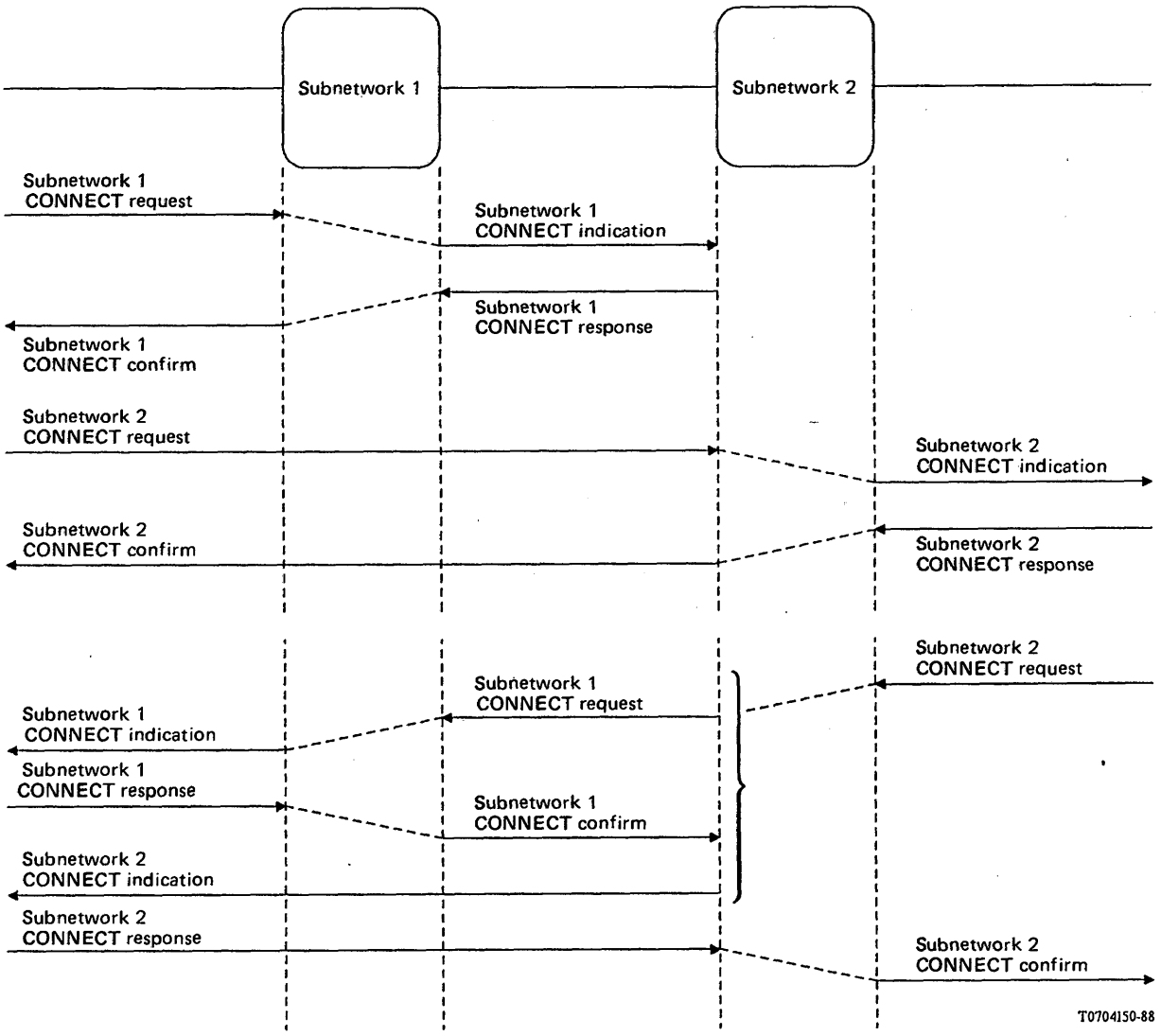


FIGURE 6-10/X.300

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*

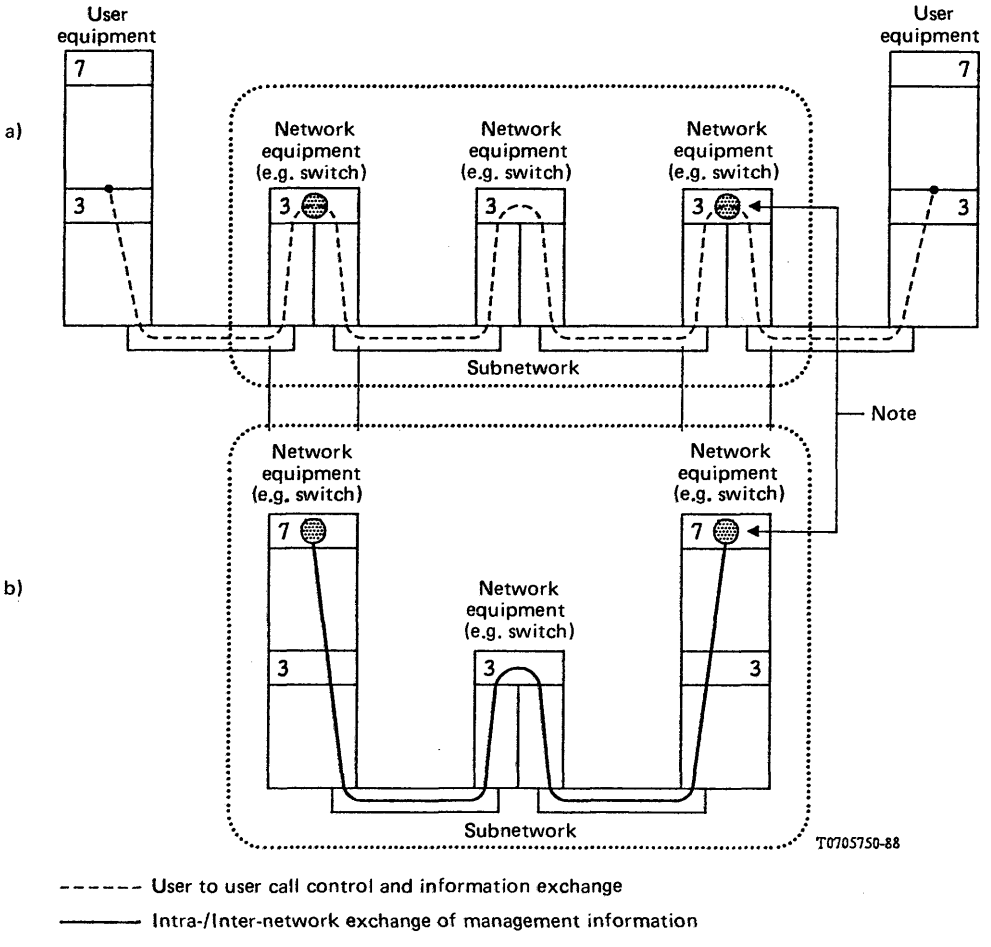
Management information for the control of user calls, internal network management, or inter-network exchange of such information, may be provided by the same and/or separate entities exchanging a user requested call control, and user to user information. Figures 6-11/X.300 and 6-12/X.300 illustrate such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

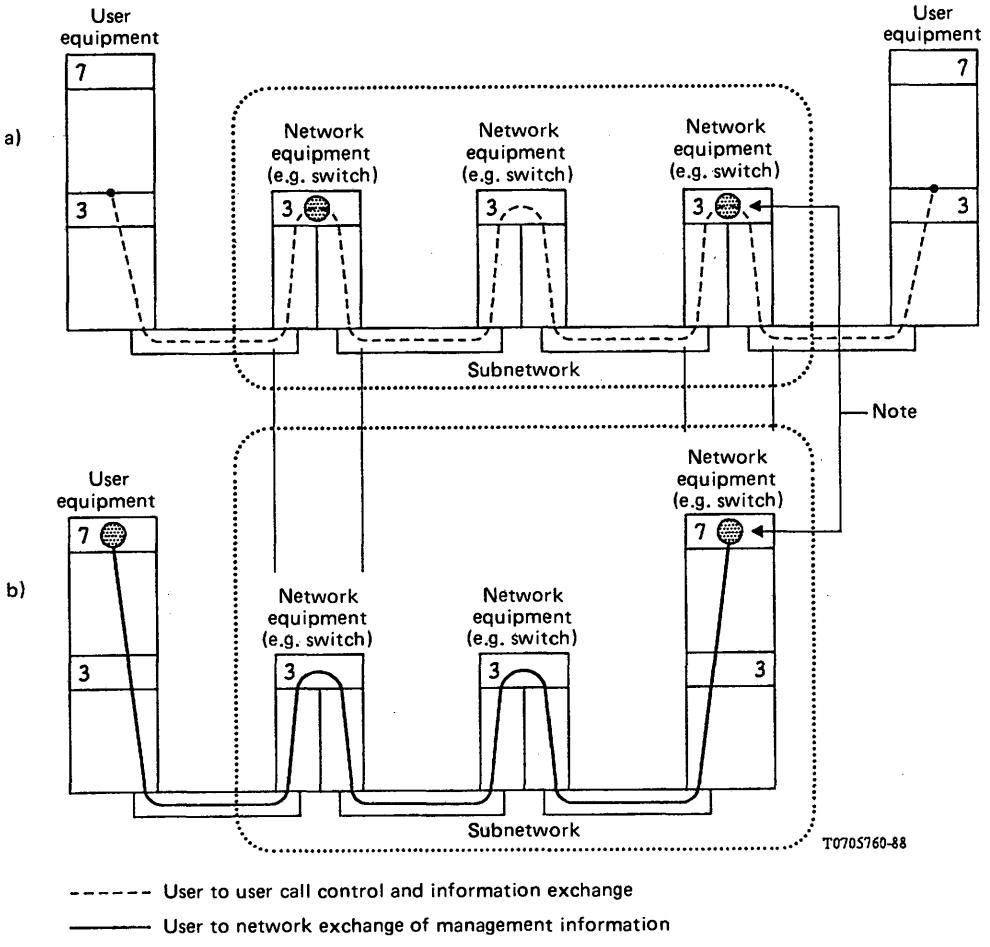
Detailed arrangements for exchange of management information is subject of separate Recommendations (e.g., Recommendation X.370 and Q.700-series Recommendations).



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.

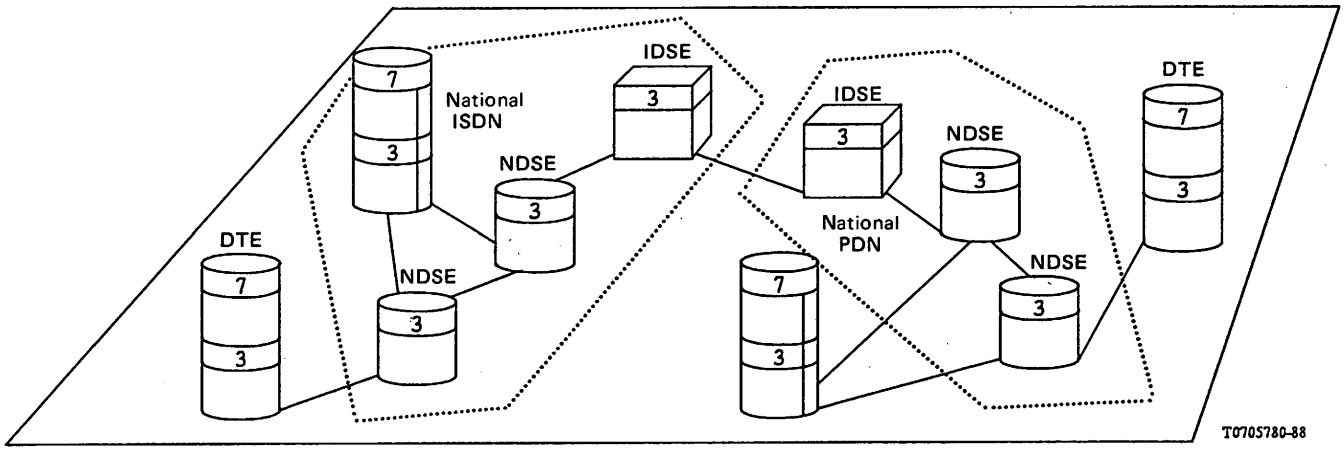


FIGURE 7-1/X.300

Example of interworking involving communication capability

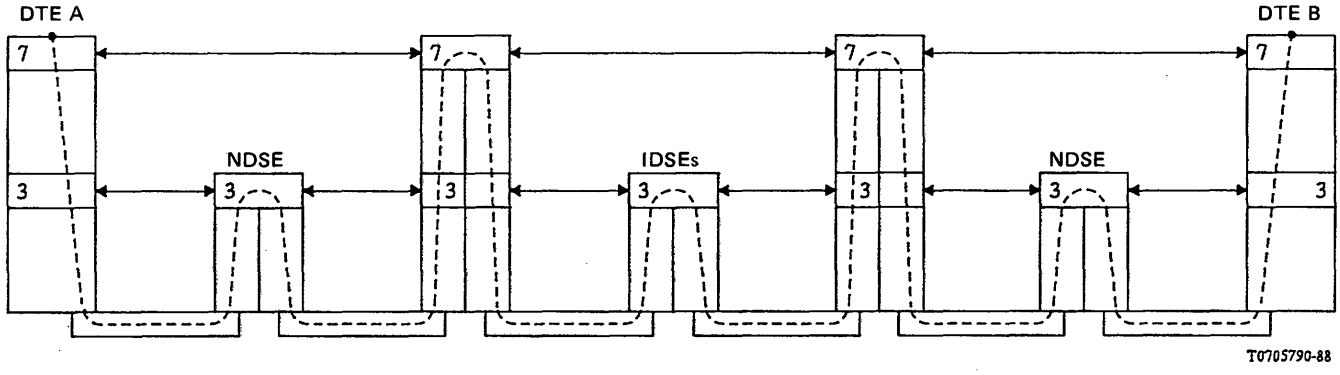


FIGURE 7-2/X.300

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).

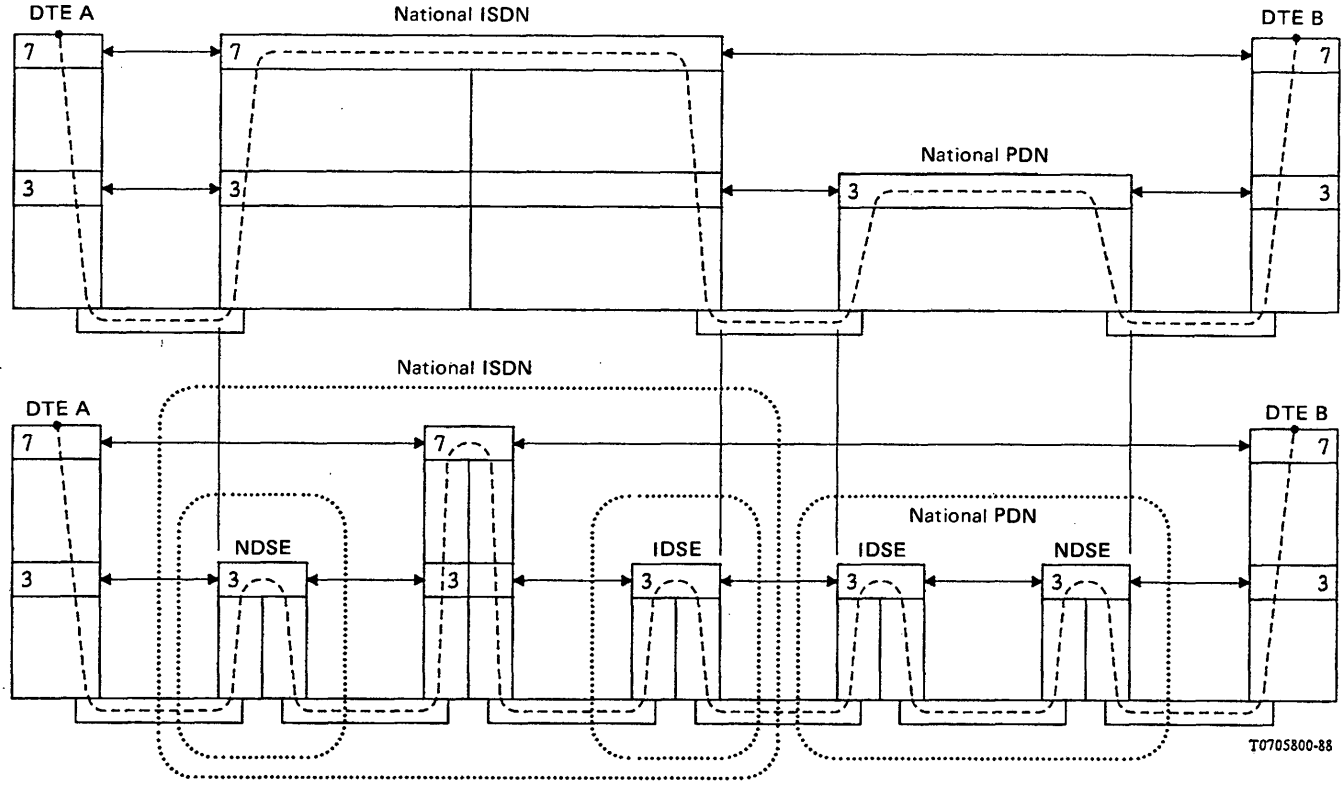


FIGURE 7-3/X.300

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.

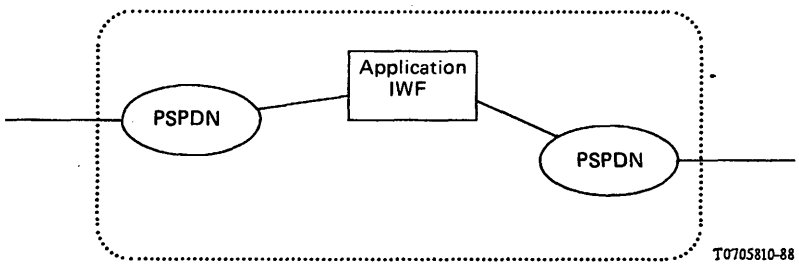


FIGURE 7-4/X.300

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,

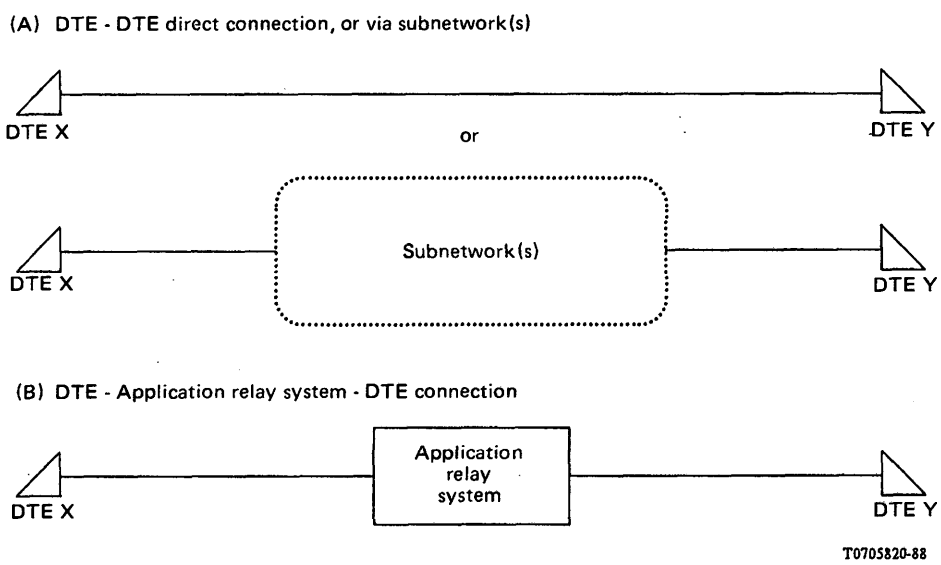
b) one end DTE and another application relay system; then at least two application relay systems are involved in the connection,

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.

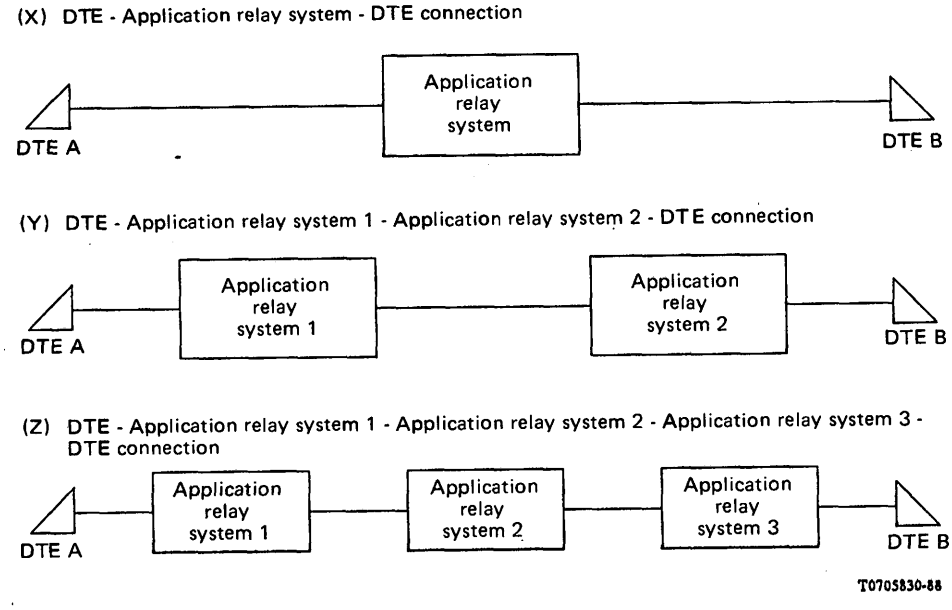
7.1.1.5 From the viewpoint of end users, there are two basic situations:



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:

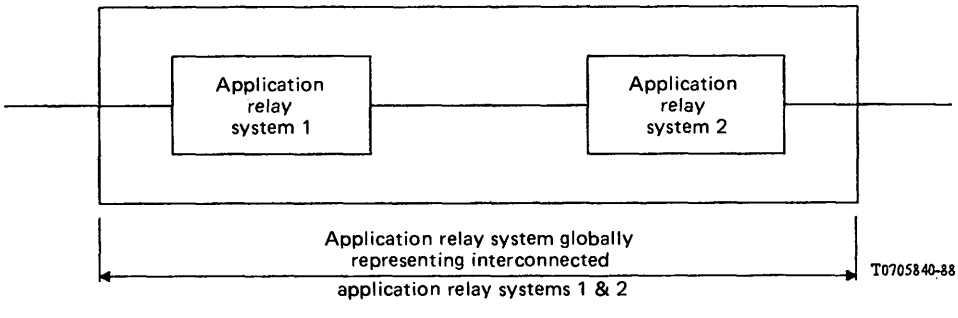


FIGURE 7-5/X.300

Global representation of application relay systems

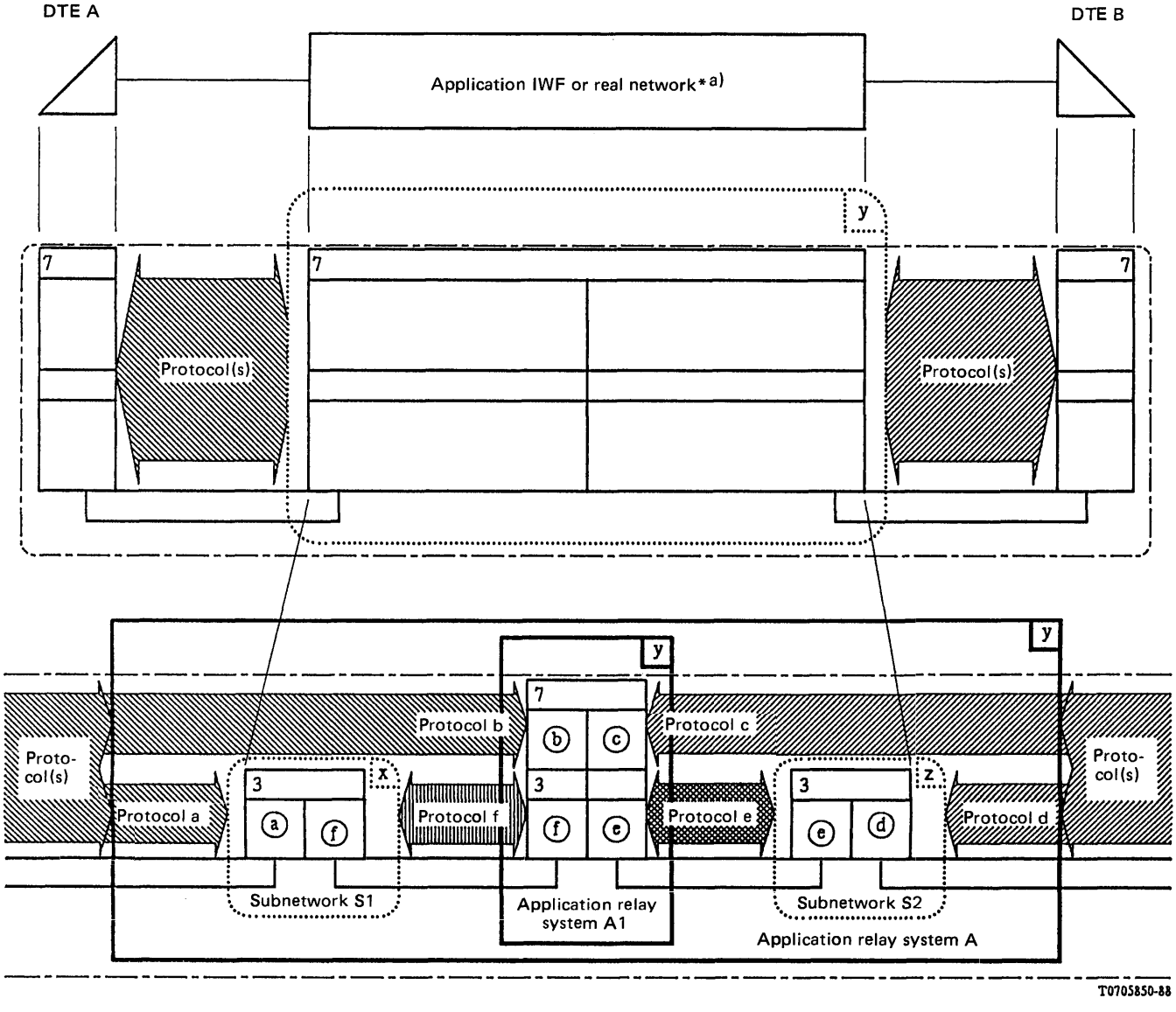
7.1.2 *Decomposition of application relay systems with respect to protocols and services*

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.

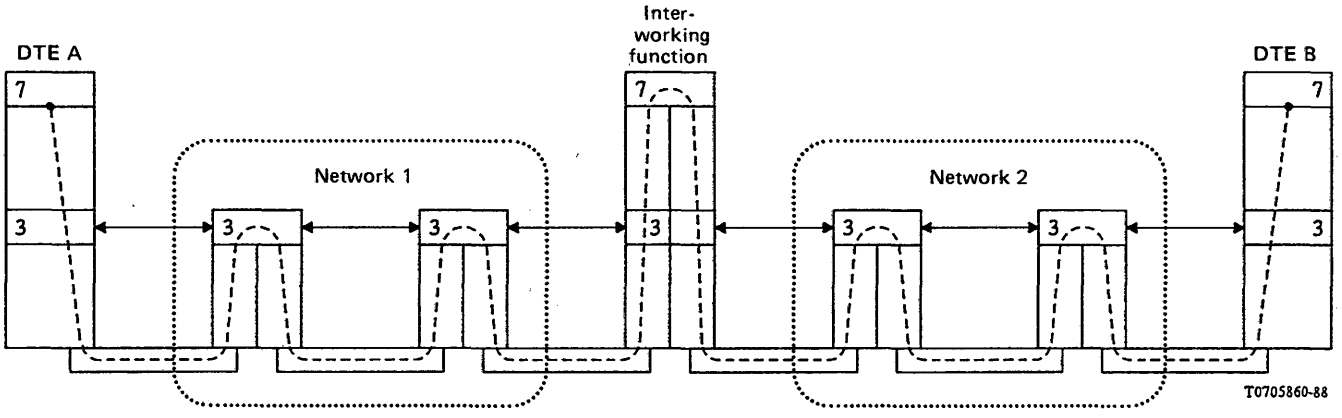


FIGURE 7-7/X.300

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.

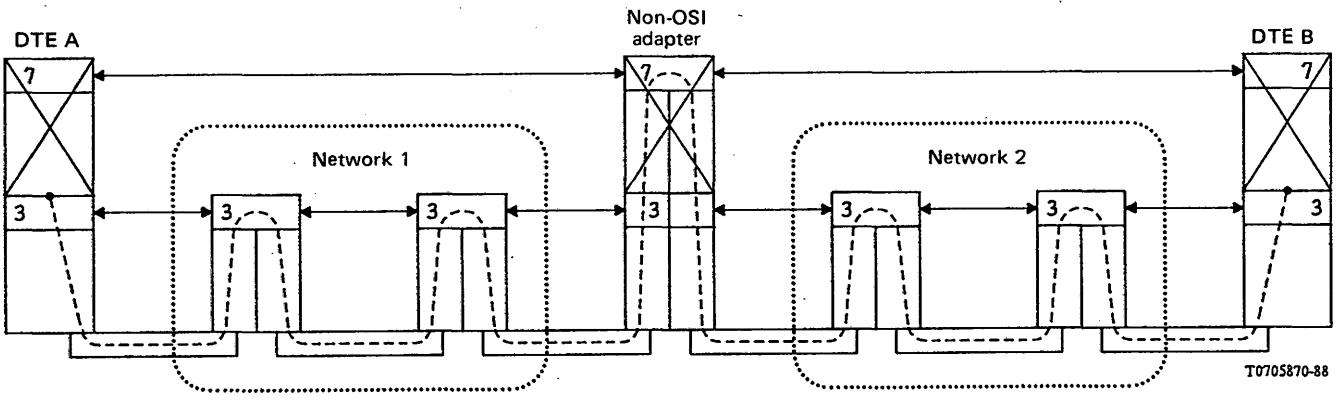


FIGURE 7-8/X.300

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.

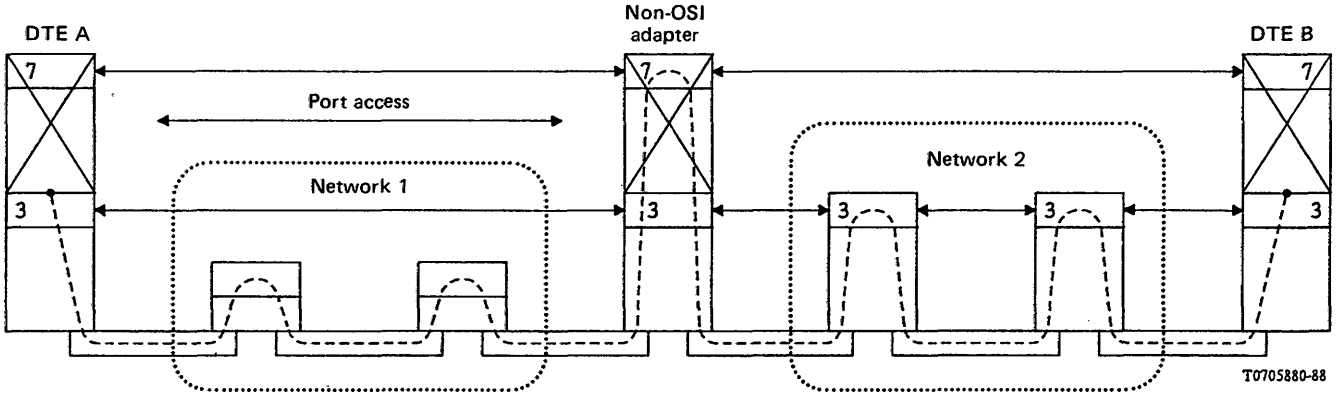


FIGURE 7-9/X.300

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		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					
	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
		PSPDN	CSPDN	PS Bearer requested / ISDN	CS Bearer requested / ISDN	CCSN	PSTN	Mobile data systems	Private networks

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.

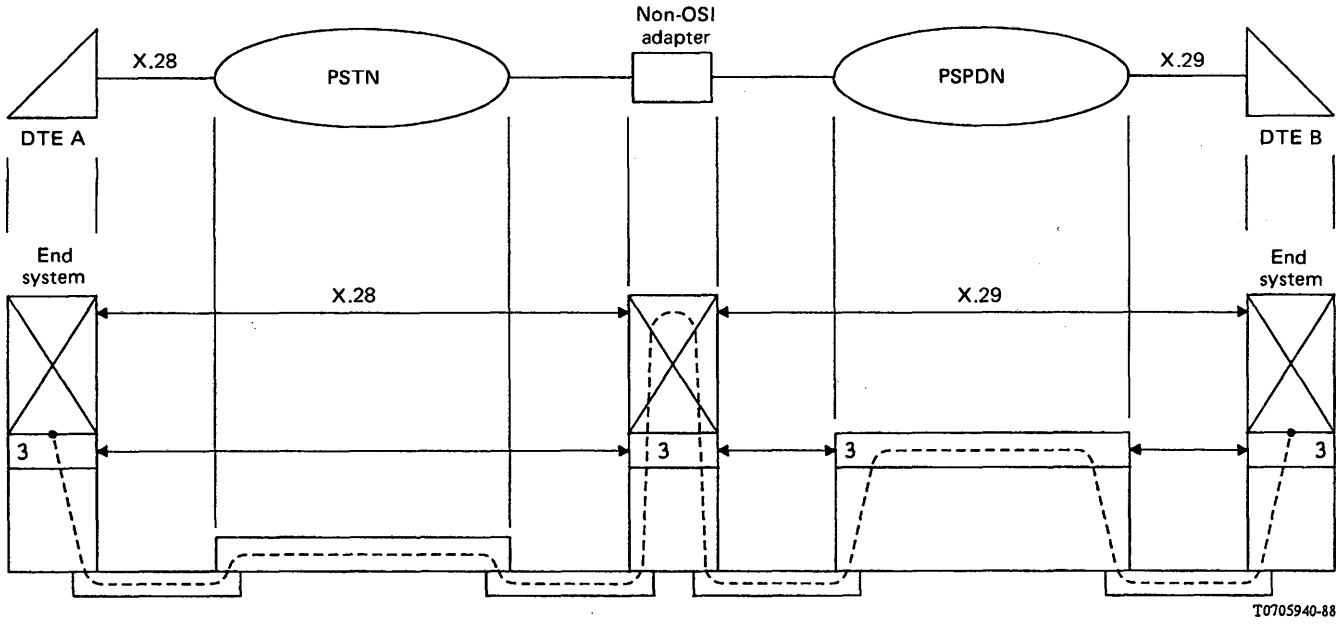


FIGURE 8-1/X.300

Direct interworking via a non-OSI adapter

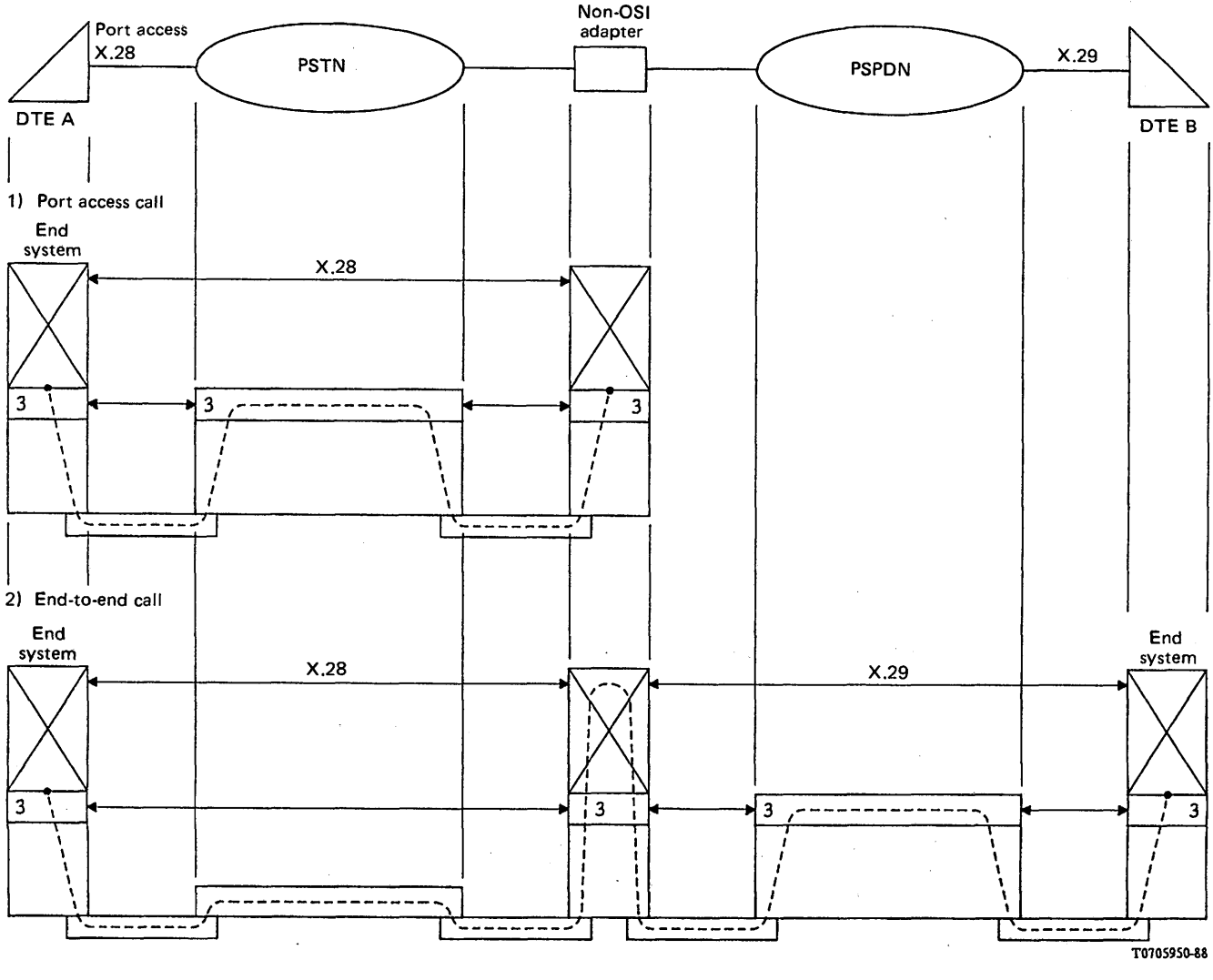


FIGURE 8-2/X.300

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.

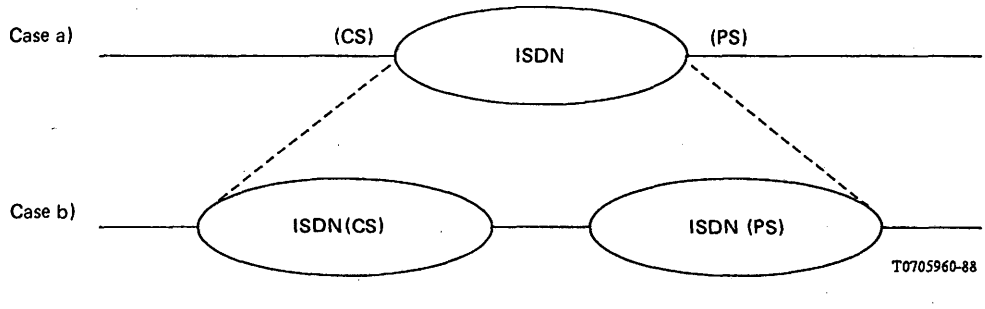


FIGURE 8-3/X.300

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.

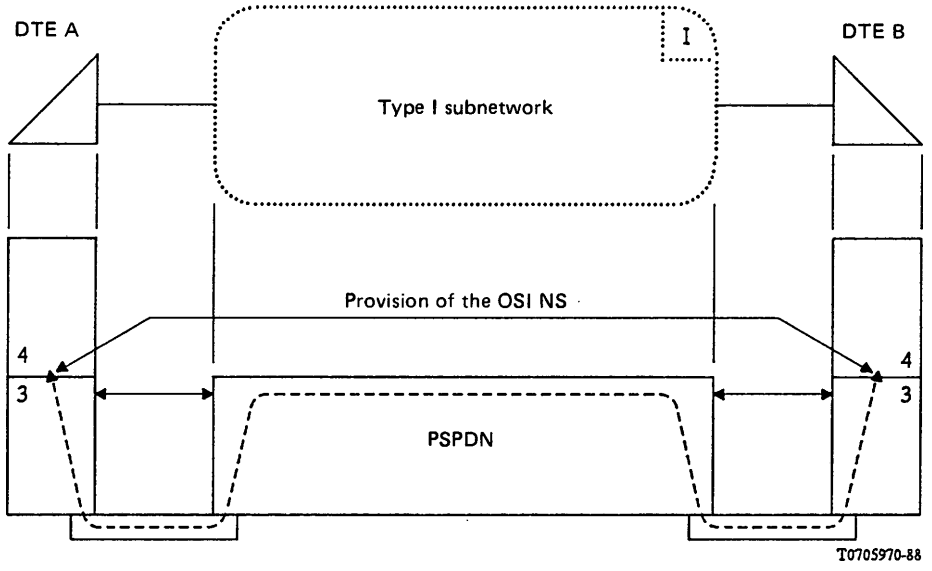
A.2 *Type II subnetwork*

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.

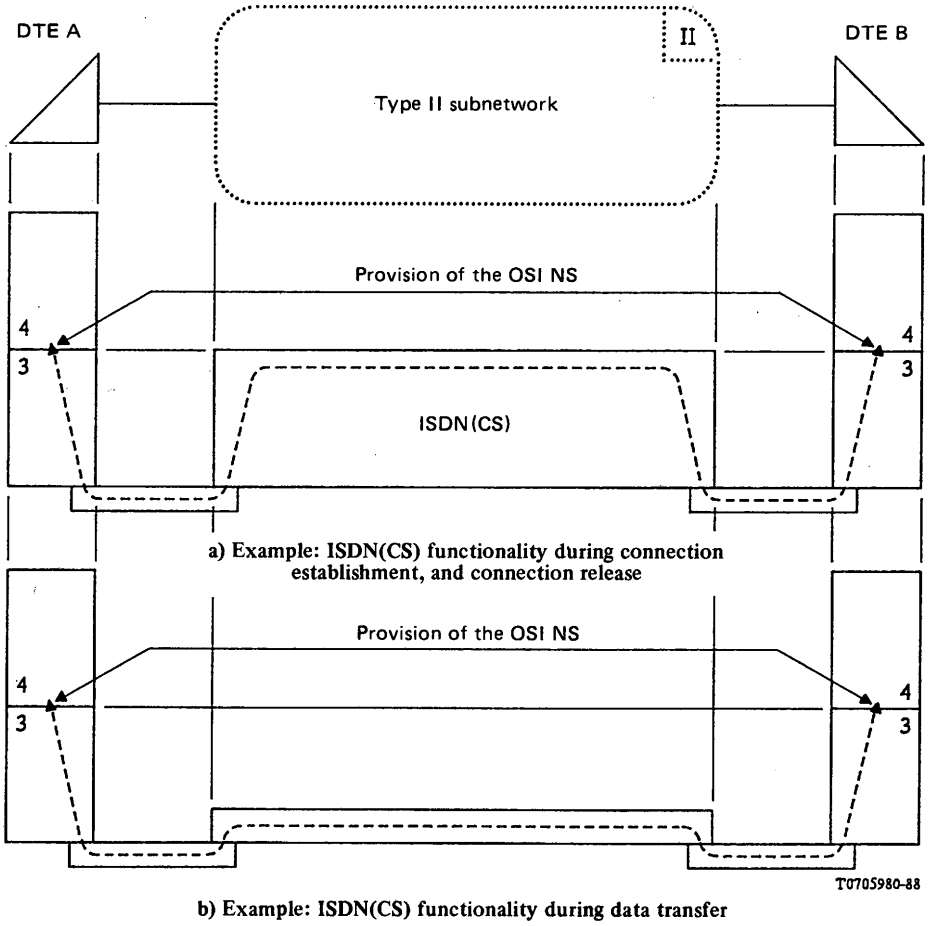
Note 1 – Details of this correspondence are under study.

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

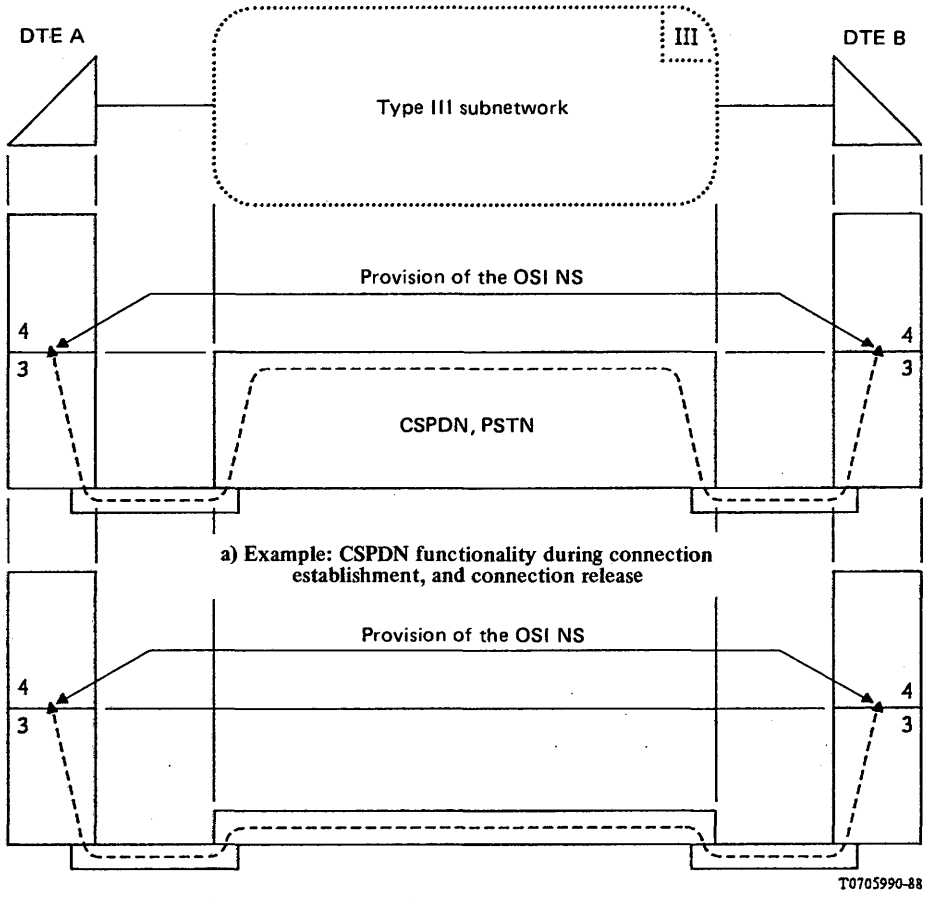
b) Example: ISDN(CS) functionality during data transfer

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.



a) Example: CSPDN functionality during connection establishment, and connection release

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.

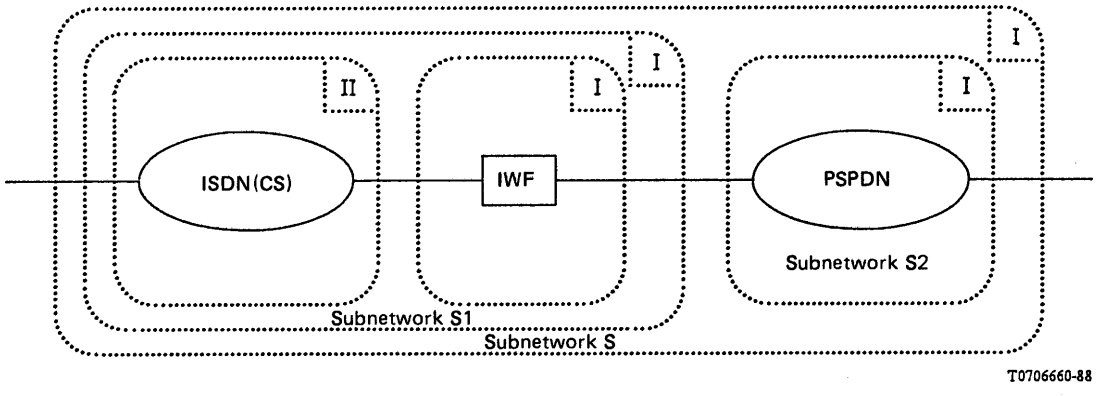


FIGURE B1-1/X.300

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.

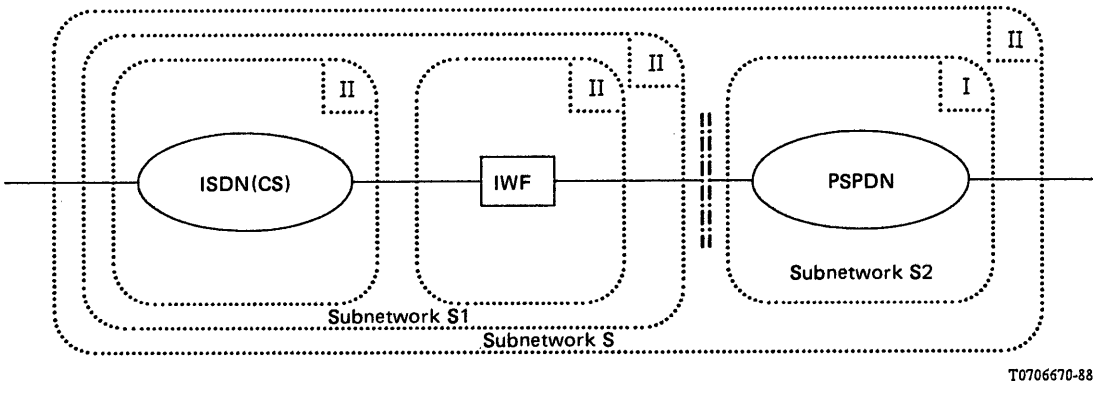


FIGURE B1-2/X.300

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.

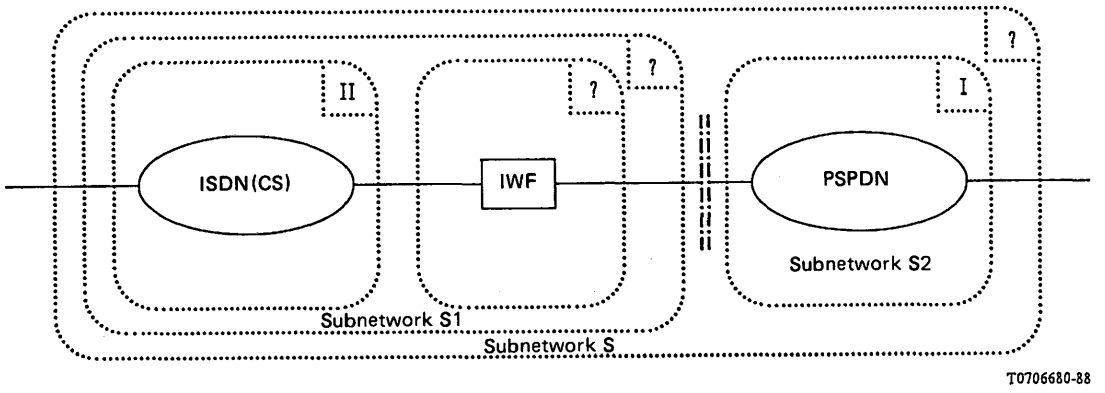


FIGURE B1-3/X.300

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.

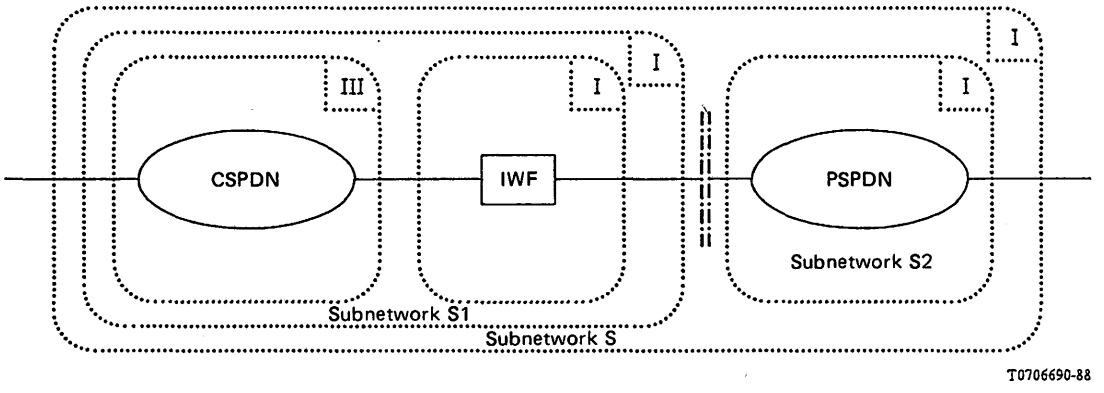


FIGURE B2-1/X.300

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.

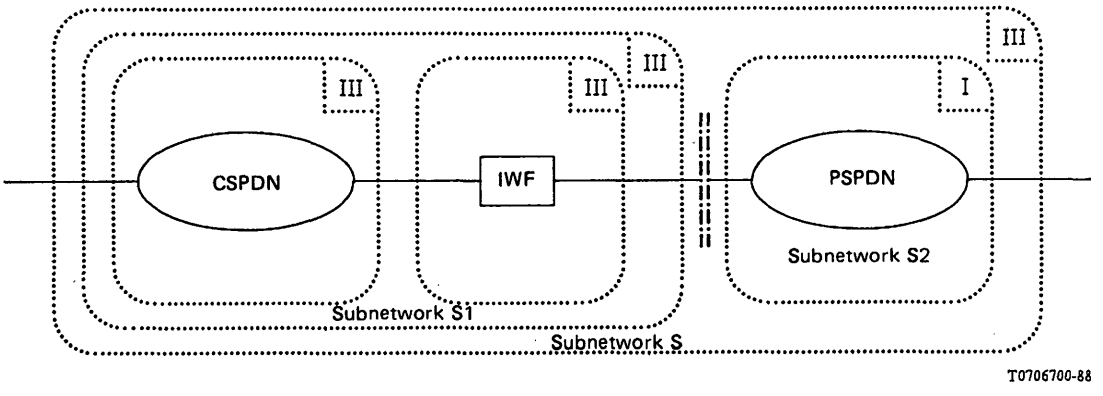


FIGURE B2-2/X.300

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.

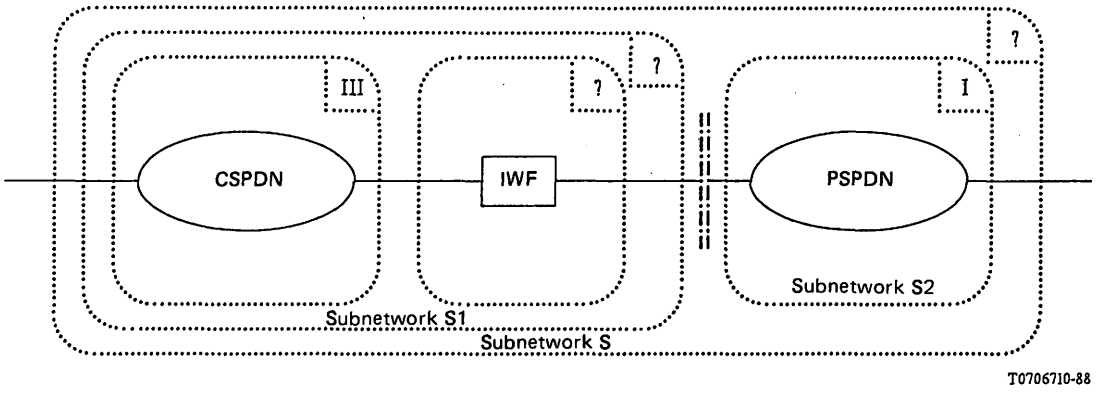


FIGURE B2-3/X.300

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.

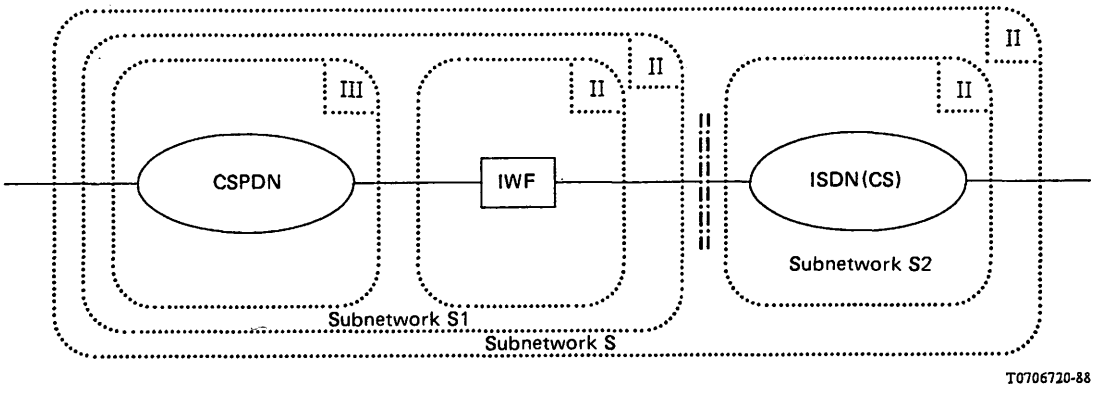


FIGURE B3-1/X.300

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.

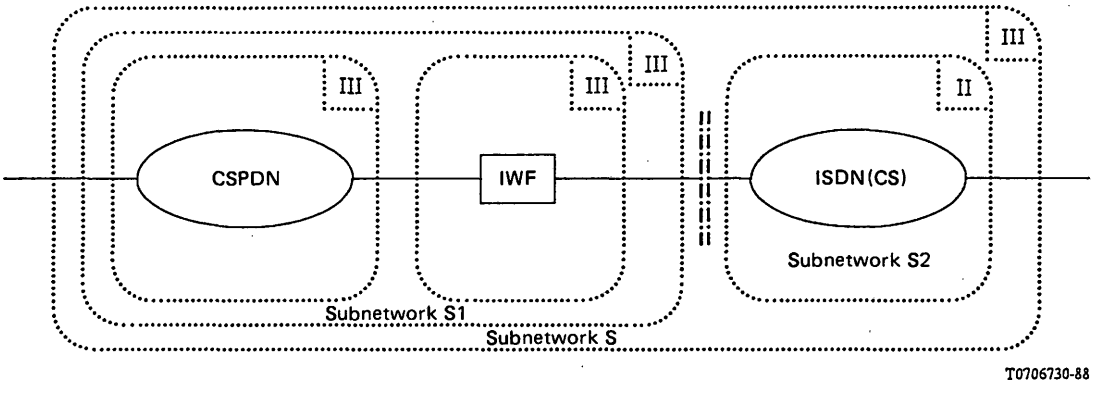


FIGURE B3-2/X.300

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.

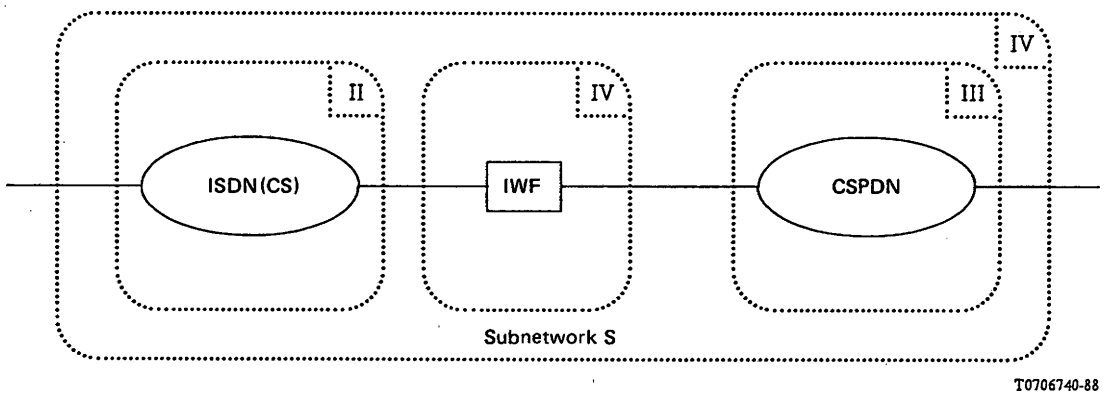


FIGURE B3-3/X.300

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.

Recommendation X.301

DESCRIPTION OF THE GENERAL ARRANGEMENTS FOR CALL CONTROL WITHIN A SUBNETWORK AND BETWEEN SUBNETWORKS FOR THE PROVISION OF DATA TRANSMISSION SERVICES

(Formerly Part of Recommendation X.300, Malaga-Torremolinos, 1984; amended at Melbourne, 1988)

The CCITT,

considering

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

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

(c) that Recommendation X.10 defines the different categories fo access of data terminal equipment (DTE) to the different data transmission services provided by public data networks (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.32, X.351 and X.352 already specify the detailed procedures applicable to different types of DTE/DCE interfaces on PDNs and that Recommendations X.30, X.31, I.420 and I.421 specify detailed procedures applicable for access to ISDN;

(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 and that Recommendation X.75 can also be applied for interworking between different PDNs and for interworking involving ISDN;

(g) that PDNs and ISDNs may be used to support CCITT recommended services (in particular, Telematic services);

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

(i) that Recommendation X.213 defines the connection-mode network service (NS) of open systems interconnection for CCITT Applications;

(j) that Recommendations X.130, X.131, X.134, X.135, X.136, X.137 and X.140 define the quality of service parameters and values required for public data transmission services;

(k) that Recommendation X.300 defines the general principles for interworking between public networks and between public networks and other networks for the provision of data transmission services;

(l) that Recommendation X.302 describes the general arrangements for internal network utilities within subnetwork and intermediate utilities between subnetworks for the provision of data transmission services;

(m) that interworking with common channel 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 arrangements for interworking between public networks and between public networks and other public networks for the provision of data transmission services;

(p) the need, in particular:

- for certain user facitilities and network utilities for communication through the national networks between the internationally designed 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 principle for realization of international user facilities and network utilities in public networks;

unanimously recommend

that arrangements for call control 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 service, 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

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

This Recommendation describes general arrangements for call control within and between subnetworks for the provision of data transmission services. Only those arrangements are described that may (also) have significance for end users of a call. Facilities that are not visible to end users of a call are the subject of other Recommendations (e.g. those arrangements described in Recommendation X.302).

1 Scope and field of application

The purpose of this Recommendation is to describe detailed internetwork arrangements for call control applicable to interworking at the OSI network layer, including some of the arrangements necessary to provide support for the capability of the OSI connection-mode NS.

These arrangements are not applicable to interworking involving communication capability as described in section 7.2 of Recommendation X.300.

It is for further study whether or not any of these arrangements are also applicable to other types of interworking, for example interworking by port access as described in Recommendation X.300.

Arrangements that are solely used for internal or internetwork operation, and which are not visible for end-users, are not described in this Recommendation. For such arrangements see Recommendation X.302.

2 References

E.164/I.331 The numbering plan for the ISDN era,

I.230-Series Bearer services supported by an ISDN,

I.250-Series Supplementary services supported by an ISDN,

I.420 Basic user-network interface,

I.421 Primary rate user-network interface,

Q.699 Interworking between ISDN user-network of interface protocol and signalling system No. 7 ISDN user part.

Q.931/I.451 ISDN user-network interface layer 3 specification,

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 and ISDNs,

X.10 Categories of access for data terminal equipment (DTE) to public data transmission services,

X.20 Interface between data terminal equipment (DTE) and Data Circuit-terminating Equipment (DCE) for star-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 data terminal equipment (DTE) and Data Circuit-Terminating Equipment (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 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,

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 packet-mode DTE or another PAD,

X.30/I.461 Support of X.21, X.21 *bis* and X.20 *bis* based data terminal equipment (DTEs) by an integrated services digital network (ISDN),

X.31/I.462 Support of packet-mode terminal equipment by an ISDN,

X.32 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.

X.61 Signalling System No. 7 – Data user part,

X.70 Terminal and transit control signalling system for start-stop services on internatinal circuits between anisochronous data networks,

X.71 Decentralized terminal and transit control signalling system on international circuits between synchronous data networks,

X.75 Packet-switched signalling system between public networks providing data transmission services,

X.80 Interworking of inter-exchange signalling systems for circuit-switched data services,

X.96 Call progress signals in PDNs,

X.110 Routing principles for international public data services through switched PDNs of the same type,

X.121 International numbering plan for public data networks,

X.130 Provisional objectives for call set-up and clear-down times in public synchronous data networks (circuit switching),

X.131 Provisional objectives for grade of service in international data communications over circuit-switched PDNs,

X.134 Portion boundaries and packet layer reference events: basis for defining packet-switched performance paramenters,

X.135 Speed of service (delay and throughput) performance values for public data networks when providing international packet-switched service,

X.136 Accuracy and dependability performance values for public data networks when providing international packet-switched service,

X.137 Availability performance values for public data networks when providing international packet-switched service,

X.140 General quality of service parameters for communication via PDNs,

X.180 Administrative arrangements for international closed user groups (CUGs),

X.200 Reference model for open systems interconnection for CCITT Applications,

X.213 Network Service Definition for Open Systems Interconnection for CCITT Applications,

X.300 General principles and arrangements for interworking between public networks, and between public networks and other networks 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.351 Special requirements to be met for packet assembly/disassembly (PAD) facilities located at or in association with coastal earth stations in the maritime satellite service,

X.352 Interworking between packet-switched public data networks and the maritime satellite data transmission system.

3 Définitions

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

a) Transmission capability
b) Communication capability
c) Data transmission service

This Recommendation makes use of the following terms defined in Recommendation X.135:

a) Transit delay

This Recommendation makes use of the following terms defined in Recommendation X.140:

a) User information transfer rate

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

a) Optional user facility

4 Abbreviations

BCUGB	Bilateral closed user group
BCUGOA	Bilateral closed user group with outgoing access
CC	Country code
CSPDN	Circuit-switched public data network
CTD	Cumulative transit delay
CUG	Closed user group
DCC	Data country code
DCE	Data circuit-terminating equipment
DNIC	Data network identification code
DSE	Data switching exchange
DTE	Data terminating equipment
EETDN	End-to-end transit delay negotiation
FS	Further study
IA	Incoming access
IC	Interlock code
ICB	Incoming calls barred
ICCM	Interworking by call control mapping
IDSE	International data switching exchange
IPA	Interworking by port access
ISDN	Integrated services digital network
IWF	Interworking function
MATD	Maximum acceptable transit delay
MSS	Maritime satellite service
NA	Not applicable
NAE	Network address extension
NAPI/TOA	Numbering and addressing plan indicator/Type of address (equivalent to NPI/TOA used in X.25)
NC	Network connection
NDC	National destination code
NPI/TOA	Numbering plan indicator/TOA (equivalent to NAPI/TOA used in Rec. Q.931)
NS	Network service (pertaining to OSI)
NTN	Network terminal number
NUI	Network user identification
OA	Outgoing access
OCB	Outgoing calls barred
OSI	Open systems interconnection
PSDN	Packet-switched data network
PSPDN	Packet-switched public data network
PSTN	Public-switched telephone network
QOS	Quality of service
QRP	QOS reference point
RPOA	Recognized private operating agency

SN	Subscriber number
TDI	Transit delay indication
TDS	Transit delay selection
TDSAI	Transit delay selection and indication
TOA	Type of address
TTD	Target transit delay

5 General aspects of call control

The internetwork arrangements described in this section relate to the general aspects of call control.

5.1 *Model applicable to internetwork arrangements*

The internetwork arrangements for call control are established according to the model illustrated in Figures 5-1 and 5-2/X.301.

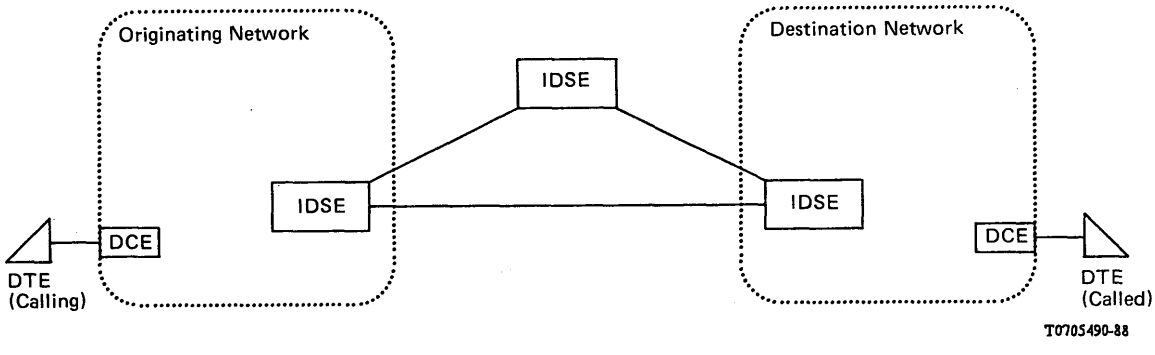


FIGURE 5-1/X.301

Model for call establishment

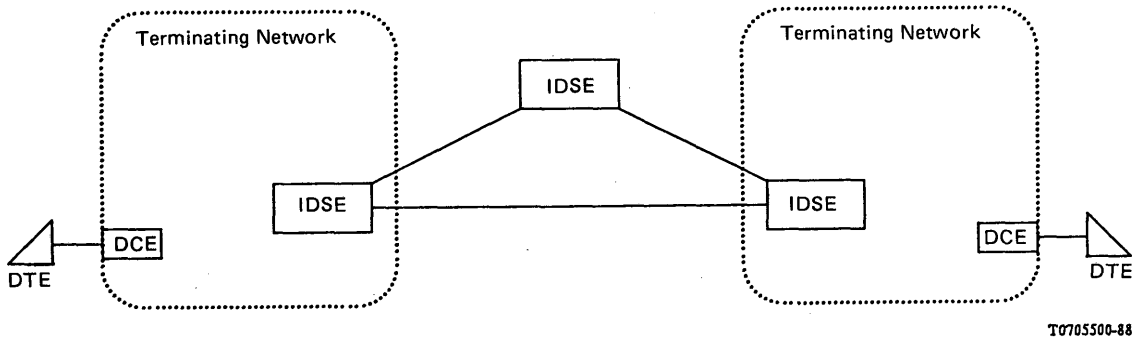


FIGURE 5-2/X.301

Model for data transfer and call clearing phases

5.2 *Classification of internetwork signals*

Recommendations dealing with internetwork signalling systems describe various signals that can be classified as follows:

5.2.1 *Internetwork data link control signals*

Data link control signals (e.g., availability of physical circuit(s)) are related to the particularly considered data link and therefore are normally confined within the two ends of the link itself. Thus, these signals do not normally pass across the interworking function.

An exception to this may be when, for example, a large number of data links in a network are unavailable or faulty, so as to prejudge routing of the calls from an interconnected network. In this case, appropriate operational signals may be generated towards the interconnected network to the extent allowed by the signalling arrangements provided in the interconnected network.

Note 1 – A given data link may convey signalling data and/or user data.

Note 2 – Between two packet switching networks, Recommendation X.75 indicates that a given data link may employ several physical circuits.

5.2.2 *Internetwork call control signals*

This type of signal includes all signals that convey between two networks the appropriate data and control information for a given call. These signals are essentially related to:

- call estabishment,
- data transfer,
- call release.

Note 1 – Some signals are essential for call establishment, for example: DTE addresses, indications for user facilities whenever required, and call progress signals. These signals are subject to general descriptions in the relevant Recommendations (for example, DTE addresses in Recommendation X.121, call progress signals in Recommendation X.96). Also, the way to convey these signals between two networks is described in the Recommendations dealing with the internetwork signalling systems.

Note 2 – Some internetwork signalling systems specify that all call control signals employ a unique data link; this is the case in the signalling system defined in Recommendation X.75. Some other inter-network signalling systems specify that the call control signals employ more than one data link; this is the case in the common channel signalling system, where both a signalling channel and a data channel are used for the same call.

5.2.3 *Internetwork operation signals*

This type of signal would consist of all signals that are not directly related to the control of a specific data link or a specifc call between two networks; these operation signals would provide the necessary general information for a satisfactory operation of the internetwork connections such as:

- system availability,
- circuit efficiency,
- congestion or failure conditions, etc.

Note 1 – The transmission of some internetwork operation signals may cause a network to modify general rules applying to the network operation, such as: change in routing scheme, control of data flow when applicable, clearing of some calls, etc.

Note 2 – The transmission of such internetwork operation signals does not prevent networks from processing some of these signals used for internetwork operation. In particular, a network may wish to note the exact circumstances of a call clearing related to a remote network failure, in order to take necessary actions as soon as possible (change in routing scheme, etc.).

5.3 *General principles concerning internetwork signals*

This section describes some general principles that could be used as a basic for the interworking between different types of networks.

5.3.1 *Basic status of a data link*

On every data link established in a network, the data link control signals should provide both ends with the capability of controlling at any time the status of the link. In particular, each end should be able to know whether or not the data link is fully operational; in the case the data link is not fully operational whether or not it is still available for additional data transmission signals related to existing call(s), signals related to new call(s); also whether or not existing call(s) should be cleared (or reset), due to that data link problem.

Note 1 – Following that principle, provision should be made within the appropriate internetwork signalling Recommendations, so that each network could be aware of the status of the links in an interconnected network whenever required.

5.3.2 *Call request and call confirmation phases*

The establishment of a call between two subscribers should consist of two consecutive phases:

- first a CALL REQUEST phase, when:
  - a call is requested by a subscriber, with specific parameters,
  - this call request is processed and routed through the network(s), unless it cannot be accepted by the network(s),
  - the call request is indicated to the called subscriber;
- then a CALL CONFIRMATION phase, when:
  - a call acceptance is reported by the called subscriber, unless this subscriber does not acept the call,
  - final arrangements are made through the network(s) for that call,
  - the call establishment is confirmed to the calling subscriber.

Note 1 – During each one of those two phases, the various actions are not necessarily carried on separately. For example, network equipment may process some call request signals received from a subscriber, before further parameters for the call request are transmitted by that subscriber.

Note 2 – Currently, the establishment of a call through certain combinations of networks necessitates more than the two phases mentioned in this section; for example, when accessing a packet switching network from a circuit switched network, the complete establishment of the switched access is usually required before the virtual call can be requested. Following the principle indicated in this section, provision should be made within the appropriate internetwork signalling Recommendations, for the establishment of direct calls between both end users whenever it is possible. Consequently, provision should also be made within the numbering plan so that a subscriber line could be directly and uniquely identified from any network.

Note 3 – The way to accept and route a call through different networks may depend not only on the called DTE address, but also on parameters or facilities defined for that call. Following the principle indicated in this section, in the case where some parameters or facilities may require negociation during the call establishment:

- the calling DTE can only indicate its specific requirements for the call when it requests the call,
- the called DTE can only modify the call characteristics when it accepts the call.

5.3.3 *Data transfer phase*

Different types of networks may provide different functionalities in this phase, e.g. transfer capabilities of continuous bit streams, transfer of blocks of data, and features like flow control, sequencing, error notification, reset services, receipt confirmation and expedited data transfer.

5.3.3 *Call clearing phase*

Any network or user involved in a call should have the possibility to clear immediately that call.

At the time a call is cleared, any network involved in the call would immediately stop transmitting user data for the call, and report the call clearing to the adjacent networks, unless they are already informed of that clearing. The clearing signal should then be transmitted with all necessary details, i.e., cause and diagnostic codes.

As soon as a call clearing is locally completed any resource used for that call can be re-used by the network for other calls.

Note 1 – Following that principle, the receipt of a clear confirmation does not necessarily mean that the end user was already informed of the clearing, and confirmed it.

Note 2 – The call clearing principle indicated in this section does not prevent both users from exchanging end-to-end information about the clearing of the call, if they wish to do so at the end of data transfer (example: invitation to clear data packet in Recommendation X.29).

Note 3 – In some cases of clearing collisions, for example when both a DTE and a network initiate the Call Clearing Phase simultaneously, parameter information provided by the DTE may be lost.

For the purpose of this Recommendation, a DTE that initiates the Call Clearing Phase is labeled "Clearing DTE". A DTE that does not initiate the Call Clearing Phase, but is informed of this phase by the network, is labeled "Cleared DTE".

6 Transfer of addressing information

The internetwork arrangements described in this section provide the capability to transfer all elements of addressing information for the provision of data transmission services. This comprises addressing information defined in Recommendation E.164, Recommendation X.121 and any additional addressing information defined at the Network Layer of OSI. Table 6-1/X.301 lists the optional user facilities relating to addressing information described in this section.

TABLE 6-1/X.301

Optional user facilities relating to the transfer of addressing informations

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PTSN	CSPDN	ISDN	ISDN	PSPDN	MSS
Calling line identification	X			X	FS			
Calling line identification	X	X (Note)		X				
Network address extension (NAE)/ sub-address		X				X	X	X

Note – This facility cannot be used unless the corresponding facility has been agreed for a period of time.

6.1 *General*

For the provision of data transmission services, different numbering plans are considered. These are the Recommendation X.121 numbering plan and the Recommendation E.164 numbering plan. Currently Recommendation X.121 is used by PDNs and Recommendation E.164 is used by the telephony network ISDN Recommendation E.164 will be used by ISDNs. Because of this, this section will refer to networks that make use of X.121 numbering as an X.121 domain (PDNs) and networks that make use of E.164 as an E.164 domain (ISDNs).

For interworking between X.121 domains and E.164 domains some indication is needed in the protocol of the numbering plan of the address present in the address protocol element(s). This indication can take the form of an escape associated directly with the address or a protocol element indication separate from the address protocol element. This latter method will be referred to as a Numbering Plan Indicator/Type of Address (NPI/TOA) in which case the domains can be considered as one combined domain. The actual value of the escape in PDNs and ISDNs is defined in X.121 and E.166. The form of the NPI/TOA depends on the actual network access protocol used.

It should be noted that no indication of address type or numbering plan is needed if the call is contained solely within one numbering plan domain. Some networks may require the indication to be present at all cases.

The model shown in Figure 6-1/X.301 is used to describe internetwork arrangements for the treatement of address information conveyance.

In the figure the following cases terms are used:

a) international data number: DNIC + NTN or DCC + NN, as defined in Recommendation X.121;

b) international X.121 format: case a), or Escape + other international number, as defined in Recommendation X.121;

c) X.121 formats: Prefix (if any) + case b), or other national format;

d) E.164 international number: CC + N(S)N, as defined in Recommendation E.164;

e) international E.164 format: case d) or Escape + other international number;

f) E.164 format: prefix (if any) + case e), or other national format;

g) combined domain address: the domain is determined by NPI/TOA.

6.2 *Transfer of X.121 calling address*

This section describes arrangements for the transfer of calling address information defined in Recommendation X.121 through PDNs and ISDNs. Such information is referred to in this section as the "X.121 calling address". In this section, it is assumed that the originating network is a PDN (X.121 domain).

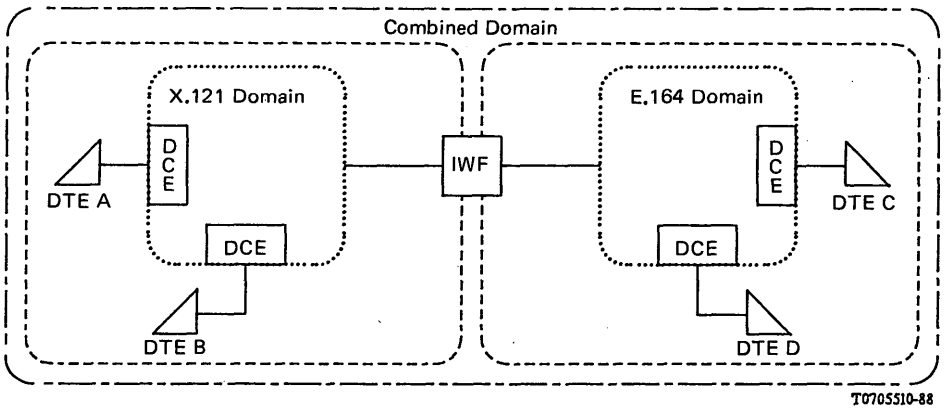
6.2.1 *Transfer during call request phase*

The X.121 calling address shall be provided by the originating PDN. In some cases this will occur automatically, and in others it will be provided only when requested by the destination PDN (see § 6.1.4). The originating PDN is responsible for the accuracy of the X.121 calling address when it is provided.

However, the following particular situations occur:

6.2.1.1 In some cases of interworking with an E.164 domain, a method of indicating that the calling address is an X.121 address must be employed. This shall be done either by using a standardized escape digit to indicate an X.121 address follows or by some form of NPI/TOA indicating the calling address is an X.121 address.

6.2.1.2 In some cases, even where the transfer of the X.121 calling address is technically possible, there may be administrative reasons why the identity of the calling user, and therefore the X.121 calling address related to it, cannot be passed over an international boundary. In such a case, the identification of the originating network shall be provided instead of the X.121 calling address.



Note – This Figure is a functional domain diagram and is not intended to imply a real internetwork implementation.

Direction	Form of address	Extent of validity	Case / Term
A to B	NTN	Network	c)
A to B	P1 + NTN	Network	c)
A to B	DNIC + NTN	Internetwork	a)
A to B	P2 + DNIC + NTN	Internetwork	c)
A to B	[NPI/TOA] + NTN	Network	g)
A to B	[NPI/TOA] + DNIC + NTN	Internetwork	g)
C to D	SN	Network	f)
C to D	P3 + SN	Network	f)
C to D	CC + N(S)N	Internetwork	d)
C to D	P4 + CC + N(S)N	Internetwork	f)
C to D	[NPI/TOA] + SN	Network	g)
C to D	[NPI/TOA] + CC + N(S)N	Internetwork	g)
A to C	E1 + CC + N(S)N	Internetwork escape to Recommendation E.164	b)
A to C	P5 + E1 + CC + N(S)N	Internetwork escape to Recommendation E.164	c)
A to C	[NPI/TOA] + CC + N(S)N	Internetwork	g)
C to A	E2 + DNIC + NTN	Internetwork escape to Recommendation X.121	e)
C to A	P6 + E2 + DNIC + NTN	Internetwork escape to Recommendation X.121	f)
C to A	[NPI/TOA] + DNIC + NTN	Internetwork	g)

FIGURE 6-1/X.301

Address forms for the Call Establishment Phase

Notes associated with Figure 6-1/X.301:

Note 1 – Refer to § 6.6 for more details on an X.121 address.

Note 2 – Refer to § 6.7 for more details on an E.164 address.

Note 3 – Prefixes are indicated by P. P1, P2, P3 and P4 are distinct decimal digits. P5 may or may not be equal to P2. P6 may or may not be equal to P4. The use and form of the prefix is a national matter. Prefixes are not passed over internetwork gateways.

Note 4 – DNIC can also be replaced by DCC as appropriate.

Note 5 – The form of the NPI/TOA depends on the actual network access protocol used.

Note 6 – E1 and E2 indicate escape digits internationally standardized that function as an indication that the digits behind the escape are from a different numbering plan. Prefixes may or may not preceed the escape digit.

Note 7 – For protocol elements used, see Appendix I to this Recommendation.

6.2.1.3 Networks other than PDNs and ISDNs, whenever they are used in conjunction with the PDN for offering data transmission services, should, if possible, provide for the transfer of an X.121 calling address. However, this transfer is not technically possible through some current networks; for example, for a call passing through a PSTN, into a PDN, the telephone network is not always able to indicate the X.121 calling address to the data network. In such a case, information transferred through the PDN instead of the X.121 calling address is for further study.

6.2.1.4 In the circuit switched service in CSPDNs, the X.121 calling address can be transferred as the calling line identification. It is transferred to the called DTE only if the called DTE subscribers to the *calling line identification* facility (see § 6.1.4).

6.2.1.5 In packet switched service in PSPDNs, ISDNs, and in the circuit-switched data transmission service in ISDNs, the X.121 calling address is transferred to the called DTE in the address field (appropriate to the relevant protocol) signalled to the called DTE (see Appendix I to this Recommendation).

6.2.2 *Transfer during call confirmation phase*

Provided the route for the call is selected during the call request phase, the X.121 calling address does not need to be transferred back through the PDNs and ISDNs during the call confirmation phase.

6.2.3 *Transfer during other phases of the call*

The X.121 calling address may not need to be transferred through the PDNs during any other phase of the call.

6.2.4 *Calling line identification*

6.2.4.1 *General*

Calling line identification is an optional user facility, standardized for circuit-switched data transmission services on a CSPDN, that enables a user to be informed of the identity of the calling user for incoming calls. When provided the facility applies to all incoming calls.

Calling line identification is an optional user facility assigned to the user for an agreed contractual period.

The calling line identity is the X.121 data number of the calling user. For international calls, the identity is the complete X.121 international data number including the DNIC or DCC component as applicable.

Note – The implications of a possible combination of *calling line identification* and the *bilateral closed user group* facility are for further study.

Information indicating that a user has the *calling line identification* facility is stored at the exchange to which the user is connected. The identity sent to the called user is originating under control of the exchange to which the calling user is connected.

Facility registration is controlled by the Administration or Recognized Private Operating Agency (RPOA).

6.2.4.2 *Call establishment procedure*

The procedure for a call to a user having the *calling line identification* facility varies depending on whether the calling line identity is included in the initial call control information received by the destination exchange at call establishment.

a) In the case where the calling line identity is included in the call control information received by the destination exchange, this identity is sent to the called user in accordance with the applicable DTE/DCE interface protocol.

b) In the case where the calling line identity is not included in the call control information received by the destination exchange, it sends a request for identification towards the originating exchange.

   i) In the case where the originating network does provide the *calling line identification* facility, the originating exchange responds with the calling line which is forwarded by the destination exchange to the called user in accordance with the applicable DTE/DCE interface protocol.

   ii) In the case where he originating network does not provide the *calling line identification* facility, the originating exchange responds with the originating network identity (see Recommendation X.302). In this case, the identification sent by the destination exchange to the called user is in accordance with the applicable DTE/DCE interface protocol.

The destination exchange must not connect through until the identity has been completely sent to the called user. Also, in the case where decentralized signalling is used, transit exchanges have to delay through-connection in certain situations until a possible identification has been completed in accordance with the applicable interexchange signalling procedures (see Recommendations X.70 and X.71).

6.3 *Transfer of E.164 calling address*

This section describes arrangements for the transfer of calling address information defined in Recommendation E.164.

6.3.1 *Transfer during call request phase*

The E.164 calling address shall be provided by the originating E.164 network for data-mode calls, when calling line identification is provided. The originating E.164 network is responsible for validating the E.164 calling address, when provided. In the case where the calling address is conveyed transparent for the E.164 network (e.g. part access), such validation, if any, will be done outside the E.164 network.

However, the following particular situations occur:

6.3.1.1 In case of interworking with a non-E.164 network, a method of indicating that the calling address is a E.164 address must be employed. This shall be done either by using a standardized escape digit to indicate a E.164 address follows or by some form of NPI/TOA indicating the calling address is an E.164 address.

6.3.1.2 In some cases, even where the transfer of the E.164 calling address is technically possible, there may be administrative reasons why the identity of the calling user, and therefore the E.164 calling address related to it, cannot be passed over an international boundary. In such a case, the procedures are for further study.

6.3.1.3 Networks other than PDNs and ISDNs, whenever they are used in conjunction with the PDN and ISDN for offering data transmission services, should, if possible, provide for the transfer of E.164 calling address. However, this transfer may not be technically possible through some current networks; for example, for a call passing through a PSTN, into a PDN or ISDN, the telephone network is not always able to indicate the E.164 calling address to the E.164 network. In such a case, alternate calling address information transferred through the PDN or ISDN instead of the E.164 calling address is for further study.

6.3.1.4 In a PDN or ISDN the E.164 calling address can be transferred to the called DTE in calling address field (appropriate to the relevant protocol) signalling to the called DTE (see Appendix I).

Note – Not all DTEs will be able to accept the long packet format that will be required for full E.164 addresses in post Time "T". The calling address could not be delivered to such DTEs.

6.3.1.5 In an ISDN, the E.164 calling address is transferred to the called DTE primarily in the calling DTE address field signalled to the called DTE. It can also be transferred in a duplicate manner using notification procedures in the calling party number information element contained in the SETUP message sent to the called party across the D-Channel (see Recommendation X.31). In this case, the calling party number information element must be so coded as to indicate that the calling address is an E.164 address.

Note – Not all DTEs will be able to accept the long packet format that will be required for full E.164 addresses in post Time "T". The calling address could not be delivered to such DTEs.

6.4 *Transfer of X.121 called address*

This section describes arrangements for the transfer of called address information defined in Recommendation X.121 through PDNs and ISDNs. Such information is referred to in this section as the "X.121 called address".

Note – The X.121 called address resides only on a PDN.

6.4.1 *Transfer during call request phase*

As it is essential for the purposes of call establishment, inlcuding routing, the X.121 called address is systematically transferred through the PDNs and ISDNs during the call request phase.

6.4.2 *Transfer during call confirmation phase*

The destination network does not need to provide the X.121 called address (or called line identity) if not requested. When provided, the destination PDN is responsible for validating the X.121 called address.

However, the following particular situations occur:

6.4.2.1 In the circuit switched data transmission service in CSPDNs, the X.121 called address can be transferred to the calling DTE as the called line identity. It is transferred if the calling DTE requests the *called line identification* facility (see § 6.4.4). If the call has been redirected or if a *hunt group* facility has been invoked in the destination PDN, the address of the called DTE/DCE interface over which the call is established shall be transferred.

6.4.2.2 In PSPDNs and ISDNs, the X.121 called address can be transferred to the calling DTE. In the case of *call redirection* facility, the address of the called DTE/DCE interface over which the call is established is always transferred. In the case of *hunt group* facility, this address is always transferred, if a specific address has been assigned to the individual DTC/DCE interface over which the call is established.

6.4.3 *Transfer during other phases of the call*

The X.121 called address does not need to be transferred through the network during any other phase of the call.

However, the following particular situation occurs:

6.4.3.1 In the packet switched data transmission service, a clear request issued by a DTE, to which a call has been redirected or distributed among a hunt group as a direct response to the call request phase, should contain the address of the DTE/DCE interface. This is mandatory in the *hunt group* facility case only if specific addresses have been assigned to the individual DTE/DCE interfaces of the hunt group. When this clear request is destined for an E.164 network, some method of indicating this in an X.121 number must be used (see § 6.1).

6.4.4 *Called line identification*

6.4.4.1 *General*

Called line identification is a user facility, standardized for circuit-switched data transmission services on a CSPDN, that enables a user to be informed for outgoing calls of the identity of the user to which the call has been connected. When provided, the facility applies to all outgoing calls.

It is an optional user facility assigned to the user for an agreed contractual period.

The called line identification is the X.121 data number of the user to which the call has been connected. For international calls, the identity is the complete X.121 international data number including the DNIC or DCC component as applicable.

Information indicating that a user has the *called line identification* facility is stored at the exchange to which the user is connected. The identity sent to the calling user is originated under control of the exchange to which the called user is connected.

6.4.4.2 *Call establishment procedures*

In the case of a call from a user having the *called line identification* facility, the call control information forwarded by the originating exchange at call establishment includes a request for called line identification. The procedure then depends on whether or not the destination network provides the facility.

a) In the case where the destination network does provide the *called line identification* facility, the destination exchange responds with the called line identity, which is returned by the originating exchange to the calling user in accordance with applicable DTE/DCE interface protocol.

b) In the case where the destination network does not provide the *called line identification* facility, the destination network responds, depending on what type of signalling is used, with the destination network identity (Recommendation X.302) or with a "dummy" identification (Recommendation X.70 or X.71). The information sent by the originating exchange to the calling user is in accordance with the applicable DTE/DCE interface protocol.

For circuit switched calls, the originating exchange must not connect through until the identity has been completely sent to the called user. Also, in the case where decentralized signalling is used, transit exchanges have to delay through-connection in certain situations until a possible identification has been completed in accordance with the applicable interexchange signalling procedures (see Recommendations X.70 and X.71).

6.5 *Transfer of E.165 called address*

This section describes the arrangements for the transfer of called address information defined in Recommendation E.164.

6.5.1 *Transfer during call request phase*

As it is essential for the purposes of call establishment, including routing, the E.164 called address is systematically transferred through the PDNs and ISDNs during the call request phase.

However, the following particular situation occurs:

6.5.1.1 In the case of interworking with a non-E.164 network where the transit network is a PDN, a method of indicating that the called address is an E.164 address must be employed. This shall be done either by using a standardized escape digit to indicate an E.164 address follows or by some form of NPI/TOA indicating the called address is an E.164 address.

6.5.2 *Transfer during call confirmation phase*

The destination network does not need to provide the E.164 called address (or called line identity) if not requested. When provided, the destination network is responsible for validating the E.164 called address.

However, the following particular situation occurs:

6.5.2.1 In PDNs and ISDNs, the E.164 called address can be transferred to the calling DTE as the called line identification. In the case of *call re-direction* facility, the address of the called DTE/DCE interface over which the call is established is always transferred. In the case of the *hunt goup* facility, this address is always transferred, if a specific address has been assigned to the individual DTE/DCE interface over which the call is established.

Note – Not all DTEs will be able to accept the long packet format that will be required for full E.164 addresses in post Time "T". The calling address could not be delivered to such DTEs.

6.5.3 *Transfer during other phases of the call*

The E.164 called address does not need to be transferred through the network during any other phase of the call.

However, the following particular situation occurs:

6.5.3.1 In the packet switched data transmission service, a clear request issued by a DTE, to which a call has been redirected or distributed among a hunt goup as a direct response to the call request phase, should contain the address of the DTE/DCE interface. This is mandatory in the *hunt group* facility case only if specific addresses have been assigned to the individual DTE/DCE interfaces of the hunt goup. When this clear request is destined for an X.121 network, some method of indicating this in an E.164 number must be used (see § 6.1).

6.6 *Format of X.121 addresses*

Section 6.1 describes the different cases for the format of X.121 addresses.

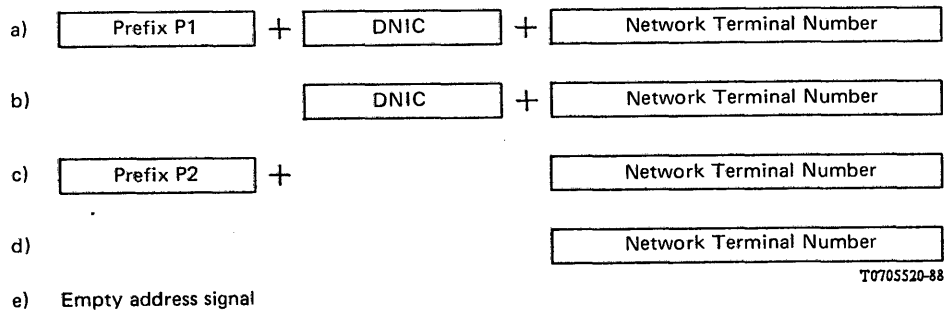
Address information defined in Recommendation X.121 is referred to in this section as the "X.121 address".

Whenever an X.121 address has to be conveyed across a DTE/DCE interface or an IDSE X/Y interface, according to the requirements mentioned in this Recommendation, this transfer should be done according to the following principles:

6.6.1 For international calls, the X.121 address shall be given explicitly in the form of the complete international data number including the DNIC or DCC component as applicable.

6.6.2 The exact format of an address signal may not necessarily be the same nationally. Such a format is a matter for specific arrangement at each interface involved in the call: calling DTE/DCE interface, called DTE/DCE interface and interexchange interfaces.

For example, on an X.21 or X.25 interface, the same address may be represented in either one of the ways illustrated in a) or b) and/or c) or d) and/or e) of Figure 6-2/X.301.



Note 1 – P1 and P2 are distinct decimal digits.

Note 2 – Case e) would only occur when the address is already known on the other side of the interface, e.g., at a DTE/DCE interface for the address corresponding to that DTE/DCE interface.

Note 3 – For cases b) and d), the prefix information could be indicated in a NPI/TOA element.

FIGURE 6-2/X.301

Examples of possible address combinations at the X.21 or X.25 DTE/DCE interface

This example illustrates the use of a prefix, as recognized in Recommendation X.121, as one way to distinguish between different format of the same address.

In the case of mobile services, a conversion between different address formats may be required at various interfaces throughout the network, for roaming subscribers.

Note – A roaming mobile subscriber is a subscriber who may obtain fully automatic connections, even when he moves out of his normal area of operation.

6.6.3 The specific format(s) that can be used at a given interface are defined in the appropriate CCITT Recommendations dealing with the interface.

6.7 *Format of E.164 Addresses*

Section 6.1 describes the different cases for the format of E.164 addresses.

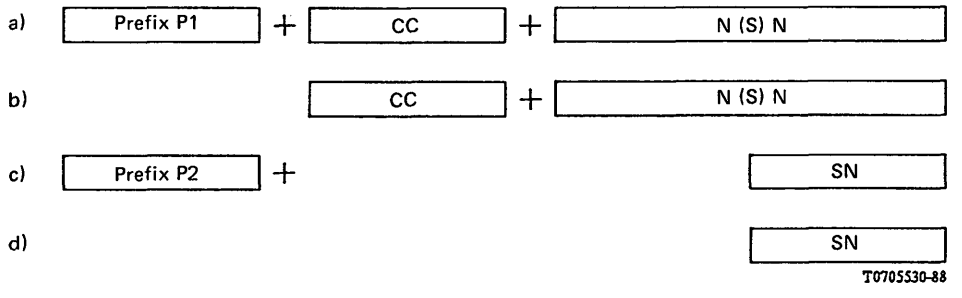
Address information defined in Recommendation E.164 is referred to in this section as the "E.164 address".

Whenever an E.164 address has to be conveyed across a network/user interface or an interexchange interface, according to the requirements mentioned in this Recommentation, this transfer should be done according to the following principles:

6.7.1 For internetwork calls the E.164 address shall be given explicitly in the form of the complete international subscriber number including the CC and N(s)N.

6.7.2 The exact coding (format) of an address signal may not necessarily be the same nationally. Such a format is a matter for specific arrangement at each interface involved in the call: calling network/user interface, called network/user interface and interexchange interfaces.

For example, on an ISDN interface, the same address may be represented in either one of the ways illustrated in a) or b) and/or c) or d) of Figure 6-3/X.301.



Note 1 – P1 and P2 are distinct decimal digits.

Note 2 – For cases b) and d) the prefix information could be contained in a NPI/TOA field.

FIGURE 6-3/X.301

Examples of possible address combinations at an ISDN S/T interface

This example illustrates the use of a prefix, as recognized in Recommendation E.164 as one way to distinguish between codings (or formats) of the same address.

6.7.3 The specific formats that can be used at a given interface are defined in the appropriate CCITT Recommendation dealing with that interface.

6.8 *Transfer of address information additional to Recommendation X.121 and E.164*

This section describes arrangements for the transfer of address information additional to that defined in Recommendations X.121 and E.164.

6.8.1 *General*

The Network Addressing Extension (NAE)/subaddress (see note) mechanism allows the transfer through PDNs on a per call basis of addressing information beyond the total limit established for X.121/E.164 addresses. This mechanism is standardized for circuit and packet switching data transmission service as shown in Table 6-2/X.301.

TABLE 6-2/X.301

Optional user facilities standardized for different data transmission services, related to addressing information additional to Recommendations X.121 and E.164

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PTSN	CSPDN	ISDN	ISDN	PSPDN	MSS
Calling NAE/sub-address		X			X	X	X	X
Called NAE/sub-address		X			X	X	X	X

If sufficient space exists in the fields carrying X.121/E.164 address information, and an arrangement exists between users and networks concerned, this constitutes an alternative capability, available on a per call basis without requiring the NAE mechanism, for the transfer of addressing information additional to that defined in Recommendation X.121/E.164.

Note – Different terms exists: In general, NAE is used in X-Series Recommendations, and subaddress is used in I-Series Recommendations.

6.8.2 *Realization*

The detailed realization of the NAE mechanism at each type of internetwork and user interface is independently defined in the appropriate signalling and interface Recommendations.

6.8.3 *Principles*

The following principles apply equally and independently to both called and calling address information:

6.8.3.1 The transfer of addressing information at the OSI Network Layer additional to that defined in Recommendation X.121/E.164 is possible during any phase of the call in which address information defined in X.121/E.164 can also be transferred (see §§ 6.1 and 6.7 above).

6.8.3.2 The addressing information in the NAE/subaddress can be of variable length. It can comprise up to 20 octets of binary coded information (see Note). The content of the information is unrestricted with respect to the grouping of digits.

Note – The maximum length of 40 decimal digits is derived from the maximum length of the OSI Network Service Access Point (NSAP) address defined in Recommendation X.213 [see also ISO 8348 AD2]. Exact arrangements for treatment of the OSI NSAP address are for further study.

6.8.3.3 Public networks are not required to look at or operate on a NAE/subaddress for any purpose including routing; however, some public networks may look at the NAE/subaddress, if they wish.

6.8.3.4 In cases where it is possible, and an arrangement exists between users and public networks concerned, the conveyance of the complete addressing information (i.e., all elements of OSI Network Addressing) may be performed without NAE/subaddress mechanism.

6.8.3.5 Each internetwork interface should simultaneously accommodate the following partitions of the addressing information between existing protocol elements for addressing and NAEs/subaddresses:

a) All elements of addressing information are contained in the existing protocol elements for addressing; no NAE/subaddress is needed; the complete DTE Network Address is contained in the existing protocol elements.

b) The complete DTE Address is contained in the NAE/subaddress; all elements of addressing information needed by the public networks involved in the call are contained in the existing protocol elements for addressing. The information used by public networks may be derived from the NAE/subaddress.

Note – In this case, for some OSI Network Addresses, part of the OSI Network Address information may be duplicated in the existing protocol elements for addressing.

c) The addressing information is split into two elements, one contained in the existing protocol elements for addressing, the other contained in the NAE/subaddress. The complete DTE address is the concatenation of the two elements.

d) The addressing information is contained in the NAE/subaddress only. This case is typical for private networks since public networks act typically on X.121/E.164 numbers.

6.8.3.6 The use of the NAE/subaddress is either:

– as defined in Recommendation X.213 (see also ISO 8348 AD2) or

– differently.

When the use of the NAE/subaddress is as defined in Recommendation X.213 (see also ISO 8348 AD2), case c) in § 6.8.3.5 does not apply.

7 **Arrangements for user facilities** (see Note 1)

The internetwork arrangements described in this section relate to the optional user facilities defined in Recommendation X.2 and I.250-Series Recommendations (see Note 4).

Note 1 – Different terms: in general *optional user facilities* is used in X-Series Recommendations, and *supplementary services* is used in I-Series Recommendations.

Note 2 – Support of these facilities by the ISDN in other modes of operation than packet-mode is for further study (see I.230-Series Recommendations).

Note 3 – General arrangements for treatment of registration procedures (e.g. Recommendation X.32) are for further study.

Note 4 – Alignment/interworking between facilities defined in X.2 and supplementary services defined in I.250-Series Recommendations is for further study.

Alphabetical List of Facilities contained in this section

Network user identification (NUI)	7.4.5
NUI override permission	7.4.6
Outgoing calls barred	7.4.4
Quality of OSI network service and of data transmission service	7.1.1
Quality of Serive parameters	7.1.2
Receipt confirmation	7.6.3
Redirection of calls	7.3.1
Reverse charging and reverse charging acceptance	7.2.1
RPOA selection	7.3.4

7.1 *Facilities related to the quality of service (QOS)for the call*

This section described arrangements required for quality of service related to the transmission capability.

7.1.1 *Quality of OSI network service and of data transmission service*

The term "Quality of Service" (QOS) refers to the specification of certain characteristics of a Network Connection (NC) as defined in the OSI network service (X.213). However, QOS can also be specified in relation to the data transmission service which is used to support the OSI network service. Each of these QOS specifications, and the relationship between them is described in the following sections.

7.1.1.1 *QOS Specification in the OSI network service*

The OSI network service including a detailed definition of QOS parameters is specified in Recommendation X.213. The reference points between which the QOS parameters apply are the network service access points (NSAPs).

The value of QOS applies to an entire NC. When determined or measured at both ends of an NC, the QOS observed by the NS users at the two ends of the NC is the same. This is true even in the case where the Network Connection is provided through the interworking of different types of networks.

Two interworking categories related to the transmission capabilities exist, i.e. interworking at the network layer, and interworking by port access. The reference point between which the QOS parameters apply are in both cases of interworking the two NSAPs involved (see Figures 7-1/X.301 and 7-2/X.301). However, the method of interworking may impact the value of QOS between the reference points.

The Transport Layer may make a request to the OSI network service provider for a network layer connection with certain QOS characteristics (e.g. in order to decide the class of transport protocol to be used). In response to such a request, the OSI network service provider may offer a network layer connection with QOS characteristics that meet (the margins of) the request, or the OSI network service provider may reject the request, if the QOS characteristics cannot be met.

The QOS Reference Points between which the QOS has to be measured for this instance of communication, are the NSAPs between which the network layer connection has to be established.

Recommendation X.224 (Transport Protocol) classifies network connections in terms of QOS with respect to error behaviour in relation to user requirements; its main purpose is to provide a basis for the decision regarding which class of transport protocol should be used on top of a given network connection.

7.1.1.2 *QOS Specification in the data transmission service*

Figure 7-3/X.301 illustrates an example of the data transmission service in the case where the data transmission service is provided by a public data network (PDN). The QOS parameters which are specified for the data transmission service can be specified in terms of event occurring within the network layer at the DTE/DCE interface. The QOS Reference Points are defined to be inside the network layer entities through which the PDN may be accessed (e.g. the DCEs) and where these network layer events are observed.

These reference points apply both to interworking at the network layer and to interworking by port access.

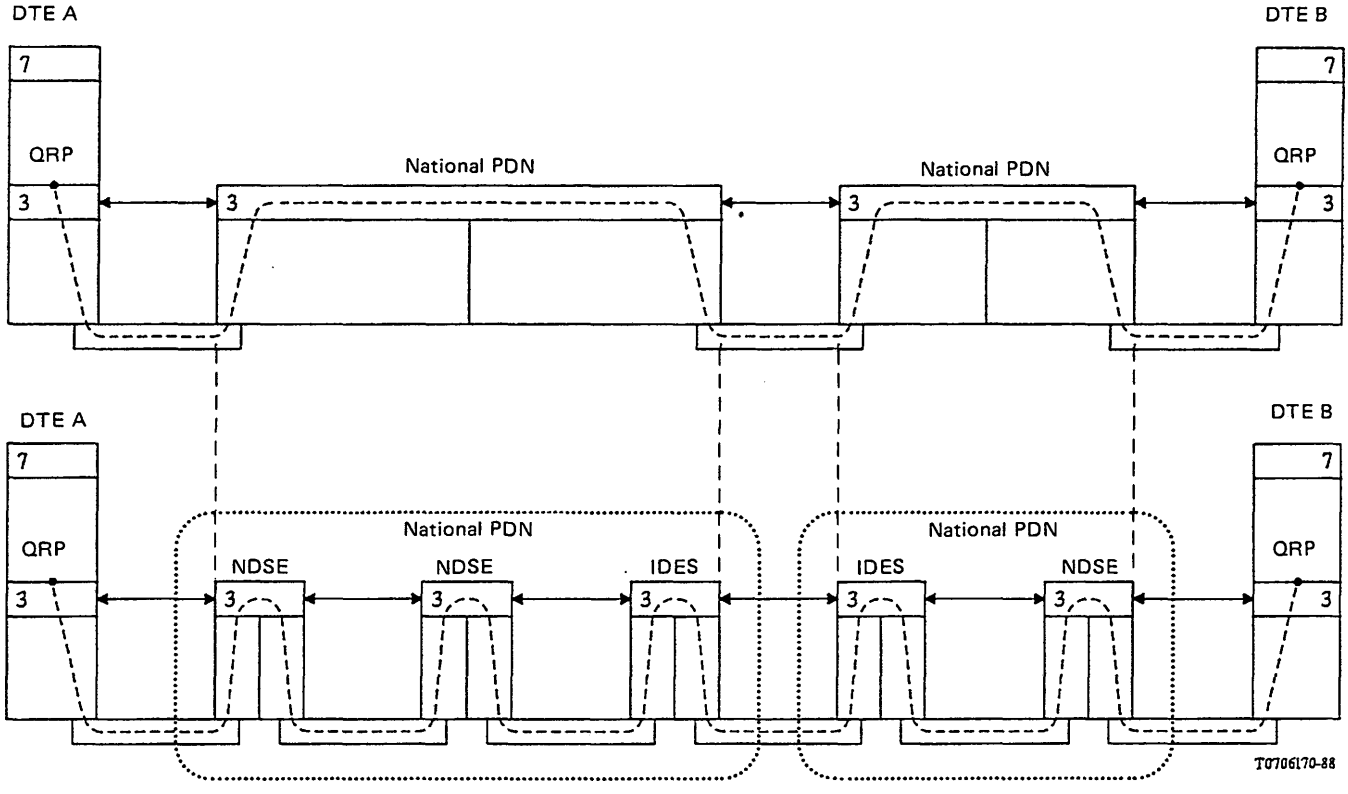


FIGURE 7-1/X.301

QOS Reference Points (QRPs) in an example of interworking at the network layer to provide the OSI connection-mode network service

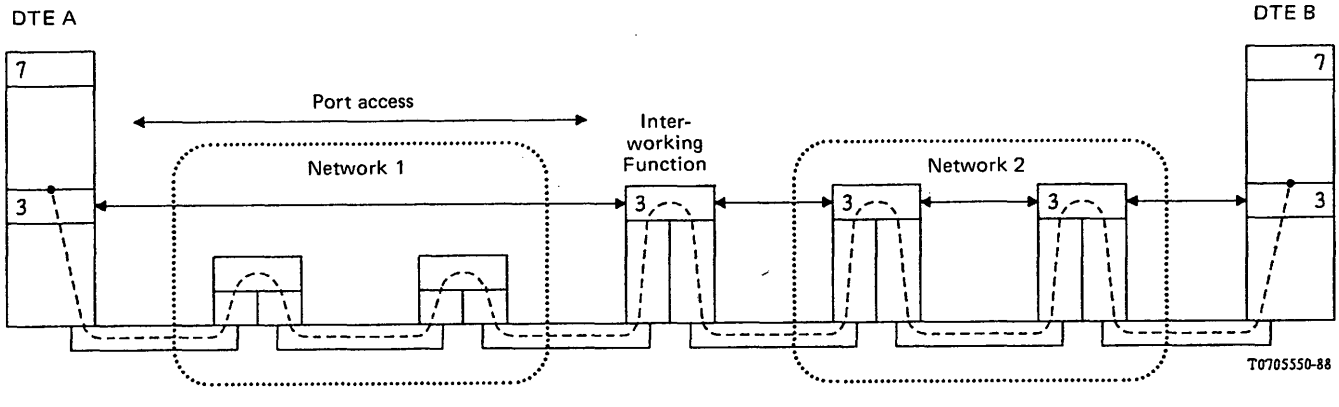


FIGURE 7-2/X.301

QOS Reference Points in an example of interworking by port access

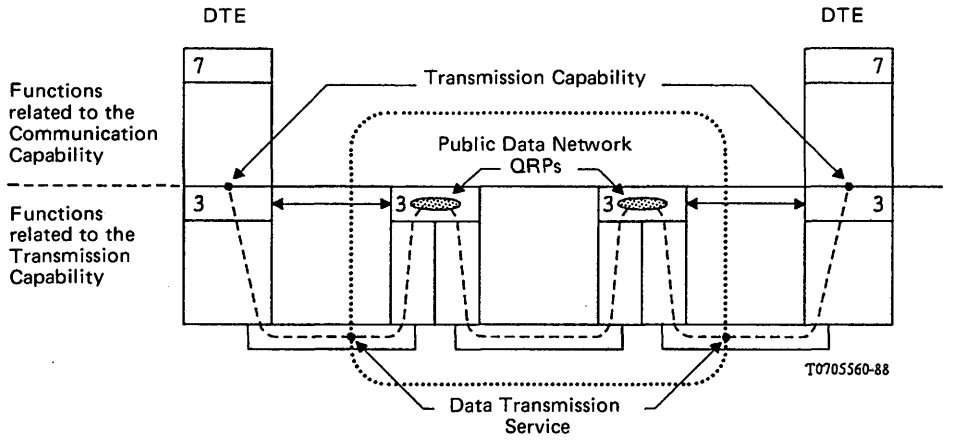


FIGURE 7-3/X.301

QOS Reference Points in an example of data transmission services offered by a PDN to participate in the provision of transmission capability

7.1.1.3 Relationships between OSI network service QOS and data transmission service QOS is illustrated in Figure 7-4/X.301. The network service QOS includes a component which is the data transmission service QOS and also a component which is due to the operation of the network service provider outside the data transmission service (i.e. the network service provider between the data transmission service QRPs and the relevant NSAPs). The operation of the network service provider outside the data transmission service may have the effect of either devaluing or improving the QOS depending upon the circumstances and the aspect of QOS involved. In any case, for an instance of communication, the QOS of the network service is different from the QOS of the data transmission service. The relationship between such QOS values is the responsibility of the network service provider outside the data transmission service.

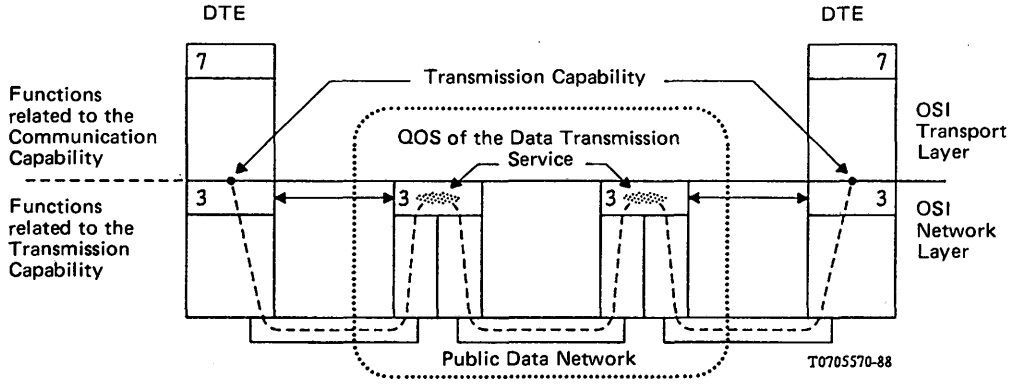


FIGURE 7-4/X.301

Relation of the QOS of the network service and data transmission service

7.1.2 *QOS Parameters*

7.1.2.1 *OSI network service QOS Parameters*

Network service QOS is described by means of QOS parameters. The definition of each parameter specifies the way in which the parameter's value is measured or determined, making reference where appropriate to the events represented by service primitives in the network service.

It is in terms of network service QOS parameters that information about QOS is exchanged among the network service provider and the NS users.

Examples of QOS parameters which are defined in the network service are throughput, transit delay, and residual error rate. Recommendation X.213 contains the definitions of the complete set of QOS parameters which apply to the nework service.

7.1.2.1.1 *QOS Parameter Values*

In some circumstances, only a single value for a QOS parameter is conveyed (e.g. the target value desired by the network service user or the value being made available by the network service provider). In other cases however, it may be possible to specify a pair of values which define an applicable range of values (e.g. the network service user may be able to specify a range bounded by a target value which is desired and the minimum acceptable value which the user is willing to agree to.) The number of values which may be conveyed is dependent upon the specific QOS parameter.

7.1.2.1.2 *QOS Parameter Categories*

The network service QOS parameters can be divided into two categories as follows:

1) Parameters negotiated on a per-connection basis – the values of these parameters can be conveyed between peer NS users by means of the NS during the establishment phase of an NC; as part of this conveyance, a three-party negotiation among the NS users and the NS provider for the purpose of agreeing upon a particular QOS parameter value may take place; and
2) Parameters not negotiated on a "per-connection" basis – the values of these parameters cannot be conveyed or negotiated among the NS users and the NS provider, for these QOS parameters, however, information about the values which is useful to the NS provider and each NS user may be made known by local means.

Only two QOS parameters of the NS, throughput and transit delay, are classified in the first category, and thus are conveyed and negotiated by means of the NS.

(The negotiation procedures and constraints are described in Recommendation X.213. The mechanisms related to the negotiation of these parameters is described in § 7.1.3.1.)

All of the remaining QOS parameters are classified as belonging to the second category. The values of these QOS parameters for a particular NC are not negotiated in a three-party fashion nor are they directly conveyed from NS user to NS user. As a local matter, however, there may be means by which the values of one or more of these QOS parameters are known and utilized by the NS provider and each NS user.

(The mechanisms related to this category of parameters are described in § 7.1.3.2.)

7.1.2.2 *Data transmission service QOS Parameters*

This section is for further study.

7.1.3 *Mechanisms related to QOS*

7.1.3.1 *Types of mechanisms related to parameters negotiated on a per connection basis*

7.1.3.1.1 Three parties are involved in the specification of these QOS parameters:

a) The service user at the calling QOS reference point,
b) The service provider between the QOS reference points,
c) The service user at the called QOS reference point.

7.1.3.1.2 The service user at the calling QOS reference point will initiate these QOS parameters.

7.1.3.1.3 Both the service provider between the reference points and the service user at the called QOS reference point may devalue these QOS parameters according to their capabilities.

7.1.3.1.4 After possible subsequent devaluation, these QOS parameters will be returned to the service user at the calling QOS reference point without further adjustment.

7.1.3.1.5 The returned QOS parameters specify the QOS between the two QOS reference points.

Note – The guarantee of the QOS during the lifetime of the connection between the two QOS reference points is subject for further study.

7.1.3.2 *Types of mechanisms related to parameters not negotiated on a per-connection basis*

Determination of the value of these types of parameters occurs somewhere within the service provider but does not require that the values be negotiated between QRPs. Values of these parameters may be requested through the calling QRP by a service user. It is also possible that the service provider may convey indications of these values to the service user at the calling QRP, called QRP or both QRPs. Unlike the parameters negotiated on a per-connection basis, the values of these parameters are not subject to negotiation mechanisms as described in § 7.1.3.1.

7.1.3.3 *Minimum and target QOS parameters*

7.1.3.3.1 The specification of QOS parameters (if present) always contains a target QOS value. In addition this specification may contain a minimum QOS value.

7.1.3.3.2 For parameters negotiated on a per-connection basis, target QOS values are subject to negotiation rules specified in § 7.1.3.1.

7.1.3.3.3 Minimum QOS values specify the least value the service user at the calling QOS reference point agrees to for establishment of a connection between the two QOS reference points. The minimum QOS value may be used by the service provider between the QOS reference points to abort the connection establishment, if the target QOS value is devalued to a value less than the minimum QOS value in the case of parameters negotiated on a per-connection basis.

Note – It is for further study whether the mechanism using minimum QOS parameters is a general applicable mechanism for all parameters.

7.1.3.4 *Specific mechanisms related to QOS*

Some mechanisms have already been defined that relate to the quality of service on a call, (e.g. flow control parameters negotiation mechanism in Recommendations X.25 and X.75).

Note – It is for further study whether there is a need to introduce new user facilities to request a target quality of service for a call and new network utilities to control that target quality of service.

The optional user facilities already standardized for different data transmission services, and related to the QOS of the call, are shown in Table 7-1/X.301.

7.1.3.4.1 *Transit delay*

For calculation and negotiation of Transit Delay, a number of facilities can be utilized:

- Transit delay selection and indication (TDSAI)
- End-to-end transit delay negotiation (EETDN), involving three parameters:
  - Cumulative transit delay (CTD)
  - Target transit delay (TTD)
  - Maximum acceptable transit delay (MATD)

TABLE 7-1/X.301

Optional user facilities, standardized for different data transmission services, related to the QOS of the call

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PTSN	CSPDN	ISDN	ISDN	PSPDN	MSS
Transit delay selection and indication		X			↑	X	X	X
End-to-End transit delay negotiation		X			↑	X	X	X
Throughput class negotiation	X	X (Note)			FS	X	X	X
Minimum throughput class		X			↓	X	X	X
Default throughput class assignment	X				↓	X	X	X

Note – This facility cannot be used unless the corresponding facility has been agreed for a period of time.

Utilization of these facilities, and their mutual relationship is described in the following sections.

7.1.3.4.1.1 *Transit Delay Selection and Indication*

7.1.3.4.1.1.1 *General*

Transit delay selection and indication is an optional user facility that permits selection and indication, on a per call basis, of the nominal maximum permissible transit delay applicable to that virtual call.

A DTE wishing to select a nominal maximum permissible transit delay for a virtual call indicates the desired nominal maximum permissible value in the call request phase.

During the call request phase, the nominal transit delay applicable to the call will be indicated to the called DTE. This transit delay may be smaller than, equal to, or greater than the desired nominal maximum permissible transit delay requested in the call request phase by the calling DTE.

During the call confirmation phase, the nominal transit delay applicable to the call will also be sent to the calling DTE.

Note – This facility specifies the transit delay between the QRPs applicable for the data transmission service (see § 7.1.1.2). Provision of transit delay values applicable for the OSI network service (see § 7.1.1.3) may require the use of an additional parameter (see § 7.1.3.4.1.2).

For internetwork communication, two utilities are defined to handle these facilities:

1) The nominal maximum permissible transit delay value requested by the DTE is signalled between networks by the transit delay selection utility in the call request phase.
2) The accumulated expected nominal transit delay up to, and including the outgoing link is signalled in the transit delay indication utility in the call request phase. The accumulated expected nominal transit delay is signalled back in the transit delay indication utility of the call confirmation phase.

7.1.3.4.1.1.2 *Transit delay definition*

This transit delay is the *data* packet transfer delay as defined in § 3.1 in Recommendation X.135, measured between boundaries B_2 and B_{n-1}, as defined in Figure 2/X.135 (that means, excluding the access lines), with the conditions given in § 3.2 in Recommendation X.135, and is expressed in terms of a mean value.

Nominal maximum permissible transit delay and the expected nominal transit delay is signalled provisionally in milliseconds and expresses the mean value for the packets (128 octet size) sent by the user on that call.

Note 1 – It is for further study whether the transit delay values shall apply only for busy hour condition.

Note 2 – The range and the number of reasonable values of the nominal maximum permissible transit delay and the expected nominal transit delay are for further study.

7.1.3.4.1.1.3 *Call request anc call confirmation phases*

a) In the call request phase a network, when able to do so, should allocate resources and route the virtual call in a manner such that the nominal transit delay applicable to that call does not exceed the desired nominal maximum permissible transit delay.

   1) In the call request phase, the calling DTE indicates the nominal maximum permissible transit delay in the *transit delay selection and indication facility*;

   2) In the call request phase on an internetwork link, the network shall, if routing on transit delay is performed, take into consideration both of the values given in the *transit delay selection and transit delay indication* utilities.

B) The network shall determine the expected nominal transit delay for the network part of the vitual circuit in question, based on the definition in § 7.1.3.4.1.1.2.

   In accordance with the definition of *t3c*, this includes the expected nominal transit delay for all DSEs and links that the call passes through, taking into consideration such elements as size of DSEs, transmission speed and type of links.

   However, determination of the actual values is a national matter.

   If the call in question is resulting from an incoming internetwork link call, the determined expected nominal transit delay shall be added to the received value in the *transit delay indication* utility.

   1) In the case of an incoming call to a DTE, the expected nominal transit delay shall be transmitted to the DTE in the *transit delay selection and indication* facility.

   2) In the case of a call request on an internetwork link, the expected nominal transit delay shall be signalled in the *transit delay indication* utility. The transit delay originally requested by the DTE is optionally signalled in the *transit delay selection* utility.

C) The total accumulated expected nominal transit delay is signalled back in the *transit delay indication* utility in the call confirmation phase. This value is transferred by the originating network to the calling DTE in the *transit delay selection and indication* facility in the call confirmation phase.

   During the call request phase the nominal transit delay applicable to the call will be indicated to the called DTE. This transit delay may be smaller than, equal to, or greater than the desired nominal maximum permissible transit delay requested in the call request phase by the calling DTE.

   During the call confirmation phase, the nominal transit delay applicable to the call will also be sent to the calling DTE.

7.1.3.4.1.2 *End-to-end transit delay negotiation*

7.1.3.4.1.2.1 *General*

End-to-end transit delay negotiation is an optional user facility that permits on a per call basis conveyance of:

a) Cumulative transit delay

b) Target transit delay (TTD) (optional)

c) Maximum acceptable transit delay (MATD) (optional)

The TTD corresponds with the target QOS parameter (see § 7.1.3.3) for transit delay.

The MATD corresponds with the minimum QOS parameter (see § 7.1.3.3) for transit delay.

The CTE accumulates the total transit delay applicable for the call by adding the individual transit delays of the subsequent portions of the connection (which may be presented by the *transit delay selection and indication* facility; see § 7.1.3.4.1).

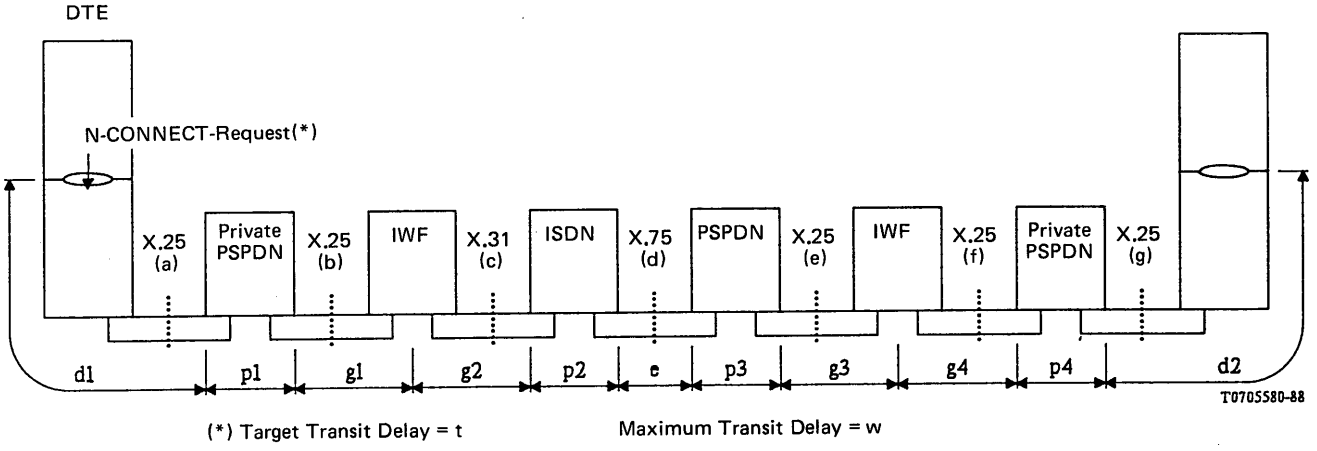
7.1.3.4.1.2.2 *Call request and call confirmation phases*

The CTD will be conveyed from calling to called DTE during the call request phase. Its values will be incremented by transit delays of individual portions of the connection that may be presented by the *transit delay selection and indication* facility (see § 7.1.3.4.1) or may be obtained from local knowledge. The TTD and MATD may also be conveyed from calling to called DTE during the call request phase, and can be used for comparison with the accumulated value.

The public networks involved in the call are not required to look at or operate on these parameters, e.g. for aborting the call; however, some networks may look at the parameters if they wish.

The total accumulated transit delay, when accepted by the called DTE, is conveyed from the called DTE to the calling DTE during the call confirmation phase in the CTE parameter. The TTD and the MATD parameters are not conveyed during the call confirmation phase.

Figure 7-5/X.301 shows an example of the utilization of all transit delay parameters.



The labels (a), (b), (c), (d), (e), (f) and (g) represent the various points between the entities involved in the scenario shown above at which the transit delay information is visible in the protocol information.

	Facility	Utilities		EETDN		
	TDSAI	TDS	TDI	CTD	TTD	MATD
Call Request Phase						
a)	t−2d1 (Note 1)	NA	NA	2d1	t	w
b)	p1	NA	NA	2d1	t	w
c)	t−2d1−p1−(g1−g2)	NA	NA	2d1+p1+(g1+g2)	t	w
d)	NA	t−2d1 −p1 −(g1−g2)	p2−e	2d1+p1+(g1+g2)	t	w
e)	p2−e−p3	NA	NA	2d1+p1+(g1+g2)	t	w
f)	t−(2d1−p1−(g1−g2)) −(g3−g4)−(p2−e−p3)	NA	NA	2d1+p1+(g1+g2) +(p2+e+p3)+ (g3+g4)	t	w
g)	p4	NA	NA	2d1+p1+(g1+g2) +(p2+e+p3)+ (g3+g4)	t	w

	Facility	Utilities		EETDN		
	TDSAI	TDS	TDI	CTD	TTD	MATD
Call Confirmation Phase (Note 2)						
g)	NA	NA	NA	2d1 + p1 + (g1 + g2) + (p2 + e + p3) + (g3 + g4) + p4	NA	NA
f)	p4	NA	NA	–	NA	NA
e)	NA	NA	NA	–	NA	NA
d)	NA	NA	p2 – e – p3	–	NA	NA
c)	p2 – e – p3	NA	NA	–	NA	NA
b)	NA	NA	NA	–	NA	NA
a)	p1	NA	NA	–	NA	NA

Note 1 – The calling DTE assumes d1 = d2.

Note 2 – The called DTE may have accepted the call on the basis of:

$$2d1 + p1 + (g1 + g2) + (p2 + e + p3) + 2(g3 + g4) + p4 \leqslant w.$$

FIGURE 7-5/X.301

Utilization of the transit delay parameters

7.1.3.4.2 *Throughput*

7.1.3.4.2.1 *Throughput class negotiation* (see Note)

Note – Different terms exist for this facility:

The present term is as denoted in Recommendations X.2, X.25 and X.75.

Recommendation X.213 uses the term "throughput".

Recommendation X.140 uses the term "User information transfer rate".

Recommendation Q.931 uses the term "Information rate".

7.1.3.4.2.1.1 *General*

Throughput class negotiation is an optional user facility that permits negotiation on a per call basis of the throughput classes. The throughput classes are considered independently for each direction of data transmission.

Default values are agreed between the DTE and the Administration (see § 7.1.3.4.2.3). The default values correspond to the maximum throughput classes which may be associated with any virtual call at the DTE/DCE interface.

This facility corresponds with the target QOS parameter (see § 7.1.3.3) for throughput.

7.1.3.4.2.1.2 *Throughput definition*

The throughput parameter is defined in Recommendation X.140 (under the term user information transfer rate).

Throughput is signalled in bits per second. Provisionally, the throughput value negotiated for a call, is achieved, as measured over the lifetime of the call, in 95% of all cases (calls) during busy hour conditions. Details are for further study.

7.1.3.4.2.1.3 *Call request and call confirmation phases*

When the calling DTE has subscribed to the *throughput class negotiation* facility, it may request the throughput classes of the virtual call in the call request phase for both directions of data transmission. If particular throughput classes are not explicitly requested, the DCE will assume that the default values were requested for both direction of data transmission.

When a called DTE has subscribed to the *throughput class negotiation* facility, the throughput classes from which DTE negotiation may start will be indicated to the called DTE during the call request phase. These throughput classes are less than or equal to the ones selected at the calling DTE/DCE interface, either explicitly, or by default if the calling DTE has not subscribed to the *throughput class negotiation* facility or has not explicitly requested throughput class values in the call request phase. These throughput classes indicate to the called DTE will also not be higher than the default throughput classes, respectively for each direction of data transmission, at the calling and the called DTE/DCE interfaces. They may be further constrained by internal limitations of the network.

The called DTE may request with a facility in the call confirmation phase the throughput classes that should finally apply to the virtual call. The only valid throughput classes in the call confirmation phase are lower than or equal to the ones (respectively) indicated to the call DTE in the call request phase. If the called DTE does not make any throughput class facility request in the call confirmation phase, the throughput classes finally applying to the virtual call will be the ones indicated to the caller DTE in the call request phase.

If the called DTE has not subscribed to the *throughput class negotiation* facility, the throughput classes finally applying to the virtual call are less than or equal to the ones selected at the calling DTE/DCE interface, and less than or equal to the default values defined at the called DTE/DCE interface.

When the calling DTE has subscribed to the *throughput class negotiation* facility, the call confirmation phase of each call will indicate the throughput classess finally applying to the call.

When neither calling DTE nor called DTE has subscribed to the *throughput class negotiation* facility, the throughput classes applying to the virtual call will not be higher than the ones agreed as defaults at the calling and called DTE/DCE interfaces. They may be further constrained to lower values by the network, e.g. for international service.

In the case of internetwork calls, any DSE, including the DSEs associated with the originating and destination networks, may reduce, but not raise, the throughput class values requested in the call request phase. Thus, the throughput classes from which the negotiation may start with the called DTE will be indicated to the DSE-associated with the destination network.

If particular throughput classes are not explicitly requested, the DSE is assumed to request the default throughput class values agreed between both Administrations.

When the called DTE has accepted the call, the DSE associated with the destination network may convey, in the call confirmation phase, the throughput class values that finally apply to the call following the negotiation with the called DTE.

If particular throughput classes are not explicitly confirmed, the DSE is assumed to confirm the default class values agreed between both Administrations.

Note – In the process of determination as whether or not to reduce throughput class values by networks or by the user, different criteria can be envisioned, e.g. the resources available. For packet switched data transmission services, flow control parameters like window and packet size may affect the attainable throughput class.

7.1.3.4.2.1.4 *Call clearing phase*

No indication of throughput class should be present during the call clearing phase.

7.1.3.4.2.2 *Minimum throughput class*

7.1.3.4.2.2.1 *General*

Minimum throughput class is an optional user facility that permits, on a per call basis, conveyance of the minimum acceptable throughput class. The minimum throughput classes are considered independently for each direction of data transmission.

This facility corresponds with the minimum QOS parameter (see § 7.1.3.3) for throughput.

7.1.3.4.2.2.2 *Call request and call confirmation phases*

The minimum throughput class parameter will be conveyed from calling DTE to called DTE during the Call Request Phase, and can be used by the called DTE for comparison with the negotiated value of the throughput class negotiation parameter.

The public networks involved in the call are not required to look at or operate on the minimum throughput class parameter, e.g. for aborting the call; however some networks may look at the parameter if they wish.

The minimum throughput class parameter is not conveyed during the call confirmation phase.

7.1.3.4.2.3 *Default throughput classes assignment*

Default throughput classes assignment is an optional user facility agreed for a period of time. This facility, if subscribed to, provides for the selection of default throughput classes from the list of throughput classes supported by the Administration. Some networks may constrain the default throughput classes to be the same for each direction of data transmission. In the absence of this facility, the default throughput classes correspond to the user class of service of the DTE (see Recommendation X.1) but does not exceed the maximum throughput class supported by the network.

The default throughput classes are the maximum throughput classes which may be associated with any call at the DTE/DCE interface. Values other than the default throughput classes may be negotiated for a call by means of the *throughput classes negotiation* facility (see § 7.1.3.4.2.1). Values other than the default throughput classes may be agreed for a period of time for each permanent virtual circuit.

7.2 *Facilities relating to the charging conditions applying to the call*

The optional user facilities which are standardized for different data transmission services, and are related to the charging conditions applying to the call are shown in Table 7-2/X.301.

TABLE 7-2/X.301

Optional user facilities, standardized for different data transmission services, related to charging conditions applying to the call

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PTSN	CSPDN	ISDN	ISDN	PSPDN	MSS
Reverse charging		X		X		X	X	X
Reverse charging acceptance	X			X	FS	X	X	X
Local charging prevention	X					X	X	X
Charging information	X	X		X		X	X	X

7.2.1 *Reverse charging and reverse charging acceptance*

7.2.1.1 *General*

Reverse charging is an optional user facility that may be requested by the user on a per-call basis. It enables a calling user to request that the call should be charged to the called user.

Reverse charging acceptance is an optional user facility assigned to the user for an agreed contractual period. It enables the user to accept reverse charging calls.

Note 1 – The international accounting arrangements for reverse charging calls and the consequent implications on network capabilities have not yet been defined.

Note 2 – All requirements of the *reverse charging* and *reverse charging acceptance* facilities have not yet been covered in the DTE/DCE interface and interexchange signalling specifications.

7.2.1.2 *Call set-up procedure*

7.2.1.2.1 A calling user may request reverse charging by means of a facility request over the DTE/DCE interface.

a) In the case where reverse charging is allowed by the originating network, the call control information forwarded to the succeeding exchange will include a *reverse charging request* indication.

b) In the case where reverse charging is not allowed by the originating network, the call is rejected and an *invalid facility request* call progress signal is returned to the calling user.

7.2.1.2.2 When receiving a call including a reverse charging request indication the destination exchange will act as follows:

a) In the case where the called user subscribes to the *reverse charging acceptance* facility, the incoming call information, including an indication that reverse charging is requested, is sent to the called user.

b) In the case where the called user does not subscribe to the *reverse charging acceptance* facility, the call is rejected and a *reverse charging acceptance not subscribed* signal is sent towards the originating exchange.

The call may also be rejected for other reasons not related to the *reverse charging* or *reverse charging acceptance* facilities.

When the incoming call information is sent to the called user, the called user may deny establishment of the call by clearing, if the called user is not willing to accept reverse charging for this particular call.

Note – The DTE/DCE interface arrangements necessary in the circuit-switched service in CSPDNs to allow the called user to deny establishment of a reverse charging call, for example after *calling line identification*, have not yet been defined. The procedure chosen is likely to affect the network procedures for reverse charging calls.

7.2.2 *Local charging prevention*

Local charging prevention is an optional user facility agreed to for a period of time. This user facility, when subscribed to, authorizes the DCE to prevent the establishment of calls which the subscriber must pay for by:

a) not transmitting to the DTE incoming calls which request the *reverse charging* facility, and

b) insuring that the charges are made to another party whenever a call is requested by the DTE. This other party can be determined by using any of a number of actions, both procedural and administrative. The procedural methods include:

- the use of reverse charging,
- identification of a third party using the *network user identification* facility (see § 7.4.5).

When the party to be charged has not been established for a call request, the DCE will apply *reverse charging* to this call.

Note – For an interim period of time, some networks may choose to enforce local charging prevention by clearing the call when the party to be charged has not been established.

7.2.3 *Charging information*

Charging information is an optional user facility which may be either agreed for a period of time or requested by the DTE for a given call.

If the DTE is the DTE to be charged, the DTE can request the *charging information* facility on a per call basis by means of an appropriate facility request in the call request phase or call confirmation phase.

If a DTE subscribes to the *charging information* facility for a contractual period, the facility is in effect for the DTE, whenever the DTE is the DTE to be charged, without sending the facility request in a call request phase or call confirmation phase.

During the call clearing phase, the DCE will send to the charged DTE information about the charge for that call and/or other information which makes it possible for the user to calculate the charge.

The charging information parameter may be expressed in any of the following measures: monetary unit, distance, segment count, call duration.

7.3 *Facilities relating to specific routing conditions requested by the user of the call*

The optional user facilities which are standardized for different data transmission services, and are related to specific routing conditions requested by the user of the call are shown in Table 7-3/X.301.

TABLE 7-3/X.301

Optional user facilities, standardized for different data transmission services, related to specific routing conditions requested by the user of the call

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PTSN	CSPDN	ISDN	ISDN	PSPDN	MSS
Redirection of calls	X			X		X	X	X
Deflection of calls		X				X	X	X
Hunt group	X			X		X	X	X
RPOA selection	X	X		X	FS	X ?	X	X
Called line address modified notification		X				X	X	X
Call redirection or deflection notification		X		X		X	X	X

7.3.1 *Redirection of calls*

7.3.1.1 *General*

Redirection of calls is an optional user facility assigned to the user for an agreed contractual period.

The facility enables a user to have calls to his address redirected to a predetermined address.

In the case of circuit-switched service in CSPDNs this shall apply to all calls to the address. In the case of packet-switched data transmission service in PSPDNs and ISDNs, this shall apply to calls which encounter the out-of-order condition, or optionally other conditions, such as number busy.

Provision of the facility and registration of the address to which calls are to be redirected is controlled by the Administration.

It is for further study whether or not a facility is required to allow user control of the address registered to which calls are to be redirected.

Depending on the possiblities offered by the Administration, facility activation and deactivation may be made:

a) by the user by means of user controlled activation and deactivation procedures;

b) by the network at predetermined times;

c) by the Administration or Recognized Private Operating Agency (RPOA) on request of the user;

d) by the Administration when providing and withdrawing the *redirection of calls* facility from the address.

User controlled procedures for inquiry of the status of the facility (i.e. whether the facility is activated or deactivated) may also be provided.

For international calls, redirection may only be made within the destination network. Some Administrations may allow redirection between networks within the destination country. In general, a call may only be redirected once. However, some Administrations may provide for multiple redirections of a call in the packet-switched data transmission service in PSPDNs and ISDNs.

The basic service is limited to one call redirection. In addition, some networks may offer either one of the following (mutually exclusive) capabilities. In the case where DTE A is the calling DTE, and DTE B is originally called DTE:

1) A list of alternate DTE's (C1, C2, ...) is stored by the network of DTE B. Consecutive attempts of call redirection are tried to each of these addresses, in the order of the list, up to the completion of the call.

2) Call redirections may be logically chained; if DTE C has subscribed to call redirection to DTE D, a call redirected from DTE B to DTE C may be redirected to DTE D; call redirections and call deflections may also be chained.

In any case, networks will ensure that loops are avoided and that the *Call Request* Phase has a limited duration, consistent with a DTE time limit.

The *redirection of call* facility will not violate the integrity of the *closed user group* facility.

For the packet switched networks, when the call is redirected, the called address of the alternate DTE and the *called line address modified notification* facility, indicating the reason why the called address is different from the one originally requested will be indicated to the calling DTE during the call confirmation phase or call clearing phase (see § 7.3.5).

When the call is redirected, some networks may indicate to the alternate DTE the reason for redirection and the address of the orignally called DTE, using the *call redirection notification* facility in the call request phase (see § 7.3.6).

The order of call set-up processing at the originally called DCE as well as the alternate DCE will be according to the sequence of call progress signals in Table 1/X.96. For those networks that provide systematic call redirection with the prior request of the called DTE, the systematic call redirection request will have the highest priority in the call set-up processing sequence at the originally called DCE.

It is for further study whether there is a need for an optional user facility for the calling DTE to indicate whether or not it is permitted to redirect calls originated by this DTE.

7.3.1.2 *Call set-up procedure for circuit switched data transmission services in CSPDNs*

7.3.1.2.1 *Calls not involving other facilities affecting the procedure*

Information that a user has the *redirection of calls* facility activated is stored, together with the redirection address, at the exchange to which the user is connected. When such a user is called, the call is set up to the redirection address in accordance with the following.

7.3.1.2.1.1 *The redirection address is at the same exchange*

In this case the destination exchange connects the call to the redirection address and returns the *redirected call* signal unless the call is rejected for one of the reasons indicated below. When receiving the *redirected call* signal, the originating exchange sends the corresponding call progress signal to inform the calling user that the call has been redirected.

In the case, where the user at the redirection address also has the *redirection of calls* facility activated, the destination exchange rejects the call and returns the *access barred* call progress signal. The call may also be rejected for other reasons (e.g. number busy) in accordance with the ordinary procedures.

7.3.1.2.1.2 *The redirection address is at another exchange*

7.3.1.2.1.2.1 In this case, the call is set up to the redirection address in accordance with one of the following procedures depending on the arrangements in the destination network.

7.3.1.2.1.2.2 The following procedure is based on the principle that the call is released back within the destination network and then set up to the new destination exchange. In the case of an international call, it is released back to the incoming gateway exchange. In the case of a national call, it is released back to the originating exchange. This procedure can be supported by common channel signalling Recommendation X.61. The means necessary to support this procedure are not defined in Recommendations X.70 and X.71.

i) The first destination exchange returns the *redirection request* signal together with the redirection address towards the controlling exchange (i.e. the incoming gateway or originating exchange).

ii) In the case of an international call, the incoming gateway exchange upon receipt of the *redirection request* signal, set up a new forward connection to the redirection address. The call control information forwarded includes a *redirected call* indication. The forward connection to the first redirection exchange is released.

iii) In the case of a national call, the originating exchange acts in accordance with ii).

iv) Upon receipt of the redirected call, the new destination exchange connects the call or rejects the call in accordance with § 7.3.1.2.1.1. The forward *redirected call* indication received by the new destination exchange is used to prevent further redirection.

v) In the case where the call is connected to the redirection address, the originating exchange will receive the *redirected call* signal. It then sends the *redirected call* call progress signal to inform the calling user that the call has been redirected.

7.3.1.2.1.2.3 The following procedure is based on the principle that the connection is extended forward from the first destination exchange to the new destination exchange. This procedure can be supported by common channel signalling and decentralized signalling in accordance with Recommendation X.61, and Recommendations X.70 and X.71 respectively.

i) The first destination exchange sets up the forward connection to the redirection address. The call control information forwarded will include a *redirected call* indication.

ii) Upon receipt of the redirected call, the new destination exchange connects or rejects the call in accordance with § 7.3.1.2.1.1. The received *redirected call* indication is used to prevent further redirection.

iii) In the case where the call is connected to the redirection address, the originating exchange will receive a *redirected call* signal. It then sends the *redirected call* call progress signal to inform the calling user that the call has been redirected.

7.3.1.2.2 *Calls involving a closed user group facility*

Redirected calls are subject to the restrictions applying for the closed user group (CUG) facilities.

a) In the case where the call is a CUG call, or the originally called user has a CUG facility, the call is rejected before redirection unless the validation check requirements applicable for the CUG facility concerned are satisfied.

b) In the case where the call is a CUG call, or the user at the redirection address has a CUG facility, the call is rejected unless the validation check requirements applicable for the CUG facility concerned are satisfied.

c) In the case where:

   i) the call is a CUG call, and

   ii) the redirection address is at an exchange other than the first destination exchange, and

   iii) the procedure for setting up the call to the redirection address is in accordance with § 7.3.1.2.1.2 (i.e. the call is released back), the first destination exchange has to send the CUG information received (e.g. the CUG call indication, and the interlock code) back to the controlling exchange together with the *redirected call* signal and the redirection address to enable the controlling exchange to include this CUG information in the call control information sent on the new forward connection.

7.3.1.2.3 *The calling user has the called line identification facility*

In the case where a call from a user that has the *called line identification* facility is redirected, the called line identity sent to the calling user is the data number of the redirection address.

7.3.2 *Deflection of calls*

7.3.2.1 *General*

Deflection of calls is an optional user facility assigned to the user for an agreed contractual period.

The facility enables a user to deflect incoming calls to another address on a per call basis for use on a packet switched virtual call service.

Upon reception of an incoming call request the originally called DTE responds with a clearing request including address of the DTE to which the call is to be deflected (i.e. data transfer phase never takes place between the calling DTE and originally called DTE). The network will consequently initiate an incoming call on the DTE interface to which the call is deflected.

For international calls, deflection may only be made within the destination network. Some Administrations may allow redirection between networks within the destination country. In general, a call may only be deflected once. However, some Administrations may provide for multiple deflections of a call in the packet switched data transmission service in PSPDNs and ISDNs.

The basic service is limited to one call deflection. In addition, in some networks call deflections and call redirections may be logically chained.

In this case, networks will ensure that loops are avoided and that the call request phase has a limited duration, consistent with a DTE time limit.

The *deflection of call* facility will not violate the integrity of the *closed user group* facility.

For the packet-switched networks, when the call is deflected, the called address of the alternate DTE and the *Called line address modified notification* facility, indicating the reason why the called address is different from the one originally requested will be indicated to the calling DTE during the call confirmation phase or call clearing phase (see § 7.3.5).

When the call is deflected, some networks may indicate to the alternate DTE the reason for redirection and the address of the originally called DTE, using the *call redirection* or *deflection notification* facility in the call request phase (see § 7.3.6).

It is for further study whether there is a need for an optional user facility for the calling DTE to indicate whether or not it is permitted to deflect calls originated by this DTE.

7.3.3 *Hunt group*

7.3.3.1 *General*

The *hunt group* facility is an optional user facility which distributes incoming calls containing a hunt group address across the available DTE/DCE interfaces associated with the facility.

Once a call is assigned to a DTE/DCE interface, the call is treated as a regular call.

Calls originated on a DTE/DCE interface belonging to the hunt group are handled as normal calls.

Note 1 – One or more addresses may be associated with the facility. If more than one address is associated with the facility, the selection procedure is performed irrespective of the particular called address.

Note 2 – A specific address may be assigned to each DTE/DCE interface associated with a hunt group. Calls placed directly to these specific addresses are treated normally (no distribution of calls). When distribution has been performed, and a specific address has been assigned in each DTE/DCE interface associated with the hunt group, this address should be returned to the calling DTE (as called line identification) together with an indicator indicating why the called line identification is different from the original called address.

7.3.3.2 *Call set-up procedure*

When receiving an incoming call having a hunt group address, the destination exchange performs the selection of DTE/DCE interface, if there is at least one idle circuit/channel available for incoming calls on any of the DTE/DCE interfaces in the group.

When calls are placed to a hunt group address, in the case specific addresses have also been assigned to the individual DTE/DCE interfaces, information is transferred to the calling DTE which contains:

1) the called address of the selected DTE/DCE interface, and
2) the reason why the called address is different from the one originally requested.

The exact arrangement is for further study.

For packet switching virtual call service, *called line address modified notification* facility is used for this purpose.

Some networks may apply call subscription time user facilities, common to all DTE/DCE interfaces in the hunt group, place a limit on the number of DTE/DCE interfaces in the hunt group, and/or constrain the size of the geographic region that can be served by a single hunt group.

7.3.4 *RPOA selection*

7.3.4.1 *General*

This facility is an optional user facility which may be either agreed for a period of time or requested by a DTE on a per call basis for use on either circuit switched or packet-switched virtual call services.

In the countries that have more than one RPOA transit network, there is a requirement for a user facility which, when requested, allows the calling DTE to select either one or a sequence of more than one RPOA transit network(s) within the originating country. In the case of international calls, this facility, when requested, allows the calling DTE to select a particular international RPOA within the country of that calling DTE.

Note – The procedure for selection of multiple RPOAs is not yet specified in the circuit switching interface Recommendations.

7.3.4.2 *Call set-up procedure*

A user in a network providing the RPOA selection facility may request selection of a particular, or a sequence of more than one RPOA transit network within the originating country, either for an agreed period of time or on a per call basis by a facility request including the NI(s) (see Recommendation X.302) identifying the RPOA transit network(s) selected.

In the case where a calling user request selection of one or more RPOA transit network(s), the originating network will route the call to the gateway exchange of the first RPOA transit network selected. In the case where the call is routed via one or more transit exchanges within the originating network, an RPOA selection request indication and the DNIC(s) identifying the RPOA transit network(s) requested will be included in the internal network call control information forwarded by the originating exchange. In a similar manner, if the calling user selects a sequence of transit networks, the first transit network shall route the call to the gateway exchange of the second RPOA transit network. Furthermore, the sequence of DNICs identifying the RPOAs selected by the user will be passed across the internetwork interface. Pending further study, the facility/utility used to provide this information is subject to bilateral agrement between the connecting transit networks.

The call control information sent over the international network will be as for an ordinary call and will not contain any *RPOA selection* related information.

In the case where the selected RPOA transit network cannot accept the call, due to, for example, congestion or network failures, the call is rejected by the gateway exchange and an *RPOA out-of-order* signal is returned towards the originating exchange which sends the corresponding call progress signal to the calling user.

7.3.5 *Called line address modified notification*

Called line address modified notification is an optional user facility used by the DCE in the call confirmation or call clearing phase to inform the calling DTE as to why the called address in this phase is different from that specified by the calling DTE in the call request phase.

When more than one address applies to a DTE/DCE interface, the called line address modified notification facility may be used by the responding DTE in the call clearing phase (when the call is rejected) or in the call confirmation phase, when the called address is presented by the responding DTE and different from that indicated to the DTE in the call request phase. When this facility is received from the responding DTE:

1) The DCE will clear the call if the called address is not one of those applying to the interface.

2) If call redirection has taken place in the PDN or ISDN, the DCE will replace the reason contained in the *called line address modified notification* facility with the reason reflecting the status of the originally called DTE; otherwise, the reason is passed transparently.

   Note – The DTE should be aware that a modification of any part of the called DTE addresses field without notification by the *called line address modified notification* facility may cause the call to be cleared.

The following reasons can be indicated with the use of the *called line address modified notification* facility in *call confirmation* phase or *clearing* phase and transmitted to the calling DTE:

1) Call distribution with a hunt group,

2) Call redirection due to originally called DTE out of order,

3) Call redirection due to originally called DTE busy,

4) Call redirection due to prior request from the originally called DTE for systematic call redirection,

5) Called DTE originated, or

6) Call reflection by the originally called DTE.

In *call conformation* or *clearing* phases, the reason indicated by the responding DTE in conjunction with the use of the *called line access modified notification* facility should be "DTE originated".

7.3.6 *Call redirection or call deflection notification*

Call redirection or *deflection notification* is an optional user facility, used by the DCE in the call request phase to inform the alternate DTE that the call has been redirected or deflected, why the call was redirected and the address of the originally called DTE.

The following reasons can be indicated with the *call redirection* or *deflection notification* facility:

1) Call redirection due to originally called DTE out of order.

2) Call redirection due to originally called DTE busy,

3) Call redirection due to prior request from the originally called DTE for systematic call redirection,

4) Call deflection by the originally called DTE, or

5) Call distribution within a hunt group.

7.4 *Facilities related to protection mechanisms requested by the user of the call*

The optional user facilities which are standardized for different data transmission services and are related to protection mechanisms requested by the user of the call are shown in Table 7-4/X.310.

TABLE 7-4/X.301

Optional user facilities, standardized for different data transmission services, related to protection mechanisms requested by the user of the call

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PTSN	CSPDN	ISDN	ISDN	PSPDN	MSS
CUG related facilities:								
– CUG	X			X		X	X	X
– CUG with outgoing access	X			X		X	X	X
– CUG with incoming access	X			X		X	X	X
– Incoming calls barred within a CUG	X					X	X	X
– Outgoing calls barred within a CUG	X					X	X	X
– CUG selection		X (Note)		X		X	X	X
– CUG with outgoing access selection		X (Note)			FS	X	X	X
Bilateral CUG related facilities:								
– Bilateral CUG	X			X		X	X	X
– Bilateral CUG with outgoing access	X			X		X	X	X
– Bilateral CUG selection		X (Note)				X	X	X
Incoming calls barred	X			X		X	X	X
Outgoing calls barred	X			X		X	X	X
NUI	X	X (Note)				X	X	X
NUI override permission		X (Note)				X	X	X

Remarque – These facilities cannot be used unless the corresponding facilities are agreed for a period of time.

7.4.1 *Closed user group*

7.4.1.1 *General*

The closed user group (CUG) facilities enable users to form groups with different combinations of restrictions for access from or to users having one or more of these facilities. The following CUG facilities are all optional user facilities that are assigned to the user for an agreed contracted period (see Note 1):

a) *Closed user group* – this is the basic facility that enables a user to belong to one or more CUGs;

b) *Closed user group with outgoing access* – this is an extension to a) which also enables the user to make outgoing calls to the open part of the network, and to DTEs having the incoming access capability [see c) below];

c) *Closed user group with incoming access* – this is a variant of a) which also enables the user to receive incoming calls from the open part of the network, and from DTEs having the outgoing access capability [see b) above];

d) *Incoming calls barred within the closed user group* – this is a supplementary facility to a), b) or c) which, when used, applies per user per CUG;

e) *Outgoing calls barred within the closed user group* – this is a supplementary facility to a), b) or c) which, when used, applies per user per CUG;

A user may belong to one or more CUGs. In the case where the user belongs to only one CUG, and the *closed user group* facility is subscribed to, it becomes the preferential CUG of that user. In the case where the user belongs to more than one CUG, and the closed user group facility is subscribed to, one of these CUGs is nominated as the preferential CUG of that user.

Each user belonging to at least one CUG has subscribed to either the *closed user group* facility or one of both of the closed user groups with outgoing access and the closed user group with incoming access. When the closed user group with outgoing access and/or the *closed user group with incoming access* facility is subscribed to, the DTE may choose whether or not to have a preferential CUG.

For each CUG to which a user belongs, either or none of the supplementary facilities incoming calls barred within the closed user group or outgoing calls barred within the closed user group facilities may apply for that user. Different combinations of CUG facilities may apply for different users belonging to the same CUG.

The realization of the CUG facilities is done by the provision of interlock codes and is based on various validation checks at call set-up, determining whether or not a requested call to or from a user having a CUG facility is allowed. In particular, a validation check is performed by verification that both the calling and called users belong to the same CUG as indicated by interlock codes.

Membership of closed user groups is controlled by the Administration or RPOA in conjunction with user requests. Assignment of interlock codes is controlled by the Administration or RPOA, and cannot be controlled by the user.

The international interlock code of an international CUG is specified in § 7.4.1.3. The international interlock code expresses the international CUG number assigned to the CUG in accordance with the administrative rules defined in Recommendation X.180.

The originating network identification utility specified in Recommendation X.302 may be used for international CUG calls under control of the gateway exchange of the destination network (see § 7.4.1.2.2).

Note 1 – Outgoing access and/or incoming access applies to an individual user and not to a specific closed user group.

Note 2 – The requirements in § 7.4.1.2 include cases which do not necessarily exist in a particular network, either because the Administration (or RPOA) has chosen not to offer the full range of CUG facility combinations or because some combinations are not meaningful from the user's point of view.

Note 3 – A network should, also in the case where the *closed user group with outgoing access* facility is not provided, be capable of supporting the signalling necessary to complete incoming calls from users in another network providing that facility.

Note 4 – Private networks, including several different terminals and types of terminals will be connected to the public data network or ISDN. In these private networks, the different terminals may belong to different groups internally in the private networks, and may also have a need to communicate into different CUGs in the public data network or ISDN. The option by the private network not to have a preferential CUG when subscribing to the *closed user group with outgoing access* facility and/or the *closed user group with incoming access* facility allows for proper interpretation of the CUG facilities.

The signals related to the treatment of calls in relation to CUGs are illustrated in Figure 7-6/X.301 and summarized in Tables 7-5/X.301, 7-6/X.301 and 7-7/X.301.

7.4.1.2 *Call set-up procedure*

7.4.1.2.1 *Originating exchange*

The DTE/DCE interface protocol and the actions at the originating exchange at call set-up from a user belong to a CUG depends on whether the user belongs to one or more CUGs and on the combination of CUG facilities that applies. See also Figure 7-7/X.301.

7.4.1.2.1.1 *CUG selection*

For each CUG that a user belongs to, the interlock code assigned to the CUG is stored, and is associated to the user at the local exchange. In the case where a user belongs to more than one CUG, a selection of the CUG preferred, and thus of the corresponding interlock code, is required at call establishment. This selection is made on the following criteria.

In the case where the calling user makes a facility request including an index identifying a particular CUG, this CUG is selected by the originating exchange.

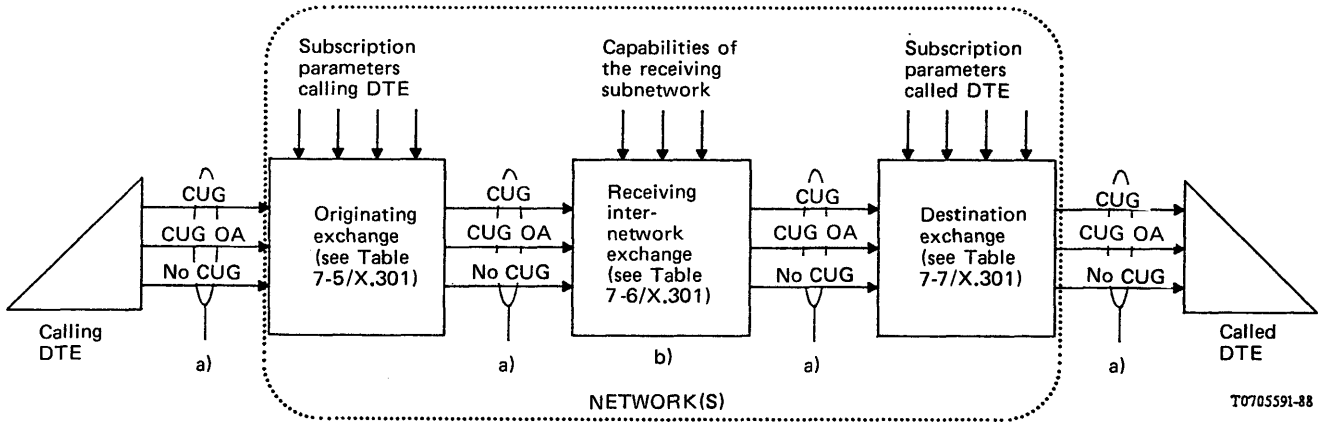
In the case where the calling user belongs to one or more CUGs and has a preferential closed user group, no facility request concerning CUG facilities is made in the case:

a) where the user belongs to one CUG only;

b) where a user belonging to more than one CUG with or without outgoing access, makes a call within the preferential CUG; or

c) where a user, having the *closed user group with outgoing access* facility, makes an outgoing access call, or a call within the preferential CUG.

A facility request is always required for a call within any CUG other than the preferential CUG.



CUG OA: closed user group with outgoing access

a) Possible different signals regarding CUG.
b) Not always present.

FIGURE 7-6/X.301

Treatment of calls in relation to CUGs

TABLE 7-5/X.301

CUG signals into the network by the originating exchange resulting from CUG signals by the calling DTE and subscription parameters of the calling DTE

Signaled by the calling DTE in the call request phase (see Note 1) / Subscription of the calling DTE	CUG selection facility	CUG/OA selection facility	No CUG nor CUG/OA selection facility
CUG with preferential (see Note 2)	CUG utility (CUG specified) (see Note 3)	Not allowed (call cleared)	CUG utility (Preferential CUG) (see Note 3)
CUG/OA with preferential	CUG/OA utility (CUG specified) (see Note 3)	Not allowed (call cleared)	CUG/OA utility (Preferential CUG) (see Note 4)
CUG/IA with preferential	CUG utility (CUG specified) (see Note 3)	Not allowed (call cleared)	CUG utility (Preferential CUG) (see Note 3)
CUG/IA/OA with preferential	CUG/OA utility (CUG specified) (see Note 3)	Not allowed (call cleared)	CUG/OA utility (Preferential CUG) (see Note 4)
CUG/OA without preferential	CUG utility (CUG specified) (see Note 3)	CUG/OA utility (CUG specified) (see Note 4)	No CUG nor CUG/OA utility
CUG/IA without preferential	CUG utility (CUG specified) (see Note 3)	Not allowed (call cleared)	Not allowed (call cleared)
CUG/IA/OA without preferential	CUG utility (CUG specified) (see Note 3)	CUG/OA utility (CUG specified) (see Note 4)	No CUG nor CUG/OA utility
No CUG	Not allowed (call cleared)	Not allowed (call cleared)	No CUG nor CUG/OA utility

IA = incoming access.
OA = outgoing access.

Note 1 – The inclusion of both CUG and CUG/OA selection facilities is not allowed in the call request phase.

Note 2 – CUG without preferential is not allowed.

Note 3 – If outgoing calls are barred within the preferential, specified CUG or only CUG then the call is cleared.

Note 4 – If outgoing calls are barred within the preferential, specified CUG or only CUG then only outgoing access applies. No CUG is signaled into the network.

TABLE 7-6/X.301

CUG signals into the receiving subnetwork by the receiving internetwork exchange resulting from CUG signals to the receiving internetwork exchange and receiving subnetwork capabilities

Signalled to the receiving internetwork exchange in the call request phase / Capabilities of the receiving subnetwork	CUG utility	CUG/OA selection facility	No CUG nor CUG/OA selection facility
No CUG nor CUG/OA utility is supported	Access barred (call cleared)	Access barred (call cleared)	No CUG nor CUG/OA utility
Only the CUG utility is supported	CUG utility (CUG specified)	Access barred [a] (call cleared)	No CUG nor CUG/OA utility
Both the CUG and CUG/OA utilities are supported	CUG utility (CUG specified)	CUG/OA utility (CUG specified)	No CUG nor CUG/OA utility

OA = outgoing access.

[a] This entry needs further study for alignment with Table 24/X.25, note 6.

TABLE 7-7/X.301

CUG signals to the called DTE by the destination exchange resulting from CUG signals from the network and subscription parameters of the called DTE

Signalled from the network to the destination exchange in the call request phase / Subscription of the called DTE	CUG utility	CUG/OA utility	No CUG nor CUG/OA utility
CUG with preferential (see Note 1)	CUG sel. fac. (CUG specified) (see Note 2.3.4)	CUG sel. fac. (CUG specified) (see Note 2.3.4)	Access barred (call cleared)
CUG/OA with preferential	CUG sel. fac. (CUG specified) (see Note 2.3.4)	CUG sel. fac. (CUG specified) (see Note 2.3.4)	Access barred (call cleared)
CUG/IA with preferential	CUG sel. fac. (CUG specified) (see Note 2.3.4)	CUG sel. fac. (CUG specified) (see Note 4.5.6)	No CUG nor CUG/OA sel. fac.
CUG/IA/OA with preferential	CUG sel. fac. (CUG specified) (see Note 2.3.4)	CUG sel. fac. (CUG specified) (see Note 4.5.6)	No CUG nor CUG/OA sel. fac.
CUG/OA without preferential	CUG sel. fac. (CUG specified) (see Note 2.3)	CUG sel. fac. (CUG specified) (see Note 2.3)	Access barred (call cleared)
CUG/IA without preferential	CUG sel. fac. (CUG specified) (see Note 2.3)	CUG/OA sel. fac. (CUG specified) (see Note 5.6)	No CUG nor CUG/OA sel. fac.
CUG/IA/OA without preferential	CUG sel. fac. (CUG specified) (see Note 2.3)	CUG/OA sel. fac. (CUG specified) (see Note 5.6)	No CUG nor CUG/OA sel. fac.
No CUG	Access barred (call cleared)	No CUG nor CUG/OA sel. fac.	No CUG nor CUG/OA sel. fac.

Note 1 – CUG without preferential is not allowed.

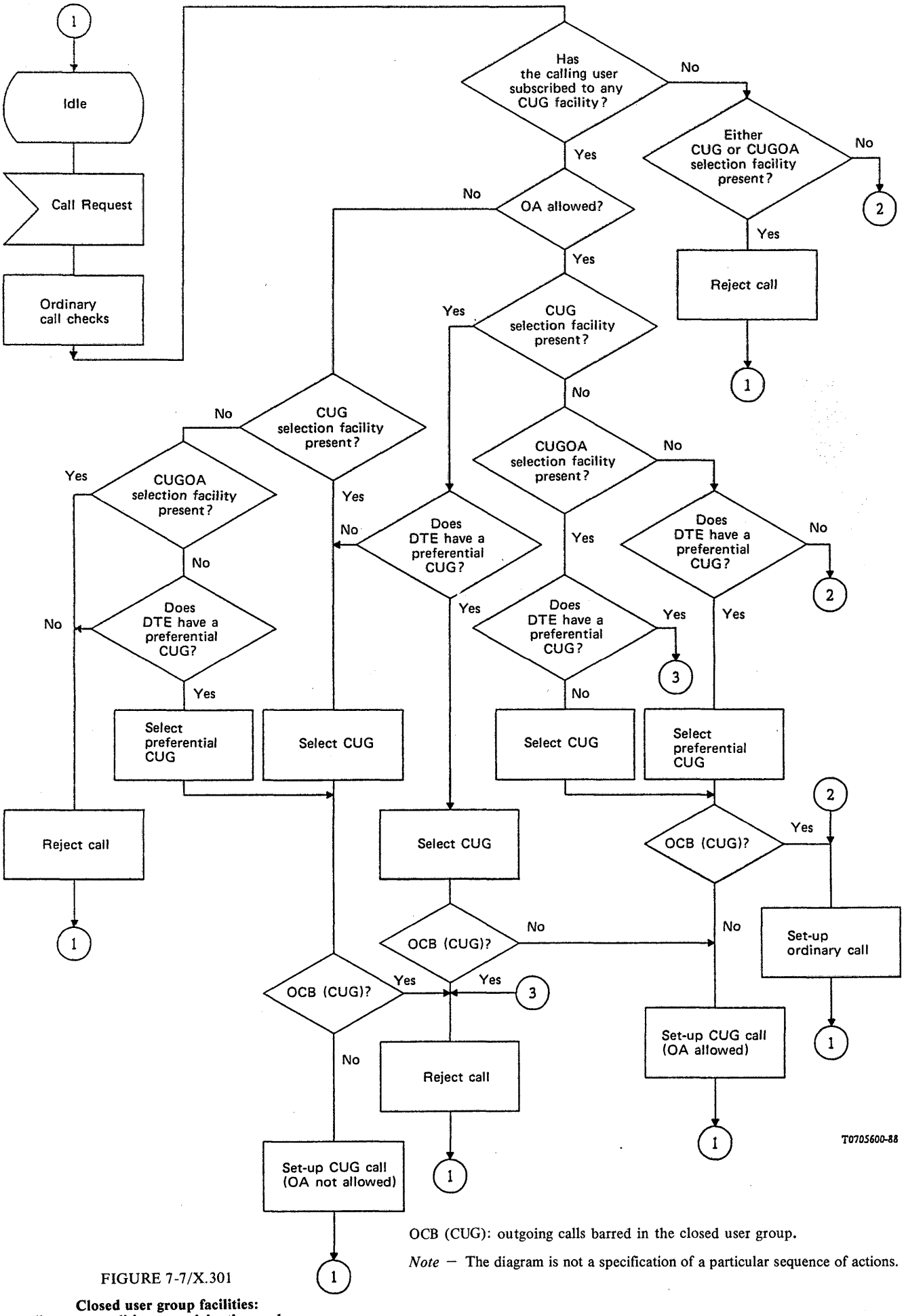
Note 2 – If the CUG specified to the destination exchange is not subscribed to by the called DTE, then the call is blocked.

Note 3 – If incoming calls are barred within the specified CUG, then the call is blocked.

Note 4 – If the specified CUG is the preferential CUG then the incoming call may contain no CUG nor CUG/OA facility.

Note 5 – If the CUG specified to the destination exchange is not subscribed to by the called DTE, then Incoming Access applies; the incoming call contains no CUG nor CUG/OA selection facility.

Note 6 – If incoming calls are barred within the specified CUG, then Incoming Access applies; the incoming call contains no CUG nor CUG/OA selection facility.



OCB (CUG): outgoing calls barred in the closed user group.

Note – The diagram is not a specification of a particular sequence of actions.

FIGURE 7-7/X.301

Closed user group facilities: call set-up conditions at originating exchange

In the case where the calling user belongs to one or more CUGs and does not have a préferential closed user group, no facility request concerning CUG facilities is made in the case where a user having the closed user group with outgoing access facility makes an outgoing access call.

7.4.1.2.1.2 *Call set-up from a user having the CUG or the CUG with incoming access facility*

The case where a user has both the *closed user group with incoming access* and *closed user group with outgoing access* facilities is handled in accordance with § 7.4.1.2.1.3.

In this case, CUG selection is performed in accordance with § 7.4.1.2.1.1.

In the case where the *outgoing calls barred within the closed user group* facility does not apply for the selected CUG, the call is set-up at the originating exchange. The call control information forwarded to the next exchange then includes the interlock code of the selected CUG together with an indication that the call is a CUG call.

In the case where the outgoing calls barred within the closed user group facility applies for the selected CUG, the call is rejected and the access barred call progress signal is returned to the calling user.

7.4.1.2.1.3 *Call set-up from a user having the closed user group with outgoing access facility*

In the case where the calling user subscribes to the *closed user group with outgoing access* facility, and has a preferential (or only) CUG, the call is regarded as an outgoing access call and a call within the preferential (or only) CUG.

In the case where the *outgoing calls barred within the closed user group* facility does not apply for the preferential (or only) CUG, the call is set up at the originating exchange. The call control information forwarded to the next exchange then includes the interlock code of the preferential (or only) CUG together with an indication that the call is a CUG call for which outgoing access is allowed.

Note – With the above procedure it is not necessary to distinguish at the originating exchange between a call within a CUG and an outgoing access call.

In the case where the *outgoing calls barred within the closed user group* facility applies for the preferential (or only) CUG, the call is regarded as an outgoing access call. In this case the call is set up at the originating exchange and no interlock code or CUG call indication is included in the call control information forwarded to the next exchange.

In the case where the calling user subscribes to the *closed user group with outgoing access* facility, and does not have a preferential closed user group, the call is regarded as an outgoing access call, unless the calling user makes a facility request identifying a particular CUG for the call.

7.4.1.2.2 *Transit exchange*

With the possible exception of some gateway exchanges, each transit exchange set-up a CUG call as an ordinary call. The information related to the CUG facilities received from the preceding exchange (i.e. an interlock code, a CUG call indication and possibly an indication that outgoing access is allowed) is forwarded to the succeeding exchange.

In the case of an international CUG call, no special functions are required at the gateway exchange provided that the international interlock code assigned to the international CUG concerned is used in the national network. However, in the case where a national interlock code other than the applicable international interlock code is used within a national network, interlock code conversion is required at the gateway (or corresponding) exchange.

In the case where a destination network has a requirement for identification of the originating network for CUG calls, the originating *network identification* utility specified in Recommendation X.302 may be employed.

7.4.1.2.3 *Destination exchange*

At the destination exchange, a validation check of the acceptability of a call is made where either the calling user (as indicated by a CUG call indication in the control information received) or the called user belongs to a CUG. The call is connected only in cases where the information received checks with the information stored at the destination exchange, associated to the called user, as specified in the following. In cases where a call is rejected because of incompatible CUG information an *access barred* call progress signal is sent towards the calling user.

The conditions for acceptance or rejection of calls because of the CUG facilities are illustrated in Figure 7-8/X.301.

Note – A call may be rejected for reasons other than those related to the CUG facilities.

7.4.1.2.3.1 *Calls to a user having the CUG or the CUG with outgoing access facility*

The case where a user has both *CUG with incoming access* and *CUG with outgoing access* facilities is handled in accordance with § 7.4.1.2.3.2.

In this case, an incoming call is accepted only when:

a) it is a CUG call, including the case where outgoing access is allowed, and

b) correspondence is found between the interlock code received and an interlock code associated with the called user, and

c) the incoming calls barred within the closed user group facility does not apply for the CUG identified by the interlock code received.

If all of the above conditions are not met, the call is rejected.

7.4.1.2.3.2 *Calls to a user having the CUG with incoming access facility*

An incoming call is accepted in the cases when:

a) it is an ordinary call, or

b) it is a CUG call for which outgoing access is allowed, or

c) it is a CUG for which outgoing access is not allowed, and both conditions specified in § 7.4.1.2.3.1 b) and c) apply.

In all other cases, the incoming call is rejected.

7.4.1.2.3.3 *CUG calls to a user not belonging to any CUG*

In the case where the incoming call is:

a) a CUG call for which outgoing access is allowed, it is accepted, or

b) a CUG call for which outgoing access is not allowed, it is rejected.

7.4.1.3 *International interlock code*

Each international CUG is assigned a unique International CUG Number (ICN) according to the administrative rules defined in Recommendation X.180.

Each international interlock code includes:

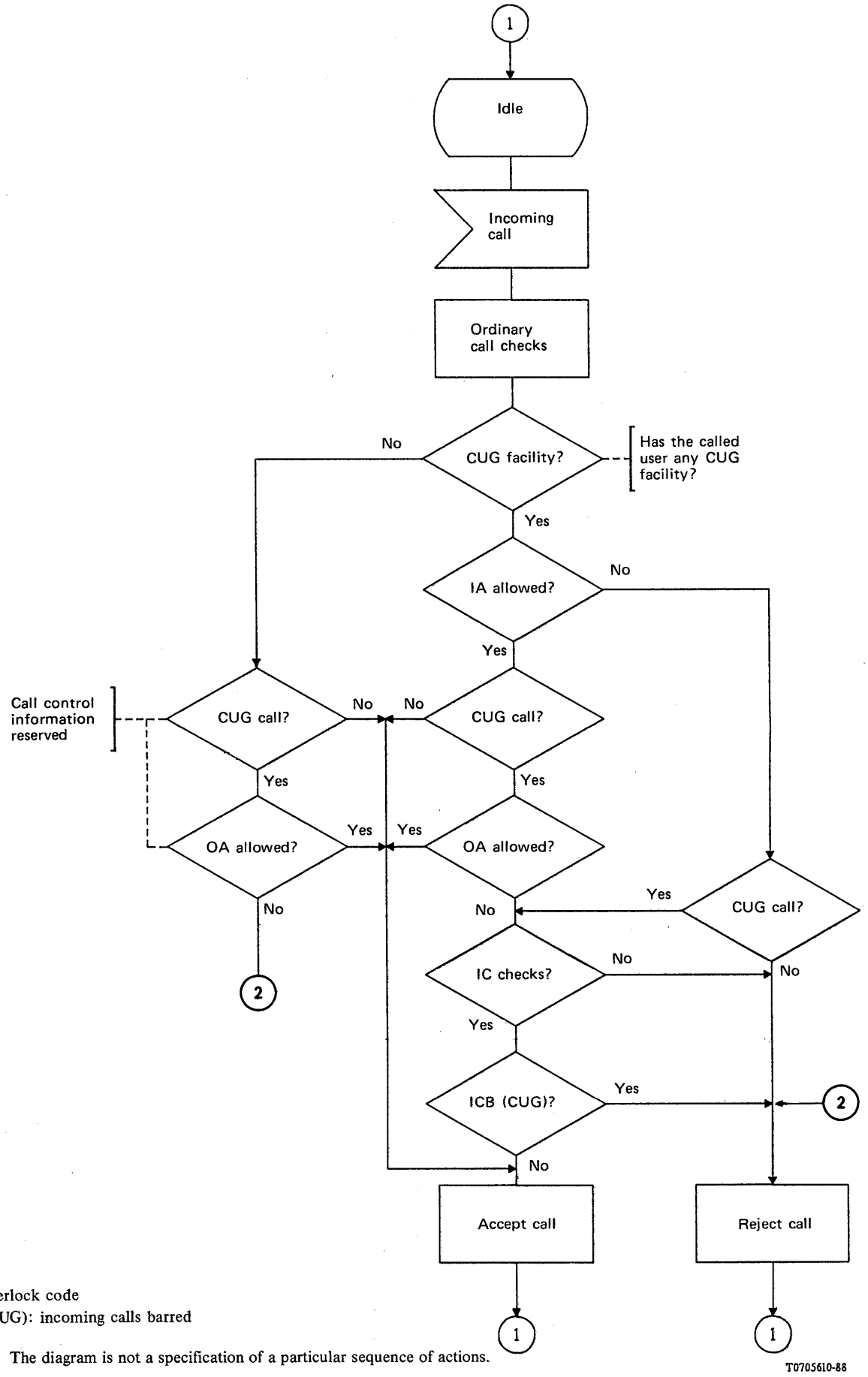
a) four binary coded decimal digits expressing the DCC plus one digit, or DNIC, or the country or network of the coordinating Administration or Recognized Private Operating Agency, i.e. the decimal number A of the international CUG number; and

b) a 16-Bit code expressing in pure binary representation the value of the decimal number B of the international CUG number.

The interlock code is transferred, DNIC/DCC portion first, in accordance with the procedures specified by the relevant Recommendations X.61, X.70, X.71 or X.75.

Note 1 – In some cases of signalling, all, some or none of the leading zeros are transmitted; see Recommendations X.70 and X.71. The binary code should then have the same meaning regardless of the number of leading zeros.

Note 2 – It is for further study whether or not the accommodation of international CUGs with members on public networks other than PDNs (e.g. ISDNs), will require any additional arrangements for handling international CUG interlock codes in PDNs.



IC: interlock code
ICB (CUG): incoming calls barred

Note – The diagram is not a specification of a particular sequence of actions.

FIGURE 7-8/X.301

Closed user group facilities:
call set-up conditions at destination exchange

7.4.2 *Bilateral closed user group*

7.4.2.1 *General*

Bilateral closed user group and *bilateral closed user group with outgoing access* are optional user facilities assigned to the user for an agreed contractual period.

The *Bilatercal Closed User Group* (BCUG) facility is a user facility that enables pairs of users to form bilateral relations allowing access between each other while excluding access to or from other users with which such a relation has not been formed. A user may belong to more than one BCUG.

The *Bilateral Closed User Group with Outgoing access* (BCUGOA) facility is a user facility that enables a user to form BCUGs as with the *bilateral closed user group* facility, but at the same time allows the user to access by outgoing calls open users not having the *bilateral closed user group* or *bilateral closed user group with outgoing access* facilities.

A user may simultaneously have the *bilateral closed user group* or *bilateral closed user group with outgoing access* facility and one or more of the *closed user group* (CUG) facilities. In such cases, a call within a CUG is handled separately from the *bilateral closed user group* facility and is not regarded as an outgoing access call in relation to the *bilateral closed user group* facility.

Registration and cancellation of a BCUG of two users to the *bilateral closed user group* or *bilateral closed user group with outgoing access* facilities are controlled by the users concerned by means of automatic registration and cancellation procedures.

The *bilateral closed user group* and *bilateral closed user group with outgoing access* facilities, including automatic user controlled facility registration and cancellation, can be supported by common channel signalling (Recommendation X.61) for the circuit-switched data transmission service. Decentralized signalling for the circuit-switched data transmission (Recommendations X.70 and X.71) and for the packet-switched data transmission service (Recommendation X.75) cannot support the facilities.

The procedures for the *bilateral closed user group* facility are based on the mutual registration method. This method makes use of the features of abbreviated address calling. Thus, a user having the *bilateral closed user group* facility uses a local index (i.e. an abbreviated address) for each remote user with which a BCUG is formed. In the exchange to which the user is connected, a table associated with that user is available. The local index used to address a remote user corresponds to a position in the table containing the data number (address) of the remote user, the local index used by that remote user to address the local user, and an indication (association bit) about the status of the BCUG.

7.4.2.2 *Registration procedures*

7.4.2.2.1 When requesting registration of a BCUG, the user *A* makes a facility request including the data number *B* of the remote user and the local index *x* used for that user. The originating exchange checks whether a data number has been registered or not in the position corresponding to the local index *x* received, in the local user *A* table.

a) In the case where a data number has not yet been registered in position *x* in the user *A* table, the originating exchange registers data number *B* in that position. The originating exchange then sends a BCUG registration request to the destination exchange, including a data number *B* as a destination address, data number *A* as a source address and the local index *x*

b) In the case where data number *B* for the remote user has already been registered in position *x* in the user *A* table, and its association bit has not yet been set, indicating that registration has not yet been completed, the originating exchange sends a BCUG registration request to the destination exchange, including the same information as described in a) above.

c) In the case where data number *B* for the remote user has already been registered in position *x* in the user *A* table and its association bit has already been set, the originating exchange sends the *registration/cancellation confirmed* call progress signal to user *A*.

d) In the case where the data number registered in that position is different from the data number *B* received, the originating exchange sends the *local procedure error* call progress signal to user *A*.

7.4.2.2.2 When receiving the BCUG registration request, the destination exchange checks the addressed user *B* table.

a) In the case where user *B* has already registered user *A* in a position *y*, where *y* is the local index used by user *B* for user *A*, and its association bit has not yet been set, indicating that registration has not yet been completed, the destination exchange sets the association bit and registers local index *x* in that position. The destination exchange then responds to the originating exchange with a *registration completed* signal together with the local index *y*.

b) In the case where user *B* has already registered user *A* in position *y* and its association bit has already been set, the destination exchange checks the local index registered in that position. In the case when that local index is equal to the local index received, the destination exchange responds to the originating exchange as under item a) above.

c) In the case where user *B* has not registered data number *A* in any position, the destination exchange responds to the originating exchange with a *registration accepted* signal.

d) In the case where user *B* does not subscribe to the BCUG facility, the destination exchange responds to the originating exchange with an *access barred* call progress signal.

e) In the case where user *B* is not accessable by user A for any other reason, the destination exchange responds to the originating exchange with the appropriate call progress signal.

7.4.2.2.3 When receiving the response to a BCUG registration request from the destination exchange, the action at the originating exchange depends on the signal received.

a) In the case where a *registration completed* signal is received, the originating exchange sets the association bit and registers the local index *y* in position *x* in the user *A* table and send the *registration/cancellation confirmed* call progress signal confirming registration to user *A*.

b) In the case where a *registration accepted* signal is received, no further registration is made at the originating exchange and the *registration/cancellation confirmed* call progress signal is sent to user *A*.

c) In the case where a signal is received indicating that BCUG registration has been rejected by the destination exchange, the originating exchange clears all the information in position *x* in the user *A* table and sends the corresponding call progress signal to user *A*.

7.4.2.2.4 With the above procedures, registration of a BCUG is completed when both users concerned have requested registration of each other and have received positive responses.

7.4.2.3 *Cancellation procedure*

7.4.2.3.1 When requesting cancellation of a BCUG, user *A* makes a facility request, including local index *x*. The originating exchange checks the status of position *x* in the user *A* table.

a) In the case where a data number is registered in position *x*, the originating exchange sends a BCUG cancellation request with data number *B* as address and including remote local index *y* and the calling user number *A*. Also, the originating exchange resets the association bit if it was set.

b) In the case where no data number is registered in position *x*, the originating exchange returns the *registration/cancellation confirmed* call progress signal to user *A*.

7.4.2.3.2 When receiving the BCUG cancellation request the destination exchange checks the addressed user *B* table.

a) In the case where the data number in position *y* in user *B* table is equal to the data number *A* received, the destination exchange clears all information in position *y*.

b) In all other cases, and in particular in the case where the data number stored in position *y* is different from the data number *A* received, the destination exchange does not alter any information stored in the user *B* table.

In cases a) and b), the destination exchange sends a *cancellation completed* signal to the originating exchange.

7.4.2.3.3 When receiving the *cancellation completed* signal in response to a BCUG cancellation request, the originating exchange clears all the information in position *x* in the user *A* table and sends the *registration/cancellation confirmed* call progress signal to user *A*.

7.4.2.3.4 With the above procedure, a BCUG is cancelled when either of the two users concerned has requested cancellation and has received the *registration/cancellation confirmed* call progress signal.

Note – Possible implications of abnormal conditions at cancellation may require further study.

7.4.2.4 *Time-out supervision in registration/cancellation procedure*

At the originating exchange in the facility registration/cancellation procedure, it is necessary to wait for receipt of the response from the destination exchange after sending a BCUG registration/cancellation request. The duration of such periods has to be controlled by appropriate time-outs.

The following time-outs are necesary:

T1 – The time between the sending of the BCUG registration request and receipt of a response in accordance with § 7.4.2.2.

T2 – The time between the sending of the BCUG cancellation request and receipt of a *cancellation completed* signal.

On expiration of time-out T1 or T2, the originating exchange sends the *network congestion* call progress sinal to user *A* thus indicating that the requested registration or cancellation has failed. User *A* then has to repeat the request for registration or cancellation.

The value of T1 and T2 should *(provisionally)* be 5-10 seconds.

7.4.2.5 *Call set-up procedure*

7.4.2.5.1 *Originating exchange*

7.4.2.5.1.1 When making a call within a BCUG, the calling user *A* uses the local index *x* as address for the called user (in accordance with the procedure for the abbreviated address calling facility). The originating exchange checks the position corresponding to the local index *x* registered in the calling user *A* table.

a) In the case where the association bit is set, indicating that the BCUG is registered by both the calling and called users, the originating exchange sets up the call towards the destination exchange, using the called user data number *B* stored in the calling user *A* table. The call control information forwarded by the originating exchange includes an indication that the call is a BCUG call.

b) In the case where the association bit is not set, indicating that the BCUG is not completely registered, the originating exchange rejects the call and sends the *access barred* call progress signal to the calling user.

7.4.2.5.1.2 In the case where a user having the *bilateral closed user group* facility makes a call with an ordinary data number or an abbreviated address not registered as a BCUG, the originating exchange rejects the call and sends *access barred* call progress signal to the calling user.

Note – In the case where the user also belongs to a closed user group (CUG), calls within a CUG are handled independently and are not rejected because of the *bilateral closed user group* facility.

7.4.2.5.1.3 In the case where a user having the *bilateral closed user group with outgoing access* facility makes a call with an ordinary data number or an abbreviated address not registered as a BCUG, the call is handled as an outgoing acces call and is set up by the originating exchange in accordance with ordinary call set up procedure.

7.4.2.5.1.4 The possibility of transfer of the local index *x* (in the forward direction) and local index *y* (in the backward direction) and the possibility of additional verification checks at the destination exchange are for further study.

7.4.2.5.2 *Transit exchange*

A transit exchange handles a BCUG call as an ordinary call.

7.4.2.5.3 *Destination exchange*

7.4.2.5.3.1 When receiving a BCUG call, the destination exchange may accept the call without checking whether the called user has the *bilateral closed user group* facility.

7.4.2.5.3.2 When receiving an ordinary call (i.e. not a BCUG call) to a user having the *bilateral closed user group* facility, the destination exchange rejects the call and responds with the *access barred* call progress signal to the originating exchange.

7.4.2.5.3.3 The call may be rejected for other reasons not related to the *bilateral closed user group* facility. Closed user group calls can be accepted regardless of the above conditions, provided that the requirements of that facility are met (see § 2).

7.4.2.5.4 *Combination of BCUG and line or terminal identification facilities*

The possible arrangements for combinations of the *bilateral closed user group* or *bilateral closed user group with outgoing access* facilities and the *calling line dentification* and/or *called line identification* facilities and the form of calling or called DTE identification of BCUG calls are for further study.

7.4.3 *Incoming calls barred*

Incoming call barred is an optional user facility agreed for a period of time. This facility applies to all calls used at the DTE/DCE interface.

This facility, if subscribed to, prevents incoming calls from being presented to the DTE. The DTE may originate outgoing calls.

Note – Some Administrations may provide a capability that also allows a call to be presented to the DTE only in cases where the called address is the address of the calling DTE.

7.4.4 *Outgoing calls barred*

Outgoing calls barred is an optional user facility agreed for a period of time. This facility applies to all calls used at the DTE/DCE interface.

This user facility, if subscribed to, prevents the DCE from accepting outgoing calls from the DTE. The DTE may receive incoming calls.

7.4.5 *Network User Identification*

Network User Identification is an optional user facility agreed for a period of time. This facility, if subscribed to, enables the DTE to provide information to the network for billing, security or network management purpose on a per call basis. This information may be provided by the calling DTE in the call request phase or by the called DTE in the call confirmation phase. It may be used whether or not the DTE has also subscribed to the *local charging prevention* facility (see § 7.2.2). If the DCE determines that the network user identifier is valid or not present when required by the network, it will clear the call.

Network user identification is never transmitted to the remote DTE. The calling DTE address transmitted to the remote DTE in the calling DTE address field should not be inferred from the network user identification transmitted by the DTE in the *call request* phase.

The contents and format of the NUI parameter is a national matter.

Use of this feature between networks is subject to bilateral agreement between Administrations.

7.4.6 *NUI override permission facility*

The *NUI override permission* facility is an optional user facility agreed to for a period of time. This facility, if subscribed to, permits an NUI facility, presented in the call request phase, to invoke features subscribed to by the DTE identified by that NUI and associated with the NUI. Facilities associated with the NUI shall override facilities which may apply to the interface. This override does not apply to existing calls or subsequent calls on the interface. It remains in effect for the duration of the particular call to which it applies.

The optional subscription facilities that may be associated with an NUI are a national matter.

7.5 *Facilities to convey user data in addition to the normal data flow in the data transfer phase*

Note – Different terms exist; in general "user data" is used in X-series Recommendations, and "user-to-user information" is used in I-series Recommendations.

7.5.1 *General*

Conveyance of user data in addition to the normal data flow in the data transfer phase can be considered in the following phases of a call:

a) Call request phase (calling DTE to called DTE),

b) Call confirmation phase (called DTE to calling DTE),

c) Call clearing phase (clearing DTE to cleared DTE).

Support of conveyance of user data during these phases is shown in Table 7-8/X.301.

TABLE 7-8/X.301

Support by different networks to convey user data in addition to the normal data flow in the data transfer phase

Network / Phases	CSPDN or PSTN	PSPDN or MSS	ISDN	
			Cicuit switched	Packet switched
Call request phase	No support	Up to 16 octets or Up to 128 octets (fast select)	Up to 128 octets	Up to 16 octets or Up to 128 octets (fast select)
Call confirmation phase	No support	Up to 128 octets (fast select)	Up to 128 octets	Up to 128 octets (fast select)
Call clearing phase	No support	Up to 128 octets (fast select)	Up to 128 octets	Up to 128 octets (fast select)

Note – Some networks require conveyance of an integral number of octets.

For interworking between networks providing a different level of support of conveying user data in addition to the normal data flow in the data transfer phase, the following principles apply:

a) the objective is that in the future all networks can support conveyance of up to 128 octets user data during the call request phase, call confirmation phase, and call clearing phase, for the provision of data transmission services;

b) in cases where conveyance of user data during these phases is requested, but where no support by the network is provided, an additional protocol mechanism, which is not operated by the network itself should be utilized (example: the use of packet procedures over the PSTN);

c) in cases where rule b) fails or is not provided, the data calls will be aborted; an appropriate call progress message is returned to the DTE initiating the phase.

7.5.2 *Fast select*

The optional user facilities which are standardized for different data transmission services, and are related to fast select are shown in Table 7-9/X.301.

TABLE 7-9/X.301

Optional user facilities standardized for different data transmission services, related to fast select

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PSTN	CSPDN	ISDN	ISDN	PSPDN	MSS
Fast select		X				X	X	X
Fast select acceptance	X					X	X	X

Calling DTEs can request the *fast select* facility on a per call basis by means of an appropriate facility request in the call request phase.

The *fast select* facility allows conveyance during the call request phase from calling DTE to called DTE of user data up to 128 octets.

If the *fast select* facility indicates "no Restriction on Response", it allows for either during the call confirmation phase or during the call clearing phase or during both phases the conveyance of up to 128 octets user data from called DTE (or clearing DTE) to calling DTE (or cleared DTE).

If the *fast select* facility indicates "Restriction on Response", it allows no call confirmation phase and data transfer phase. However, it does allow conveyance during the call clearing phase (if initiated by the called DTE) of up to 128 octets from called DTE to calling DTE.

Where a calling DTE requests a *fast select* facility, the incoming call should only be delivered to the called DTE if that DTE has subscribed to the *fast select acceptance* facility (see § 7.5.3).

Where a calling DTE requests the *fast select* facility, and if the called DTE has subscribed to *fast select acceptance*, the *fast select* facility and whether or not there is a "Restriction on Response" will be conveyed during the call request phase from calling DTE to called DTE.

If the called DTE has not subscribed to the *fast select acceptance* facility, no calls containing the *fast select* facility will be delivered to the called DTE. Such calls will be cleared by the network and a call progress signal *fast select acceptance not subscribed* will be returned to the calling DTE.

Note 1 – For an interim period, some networks may not allow a DTE to transmit any user data in the call clearing phase when this phase is not initiated as a response on the call request phase.

Note 2 – The user data conveyed in addition to the normal data flow in the data transfer phase will not be fragmented for delivery across the DTE/DCE interface.

Note 3 – The significance of the call confirmation phase, or the call clearing phase conveying the call progress signal DTE originated as a direct response to the call request phase where the *fast select* facility has been used, is that the user data in the call request phase has been received by the called DTE.

7.5.3 *Fast select acceptance*

Fast select acceptance is an optional user facility agreed for a period of time. This facility, if subscribed to, authorizes the DCE to transmit to the called DTE incoming calls which request the *fast select* facility. In the absence of this facility, the DCE will not transmit to the called DTE incoming calls which request the *fast select* facility.

7.6 *Other facilities*

The other optional user facilities which are standardized for different data transmission services are shown in Table 7-10/X.301.

TABLE 7-10/X.301

Other optional user facilities standardized for different data transmission services

Optional user facility	Period of Time	Applies per call	Applies to circuit switched data transmission service			Applies to Packet switched data transmission service		
			PSTN	CSPDN	ISDN	ISDN	PSPDN	MSS
Manual answer	X			X	↑			
Connect when free	X			X	|			
Waiting allowed	X			X	FS			
Receipt confirmation selection		X			|	X	X	X
Expedited data negotiation		X			↓	X	X	X

FS = For further study.

7.6.1 *Manual answer*

7.6.1.1 *General*

Manual answer is a DTE operating mode allowed by some networks for the circuit-switched service in CSPDNs. DTEs operating in this mode may, when called, delay responding by the *call accepted* signal. Information indicating that a DTE operates with *manual answer* is stored at the exchange to which the user is connected.

7.6.1.2 *Call establishment procedure*

In the case of a call to a user DTE operating with *manual answer*, the destination exchange sends the *terminal called* signal to the originating exchange at connection of the call. At the originating exchange, this results in sending of the *terminal called* call progress signal to the calling user. It also results in extending the value of any time-out applicable to this phase of the call.

The call is completed as an ordinary call when the *call accepted* signal is received from the called user by the destination exchange and a signal indicating that the call has been connected is sent towards the originating exchange. If the *call accepted* signal is not received by the destination exchange within the applicable DCE time-out after sending of the *incoming call* signal to the called user, the call is cleared from the destination exchange without sending any call progress type backward signal.

Note – In the case where the originating network does not allow *manual answer* and the called user operates with *manual answer*, the originating network may charge the calling user for the time from the receipt of the *terminal called* signal.

7.6.2 *Connect when free and waiting allowed*

7.6.2.1 *General*

Connect when free and *waiting allowed* are optional user facilities assigned to the user for an agreed contractual period.

A user subscribing to the *connect when free* facility is assigned a number of waiting positions at his local exchange at which incoming calls received can wait when the access line(s) to the user is busy. The *waiting allowed* facility enables a user calling a busy user having the *connect when free* facility to wait for the completion of the call when the called user becomes free. During waiting, the connection is maintained.

The two facilities thus provide an opportunity for users having certain data traffic characteristics to make more efficient use of the network than in the ordinary case when a call to a busy user is rejected.

Facility registration is controlled by the Administration or Recognized Private Operating Agency.

7.6.2.2 *Call establishment procedure*

7.6.2.2.1 When receiving a call to a busy user (i.e., at least one access line to the called user is occupied by a call in progress) having the *connect when free* facility, the destination exchange checks the waiting positions at the called user:

a) in the case where a free waiting position exists the call is placed in the queue and the *connect when free* signal is sent towards the originating exchange;

b) in the case where all waiting positions the occupied the call is rejected and the *number busy* signal is sent towards the originating exchange.

The call may be rejected for other reasons not related to the *connect when free* facility.

7.6.2.2.2 The action at the originating exchange depends on whether the calling user has the *waiting allowed* facility and which signal is received.

a) In the case where the *connect when free* signal is received and the calling user has the *waiting allowed* facility, the *connect when free* call progress signal is sent to the calling user. The calling user can then either wait for completion of the call or clear the call. In the case where the calling user chooses to wait, the connection is maintained but is not through-connected. The normal time-out for completion of the call at the originating exchange is inhibited. The calling user cannot make or receive another call on the same access line during waiting.

b) In the case where the *connect when free* signal is received and the calling user does not have the *waiting allowed* facility, the *number busy* signal is sent to the calling user and the call is cleared.

c) In the case where the *number busy* signal is received, the *number busy* call progress signal is sent to the calling user and the call is cleared; this is also the case when the calling user has the *waiting allowed* facility.

7.6.2.2.3 When an access line becomes free to the called user, the destination exchange connects the first call in the queue in the normal manner. A signal indicating that the call has been connected is sent towards the originating exchange.

7.6.2.2.4 When receiving the signal indicating that the call has been connected, the originating exchange through-connects the call in the normal manner.

7.6.2.2.5 The waiting time will be charged. The calling user may send a clear request at any time to terminate the waiting which will result in normal network clearing and removal of the call from the queue. The waiting may also be terminated by the destination exchange in some abnormal situations resulting in a clearing sequence towards the calling user.

Note – The possible provision of a network time-out to limit the waiting time is for further study.

7.6.3 *Receipt confirmation selection*

7.6.3.1 *General*

Receipt confirmation selection is an optional user facility that permits on a per call basis of whether or not the receipt of data units in the data transfer phase will be confirmed end-to-end.

Note – Realization of this facility in PSPDNs and ISDNs can be performed by using the D-bit procedures (see Recommendation X.25).

7.6.3.2 *Call request phase and call confirmation phase*

The calling DTE may request during the call request phase end-to-end acknowledgement of delivery of data units it will be transmitting in the data transfer phase, by setting the receipt selection parameter to *end-to-end acknowledgement.* During the call request phase, any (part of the) network involved in the call, as well as the called DTE, that cannot support this end-to-end acknowledgement will set the receipt selection parameter to "non end-to-end acknowledgement". The finally resulting value will be applicable for the call and will be conveyed by the called DTE to the calling DTE during the call confirmation phase.

7.6.3.3 *Data transfer phase*

Delivery of data units to the receiving DTE will be confirmed to the sending DTE if the receipt confirmation parameter, conveyed in the call confirmation phase, had the value "end-to-end acknowledgement".

Note – In some cases (e.g. in PSPDNs) end-to-end receipt confirmation in this phase could still be applied independent of the presence of the negotiation in the call request phase/call confirmation phase. However, definitions in Recommendation X.213 do also require the negotiation.

7.6.3.4 *Call clearing phase*

No end-to-end acknowledgement applies to this phase.

7.6.4 *Expedited data negotiation*

7.6.4.1 *General*

Expedited data negotiation is an optional user facility that permits on a per call basis negotiation during the call request phase and call confirmation phase of whether or not expedited data transfer can be applied during the data transfer phase.

7.6.4.2 *Call request phase and call confirmation phase*

The calling DTE may request in the call request phase the possibility to use expedited data procedures in the data transfer phase, by setting the expedited data parameter to "expedited data". During the call request phase, any (part of the) network involved in the call, as well as the called DTE, that cannot support this expedited data, will set the expedited data negotiation parameter to "no expedited data". The finally resulting value will be applicable for the call and will be conveyed by the called DTE to the calling DTE during the call transfer phase.

The public networks involved in the call are not required to look at or operate on this parameter; however some networks may look at the parameter if they wish.

7.6.4.3 *Data transfer phase*

During the data transfer phase expedited data procedures can be applied if the expedited data negotiation parameter, conveyed in the call confirmation phase, had the value expedited data.

Note – Expedited data procedures in PSPDN and ISDN(ps) can be performed by using interrupt packet procedures.

8 Arrangements for call progress signals

Table 8-1/X.301 indicates different networks using different sets of call progress signals.

TABLE 8-1/X.301

Use of different sets of call progress signals by different networks

Call Progress Signal	Applies to Circuit Switched Data Transmission Service			Applies to Packet Switched Data Transmission Service		
	PSTN	CSPDN	ISDN	ISDN	PSPDN	MSS
X.96		X		X	X	X
Q.931			X	X		
Q.699			X			

In the case of terminals connected to public networks via private networks, call progress signals originated in the private network are distinguished from those originated in the public data network. In CSPDN, the call progress signal "subaddress called" is sent by the destination PDN when it passes a call containing private network address information to the called DTE/DCE interface. Any subsequent call progress signals will have been originated by the private network. In PSPDN, a specific and distinct coding range is allocated for call progress signals originated in a private network.

The internetwork arrangements described in this paragraph relate to the transfer across networks of the call progress signals. Different categories of interworking are considered:

- interworking by call control mapping (ICCM),
- interworking by port access (IPA).

Table 8-2/X.301 shows the different cases of interworking with regard to call progress signals, referring to the appropriate sections.

TABLE 8-2/X.301

Different cases of interworking with regard to call progress signals

Q.699 (SS No. 7)	ICCM: § 8.3.1 IPA: NA		
Q.931	ICCM: § 8.6.1 IPA: NA	ICCM: § 8.2.1 IPA: NA	
X.96	ICCM: § 8.5.1 IPA: § 8.5.2	ICCM: § 8.4.1 IPA: § 8.4.2	ICCM: § 8.1.1 IPA: § 8.1.2
	Q.699 (SS No. 7)	Q.931	X.96

8.1 *Interworking arrangements involving call progress signals defined in Recommendation X.96 only*

8.1.1 *Interworking by call control mapping*

8.1.1.1 *Call progress signals during call establishment*

8.1.1.1.1 *Call progress signals originated by the calling DTE (call request phase)*

At the time of the call request, the calling DTE is not transmitting any call progress signal.

8.1.1.1.2 *Call progress signals generated by the originating PDN (call request phase)*

At the time of the call request, the originating PDN (including the DCE associated with the calling DTE) may have to clear the call, due to constraints related to the DTE/DCE interface of that calling DTE.

8.1.1.1.2.1 *Incorrect called DTE address in a call request*

8.1.1.1.2.1.1 The originating PDN may receive from the calling DTE a call request with a called DTE address which is not correct. If the originating PDN detects such a difficulty, it should clear the call with NOT OBTAINABLE indication. A possible reason is that the DCC or DNIC is the one assigned to the originating PDN, but the remaining digits of the address are not assigned to any DTE on that PDN.

Note 1 – The transmission by the calling DTE of an incorrect national prefix (see § 2.5 of Recommendation X.121) should be considered as a local procedure error.

Note 2 – The reaction of the originating PDN to an incorrect called DTE address received from the calling DTE is for further study.

8.1.1.1.2.2 *Invalid facility requested by the calling DTE*

When receiving from the calling DTE a call request that requires an optional user facility which is not offered to that DTE, the originating PDN should CLEAR the call with an INVALID FACILITY REQUEST indication.

Possible reasons include:

a) request for a facility which has not been subscribed by the DTE;

b) request for a facility which is not available in the originating PDN;

c) facility request which has not been recognized as valid by the originating PDN.

The exact circumstances for such call clearing by the originating PDN with an indication of invalid facility request, are detailed in the relevant X-Series Recommendations, i.e. DTE/DCE interface Recommendations, interwork signalling Recommendations.

8.1.1.1.2.3 *Calling DTE procedure error related to a call request*

8.1.1.1.2.3.1 When receiving a call request from the calling DTE, the originating PDN may detect a procedure error caused by the DTE. The originating PDN should then CLEAR the call with LOCAL PROCEDURE ERROR indication. Detailed circumstances of such procedure errors in a call request are indicated in the relevant X-series DTE/DCE interface Recommendations.

Possible circumstances include:

a) call request on a logical channel which is not in the ready state (in the case of an X.25 interface);

b) incorrect reference of a logical channel for the call (in the case of an X.25 interface);

c) incorrect format during call establishment.

8.1.1.1.3 *Call progress signals generated by an IDSE (call request phase)*

At the time of a call request, an International Data Switching Equipment (IDSE) involved in call establishment may have to clear the call.

8.1.1.1.3.1 *Incorrect called DTE address*

8.1.1.1.3.1.1 In some calls, an IDSE may receive a called DTE address which is not compatible with the numbering plan or not assigned to any DTE at that time. The IDSE should then clear the call with NOT OBTAINABLE indication. Possible reasons include: Unknown called DCC or DNIC.

8.1.1.1.3.1.2 However, it should also be noted that an IDSE should, if possible, not transmit to the next IDSE a call request with a called DTE address which does not correspond to a predetermined route. If an IDSE receives a called DTE address which does not conform to predetermined route, the call may be cleared with ACCESS BARRED indication.

8.1.1.1.3.2 *Internal network failure or congestion*

8.1.1.1.3.2.1 When an IDSE detects that all possible suitable routes, from the calling DTE to the called DTE via this IDSE, are temporarily unavailable, the IDSE will clear the call with NETWORK CONGESTION indication.

8.1.1.1.3.3 *Internal network failure on the transit route(s)*

A temporary network failure may force an IDSE to clear the call request passing through it, with NETWORK CONGESTION indication.

8.1.1.1.3.4 *Facility not available on the transit route(s)*

When an IDSE detects a request for a facility intentionally not available on the transit route(s), the IDSE clears the call with INCOMPATIBLE DESTINATION indication or NETWORK CONGESTION indication in the case of CSPDN.

8.1.1.1.3.5 *Charging facility not available on the transit route(s)*

When an IDSE detects that requested charging facilities are intentionally not available on the transit route(s) it clears the call with INCOMPATIBLE DESTINATION indication or NETWORK CONGESTION indication in the case of CSPDN.

8.1.1.1.3.6 *Access protection facility not available on the transit route(s)*

When an IDSE detects that requested access protection facilities are intentionally not available on the transit route(s), it clears the call with ACCESS BARRED indication.

8.1.1.1.4 *Call progress signals generated by the destination PDN (call request phase)*

At the time of a call request, the destination PDN (including the DCE associated with the called DTE) may have to clear the call, due to constraints related to the DTE/DCE interface of that called DTE.

8.1.1.1.4.1 *DTE/DCE interface not operational*

The DTE/DCE interface of the called DTE may be out of order. Possible reasons include:

a) DTE uncontrolled not ready,
b) DCE power off,
c) Network fault in the local loop,
d) Level 1 not functioning (X.25 only),
e) Level 2 not in operation (X.25 only).

8.1.1.1.4.1.1 If the called DTE interface is not operational, and an incoming call cannot therefore be transmitted to that DTE, the destination PDN should clear the call with OUT OF ORDER indication, or in CSPDN with either UNCONTROLLED NOT READY, DCE POWER OFF or NETWORK FAULT IN THE LOCAL LOOP indication.

Note – Special conditions may apply, if a call redirection facility is subscribed to the called DTE.

8.1.1.1.4.2 *Busy DTE/DCE interface*

8.1.1.1.4.2.1 When the called DTE is detected by the destination PDN as engaged on other call(s), and therefore as not being able to accept a new incoming call, the destination PDN should clear the call with NUMBER BUSY indication. The called DTE is not indicating the incoming call.

Note 1 – In case of an X.25 interface, some logical channel may be reserved (e.g. for outgoing calls) and be unavailable for incoming calls (see also Annex B of Recommendation X.25). The number busy condition described in this section applies if at least one logical channel supports incoming calls.

Note 2 – Special conditions may apply if a call redirection facility is subscribed to by the called DTE.

Note 3 – In the case where the called DTE subscribes to the Hunt group facility the busy condition occurs when all available circuits/channels are busy in all DTE/DCE interfaces in the Hunt group.

8.1.1.1.4.2.2 When the called DTE interface is an X.25 interface, a call collision may occur on one of the logical channels. If such a collision occurs, it normally means that the X.25 interface is saturated and cannot therefore accept any additional calls at that time. The called DTE is then given priority for its call establishment, and the destination PDN should clear the incoming call with NUMBER BUSY indication. The incoming call is not transmitted to the called DTE.

8.1.1.1.4.3 *Non-acceptance of a facility by the called DTE*

8.1.1.1.4.3.1 Except in the cases specified in §§ 8.1.1.1.4.3.2, 8.1.1.1.4.4 and 8.1.1.1.4.5, when the called DTE interface does not support a function or facility requested in the incoming call, the destination PDN should clear the call with INCOMPATIBLE DESTINATION indication (for PSPDN). The incoming call is not transmitted to the called DTE. The call progress signal used in CSPDN is for further study.

The exact circumstances for such call clearing by the destination PDN are detailed in the relevant X-series DTE/DCE interface Recommendations.

8.1.1.1.4.3.2 When the called DTE in PSPDN has not subscribed to the fast select acceptance facility, the destination PDN should clear a fast select call with FAST SELECT ACCEPTANCE NOT SUBSCRIBED indication. The incoming call is not transmitted to the called DTE.

8.1.1.1.4.4 *Specific charging facility requested by the called DTE*

8.1.1.1.4.4.1 When the called DTE has not subscribed to the reverse charging acceptance facility, and if an incoming call requests reverse charging, the destination PDN should clear that call with REVERSE CHARGING ACCEPTANCE NOT SUBSCRIBED indication. The incoming call is not transmitted to the called DTE.

8.1.1.1.4.5 *Specific access protection conditions required by the called DTE*

8.1.1.1.4.5.1 If an incoming call is destined for a DTE which has subscribed to the *incoming calls barred* facility, the destination PDN should clear the call with ACCESS BARREDindication. The incoming call is not transmitted to the called DTE.

8.1.1.1.4.5.2 If the destination PDN detects that the calling DTE is not permitted to make the connection to the called DTE, it should clear the call with ACCESS BARRED indication. The incoming call is not transmitted to the called DTE. Possible reasons include:

a) incompatible closed user group;

b) unauthorized access between the calling DTE and the called DTE. The possible exact circumstances of such restrictions are for further study.

Note – The fact that the calling DTE is not permitted to make the connection to the called DTE may be previously detected on the international part of the route where the call would then be cleared. In that case, the destination PDN is not aware of the incoming call.

8.1.1.1.5 *Call progress signals generated by the called DTE (call request and call confirmation phases)*

The called DTE may decide to refuse the incoming call. It will then clear the call with DTE ORIGINATED indication (in PSPDN). In CSPDN, the destination PDN may signal SUBADDRESS CALLED, following which a call progress signal may be indicated in a clearing signal from the DTE. Call progress signals generated by the called DTE are transferred to the calling DTE.

8.1.1.1.6 *Call progress signals generated by the destination PDN (call confirmation phase)*

8.1.1.1.6.1 *Called DTE procedure error related to a call acceptance*

8.1.1.1.6.1.1 When expecting a CALL ACCEPTED indication from the called DTE, the destination PDN may detect a procedure error caused by the DTE. The destination PDN should then clear the call, with LOCAL PROCEDURE ERROR indication to the called DTE, and REMOTE PROCEDURE ERROR to the calling DTE. Detailed circumstances of such procedure errors in a call accepted indication are described in the relevant X-series DTE/DCE interface Recommendations. Possible circumstances include incorrect format of the CALL ACCEPTED indication.

8.1.1.1.7 *Call progress signals generated by an IDSE (call confirmation phase)*

For further study.

8.1.1.1.8 *Call progress signals generated by the originating PDN (call confirmation phase)*

For further study.

8.1.1.1.9 *Call progress signals resulting of call abortion (call request and call confirmation phases)*

For further study.

8.1.1.2 *Clearing call progress signals during data transfer phase*

8.1.1.2.1 *Clearing call progress signals generated by a DTE (data transfer phase)*

8.1.1.2.1.1 When a call clearing comes from an X.25 DTE, the following rules apply:

8.1.1.2.1.1.1 The clearing cause should be DTE ORIGINATED.

8.1.1.2.1.1.2 A diagnostic of one octet may be transmitted by the DTE, is passed unchanged from the clearing DTE to the other DTE.

8.1.1.2.1.2 In CSPDN no call progress signal is generated when initiating clearing during the data transfer phase.

8.1.1.2.2 *Clearing call progress signals generated by a terminating PDN (data transfer phase)*

After call establishment, either of the two terminating PDNs may have to clear the call, due to events occurring at the corresponding DTE/DCE interface.

8.1.1.2.2.1 *DTE/DCE interface not operational*

8.1.1.2.2.1.1 When a DTE/DCE interface on a PSPDN ceases to be operational, and cannot therefore convey any more signals for a call already established through that interface, the terminating PDN may clear that call with OUT OF ORDER indication. Possible reasons include:

a) Layer 1 not functioning;

b) Layer 2 not in operation.

Note 1 – The exact circumstances, in which the terminating PDN would have to clear the virtual call because of the out of order condition of the DTE/DCE interface, are for further study.

Note 2 – In the case of packet switched services, although the basic out of order indication is transmitted for either condition a) or b) above, the diagnostic may give more detail.

Note 3 – When the network is ready to resume normal operation after a temporary failure or congestion, the terminating PDN may inform the DTE with a NETWORK OPERATIONAL indication. In the case of an X.25 interface, this information is passed in a restart indication packet.

8.1.1.2.2.2 *Procedure error at a DTE/DCE interface*

8.1.1.2.2.2.1 When a procedure error caused by the DTE on a PSPDN is detected that necessitates a call clearing, the terminating PDN should clear the call with LOCAL PROCEDURE ERROR indication to the local DTE, and with REMOTE PROCEDURE ERROR indication to the remote DTE. Detailed circumstances of such procedure errors are indicated in the relevant X-series DTE/DCE interface Recommendations (e.g. incorrect format, expiration of a time-out).

8.1.1.2.3 *Clearing call progress signals generated by an IDSE (data transfer phase)*

After call establishment, an International Data Switching Equipment (IDSE) may have to clear a call due to some constraints in the international transit part of the route.

8.1.1.2.3.1 *Internal network failure or congestion*

A temporary network failure or congestion may force an IDSE to clear call passing through it, with NETWORK CONGESTION indication (PSPDN only).

8.1.1.2.3.2 *Facility not available on the transit route(s)*

When an IDSE detects that it is not possible to offer a facility at a certain time, it clears the call passing through it with NETWORK CONGESTION indication (PSPDN only).

8.1.1.2.4 *Possible collisions between clearing call progress signals (data transfer phase)*

For further study.

8.1.1.3 *Reset call progress signals during data transfer*

This paragraph only applies to packet switched services, in which a virtual call or a permanent virtual circuit may be reset.

8.1.1.3.1 *Reset call progress signals generated by a DTE (data transfer phase)*

8.1.1.3.1.1 When a reset comes from an X.25 DTE, the following rules apply:

8.1.1.3.1.1.1 The reset cause should be DTE ORIGINATED.

8.1.1.3.1.1.2 A diagnostic of one octet may be transmitted by the DTE, and is passed unchanged from the resetting DTE to the other DTE.

8.1.1.3.2 *Reset call progress signals generated by a terminating PDN (data transfer phase)*

8.1.1.3.2.1 When a failure occurs at an X.25 DTE/DCE interface, without call clearing being necessary, the terminating PDN may reset the virtual call with OUT OF ORDER indication.

Note – The exact circumstances, in which the terminating PDN would have to reset the virtual call because of the out of order condition at the DTE/DCE interface, are for further study.

8.1.1.3.2.2 On an X.25 interface, certain procedure errors caused by the DTE may not necessitate a call clearing. The terminating PDN should then reset the virtual call with LOCAL PROCEDURE ERROR indication to the local DTE, and with REMOTE PROCEDURE ERROR indication to the remote DTE. Detailed circumstances of such procedure errors are indicated in Recommendation X.25.

8.1.1.3.2.3 When an X.25 interface is ready to resume normal data transfer on a permanent virtual circuit after a failure or out of order condition (e.g. restart), the terminating PDN should reset the permanent virtual circuit with REMOTE DTE OPERATIONAL indication.

8.1.1.3.3 *Reset call progress signals generated by an IDSE (data transfer phase)*

8.1.1.3.3.1 *Internal network failure or congestion*

In a permanent virtual circuit, a network failure or congestion may force an IDSE to send a reset packet with NETWORK OUT OF ORDER indication toward both DTEs involved.

8.1.1.3.4 *Possible collisions between reset call progress signals (data transfer phase)*

For further study.

8.1.2 *Interworking by port access*

For further study.

8.2 *Internetwork arrangements involving call progress signals defined in Recommendation Q.931 only*

8.2.1 *Interworking by call control mapping*

For further study.

8.3 *Internetwork arrangements involving call progress signals defined in Recommendation Q.699 only*

8.3.1 *Interworking by call control mapping*

For further study.

8.3.2 *Interworking by port access*

For further study.

8.4 *Internetwork arrangements involving call progress signals defined in Recommendations X.96 and Q.931*

8.4.1 *Interworking by call control mapping*

For further study.

8.4.2 *Interworking by port access*

For further study.

8.5 *Internetwork arrangements involving call progress signals defined in Recommendations X.96 and Q.699*

8.5.1 *Interworking by call control mapping*

For further study.

8.5.2 *Interworking by port access*

For further study.

8.6 *Internetwork arrangements involving call progress signals defined in Recommendations Q.931 and Q.699*

8.6.1 *Interworking by call control mapping*

See Recommendation Q.699.

APPENDIX I

(to Recommendation X.301)

Protocol elements of different networks used for the facilities and arrangements described in this Recommendation

This Appendix describes the protocol elements of different networks, used for the facilities and arrangements described in this Recommendation.

The following access protocols or protocol combinations are considered:

I.1 *Circuit switched data transmission services:*

CSPDN	X.20, X.20 *bis*, X.21, X.21 *bis*, X.22
ISDN	I.420, I.421

I.2 *Packet switched data transmission service:*

CSPDN	X.25, X.32
ISDN	X.31
Mobile data systems	X.350/X.352

The following Table I-1/X.301 shows the protocol elements in each of the protocol combinations, used in the call request phase, call confirmation phase, and call clearing phase of the call, and which can be utilized for conveyance of the parameters for the facilities and arrangements described in this Recommendation.

The following tables summarize how the arrangements and facilities described in this Recommendation apply to the call request phase, call confirmation phase, and call clearing phase of the call.

Conventions used in the Tables I-2/X.301 to I-7/X.301:

* The arrangement or facility parameter (if requested) will be conveyed (by means of the protocol elements shown in Tables I-1/X.301.

B The arrangement or facility parameter (if requested) will be conveyed and has a boolean value.

(=) The conveyed parameter has the identical value as the parameter supplied by the remote DTE initiating this phase of the call.

(≥) The conveyed parameter has a greater or equal value than the parameter supplied by the remote DTE initiating this phase of the call.

(≤) The conveyed parameter has a smaller or equal value than the parameter supplied by the remote DTE initiating this phase of the call. In case of a boolean, the conveyed parameter value may have changed from **true** to **false** compared with the value supplied by the remote DTE initiating this phase of the call.

TABLE I-1/X.301

Protocol elements that can be used in the different phases of a call for the conveyance of facility parameters

Circuit Switched Data Transmission Service		Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
Network	Protocol(s)	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
CSPDN	X.20	Call Request	Incoming Call	Call Accepted	Ready for Data	DTE Clear Request	DCE Clear Indication
	X.20 *bis*	108.1 ON (Note 3)	125 ON	108 ON	107 ON	108 OFF	107 OFF
	X.21	Call Request	Incoming Call	Call Accepted	Ready for Data	DTE Clear Request	DCE Clear Indication
	X.21 *bis*	108.1 ON (Note 3)	125 ON	108 ON	107 ON	108 OFF	107 OFF
	X.22	← See Recommendation X.21 →					
ISDN	I.420, I.421	FS	FS	FS	FS	FS	FS
Packet Switched Data Transmission Service							
Network	Protocol(s)						
PSPDN	X.25	Call request packet	Incoming call packet	Call accepted packet	Call connected packet	Clear request packet	Clear indication packet
	X.32	Call request packet	Incoming call packet	Call accepted packet	Call connected packet	Clear request packet	Clear indication packet
ISDN	X.31	Call request packet	Incoming call packet	Call accepted packet	Call connected packet	Clear request packet	Clear indication packet
Mobile Data Systems	X.350/ X.352	Call request packet	Incoming call packet	Call accepted packet	Call connected packet	Clear request packet	Clear indication packet

FS For further study

Note 1 – For conveyance of the facility parameters, utilization of the Incoming Call Packet is mandatory. However, in order to speed up the decision by the called DTE whether or not to accept the call, optionally all facility parameters may be copied in the SETUP message.

Note 2 – The RELease or RELease COMplete messages can only be utilized for facility parameter conveyance if such message is issued in direct response to a SETUP message.

Note 3 – Only for direct call facilities.

TABLE I-2/X.301

Arrangements and facilities related to the transfer of addressing information

Arrangement/Optional User Facility	Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
Transfer of X.121 Calling Address	* Note 1	*(=) Note 2				
Transfer of E.164 Calling Address	* Note 1	*(=) Note 2				
Transfer of X.121 Called Address	*	*(=) Note 2	* Notes 1, 3	*(=) Note 2	* Notes 1, 3	*(=) Note 2
Transfer of E.164 Called Address	*	*(=) Note 2	* Notes 1, 3	*(=) Note 2	* Notes 1, 3	*(=) Note 2
Transfer of Calling NAE/Subaddress	*	*(=)				
Transfer of Called NAE/Subaddress	*	*(=)	* Note 3	*(=)	* Note 3	*(=)

Note 1 – The address may be provided by the network.

Note 2 – The value may have been changed, e.g. due to the use of prefixes, country codes.

Note 3 – May only be needed in cases where the responding address is different from the originally called address.

TABLE I-3/X.301

Arrangements and optional user facilities related to the QOS of the call

Arrangement/Optional User Facility	Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
Transit Delay Selection Indication	*	*(≤ ≥)		*(≤ ≥)		
End-to-End Transit Delay Negotiation						
Cumulative Transit Delay	*	*(≤)	*	*(=)		
Request End-to-End Delay	*	*(=)				
Maximum Acceptable Transit Delay	*	*(=)				
Throughput Class Negotiation	*	*(≥)	*	*(=)		
Minimum Throughput Class	*	*(=)				

Note – Compared with the parameter value supplied in the Call Request Phase.

TABLE I-4/X.301

Arrangements and optional user facilities related to the charging conditions applying to the call

Arrangement/Optional User Facility	Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
Reverse Charging	B	B(=)				
Charging Information	B Note		B Note		* Note	* Note

Note – Charging Information is an arrangement between DTE and Network only. The Request is made in the first message sent to the network. The response is provided in the first message from the network to the information requesting DTE in the Call Clearing Phase. In case that the information requesting DTE is also the clearing DTE, the requested information can only be conveyed if additional call clearing confirmation arrangement exist (e.g. in packet procedures the Clear Confirmation packet).

TABLE I-5/X.301

Arrangements and optional user facilities related to specific routing conditions requested by the user of the call

Arrangement/Optional User Facility	Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
	Calling DTE	Called DTE	Calling DTE	Called DTE	Clearing DTE	Cleared DTE
RPOA Selection	*					
Called Line Address			*	*(=)	*	*(=)
Modified Notification					Note	Note
Call Redirection or Deflection Notification		*				

Note – Only conveyed when the call clearing phase follows directly after the call request phase.

TABLE I-6/X.301

Arrangements and optional user facilities related to protection mechanisms requested by the user of the call

Arrangement/Optional User Facility	Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
CUG Selection	*	*(=) Note				
CUG with Outgoing Access Selection	*	*(=) Note				
Bilateral CUG Selection	*	*(=) Note				
NUI	*		*			
NUI Override Permission	*					

Note – The value could have been changed due to international interworking.

TABLE I-7/X.301

Arrangements and optional user facilities to convey user data in addition to the normal data flow in the data transfer phase

Arrangement/Optional User Facility	Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
User Data conveyed in the Call Request Phase	*	*(=)				
User Data conveyed in the Call Confirmation Phase			*	*(=)		
User Data conveyed in the Call Clearing Phase					*	*(=)
Fast Select						
– Restriction on Response	B	B(=)				
– No Restriction on Response	B	B(=)				

TABLE I-8/X.301

Other arrangements and optional user facilities

Arrangement/Optional User Facility	Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
Receipt Confirmation Selection	B	B(⩽)	B	B(=)		
Expedited Data Negotiation	B	B(⩽)	B	B(=)		

APPENDIX II

(to Recommendation X.301)

Arrangements to support the OSI Network Service

This appendix lists the arrangements and facilities described in this Recommendation that can be utilized to fully support the OSI Network Service as standardized in Recommendation X.213.

(This is for further study)

Recommendation X.302

DESCRIPTION OF THE GENERAL ARRANGEMENTS FOR INTERNAL NETWORK UTILITIES WITHIN A SUBNETWORK AND INTERMEDIATE UTILITIES BETWEEN SUBNETWORKS FOR THE PROVISION OF DATA TRANSMISSION SERVICES

(Formerly part of Recommendation X.300, Malaga-Torremolinos, 1984, amended at Melbourne, 1988)

The CCITT,

considering

(a) that Recommendation X.300 defines the general principles for interworking between public networks and between public networks and other networks for the provision of data transmission services;

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

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

(d) the need that interconnected networks can communicate the necessary internal utilities related to the operation of the data transmission services;

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

(f) the need for arrangements for interworking between subnetworks;

(g) the need, in particular, for certain inter-network utilities defined between international exchange systems for the provision of data transmission services;

(h) the need for compatibility and uniformity in the principle for realization of internal network utilities within a subnetwork and between subnetworks for the provision of data transmission services,

unanimously recommends

that arrangements for internal utilities within a subnetwork and between subnetworks for the provision of data transmission services, and that the necessary elements for realization of such internal network utilities be in accordance with the principles and arrangements specified in this Recommendation.

CONTENTS

0 Introduction

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

This Recommendation describes utilities that can be used within a subnmetwork and between subnetworks for the provision of data transmission services. Only those utilities are described that are needed for the internal and inter-network operation, and that are not visible to the end users of a call. Facilities that are (also) visible to end users of a call are subject of other Recommendations (e.g. those arrangements described in Recommendation X.301).

1 Scope and field of application

The purpose of this Recommendation is to describe general arrangements for internal network utilities applicable to interworking at the network layer. Such arrangements are not visible for the end users of the network layer connection and apply within a subnetwork and between subnetworks.

These arrangements are not applicable to interworking involving communication capability as described in § 7 of Recommendation X.300.

2 References

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 circuits between synchronous data networks

X.75 Packet switched signalling system between public networks providing data transmission services

X.121 International numbering plan for public data networks

X.300 General principles for interworking between public networks, and between public networks and other networks for the provision of data transmission services

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

3 Definitions

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

a) transmission capability;
b) communication capability;
c) data transmission services.

This Recommendation makes use of the following terms defined in Recommendation X.301:

a) call request phase;
b) call information phase;
c) data transfer phase;
d) call clearing phase.

4 Abbreviations

CCSN Common channel signalling network

CNIC Clearing network identification code

CSPDN Circuit switched public data network

DCC Data country code

DCE Data circuit-terminating equipment

DNIC Data network identification code

DTE Data terminal equipment

IDSE International data switching exchange

INIC ISDN network identification code

ISDN Integrated services digital network

NI Network identifier

NUI Network user identification

PDN Public data network

PSPDN Packet switched public data network

5 General aspects

The network utilities described in this Recommendation can be applied for internal network operation and for arrangements between networks, and are not conveyed across the DTE/CDE interface.

The general principles concerning inter-network signals are defined in Recommendation X.301, in particular the phases related to a call:

- call request and call confirmation phases,
- data transfer phase,
- call clearing phase.

The corresponding model applicable to inter-network arrangements is reproduced in Figures 5-1/X.302 and 5-2/X.302.

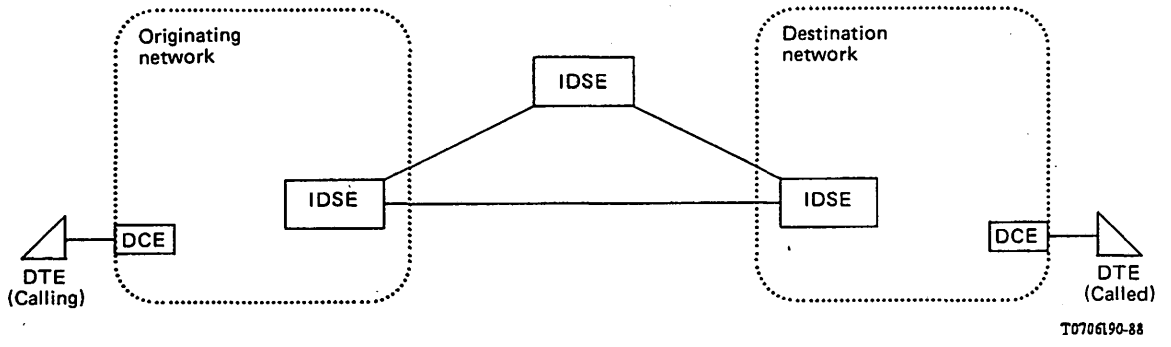


FIGURE 5-1/X.302

Model for Call Establishment

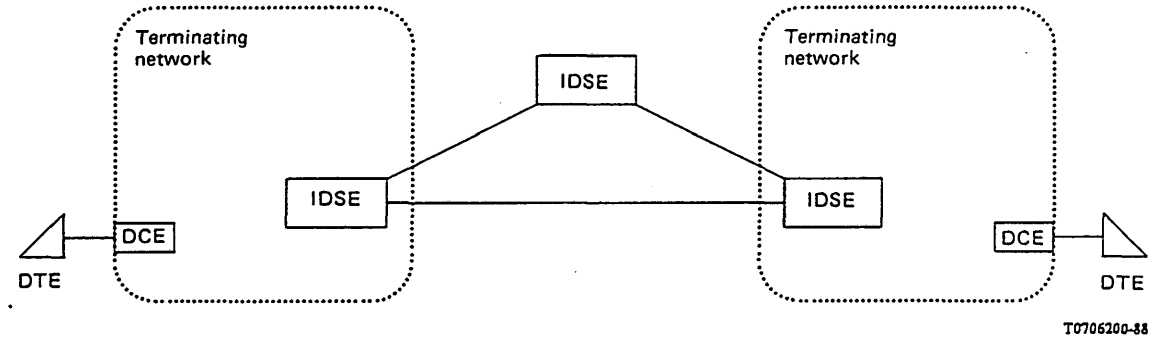


FIGURE 5-2/X.302

Model for data transfer and call clearing phases

6 Arrangements for internal network utilities

6.1 *Network identification*

6.1.1 *General*

The international *network identification* utilities provide information about the network(s) from, via or to which an international call is routed. In the general case, the term network identifier (NI) is the name of the number that identifies a network. Depending on the type of network and geographic location of the network, the format of the NI may vary.

A PDN is identified by four decimal digits that indicate:

a) in the case of the network of a country using the DCC format of the international data numbering plan (see Recommendation X.121), the applicable DCC plus one digit consistent with the numbering plan;

b) in the case of a network using the DNIC format of the international data numbering plan (see Recommendation X.121), the applicable DNIC.

In the short term, an ISDN is identified by a 4-digit INIC (ISDN network identification code), that has been designed not to coincide with a valid PDN DNIC value (see Recommendation X.75).

Note – The long term solution for network identification (NI) is for further study.

6.1.2 *Originating network identification*

The *originating network identification* utility identifies the originating network of a call.

In the packet-switched data transmission service in PSPDNs, the identity of the originating network (DNIC) is transferred in the *call request* phase to the destination networks as part of the international data number (see Recommendation X.75). To perform the function of the *originating network identification* utility this DNIC, which is part of the international data number, is always either inserted or checked by the originating network.

Provision of *originating network identification* as an optional network utility on request by a transit or destination network on a per call basis is mandatory for the circuit-switched data transmission service.

In the case of common channel signalling (see Recommendation X.61), a network requiring identification of the originating network requests such identification by returning an *originating network identification* request indication. When receiving such a request the originating network responds by sending:

a) the complete calling line identity in accordance with § 6.2.4 of Recommendation X.301 in the case where the *calling line identification* facility is provided by the originating network and such identification is also requested;

b) the originating network identity in the case where *calling line identification* is not provided or requested.

In the case of decentralized signalling (see Recommendations X.70 and X.71), a network requiring identification of the originating network requests such identification by returning a *calling line identification* request indication. When receiving such a request, the originating network responds with the calling line identity or the originating network identity depending on whether or not the *calling line identification* facility is provided by the originating network (see § 6.2.4 of Recommendation X.301).

6.1.3 *Destination network identification*

The *destination network identification* utility identifies the destination network of a call.

In the circuit-switched data transmission service in CSPDNs *destination network identification* for all international calls is a mandatory network utility. Thus, for each international call the identity of the destination network is returned in accordance with the applicable signalling procedures (see Recommendations X.61, X.70 and X.71).

In the packet-switched data transmission service, the identity of the destination network (DNIC) may be transferred in the *call confirmation* phase to the originating network as part of the international data number (see Recommendation X.75). When transferred, this DNIC must either be inserted or checked by the destination network.

6.1.4 *Transit network identification*

The transit network identification utility identifies the transit network(s) via which the call has been set up, and is conveyed during the call request phase.

In the packet-switched data transmission service in PSPDNs and ISDNs *transit network identification*, in both the forward and backward directions, is a mandatory network utility for international calls (see Recommendation X.75).

In the circuit-switched data transmission service in CSPDNs *transit network identification* in the backward direction is a mandatory network utility for international calls (see Recommendations X.61, X.70 and X.71).

In cases where more than one transit network is identified, the identities are indicated in the order of transit networks traversed by the call following the established path from the calling user towards the called user.

6.1.5 *Clearing network identification*

The CNIC utility identifies the network that has cleared the call and is only used when the call clearing phase has been initiated by a network during the data transfer phase.

In the packet switched data transmission service in PSPDNs and ISDNs, the CNIC is an optional network utility, subject to bilateral agreement between Administrations (see Recommendation X.75).

The network initiating the call clearing phase is identified in PDNs and ISDNs by the NI (see Recommendations X.75 and X.121). An IDSE receiving a CNIC will pass this code unchanged whenever applicable.

6.2 *Call identifier*

The *call identifier* utility gives the identification of a call. When the utility is used in conjunction with the calling DTE address, it uniquely identifies the call over a period of time, the duration of this time period is for further study. This utility is standardized for packet-switched data transmission service in PSPDNs and ISDNs (see Recommendation X.75).

A significant call identifier may or may not be created for a given call (see also Note 2). This is the responsibility of the originating network. Each transit network will always transfer a received significant call identifier without change. The definition of the content of the call identifier, and further specification of the associated signalling mechanisms, require further study.

Note 1 – However, it is for further study whether a transit network can create a significant call identifier, if it received a call identifier which was not significant.

Note 2 – On links designed according to Recommendation X.75, a call identifier utility of 4 octets is always present in the *call request* packet. The value of the 3 octet call identifier parameter may or may not be significant.

In the permanent virtual circuit service, the call identifier might be systematically required. However, it is left for further study.

6.3 *Target quality of service parameters*

It is for further study whether or not a network utility is required to signal information related to the achievement of target quality of service parameters (e.g. target transit delay) for network purposes outside the control of a user (see also § 7.1 of Recommendation X.301).

6.4 *Tariffs*

The *tariffs* utility is an optional utility, standardized for PSPDNs and ISDN (PS). Support of this utility for a given inter-network interface is subject to a bilateral agreement between Administrations.

The utility is used to pass information from one network to one or more other networks participating in the call for the purpose of implementating billing, accounting, or tariff arrangements that may exist among the respective Administrations.

The *tariffs* utility may appear in the call request, call confirmation and clear request phases of a call. If this utility appears in the call confirmation or clear request phase, the information it contains relates to the ultimate destination interface of the network. The utility may appear in the clear request phase only if that phase is initiated by the destination DTE or DCE, in direct response to the call request phase.

The content of this utility is determined by the originating or destination network and does not depend on information passed to the network by a DTE.

Even if this utility is supported on the inter-network interface, it may not be present in a phase for a given call if there is no need to exchange tariff-related information with that phase.

6.5 *Network user identification (NUI)*

The *network user identification* utility is an optional network utility standardized for PSPDNs and ISDNs (PS). The use of this utility is subject to bilateral agreement between Administrations.

The utility may be present in the call request. Use of utility in the call confirmation phase is for further study.

As agreed by the interfacing Administrations, the parameter field of this utility appearing in the call request phase may contain:

a) all, part or none of the parameter field of the NUI selection facility passed to the network by the DTE in the call request phase, and/or

b) an appropriate network-generated identification/verification/security code associated with the corresponding end user.

Recommendation X.305

FUNCTIONALITIES OF SUBNETWORKS RELATING TO THE SUPPORT OF THE OSI CONNECTION-MODE NETWORK SERVICE

(Melbourne, 1988)

The CCITT,

considering

(a) that Recommendation X.200 defines the reference model of open systems interconnection for CCITT applications;

(b) that Recommendation X.213 is the network service definition for open systems interconnection for CCITT applications;

(c) that Recommendation X.300 defines the general principles for interworking between public networks, and between public networks and other networks for the provision of data tansmission services; and that Recommendation X.300 indicates in particular how real pieces of network equipment can be represented as subnetworks;

(d) that different types of subnetworks need to be considered, which all support the OSI connection-mode network service in different degrees: and that the different ways in which the different types of subnetworks support the OSI connection-mode network service need to be described,

unanimously declares

(1) that the description of those functionalities of a subnetwork which relate to the connection establishment phase of the OSI connection-mode network services is given in § 6;

(2) that the description of those functionalities of a subnetwork which relate to the connection release phase of the OSI connection-mode network service is given in § 7;

(3) that the description of those functionalities of a subnetwork which relate to the data transfer phase of the OSI connection-mode network service is given in § 8.

CONTENTS

0 Introduction

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

This Recommendation describes those functionalities of subnetworks which relate to the support of the OSI connection-mode network service.

This Recommendation does not describe those functionalities of subnetworks which do not relate to the support of the OSI connection-mode network service (e.g., those arrangements in Recommendation X.301 which do not relate to the support of the OSI connection-mode network service).

1 Scope and field of application

This Recommendation defines those functionalities of subnetworks which relate to the OSI connection-mode network service in terms of:

a) the actions and events which occur at the interfaces to a subnetwork;

b) the parameters associated with each action and event, and the form which they take;

c) the interrelationship between, and the valid sequences of, these actions and events, for a given connection;

d) the interrelationship between different connections established through the same subnetwork.

This Recommendation also defines the ways different types of subnetworks support the OSI connection-mode network service, by including within the subnetwork part or all of the functionalities of subnetworks which relate to the OSI connection-mode network service.

The principal objective of this Recommendation is to provide guidance for consideration of interworking between subnetworks, in relation with the support of the OSI connection-mode network service.

This Recommendation does not specify products, or implementations of those functionalities in real network equipment, nor does it constrain the distribution of those functionalities among the pieces of network equipment considered within a given subnetwork (e.g. PDNs, IWFs, ISDNs, . . .).

2 References

Recommendation I.430 – Basic user-network – Layer 1 specification

Recommendation I.431 – Primary rate user-network interface – Layer 1 specification

Recommendation T.70 – Network-independent basic transport service for the telematic services

Recommendation Q.701 – Functional description of the signalling system (Message Transfer Part)

Recommendation Q.702 – Signalling data link

Recommendation Q.703 – Signalling link

Recommendation Q.704 – Signalling network functions and messages

Recommendation Q.705 – Signalling network structure

Recommendation Q.706 – Message Transfer Part signalling performance

Recommendation Q.707 – Testing and maintenance

Recommendation Q.711 – Functional description of the Signalling Connection Control Part (SCCP) of Signalling System No. 7

Recommendation Q.712 – Definition and functions of Signalling Connection Control Part messages

Recommendation Q.713 – Signalling Connection Control Part (SCCP) formats and codes

Recommendation Q.714 – Signalling Connection Control Part procedures

Recommendation Q.921 – ISDN user-network interface data link layer specification

Recommendation Q.931 – ISDN user-network interface layer 3 specification

Recommendation X.21 – Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for synchronous operation on public data networks

Recommendation X.25 – 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

Recommendation X.75 – Packet switched signalling system between public networks providing data transmission services

Recommendation X.200 – Reference model of open systems interconnections for CCITT applications

Recommendation X.213 – Network service definition for open systems interconnection for CCITT applications

Recommendation X.223 – User of X.25 to provide the OSI connection-mode network service

Recommendation X.300 – General principles for interworking between public networks, and between public networks and other networks for the provision of data transmission services

Recommendation X.301 – General arrangements for call control within a subnetwork and between subnetworks for the provision of data transmission services

3 Definitions

3.1 This Recommendation makes use of the following terms defined in Recommendation X.200:

a) network-connection;

b) network layer;

c) network service;

d) subnetwork.

3.2 This Recommendation makes use of the following terms defined in Recommendation X.213:

a) calling network service user;

b) called network service user.

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

a) type I subnetwork;

b) type II subnetwork;

c) type III subnetwork;

d) type IV subnetwork.

3.4 *Conventions*

The arrows used in the figures of § 6 to 8 indicate in a generic way the exchange of information that occurs at the interface of the subnetwork. Their purpose is not to represent the NS primitives conveyed through the horizontal abstract interface between the network layer and the transport layer.

4 Abbreviations

CCSN	Common channel signalling network
CONS	Connection-mode network service
CS	Circuit switched
CSPDN	Circuit switched public data network
DTE	Data terminal equipment
ISDN	Integrated services digital network
IWF	Interworking function
LAPB	Link access procedure balanced
MTP	Message transfer part
MSS	Mobile satellite systems
NC	Network connection
NL	Network layer
NS	Network service

NSP	Network service part
OSI	Open systems interconnection
PLMN	Public land mobile network
PLP	Packet level protocol
PS	Packet switched
PSDN	Packet switched data network
PSPDN	Packet switched public data network
PSTN	Public switched telephone network
QOS	Quality of service
SCCP	Signalling connection control part

5 Overview and general characteristics

5.1 The functionalities of a subnetwork include provision for the transparent transfer of data between two interfaces to the subnetwork, on a connection (NC). More than one NC may exist between the same pair of interfaces.

Note 1 – The extent to which a subnetwork can support more than one connection (NC) between the same pair of interfaces, may be dependent on the types of subnetworks; also the extent to which a subnetwork can support simultaneous connections (NCs) between a given interface to the subnetwork and other distinct interfaces, may be dependent on the types of subnetworks (see also Figure 5-1/X.305).

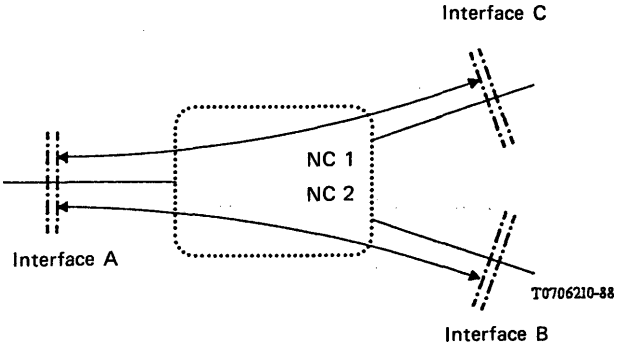


FIGURE 5-1/X.305

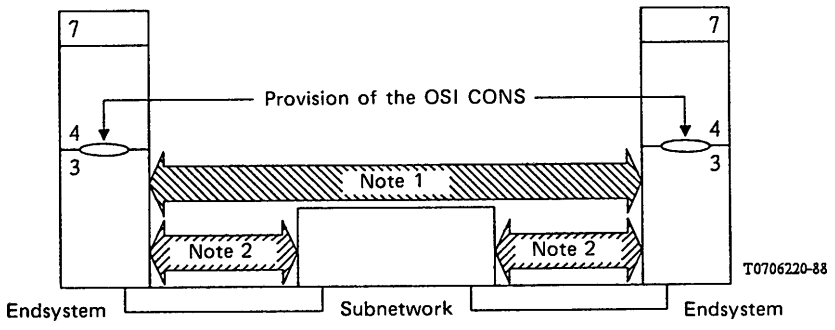
Note 2 – Also the interfaces to the subnetwork may be using either the same protocol, or different protocols depending on the nature of the system attached to that interface (e.g., X.25 if DTE, X.75 if another subnetwork).

5.2 Within a subnetwork, support of the OSI connection-mode network service may involve functionalities of that subnetwork performed:

- either at all the Layers 1 to 3,
- or at Layer 1 and 2,
- or only at Layer 1.

This may depend on the type of subnetwork which is considered.

This may also depend on the phase in the network connection (i.e., connection establishment, connection release, data transfer), and also on the element of the connection-mode network service considered within that phase.



Note 1 – Procedures required to provide the OSI CONS, but not operated by the subnetwork. These may not be required in some or all phases of a call for some types of subnetworks.

Note 2 – Procedures operated by the subnetwork.

FIGURE 5-2/X.305

Support and provision of the OSI CONS

6 Connection establishment phase

6.1 The functionalities of a subnetwork which relate to the connection establishment phase of the OSI network layer service correspond to the following actions and events at the interfaces to the subnetwork:

a) *Connect request,* with the following parameters:
   - called address,
   - calling address,
   - receipt confirmation selection (see Note 1),
   - expedited data selection (see Note 1),
   - QOS-parameter set (see Note 2),
   - NS-user-data (see Note 3).

b) *Connect indication,* with the following parameters:
   - called address,
   - calling address,
   - receipt confirmation selection (see Note 1),
   - expedited data selection (see Note 1),
   - QOS-parameter set (see Note 2),
   - NS-user-data (see Note 3).

c) *Connect response,* with the following parameters:
   - responding address,
   - receipt confirmation selection (see Note 1),
   - expedited data selection (see Note 1),
   - QOS-parameter set (see Note 2),
   - NS-user-data (see Note 3).

d) *Connect confirm,* with the following parameters:
   - responding address,
   - receipt confirmation selection (see Note 1),
   - expedited data selection (see Note 1),
   - QOS-parameter set (see Note 2),
   - NS-user-data (see Note 3).

Note 1 – NS provider-option.

Note 2 – The implementation of the transit delay negotiation requires urgent further study in order to have a harmonized realization in different types of subnetworks. Special attention is required as regards routing and charging consequences.

Note 3 – The objective is to make this parameter a mandatory parameter to be supported by all subnetworks in the future. However, a number of existing subnetworks cannot support it now. During the interim period, while these subnetworks exist and are not modified to provide this parameter, it is considered as a provider-option. No negotiation mechanism is needed in the OSI connection-mode network service. Limiting, in some subnetworks, length of NS-user-data to be provided to a value lower than 128 octets (e.g., 16 to 32 octets) for an interim period would imply fewer changes to existing interfaces and signalling systems and would simplify the introduction of such a service in existing subnetworks.

6.2 In relation with the support of the OSI connection-mode network service, the various actions and events at the interfaces to the subnetworks which are described in § 6.1 above, are expected to be sequenced according to § 11 of Recommendation X.213. In particular a successful connection establishment is expected to be as in the following figure:

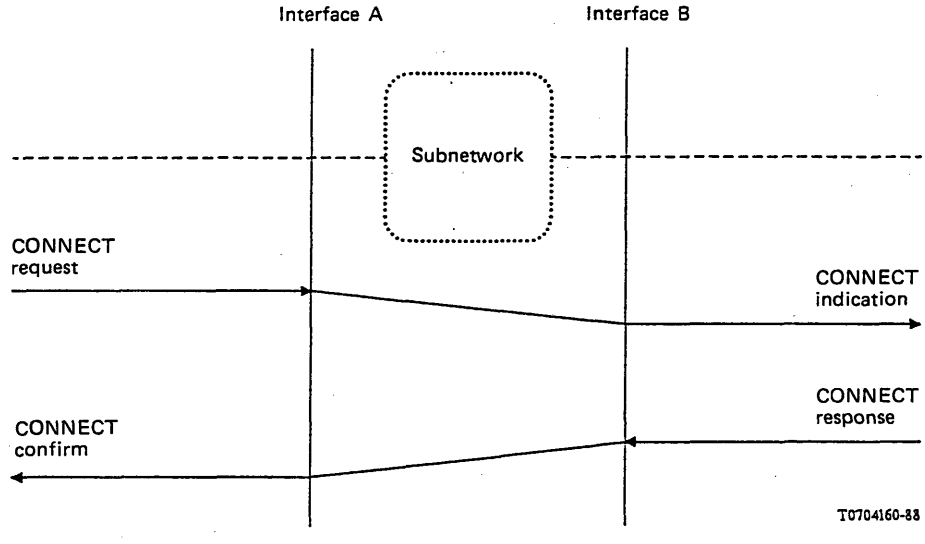


FIGURE 6-1/X.305

Connection establishment phase

6.3 In relation with the support of the OSI connection-mode network service, the parameters listed in § 6.1 above are expected to be handled as described in § 12 of Recommendation X.213.

6.4 The ways the different types of subnetworks support the elements of a connection establishment phase of the OSI connection-mode network service, are as follows:

a) *Type I and Type II subnetworks*

Functionalities of Type I and Type II subnetworks include all elements described in §§ 6.1 to 6.3 above.

b) *Type III subnetworks*

Functionalities of Type III subnetworks do not include all elements described in §§ 6.1 to 6.3 above.

Note – In some instances (i.e., Type III), the inclusion of some elements described in §§ 6.1 to 6.3 within the functionalities of the subnetwork requires further study.

c) *Type IV subnetworks*

Functionalities within Type IV subnetworks either include all elements described in §§ 6.1 to 6.3 above, or this type of subnetwork may only include a subset of these elements.

7 Connection release phase

7.1 The functionalities of a subnetwork which relate to the connection release phase of the OSI connection-mode network service correspond to the following actions and events at the interfaces to the subnetwork:

a) *Disconnect request*, with the following parameters:
   - reason,
   - NS-user-data (see Note),
   - responding address.

b) *Disconnect indication*, with the following parameters:
   - originator,
   - reason,
   - NS-user-data (see Note),
   - responding address.

Note – The objective is to make this parameter a mandatory parameter to be supported by all subnetworks in the future. However, a number of existing subnetworks cannot support it now. During the interim period, while these subnetworks exist and are not modified to provide this parameter, it is considered as a provider-option. No negotiation mechanism is needed in the connection-mode network service.

7.2 In relation with the support of the OSI connection-mode network service, the various actions and events at the interfaces to the subnetwork which are described in § 7.1 above, are expected to be sequenced according to § 11 of Recommendation X.213. In particular an NS user initiated connection release is expected to be as in the Figure 7-1/X.305.

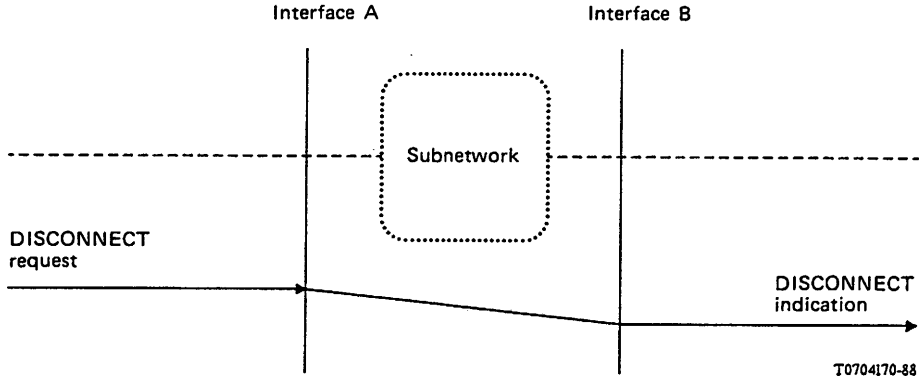


FIGURE 7-1/X.305

Connection release phase

7.3 In relation with the support of the OSI connection-mode network service, the parameters listed in § 7.1 above are expected to be operated as described in § 13 of Recommendation X.213.

7.4 The ways the different types of subnetworks support the elements of a connection release phase of the OSI connection-mode network service, are as follows:

a) *Type I and Type II subnetworks*

Functionalities within Type I and Type II subnetworks include all elements described in §§ 7.1 to 7.3 above.

b) *Type III subnetworks*

Functionalities within Type III subnetworks do not include all elements described in §§ 7.1 to 7.3 above.

Note – In some instances (i.e., Type III), the inclusion of some elements described in §§ 7.1 to 7.3 within the functionalities of the subnetwork requires further study.

c) *Type IV subnetworks*

Functionalities within Type IV subnetworks either include all elements described in §§ 7.1 to 7.3 above, or this type of subnetwork may only include a subset of these elements.

8 Data transfer phase

8.1 The functionalities of a subnetwork which relate to the data transfer phase of the OSI network layer service correspond to the following actions and events at the interfaces to the subnetwork:

a) *DATA request*, with the following parameters:
   - NS-user-data,
   - confirmation request (see Note).

b) *DATA indication*, with the following parameters:
   - NS-user-data,
   - confirmation request (see Note).

c) *RESET request*, with the following parameter:
   - reason.

d) *RESET indication*, with the following parameters:
   - originator,
   - reason.

e) *RESET response*, with no parameter.

f) *RESET confirm*, with no parameter.

g) *EXPEDITED DATA request* (see Note).

h) *EXPEDITED DATA indication* (see Note).

Note – NS provider options, when provided within a subnetwork, would lead to additional actions and events.

8.2 In relation with the support of the OSI connection-mode network service, the various actions and events at the interfaces to the subnetwork which are described in § 8.1 above, are expected to be sequenced according to §§ 11 and 14 of Recommendation X.213.

8.3 Also the parameters listed in § 8.1 above are expected to be handled as described in § 14 of Recommendation X.213.

8.4 The flow control conditions applying on a connection are expected to be as described in § 9.2 of Recommendation X.213 (Model of a network connection).

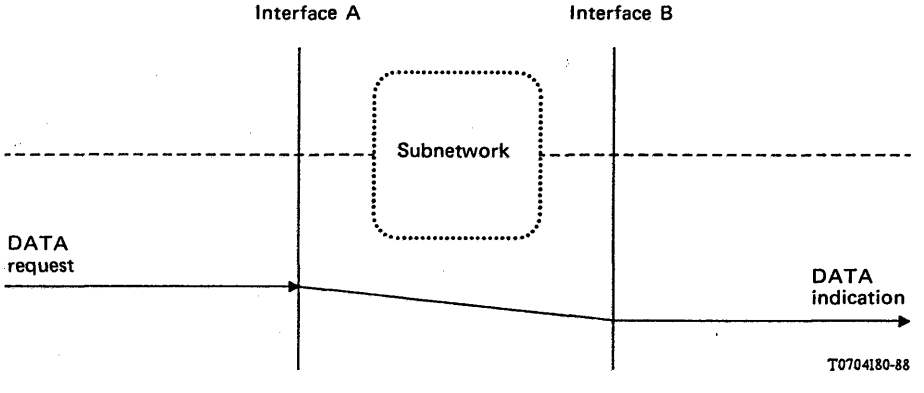


FIGURE 8-1/X.305

Normal data transfer

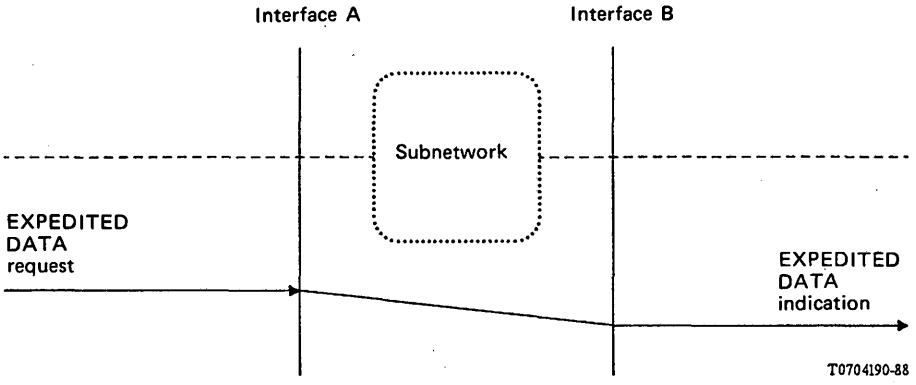


FIGURE 8-2/X.305

Expedited data transfer

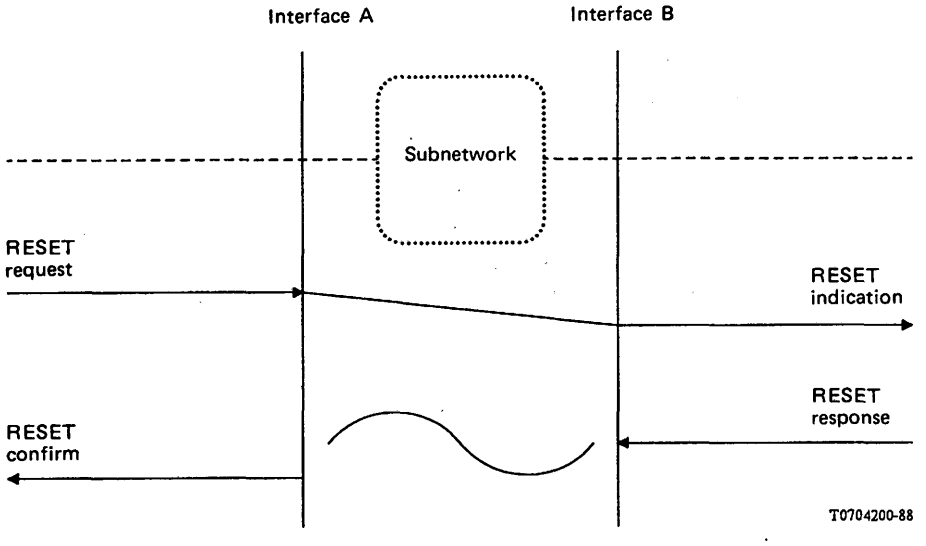


FIGURE 8-3/X.305

Reset

8.5 The ways the different types of subnetworks support the elements of a data transfer phase of the OSI network layer service, are as follows:

a) *Type I subnetworks*

Functionalities within Type I subnetworks include all elements described in §§ 8.1 to 8.4 above (see also Annex A).

Functions and protocols required to complete the support of the OSI CONS then reside within the subnetwork, and the systems attached to the subnetwork.

b) *Type II or III subnetworks*

Functionalities within Type II or III subnetworks include some elements described in §§ 8.1 to 8.4 above (see also Annex A).

Those elements correspond to the provision of a physical connection.

Functions and protocols required to complete the support of the OSI CONS then reside in systems attached to the subnetwork, and are not operated within the subnetwork.

c) *Type IV subnetworks*

Functionalities within Type IV subnetworks include some elements described in §§ 8.1 to 8.4 above (see also Annex A).

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

Functions and protocols required to complete the support of the OSI CONS then reside in systems related to the subnetwork, and are not operated within the subnetwork.

ANNEX A

(to Recommendation X.305)

Functionality related to the data transfer phase of the OSI CONS within the different types of networks

TABLE A-1/X.305

Functionality related to the data transfer phase of the OSI CONS	Within a Type I subnetwork?	Within a Type II subnetwork?	Within a Type III subnetwork?	Within a Type IV subnetwork?
NSDU data transfer	Yes	No (Note 1)	No (Note 1)	No/Yes (Note 3)
Flow control	Yes	No (Note 1)	No (Note 1)	No/Yes (Note 3)
Mechanism for sequencing in the subnetwork	Yes	Yes (Note 1)	Yes (Note 1)	No/Yes (Note 3)
Error notification	Yes	No (Note 1)	No (Note 1)	No/Yes (Note 3)
Reset	Yes	No (Note 1)	No (Note 1)	No/Yes (Note 3)
Receipt confirmation (option)	Optional (Note 2)	No (Note 1)	No (Note 1)	No/Yes (Note 3)
Expedited data transfer (option)	Optional (Note 2)	No (Note 1)	No (Note 1)	No/Yes (Note 3)

Note 1 – Funcionalities within Type II and Type III subnetworks consist of the transparent transfer of bit stream. Consequently the grouping of data as NSDUs requires then an additional protocol mechanism which is not operated by the subnetwork itself. The subnetwork only preserves sequencing in the sense that all bits arrive in sequence.

Note 2 – Since it is an NS option, subnetworks are not required to contain any functionalities related to that element.

Note 3 – Some form of packetizing or framing is operated by the subnetwork, without providing all mandatory elements required for the support of the OSI CONS.

ANNEX B

(to Recommendation X.305)

Sets of protocols for the provision of the OSI CONS over different examples of subnetworks

B.1 *General*

Annex B illustrates some examples of subnetworks (Type I, Type II, Type III subnetworks) in giving possible sets of protocols at Layers 1 to 3 for the provision of the OSI CONS over these examples of subnetworks (see Table B-1/X.305).

TABLE B-1/X.305

Protocols to provide and support the OSI connection-mode network service

Network	Provision and support of the OSI connection-mode network service
CCSN	See § B.2
CSPDN	See § B.3
ISDN – CS bearer requested – PS bearer requested	 See § B.4 See § B.5
Mobile data systems	See § B.6
Private networks	See § B.7
PSPDN	See § B.8
PSTN	See § B.9

Related to functionalities within subnetwork.

Not related to functionalities within subnetwork.

B.2 *CCSN*

The subnetwork representation for consideration of possible sets of protocols to provide the OSI CONS in the case of a CCSN is shown in Figure B-1/X.305.

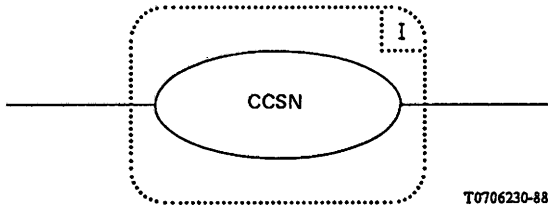
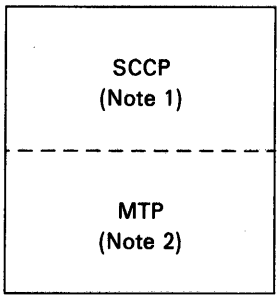


FIGURE B-1/X.305

Subnetwork representation of a CCSN

The possible set of protocols to provide the OSI CONS related to this representation is shown in Figure B-2/X.305.



Note 1 – Signalling Connection Control Part (SCCP), defined in Recommendations Q.711 to Q.714. Protocol class 3 of SCCP is used.

Note 2 – Message Transfer Part (MTP), defined in Recommendations Q.701 to Q.707.

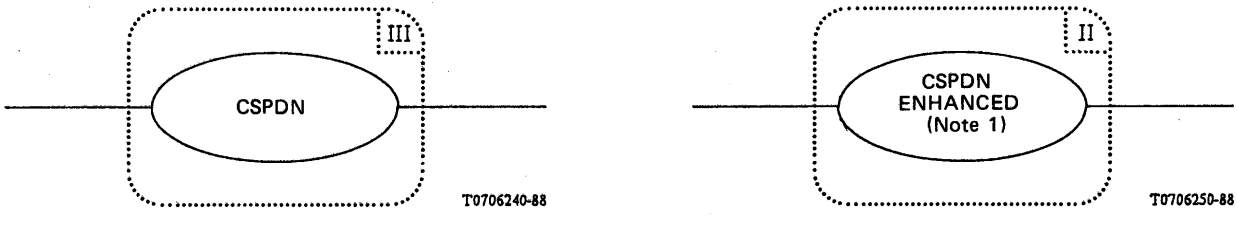
Note 3 – The combination of the MTP and the SCCP is also called "Network Service Part" (NSP).

FIGURE B-2/X.305

Possible protocol set to provide the OSI CONS in case of a CCSN

B.3 *CSPDN*

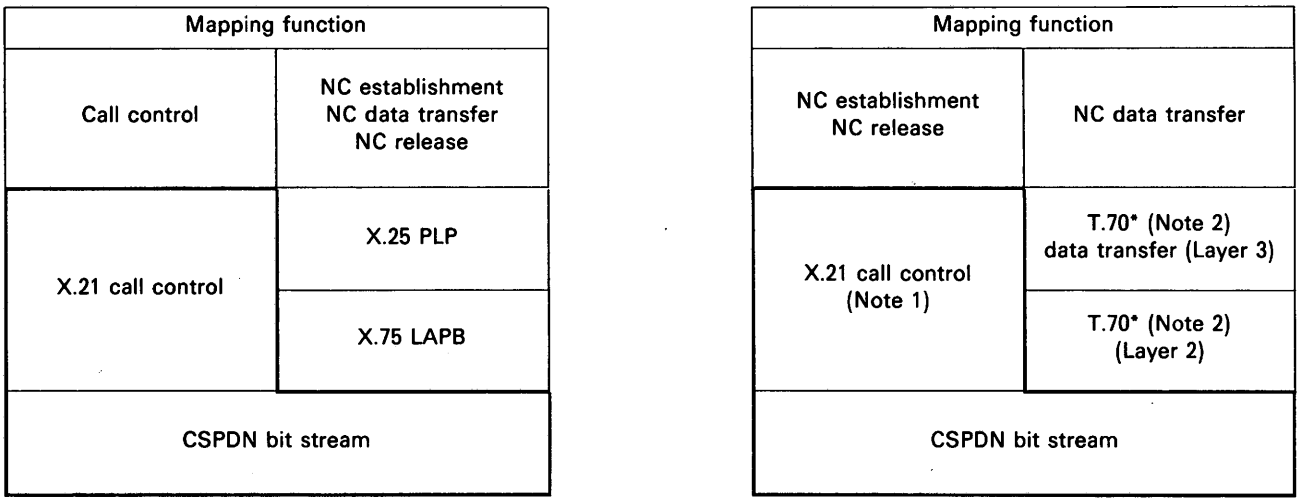
The subnetwork representation for consideration of possible sets of protocols to provide the OSI CONS in the case of a CSPDN is shown in Figure B-3/X.305.



Note 1 – The enhancement of Rec. X.21 is for further study.
a) Subnetwork representation of a CSPDN.
b) Subnetwork representation of an enhanced CSPDN.

FIGURE B-3/X.305

The possible sets of protocols to provide the OSI NLS related to this representation are shown in Figure B-4/X.305.



Note 1 – The enhancement of Recommendation X.21 is for further study.

Note 2 – T.70* represents the data phase procedure described in Recommendation T.70 for data transfer over the CSPDN, but needs to be enhanced so that the reset service is supported.

FIGURE B-4/X.305

Possible protocol set to provide the OSI CONS in case of a CSPDN

B.4 *ISDN (CS bearer is requested)*

The subnetwork representation for consideration of possible sets of protocols to provide the OSI CONS in the case of an ISDN where a CS bearer is requested is shown in Figure B-5/X.305.

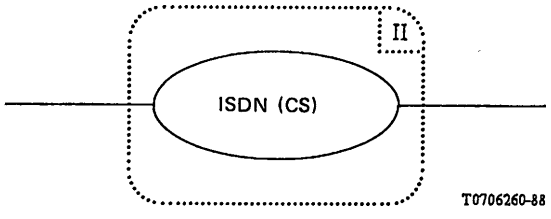


FIGURE B-5/X.305

Subnetwork representation of a ISDN where a CS bearer is requested

A possible set of protocols to provide the OSI CONS related to this representation is shown in Figure B-6/X.305.

Note – Other possible sets of protocols to provide the OSI CONS are for further study.

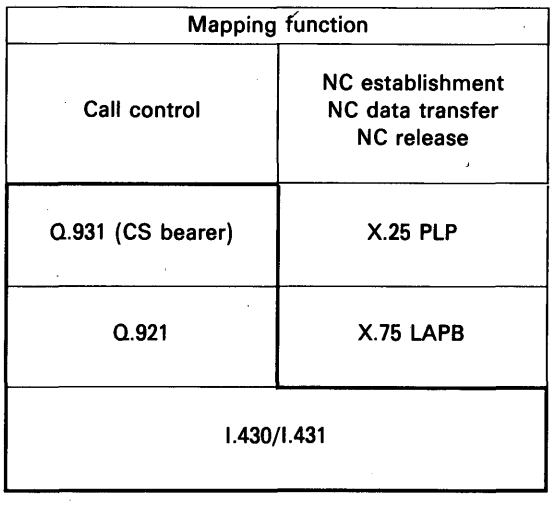


FIGURE B-6/X.305

Possible protocol set to provide the OSI CONS in case of a ISDN where a CS bearer is requested

B.5 *ISDN (PS bearer is requested)*

The subnetwork representation for consideration of possible sets of protocols to provide the OSI CONS in the case of an ISDN where a PS bearer is requested is shown in Figure B-7/X.305.

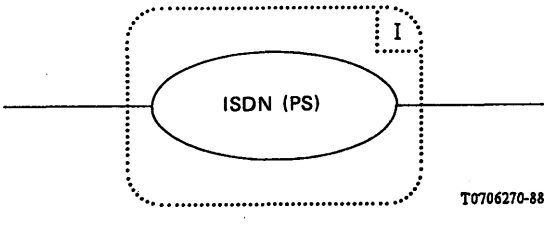
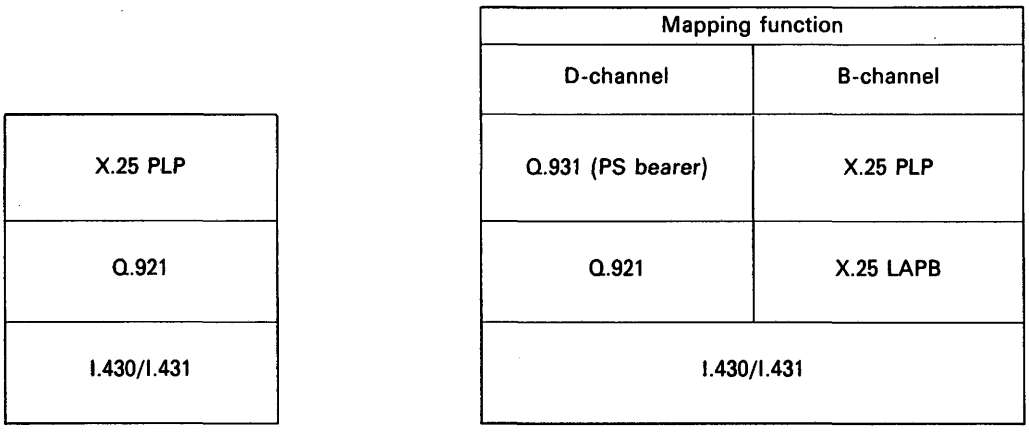


FIGURE B-7/X.305

Subnetwork representation of a ISDN where a PS bearer is requested

The possible sets of protocols to provide the OSI CONS related to this representation are shown in Figure B-8/X.305.



Note – Q.931 procedures are not used in the hot line access case.

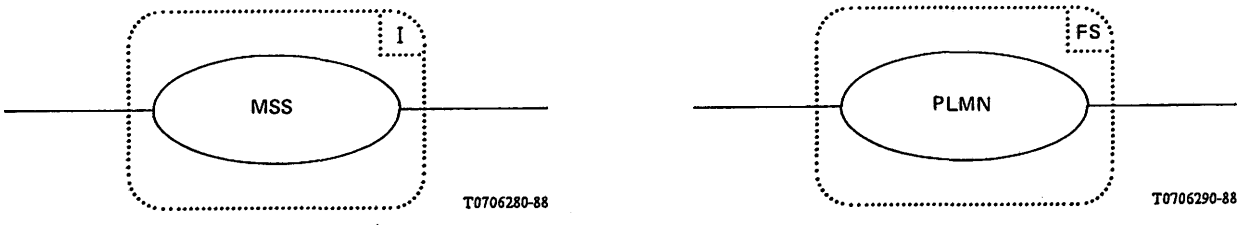
a) Possible protocol set to provide the OSI CONS in case of a ISDN where a PS bearer on the D-channel is requested.

b) Possible protocol set to provide the OSI CONS in case of a ISDN where a PS bearer on the B-channel is requested.

FIGURE B-8/X.305

B.6 *Mobile data systems*

The subnetwork representation for consideration of possible sets of protocols to provide the OSI CONS in the case of mobile data systems is shown in Figure B-9/X.305.



FS For further study

FIGURE B-9/X.305

Subnetwork representation of Mobile Data Systems

The possible sets of protocols to provide the OSI CONS related to this representation are shown in Figure B-10/X.305.

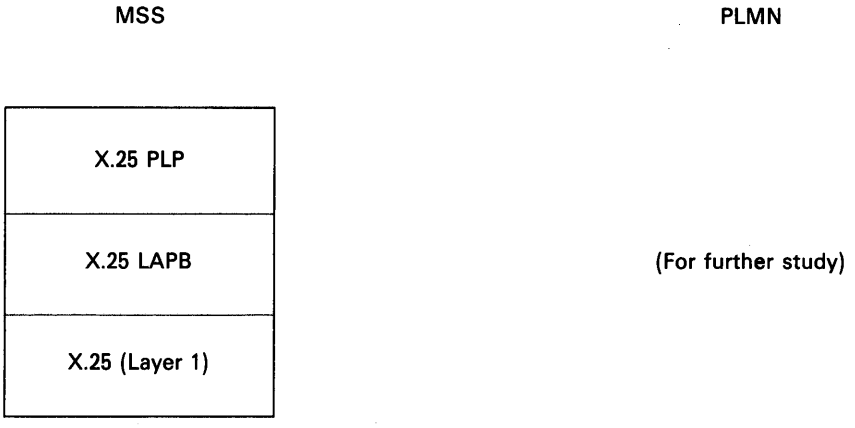


FIGURE B-10/X.305

Possible protocol set to provide the OSI CONS in case of Mobile Systems

B.7 *Private networks*

The subnetwork representation for consideration of possible sets of protocols to provide the OSI CONS in the case of private networks depends on the type of private network that is used. In case of private PSDNs, see § B.8. In case of private ISDNs, see §§ B.4 and B.5.

B.8 *PSPDN*

The subnetwork representation for consideration of possible sets of protocols to provide OSI CONS in the case of a PSPDN is shown in Figure B-11/X.305.

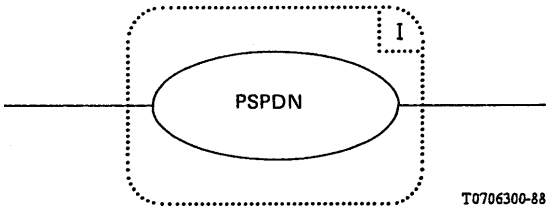


FIGURE B-11/X.305

Subnetwork representation of a PSPDN

The possible-set of protocols to provide the OSI CONS related to this representation is shown in Figure B-12/X.305.

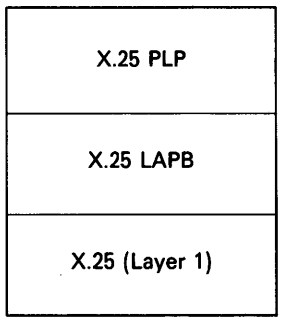


FIGURE B-12/X.305

Possible protocol set to provide the OSI CONS in case of a PSPDN

B.9 *PSTN*

The subnetwork representation for consideration of possible sets of protocols to provide the OSI CONS in the case of a PSTN is shown in Figure B-13/X.305.

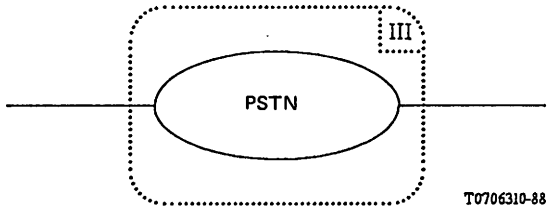


FIGURE B-13/X.305

Subnetwork representation of a PSTN

The possible set of protocols to provide the OSI CONS related to this representation is shown in Figure B-14/X.305.

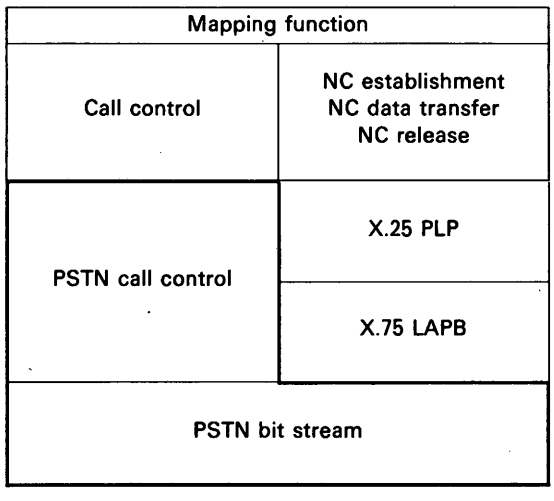


FIGURE B-14/X.305

Possible protocol set to provide the OSI CONS in case of a PSTN

Recommendation X.320

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

(Melbourne, 1988)

The CCITT,

considering

(a) that Recommendation X.300 defines the general principles for interworking between public networks, and between public networks and other networks for the provision of data transmission services;

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

(c) that Recommendation X.302 defines the general arrangements for internal network utilities within a subnetwork and between subnetworks for the provision of data transmission services;

(d) that Recommendation X.75 already specifies detailed procedures applicable to call control between public networks providing data transmission services;

(e) that Recommendation X.10 describes categories of access to ISDNs for the provision of data transmission services;

(f) that Recommendation X.213 describes the network service definition for open systems interconnection for CCITT applications;

(g) that Recommendation X.305 describes functionalities of subnetworks relating to the support of the OSI network service;

(h) that Recommendation I.520 describes requirements for ISDN-ISDN interworking for both non-data and data transmission services;

(i) the need for arrangements when interworking between ISDNs for the provision of data transmission services,

unanimously declares

that arrangements for the interworking between ISDNs and ISDNs for the provision of data transmission services be in accordance with the principles and arrangements specified in this Recommendation.

CONTENTS

0 Introduction

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

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

1 Scope and field of application

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

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

2 References

[1] Recommendation X.300

[2] Recommendation X.301

[3] Recommendation X.302

[4] Recommendation X.305

[5] Recommendation X.31

[6] Recommendation X.75

[7] Recommendation X.1

[8] Recommendation X.2

[9] Recommendation X.10

[10] I.230 series Recommendations
I.250 series Recommendations

[11] Recommendation I.500

[12] Recommendation X.121

[13] Recommendation X.122

[14] Recommendation E.164

[15] Recommendation E.166

3 Definitions

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

a) transmission capability,
b) communication capability,
c) subnetwork functionality,
d) data transmission service,
e) interworking by call control,
f) interworking by port access.

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

a) circuit switched bearer service,
b) packet switched virtual circuit bearer service.

4 Abbreviations

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

5 General aspects

This Recommendation, in describing interworking arrangements between two subnetworks for the provision of data transmission services, adheres to the general principles of Recommendation X.300. The environments of these two subnetworks are described in the following sections. See also Table 1/X.320.

5.1 *ISDN*

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

Note – Supplementary services/optional user facilities for the circuit-mode operation on ISDN are in the I.250 series. Recommendation X.2 applies to ISDN packet switched data transmission services/bearer services.

For the provision of data transmission services, the ISDN may be accessed by DTEs/TEs by the categories of access S, T, U as defined in Recommendation X.10 and/or the access methods defined in the I.230 series Recommendations. In addition the ISDN may also be accessed via other networks, i.e., PSTN (Recommendation I.530), CSPDN (Recommendation X.10, category B and Recommendation X.321), PSPDN (Recommendations X.325 and X.10, categories C, D), MSS (Recommendation X.324), or ISDN (SS No. 7, Recommendation X.75, Recommendation X.10, category Y and this Recommendation).

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

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

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

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

d) virtual call and permanent virtual circuit.

5.2 *Call control between the ISDN and ISDN*

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

5.3 *Functionalities of the ISDN*

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

TABLE 1/X.320

General characteristics of ISDN

General characteristics	ISDN
Data transmission service/Bearer service	X.1, I.230 Series
Optional user facilities/Supplementary services	Circuit-Mode I.250 Series, Packet-Mode X.301
Categories of access	X.10 categories S, T, U See also § 5.1 of this Recommendation
Access via other networks	
PSTN	I.530
CSPDN	Recommendations X.321, X.10 category B
PSPDN	Recommendations X.325, X.10 categories C, D
MSS	X.324
ISDN	SS No. 7, X.75, X.10 category Y, this Recommendation

6 Specific interworking arrangements

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

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

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

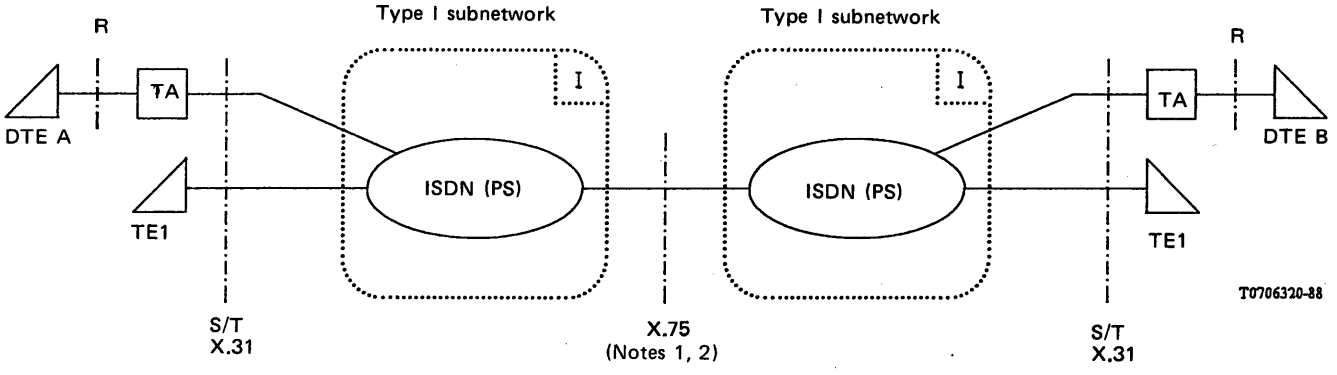
c) interworking between ISDNs, where a packet switched bearer is used on one ISDN, and a circuit switched bearer is used on the other:

   1) interworking by call-control mapping;

   2) interworking by port access.

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

The detailed procedures for interworking by call-control mapping are defined in Recommendation X.75 (see Figure 1/X.320). The use of other Recommendations is for further study. In particular, the following applies:



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

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

FIGURE 1/X.320

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

6.1.1 *Transfer of addressing information*

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

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

These arrangements are as described in Recommendation X.301.

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

These arrangements are as described in Recommendation X.301.

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

These arrangements are as described in Recommendation X.301.

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

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

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

These arrangements are as described in Recommendation X.301.

6.1.7 *Arrangements for other facilities*

These arrangements are as described in Recommendation X.301.

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

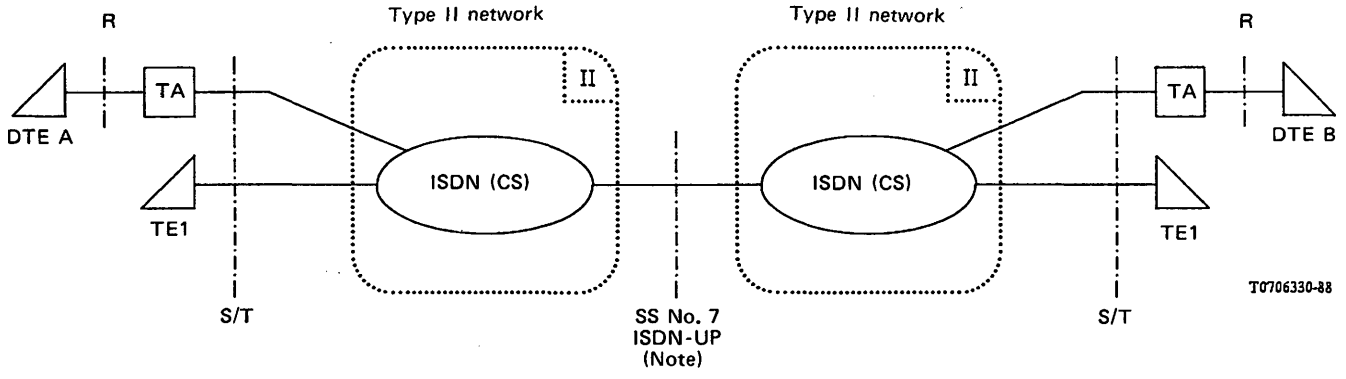
These arrangements are as described in Recommendation X.302. In particular, the mechanisms for network identification are applied as follows:

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

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

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

The detailed procedures for interworking are defined in Signalling System No. 7, ISDN-user part (see Figure 2/X.320). In particular, the following applies:



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

FIGURE 2/X.320

ISDN/ISDN circuit-mode interworking

6.2.1 *Transfer of addressing information*

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

6.2.2 *Arrangements for facilities related to QOS of the call*

These arrangements are as described in Recommendation X.301.

6.2.3 *Arrangements for facilities related to changing conditions applying to the call*

These arrangements are as described in Recommendation X.301.

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

These arrangements are as described in Recommendation X.301.

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

These arrangements are as described in Recommendation X.301.

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

These arrangements are as described in Recommendation X.301.

6.2.7 *Arrangements for other facilities*

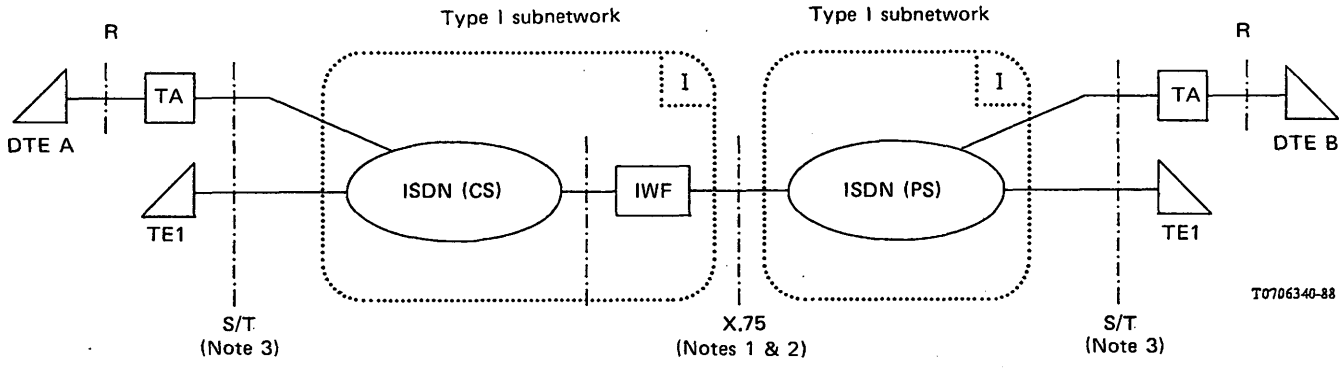
These arrangements are as described in Recommendation X.301.

6.2.8 *Arrangements for internal network utilities*

These arrangements are as described in Recommendation X.302.

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

6.3.1 *Interworking by call-control mapping*



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

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

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

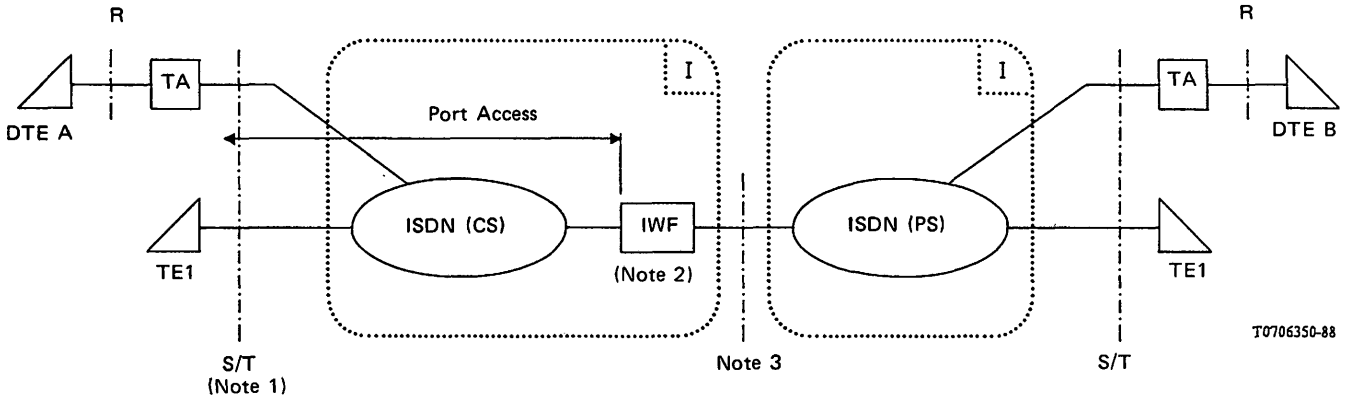
FIGURE 3/X.320

Interworking by call control mapping

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

- Call-control arrangements in the circuit-switched case of ISDN (i.e. I.420 or the functionality identical SS No. 7 protocol or a functionally identical internal network protocol) should be mapped in the IWF to the call-control arrangements in the packet switched case of ISDN (i.e., X.75 or a functionally identical internal network protocol). This mapping is for further study.
- Data transfer arrangements in the packet switched case of ISDN (i.e., X.75 or a functionally identical internal network protocol) should be mapped in the IWF to the procedures operated over the circuit switched bearer between IWF and TE/DTE. This mapping is for further study.

6.3.2 *Interworking by port access*



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

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

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

FIGURE 4/X.320

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

In order to enable interworking, procedures must be operated over the ISDN circuit switched bearer to achieve functional compatibility. These procedures follow Recommendation X.25 (see Recommendations X.31 and X.10 access category Y). Aspects of X.32 apply as noted in X.31.

In general, the following applies:

- X.75, or a functionally identical internal network protocol is operated between the packet switched case of ISDN and IWF.
- I.420, or ISDN-UP, or a functionally identical internal network protocol is operated between the circuit switched case of ISDN and the IWF, and used to control the circuit switched bearer.
- X.25 is operated between the IWF and the DTE/TE over the ISDN circuit switched bearer.

"Dialling out" considerations:

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

- The Q.931 called party number (and subaddress, if provided) are derived from the X.75 call request packet.
- The Q.931 bearer capability is coded as circuit mode.
- After establishment of the circuit switched bearer, a link connection will be established and the X.75 call request packet will be mapped by the IWF to an X.25 incoming call packet.
- Further procedures are as detailed in Recommendation X.31.

"Dialling in" considerations:

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

- The Q.931 called party number is the address of the IWF (port address).
- The Q.931 bearer capability is coded as circuit mode.
- After establishment of the circuit switched bearer, a link connection will be established.
- An X.25 call request packet will be mapped by the IWF to an X.75 call request packet.
- Further procedures are as detailed in Recommendation X.31.

Recommendation X.321 [1]

GENERAL ARRANGEMENTS FOR INTERWORKING BETWEEN CIRCUIT SWITCHED PUBLIC DATA NETWORKS (CSPDNs) AND INTEGRATED SERVICE DIGITAL NETWORKS (ISDNs) FOR THE PROVISION OF DATA TRANSMISSION SERVICES

(Melbourne, 1988)

The CCITT,

considering

(a) that Recommendation X.300 defines the general principles for interworking between public networks, and between public networks and other networks for the provision of data transmission services;

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

(c) that Recommendation X.302 defines the general arrangements for internal network utilities within a subnetwork and between subnetworks for the provision of data transmission services;

(d) that Recommendation X.75 specifies detailed procedures applicable to call control between public networks providing data transmission services;

(e) that Recommendation X.10 describes categories of access to CSPDNs and ISDNs for the provision of data transmission services;

(f) that Recommendation X.213 describes the network service definition for open systems interconnection for CCITT applications;

(g) that Recommendation X.305 describes functionalities of subnetworks relating to the support of the OSI network service;

(h) the need for arrangements when interworking between ISDNs and CSPDNs for the provision of data transmission services,

unanimously recommends

that arrangements for the interworking between CSPDNs and ISDNs for the provision of data transmission services be in accordance with the principles and arrangements specified in this Recommendation.

CONTENTS

[1] This Recommendation can also be found in the I-series, under the number I.540.

0 Introduction

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

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

1 Scope and field of application

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

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

2 References

[1] Recommendation X.300

[2] Recommendation X.301

[3] Recommendation X.302

[4] Recommendation X.305

[5] Recommendation X.31

[6] Recommendation X.75

[7] Recommendation X.1

[8] Recommendation X.2

[9] Recommendation X.10

[10] I.230 series Recommendations
I.250 series Recommendations

[11] Recommendation I.500

[12] Recommendation X.121

[13] Recommendation X.122

[14] Recommendation E.164

[15] Recommendation E.166

3 Definitions

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

a) transmission capability,
b) communication capability,
c) subnetwork functionality,
d) data transmission service.

This Recommendation makes use of the following terms defined in Recommendation I.211:

a) circuit switched bearer service,
b) packet switched virtual circuit bearer service.

4 Abbreviations

CNIC	Clearing Network Identification Code
CUG	Closed User Group
CUG/OA	Closed User Group with Outgoing Access
DTE	Data Terminal Equipment

ISDN	Integrated Services Digital Network
IWF	Interworking Function
MSS	Mobile Satellite System
PSPDN	Packet Switched Public Data Network
SS No. 7	Signalling System No. 7
TA	Terminal Adaptor
TE	Terminal Equipment
TNIC	Transit Network Identification Code

5 General aspects

This Recommendation, in describing interworking arrangements between two subnetworks for the provision of data transmission services, adheres to the general principles of Recommendation X.300. The environments of these two subnetworks are described in the following sections. See also Table 1/X.321.

5.1 *CSPDN*

The CSPDN provides circuit switched data transmission services as defined in Recommendations X.1 and X.2 for the provision of data transmission services, the CSPDN may be accessed by DTEs by the category of access B as defined in Recommendation X.10. In addition, the CSPDN may also be accessed via other networks, i.e., PSPDN (X.10 categories C, D and Recommendation X.75), MSS (Recommendation X.75), or ISDN (this Recommendation). Private network access to the CSPDN is for further study (see Recommendation X.300).

5.2 *ISDN*

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

Note – Supplementary services/optional user facilities for the circuit-mode operation on ISDN are in the I.250 series. Recommendation X.2 applies to ISDN packet switched data transmission services/bearer services.

For the provision of data transmission services, the ISDN may be accessed by DTEs/TEs by the categories of access S, T, U as defined in Recommendation X.10 and/or the access methods defined in the I.230 series Recommendations. In addition, the ISDN may also be accessed via other networks, i.e., PSTN (Recommendation I.530), CSPDN (X.10, category B, and this Recommendation), PSPDN (Recommendations X.325 and X.10, categories C, D), MSS (Recommendation X.324), or ISDN (SS No. 7, Recommendations X.75 and X.10, category Y).

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

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

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

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

d) virtual call and permanent virtual circuit.

5.3 *Call control between the CSPDN and ISDN*

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

5.4 *Functionalities of the CSPDN and ISDN*

The functionalities of different types of subnetworks are described in Recommendation X.305. In the case where the ISDN is used to provide a packet switched data transmission service/bearer service, the functionality of the CSPDN and ISDN differ. Therefore, in order to enable interworking, procedures must be operated over the circuit switched bearer on the CSPDN to achieve functional compatibility. In the case where the ISDN is used to provide a circuit switched data transmission service/bearer service, the CSPDN and ISDN are functionally compatible.

TABLE 1/X.321

Comparison of general characteristics of CSPDN and ISDN

General characteristics	CSPDN	ISDN
Data transmission service/ Bearer service	X.1, X.2	X.1, I.230 Series
Optional user facilities/ Supplementary services	X.2	Circuit-Mode I.250 Series Packet-Mode X.301
Categories of access	X.10 category B	X.10 categories S, T, U See also § 5.2 of this Recommendation
Access via other networks		
PSTN	–	I.530
CSPDN	X.71, X.60	This Recommendation, X.10 category B
PSPDN	Recommendations X.322, X.10 categories C, D	Recommendations X.325, X.10 categories C, D
MSS	X.75	X.324
ISDN	This Recommendation	SS No. 7, X.75 X.10 category Y

6 Specific interworking arrangements

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

a) interworking between CSPDN and ISDN where a packet switched bearer is used;

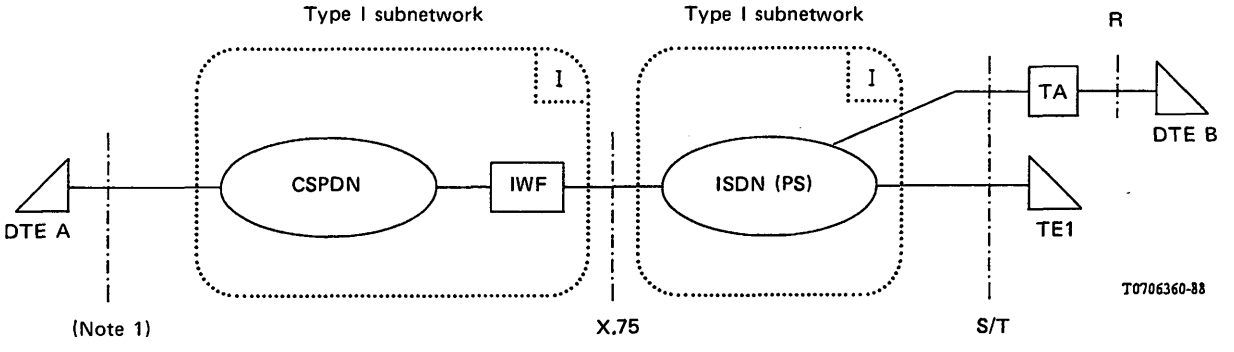
b) interworking between CSPDN and ISDN where a circuit switched bearer is used.

6.1 *Interworking between CSPDN and ISDN where a packet switched bearer is requested*

The detailed procedures for interworking are defined in Recommendation X.75. See Figure 1/X.321. In particular, the following applies:

6.1.1 *Transfer of addressing information*

ISDNs and CSPDNs typically utilize different numbering plans (i.e., E.164 and X.121 respectively). The considerations on the transfer of addressing informations of the two different types as described in Recommendation X.301 apply. Further specifics on interworking between the two numbering plans concerned, are detailed in Recommendations E.166 and X.122.



Note 1 – The exact protocols to be used in this case are for further study.

FIGURE 1/X.321

CSPDN/ISDN(PS) interworking

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

These arrangements are as described in Recommendation X.301. However, for the throughput facility, different classes are supported in the ISDN and CSPDN (i.e., the class of 64 kbit/s). Whenever a request is made for a throughput class higher than 48 kbit/s from the ISDN, the request should be negotiated down to a lower user class supported on the CSPDN.

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

For further study.

6.1.4 *Arrangements for facilities related to specific routing conditions requested by the user*

For further study.

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

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

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

For further study.

6.1.7 *Arrangements for other facilities*

For further study.

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

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

- the CSPDN is identified by the DNIC/DCC method;
- the ISDN is identified by the Recommendation X.302 method.

These network identifications are then further applied in the TNIC and CNIC utilities of Recommendation X.75.

6.2 *Interworking between a CSPDN and ISDN where a circuit switched bearer is requested*

The detailed procedures for interworking are defined in Recommendation X.81 (see Figure 2/X.321). In particular, the following applies:

6.2.1 *Transfer of addressing information*

ISDNs and CSPDNs typically utilize different numbering plans (i.e., E.164 and X.121 respectively). The considerations on the transfer of addressing information of the two different types as described in Recommendation X.301 apply. Further specifics on interworking between the two numbering plans concerned, are detailed in Recommendations E.166 and X.122.

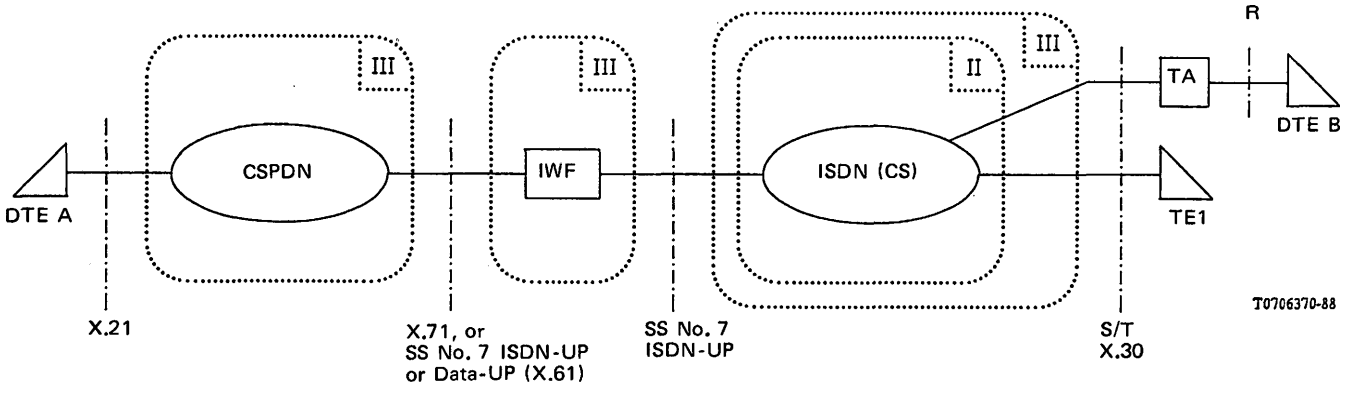


FIGURE 2/X.321

CSPDN/ISDN interworking where a circuit switched bearer is requested to the ISDN

6.2.2 *Arrangements related to QOS of the call*

These arrangements for the CSPDN are described in Recommendation X.301. For the ISDN (CS), the arrangements are for further study.

6.2.3 *Arrangements for facilities related to the changing condition requested by the user of the call*

For further study.

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

For further study.

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

These arrangements for CSPDN are described in Recommendation X.301. Arrangements for ISDN (CS) are for further study.

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

For further study.

6.2.7 *Arrangements for other facilities*

For further study.

6.2.8 *Arrangements for internal network*

These arrangements for CSPDN are described in Recommendation X.302. The arrangements for ISDN (CS) are for further study.

Recommendation X.322

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

(Melbourne, 1988)

The CCITT,

considering

(a) that Recommendation X.300 defines the general principles for interworking between public networks, and between public networks and other networks for the provision of data transmission services;

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

(c) that Recommendation X.302 defines the general arrangements for internal network utilities within a subnetwork and between subnetworks for the provision of data transmission services;

(d) that Recommendation X.75 defines procedures for PSPDN/PSPDN interworking and that Recommendations X.61 and X.71 define procedures for CSPDN/CSPDN interworking;

(e) that Recommendation X.10 describes categories of access to PDNs and ISDNs for the provision of data transmission services;

(f) that Recommendation X.213 describes the network service definition for open systems interconnection for CCITT applications;

(g) that Recommendation X.305 describes functionalities of subnetworks relating to the support of the OSI network service;

(h) the desirability to maintain compatibility in the procedures used at layers 1, 2 and 3 on CSPDN, for current and future telematic terminals, and also for terminals in non-telematic applications;

(i) that Recommendation X.223 defines the use of X.25 to provide the OSI connection-mode network service;

(j) that Recommendation T.70 defines the network-independent basic transport service for the telematic services;

(k) that Recommendation X.32 defines the 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;

(l) that Recommendation X.82 defines detailed arrangements for interworking between CSPDNs and PSPDNs based on Recommendation T.70;

(m) the need for arrangements when interworking between PSPDNs and CSPDNs for the provision of data transmission services,

unanimously recommends

that arrangements for the interworking between PSPDNs and CSPDNs for the provision of data transmission services be in accordance with the principles and arrangements specified in this Recommendation.

CONTENTS

0 Introduction

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

This Recommendation describes the interworking arrangements between CSPDNs and PSPDNs for the provision of data transmission services.

1 Scope and field of application

The purpose of this Recommendation is to describe the general arrangements for the interworking between PSPDNs and CSPDNs for the provision of data transmission services (Note 1). These arrangements are applicable only to the interworking involving transmission capabilities, and not to interworking involving communication capabilities as described in Recommendation X.300.

Note 1 – These arrangements could also be used for the support of telematic services.

Note 2 – The typing of subnetworks in this Recommendation is based on the support for the OSI connection-mode network service and is therefore only valid in that context.

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

2 References

X.300 General principles for interworking between public networks, and between public networks and other networks for the provision of data transmission services

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 intermediate utilities 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.1 International user classes of service in public data networks and integrated services digital networks (ISDNs)

X.2 International data transmission services and optional user facilities in public data networks and ISDNs

X.10 Categories of access for data terminal equipment (DTE) to public data transmission services

X.71 Decentralized terminal and transit control signalling system on international circuits between synchronous data networks

X.75 Packet switched signalling system between public networks providing data transmission services

X.82 Detailed arrangements for interworking between CSPDNs and PSPDNs based on Recommendation T.70

X.121 International numbering plan for public data networks

X.223 Use of X.25 to provide the OSI connection-mode network service for CCITT applications

T.70 Network independent basic transport service for telematic services

3 Definitions

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

a) transmission capability,
b) communication capability,
c) subnetwork functionality,
d) data transmission service,
e) network*,
f) interworking by call control mapping,
g) interworking by port access.

4 Abbreviations

CSPDN	Circuit switched public data network
DTE	Data terminal equipment
ISDN	Integrated services digital network
IWF	Interworking function
LAN	Local area network
MSS	Maritime satellite service
PBX	Private branch exchange
PSPDN	Packet switched public data network
PSTN	Public switched telephone network
QOS	Quality of service
TNIC	Transit network identification code

5 General aspects

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

5.1 *PSPDN*

The PSPDN provides packet switched data transmission services described in Recommendations X.1 and X.2. For the provision of data transmission services, the PSPDN may be accessed by DTEs by the categories of access C and D as defined in Recommendation X.10. In addition, the PSPDN may also be accessed via other

networks, i.e., PSTN (X.10 category L, P), CSPDN (X.10 category K, O and this Recommendation), PSPDN (Recommendation X.75), MSS (Recommendation X.75), or ISDN (Recommendation X.325). Private networks access the PSPDN via X.10 category of access D.

5.2 *CSPDN*

The CSPDN provides circuit switched data transmission services described in Recommendations X.1 and X.2. For the provision of data transmission services, the CSPDN may be accessed by DTEs by the categories of access B as defined in Recommendation X.10. In addition, the CSPDN may also be accessed via other networks, i.e., PSPDN (this Recommendation), CSPDN (Recommendation X.71), or ISDN (Recommendation X.321). Access of private networks and mobile systems to the CSPDN is for further study (see Recommendation X.300).

5.3 *Call control between the PSPDN and CSPDN*

The general arrangements for call control between the PSPDN and CSPDN are as defined in Recommendation X.301. Network utilities used between the PSPDN and CSPDN are as defined in Recommendation X.302 (not visible for users).

5.4 *Functionalities of the PSPDN and CSPDN*

The functionalities of different types of subnetworks are described in Recommendation X.300. The functionalities of the PSPDN and CSPDN differ. Therefore, in order to enable interworking, procedures must be operated over the CSPDN to achieve functional compatibility.

Two different sets of procedures are considered for this purpose:

a) T.70 based procedures for the support of telematic procedures (see § 6.1);

b) X.25 based procedures (see Recommendation X.32); (see § 6.2).

However, the T.70 based procedures do not provide full functional compatibility; some protocol elements from the PSPDNs cannot be mapped by the IWF (see Recommendation X.82).

TABLE 1/X.322

Comparison of general characteristics of PSPDN and CSPDN

General characteristics	PSPDN	CSPDN
Data transmission service/ Bearer service	X.1, X.2	X.1, X.2
Optional user facilities/ Supplementary services	X.2	X.2
Categories of access	X.10 categories C, D	X.10 category B
Access via other networks		
PSTN	X.10 categories L, P	–
CSPDN	This Recommendation	X.71
PSPDN	X.323	This Recommendation
MSS	X.324	–
ISDN	X.325	X.321
Private networks	X.327	Further study

5.5 *Routing*

5.5.1 *Routing considerations related to the use of T.70*

a) When crossover from packet switched to circuit switched PDNs is needed, this changeover should occur as late as possible:

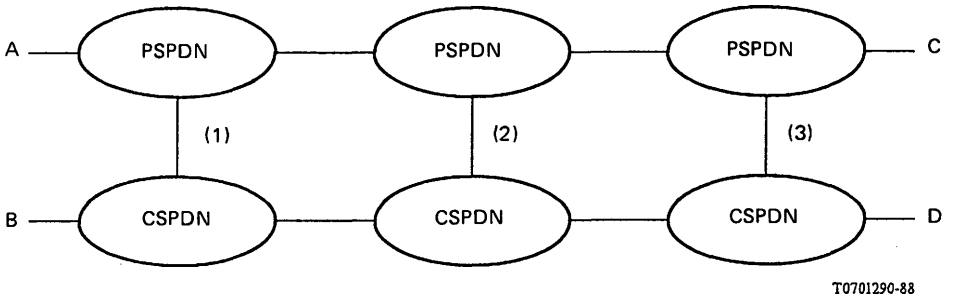


FIGURE 1/X.322

i.e., going from A to D, crossover at (3) is preferred.

b) The T.70 (§ 3.3.3) based solution should not be used for cases where the CSPDN acts as transit network in cases where the preservation of functional compatibility is necessary to the highest possible extent.

c) It is for further study whether beyond an X.21 subscriber interface, typically private networks may need to be expected other than PBX type (circuit switched) of networks (e.g., not LANs). This assumption is particularly relevant for the treatment of QOS parameters in the IWF.

5.5.2 *IWF selection*

When the crossover from PSPDN to CSPDN is needed, the appropriate IWF must be selected, i.e., X.25 based IWF, or the T.70 based IWF. (In case the IWFs are physically colocated, still the proper procedures must be selected.) The appropriate selection can be made on the basis of the called DTE address.

6 Specific interworking arrangements

6.1 *Interworking by call control mapping*

The interworking arrangement is illustrated in Figure 2/X.322.

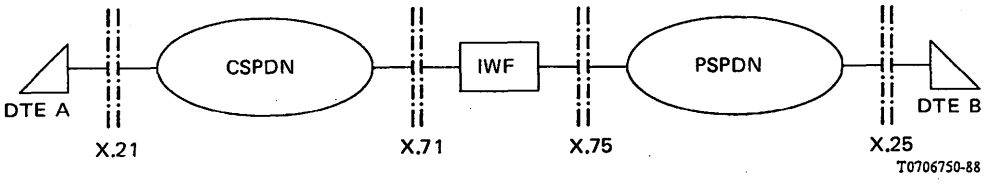


FIGURE 2/X.322

In this interworking arrangement:

a) the international arrangement between both subnetworks (i.e., in the figures between the interworking functions and the PSPDN) is based on Recommendation X.75;

b) the interworking function (IWF) provides conversion between signalling system X.71 or X.61, and X.75. During data transfer phase, and for telematic terminals mentioned in Recommendation T.70, the protocols defined in §§ 3.3.2 and 3.3.3 of T.70 are used on CSPDN at layers 2 and 3; for other terminals on CSPDN, the application of these protocols or alternative protocols is possible.

Note 1 – In establishing international accounting principles in relation with this interworking arrangement, consideration should be given to the distribution of the functional elements involved in this interworking arrangement (e.g., cost/revenues of the IWF).

Note 2 – For any of the cases in § 6.1, the Administrations involved may agree exceptionally that the interworking function or crossover point between the CSPDN and PSPDN be placed in a country different than the CSPDN.

The detailed procedures for interworking are defined in Recommendation X.82 (does not yet cover the X.61 case). In particular, the following applies:

6.1.1 *Transfer of addressing information*

For further study.

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

For further study.

6.1.3 *Arrangements for facilities relating to charging conditions applying to the call*

For further study.

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

For further study.

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

For further study.

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

For further study.

6.1.7 *Arrangements for other facilities*

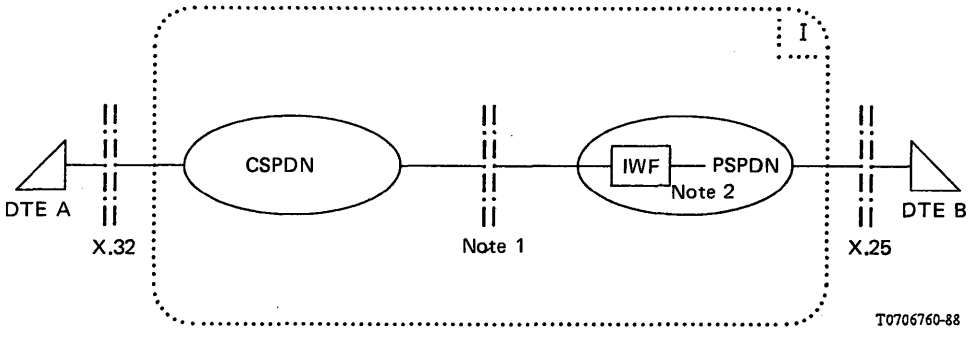
For further study.

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

These arrangements are as described in Recommendation X.302.

6.2 *Interworking by port access*

The interworking arrangement is illustrated in Figure 3/X.322.



Note 1 – X.21 is used. However, some Administrations may use other internal protocol, in which case a physically or logically separate IWF may be required.

Note 2 – The IWF performs the functions for accessing the PSPDN via a CSPDN.

Note 3 – Further typing of subnetworks may be done.

FIGURE 3/X.322

The detailed procedures for interworking are defined in Recommendation X.32. In particular, the following applies:

6.2.1 *Transfer of addressing information*

These arrangements are described in Recommendation X.301.

6.2.2 *Arrangements for facilities related to QOS of the call*

These arrangements are described in Recommendation X.301.

6.2.3 *Arrangements for facilities relating to charging conditions applying to the call*

These arrangements are described in Recommendation X.301.

6.2.4 *Arrangements for facilities relating to specific routing conditions applying to the call*

These arrangements are described in Recommendation X.301.

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

These arrangements are described in Recommendation X.301.

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

These arrangements are described in Recommendation X.301.

6.2.7 *Arrangements for other facilities*

These arrangements are described in Recommendation X.301.

6.2.8 *Arrangements for internal network utilities (not visible for users)*

These arrangements are as described in Recommendation X.302.

Recommendation X.323

GENERAL ARRANGEMENTS FOR INTERWORKING BETWEEN PACKET SWITCHED PUBLIC DATA NETWORKS (PSPDNs)

(Melbourne, 1988)

The CCITT,

considering

(a) that Recommendation X.300 defines the general principles for interworking between public data networks, and between public networks and other networks for the provision of data transmission services;

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

(c) that Recommendation X.302 defines the general arrangements for internal network utilities within a subnetwork and between subnetworks for the provision of data transmission services;

(d) that Recommendation X.75 specifies packet switching signalling system between public networks providing data transmission services;

(e) that Recommendation X.10 describes categories of access to PSPDNs and ISDNs for the provision of data transmission services;

(f) that Recommendation X.213 describes the network service definition for open systems interconnection for CCITT applications;

(g) that Recommendation X.305 describes functionalities of subnetworks relating to the support of the OSI network service;

(h) the need for arrangements when interworking between ISDNs and PSPDNs for the provision of data transmission services,

unanimously recommends

that arrangements for the interworking between PSPDNs for the provision of data transmission services be in accordance with the principles and arrangements specified in this Recommendation.

CONTENTS

0 Introduction

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

This Recommendation describes the interworking arrangements between PSPDNs for the provision of data transmission services. These interworking arrangements should include all the capabilities required to support the network service for open systems interconnection for CCITT applications as described in Recommendation X.213.

1 Scope and field of application

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

2 References

[1] Recommendation X.300

[2] Recommendation X.301

[3] Recommendation X.302

[4] Recommendation X.305

[5] Recommendation X.31

[6] Recommendation X.75

[7] Recommendation X.1

[8] Recommendation X.2

[9] Recommendation X.10

[10] Recommendation I.211

[11] Recommendation I.500

[12] Recommendation X.121

[13] Recommendation E.164

3 Definitions

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

a) transmission capability,

b) communication capability,

c) subnetwork functionality,

d) data transmission service.

4 Abbreviations

CNIC	Clearing Network Identification Code
CUG	Closed User Group
CUG/OA	CUG with outgoing access
DTE	Data Terminal Equipment
IWF	Interworking Function
PSPDN	Packet Switched Public Data Network
TNIC	Transit Network Identification Code

5 General aspects

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

5.1 *PSPDN*

The PSPDN provides packet-switched data transmission services as defined in Recommendations X.1 and X.2 for the provision of data transmission services. The PSPDN may be accessed by DTEs by the categories of access C and D as defined in Recommendation X.10.

5.2 *Call control between the PSPDNs*

The general arrangements for call control between the PSPDNs are as defined in Recommendation X.301. Network utilities used between the PSPDNs are as defined in Recommendation X.302 (not visible for users).

6 Specific interworking arrangements

6.1 *Interworking between PSPDNs*

The detailed procedures for interworking are defined in Recommendation X.75. In particular, the following applies:

6.1.1 *Transfer of addressing information*

The considerations on the transfer of addressing information as described in Recommendation X.301 may apply.

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

These arrangements are described in Recommendation X.301.

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

These arrangements are described in Recommendation X.301.

6.1.4 *Arrangements for internal network utilities (not visible for users)*

These arrangements are as described in Recommendation X.302.

Recommendation X.324

GENERAL ARRANGEMENTS FOR INTERWORKING BETWEEN PACKET SWITCHED PUBLIC DATA NETWORKS (PSPDNs) AND PUBLIC MOBILE SYSTEMS FOR THE PROVISION OF DATA TRANSMISSION SERVICES

(Melbourne, 1988)

The CCITT,

considering

(a) that Recommendation X.300 defines the general principles for interworking between public data networks, and between public data networks and other networks for the provision of data transmission services;

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

(c) that Recommendation X.302 defines the general arrangements for internal network utilities within a subnetwork and between subnetworks for the provision of data transmission services;

(d) that Recommendation X.75 already specifies detailed procedures applicable to call control between two public networks providing data transmission services;

(e) that Recommendation X.10 describes categories of access to PSPDNs for the provision of data transmission services;

(f) that Recommendation X.213 describes the network service definition for open systems interconnection for CCITT applications;

(g) that Recommendation X.305 describes functionalities of subnetworks relating to the support of the OSI network service;

(h) that the Q.1000 series of Recommendations define public land mobile networks (PLMNs);

(i) that the International Maritime Satellite Organization (INMARSAT) is currently operating a maritime satellite system designated as Standard-A providing voice, telex and data transmission services;

(j) that new INMARSAT standards designated Standard-B (digital replacement/upgrade for Standard-A), Standard-C (low data rate messaging system) and Aeronautical (digital voice and data transmission system for aircrafts) will be brought into service;

(k) the need for arrangements when interworking between mobile systems and PSPDNs for the provision of data transmission services,

unanimously recommends

that arrangements for the interworking between PSPDNs and mobile systems for the provision of data transmission services be in accordance with the principles and arrangements specified in this Recommendation.

CONTENTS

0 Introduction

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

This Recommendation describes the interworking arrangements between mobile systems and PSPDNs for the provision of data transmission services. These interworking arrangements should include all the capabilities as described in Recommendation X.213.

1 Scope and field of application

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

2 References

[1] Recommendation X.300

[2] Recommendation X.301

[3] Recommendation X.302

[4] Recommendation X.305

[5] Recommendation X.325

[6] Recommendation X.1

[7] Recommendation X.2

[8] Recommendation X.10

[9] Recommendation X.121

3 Definitions

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

a) transmission capability,

b) communication capability,

c) subnetwork functionality,

d) data transmission service.

4 Abbreviations

CSPDN	Circuit switched public data network
DTE	Data terminal equipment
ISDN	Integrated services digital network
PDN	Public data network
PLMN	Public land mobile network
PSPDN	Packet switched public data network
PSTN	Public switched telephone network

5 General aspects

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

5.1 *PSPDN*

The PSPDN provides packet switched data transmission services as defined in Recommendations X.1 and X.2 for the provision of data transmission services, the PSPDN may be accessed by DTEs by the categories of access C and D as defined in Recommendation X.10. In addition, the PSPDN may also be accessed via other networks, i.e., PSTN (X.10 category L, P), CSPDN (X.10 category K, O), PSPDN (Recommendation X.75), ISDN (Recommendation X.325), or mobile systems (this Recommendation). Private networks access the PSPDN via X.10 category of access D.

5.2 *Public mobile system*

The public mobile system may either be a public land mobile network (PLMN) as defined in Recommendation Q.1001 on a mobile satellite system (MSS) such as the one operated by the International Maritime Satellite Organisation (INMARSAT).

The mobile system may provide packet switched data transmission services as defined in Recommendations X.1 and X.2.

In the context of this Recommendation, DTEs may access the mobile system by the categories of access C and D as defined in Recommendation X.10.

5.3 *Specific aspects of public mobile systems*

In addition to the basic functions of networks they share with other types of networks, public mobile systems have specific functions related to the mobility of their users accessing the system via mobile stations.

Mobile systems deal with the mobility of their users in one of two ways:

a) by requiring the calling user to specify one of a small number of zones as the location of the mobile user;

b) by maintaining a data base containing the current location of each mobile station (called a location register in Recommendation Q.1001) and arranging for the interconnected fixed network(s) to route calls to an appropriate access point to the public mobile system. With such a mechanism, the calling user need not know the current location of the called mobile user.

The first method (called designation method call routing to mobile users) is used in the public maritime mobile satellite system where the mobile station may be in one of three satellite regions. The second method (called non-designation method call routing to mobile users) is typified by systems conforming to the Q.1000 series of Recommendations.

5.4 *Organisation of X-series Recommendations related to interworking between PSPDNs and public mobile systems*

Since mobile systems fall into the two categories mentioned in § 5.3, two sets of Recommendations are necessary to describe the associated interworking arrangements. The existing and planned structure of these Recommendations is given in Figure 1/X.324.

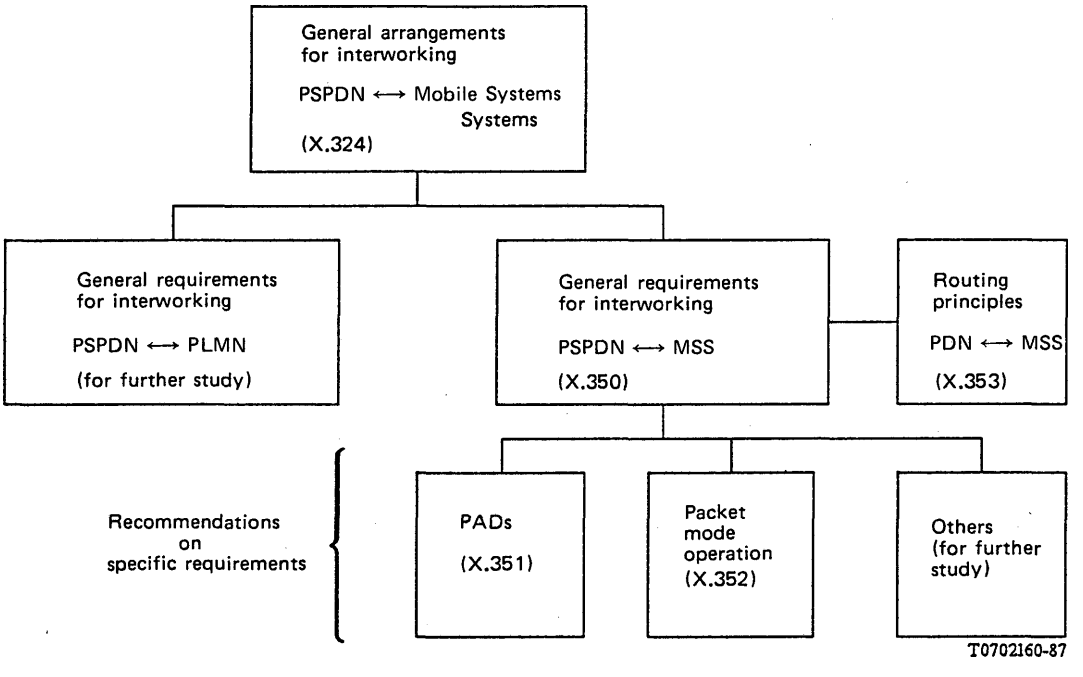


FIGURE 1/X.324

Structure of Recommendations for interworking between PSPDNs and Public Mobile Systems

6 **Specific interworking arrangements**

For further study.

See also Recommendations X.351, X.352 for the public mobile satellite system.

7 **International interworking**

For further study.

Recommendation X.325 [1)]

GENERAL ARRANGEMENTS FOR INTERWORKING BETWEEN PACKET SWITCHED PUBLIC DATA NETWORKS (PSPDNs) AND INTEGRATED SERVICES DIGITAL NETWORKS (ISDNs) FOR THE PROVISION OF DATA TRANSMISSION SERVICES

(Melbourne, 1988)

The CCITT,

considering

(a) that Recommendation X.300 defines the general principles for interworking between public networks, and between public networks and other networks for the provision of data transmission services;

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

(c) that Recommendation X.302 defines the general arrangements for internal network utilities within a subnetwork and between subnetworks for the provision of data transmission services;

(d) that Recommendation X.75 already specifies detailed procedures applicable to call control between public networks providing data transmission services;

(e) that Recommendation X.10 describes categories of access to PSPDNs and ISDNs for the provision of data transmission services;

(f) that Recommendation X.213 describes the network service definition for open systems interconnection for CCITT applications;

(g) that Recommendation X.305 describes functionalities of subnetworks relating to the support of the OSI network service;

(h) the need for arrangements when interworking between ISDNs and PSPDNs for the provision of data transmission services,

unanimously recommends

that arrangements for the interworking between PSPDNs and ISDNs for the provision of data transmission services be in accordance with the principles and arrangements specified in this Recommendation.

CONTENTS

[1)] This Recommendation can also be found in the I-series, under the number I.540.

5 *General aspects*

6 *Specific interworking arrangements*

0 Introduction

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

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

1 Scope and field of application

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

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

2 References

[1] Recommendation X.300

[2] Recommendation X.301

[3] Recommendation X.302

[4] Recommendation X.305

[5] Recommendation X.31

[6] Recommendation X.75

[7] Recommendation X.1

[8] Recommendation X.2

[9] Recommendation X.10

[10] I.230 series Recommendations
I.250 series Recommendations

[11] Recommendation I.500

[12] Recommendation X.121

[13] Recommendation X.122

[14] Recommendation E.164

[15] Recommendation E.166

3 Definitions

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

a) transmission capability,
b) communication capability,
c) subnetwork functionality,
d) data transmission service,
e) interworking by call-control mapping,
f) interworking by port access.

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

a) circuit switched bearer service,
b) packet switched virtual circuit bearer service.

4 Abbreviations

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

5 General aspects

This Recommendation, in describing interworking arrangements between two subnetworks for the provision of data transmission services, adheres to the general principles of Recommendation X.300. The environments of these two subnetworks are described in the following sections. See also Table 1/X.325.

5.1 *PSPDN*

The PSPDN provides packet switched data transmission services services as defined in Recommendations X.1 and X.2 for the provision of data transmission services, the PSPDN may be accessed by DTEs by the categories of access C and D as defined in Recommendation X.10. In addition, the PSPDN may also be accessed via other networks, i.e., PSTN (X.10 categories L, P), CSPDN (X.10, categories K, O), PSPDN (Recommendation X.75), MSS (Recommendation X.75), or ISDN (this Recommendation and X.10, category Q). Private networks access the PSPDN via X.10, category of access D.

5.2 *ISDN*

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

Note – Supplementary services/optional user facilities for the circuit-mode operation on ISDN are in the I.250 series. Recommendation X.2 applies to ISDN packet switched data transmission services/bearer services.

For the provision of data transmission services, the ISDN may be accessed by DTEs/TEs by the categories of access S, T, U as defined in Recommendation X.10 and/or the access methods defined in the I.230 series Recommendations. In addition, the ISDN may also be accessed via other networks, i.e., PSTN (Recommendation I.530), CSPDN (Recommendation X.10, category B and Recommendation X.321), PSPDN (this Recommendation), MSS (Recommendation X.324), or ISDN (SS No. 7, Recommendations X.75 and X.10, category Y).

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

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

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

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

d) virtual call and permanent virtual circuit.

5.3 *Call control between the PSPDN and ISDN*

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

5.4 *Functionalities of the PSPDN and ISDN*

The functionalities of different types of subnetworks are described in Recommendation X.305. In the case where the ISDN is used to provide a packet switched data transmission service/bearer service, the functionality of the PSPDN and ISDNs differ. Therefore, in order to enable interworking, procedures must be operated over the circuit switched bearer on the PSPDN to achieve functional compatibility. In the case where the ISDN is used to provide a packet switched data transmission service/bearer service, the PSPDN and ISDN are functionally compatible.

6 Specific interworking arrangements

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

a) interworking between PSPDN and ISDN where a packet switched bearer is used;

b) interworking between PSPDN and ISDN where a circuit switched bearer is used:

   1) interworking by call-control mapping;

   2) interworking by port access.

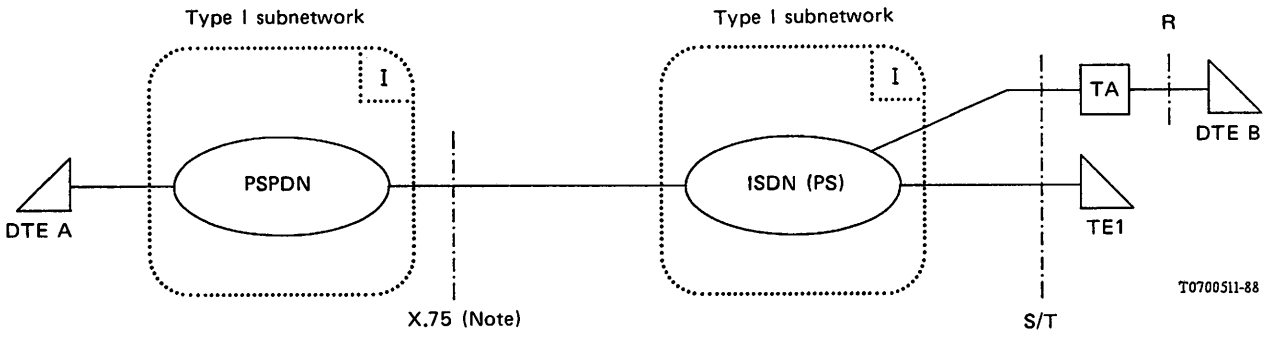
TABLE 1/X.325

Comparison of general characteristics of PSPDN and ISDN

General characteristics	PSPDN	ISDN
Data transmission service/ Bearer service	X.1, X.2	X.1, I.230 Series
Optional user facilities/ Supplementary services	X.2	Circuit-Mode I.250 Series Packet-Mode X.301
Categories of access	X.10 categories C, D	X.10 categories S, T, U See also § 5.2 of this Recommendation
Access via other networks		
PSTN	X.10 categories L, P	I.530
CSPDN	X.10 categories K, O	Recommendations X.321, X.10 category B
PSPDN	X.75	This Recommendation, X.10 categories C, D
MSS	X.75	X.324
ISDN	This Recommendation	SS No. 7, X.75 X.10 category Y

6.1 *Interworking between PSPDN and ISDN where a packet switched bearer is requested*

The detailed procedures for interworking by call-control mapping are defined in Recommendation X.75 (see Figure 1/X.325). In particular, the following applies:



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

FIGURE 1/X.325

Use of an ISDN virtual circuit bearer service, ISDN(PS)/PSPDN Interworking

6.1.1 *Transfer of addressing information*

ISDNs and PSPDNs typically utilize different numbering plans (i.e., E.164 and X.121 respectively). The considerations on the transfer of addressing informations of the two different types as described in Recommendation X.301 apply. Further specifics on interworking between the two numbering plans concerned, are detailed in Recommendations E.166 and X.122.

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

These arrangements are as described in Recommendation X.301. However, for the throughput facility, different classes are supported in the ISDN and PSPDN (i.e., the class of 64 kbit/s). Whenever a request is made for a throughput class higher than 48 kbit/s from the ISDN, the request should be negotiated down to a lower class supported on the PSPDN.

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

These arrangements are as described in Recommendation X.301.

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

These arrangements are as described in Recommendation X.301.

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

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

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

These arrangements are as described in Recommendation X.301.

6.1.7 *Arrangements for other facilities*

These arrangements are as described in Recommendation X.301.

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

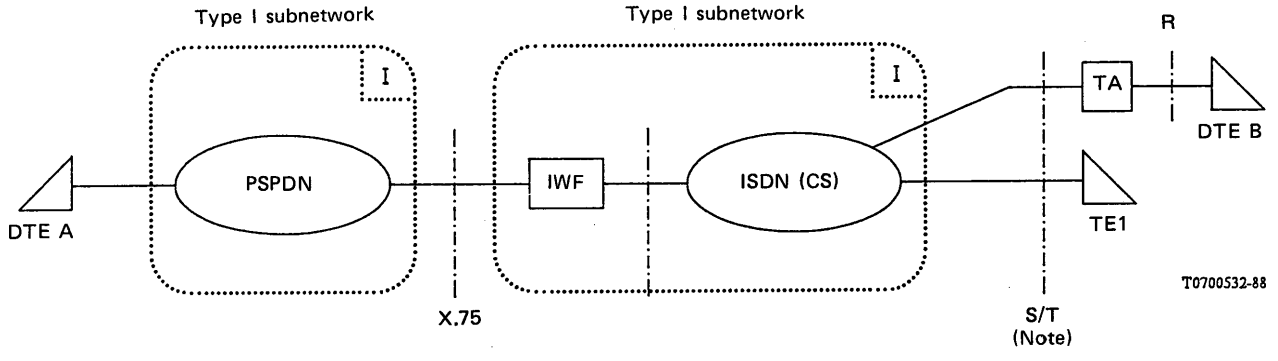
These arrangements are as described in Recommendation X.302. In particular, the mechanisms for network identification are applied as follows:

- the PSPDN is identified by the DNIC/DCC method;
- the ISDN is identified by the Recommendation X.302 method.

These network identifications are then further applied in the TNIC and CNIC utilities of Recommendation X.75.

6.2 *Interworking between a PSPDN and ISDN where a circuit switched bearer is requested*

6.2.1 *Interworking by call-control mapping*



Note – This interworking arrangement is not covered in Recommendation X.31 and therefore requires further study.

FIGURE 2/X.325

Interworking by call control mapping

This case of interworking by call-control mapping is not covered in Recommendation X.31. In order to enable interworking, procedures must be operated over the ISDN circuit switched bearer to achieve functional compatibility. However, these procedures are for further study. In general, the following applies:

- Call-control arrangements in the ISDN (i.e., I.420 or the functionally identical SS No. 7 protocol or a functionally identical internal network protocol) should be mapped in the IWF to the call-control arrangements in the PSPDN (i.e., X.75, or a functionally identical internal network protocol). This mapping is for further study.
- Data transfer arrangements in the PSPDN (i.e., X.75, or a functionally identical internal network protocol) should be mapped in the IWF to the procedures operated over the circuit switched bearer between IWF and TE/DTE. This mapping is for further study.

6.2.2 *Interworking by port access*

In order to enable interworking, procedures must be operated over the ISDN circuit switched bearer to achieve functional compatibility. These procedures follow Recommendation X.25 (see Recommendation X.31 and X.10 access category Y). Aspects of X.32 apply as noted in X.31.

In general, the following applies:

- X.75, or a functionally identical internal network protocol is operated between the PSPDN and the IWF.
- I.420, or ISDN-UP, or a functionally identical internal network protocol is operated between the ISDN and the IWF, and used to control the circuit switched bearer.
- X.25 is operated between the IWF and the DTE/TE over the ISDN circuit switched bearer.

"Dialling out" considerations:

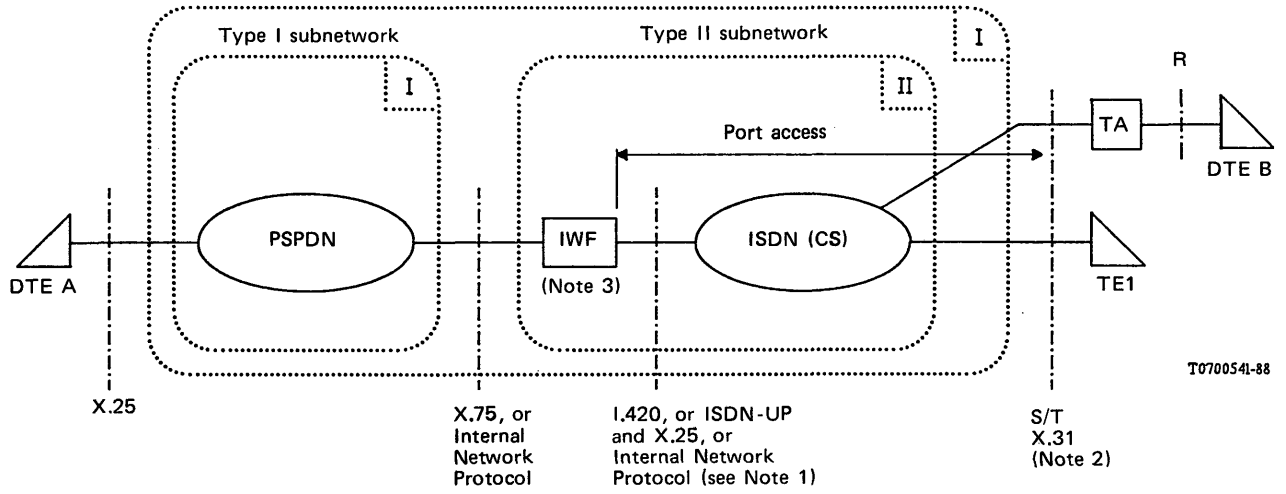
A circuit switched bearer will be set up through the ISDN upon receipt of a X.75 call request packet, i.e.:

- The Q.931 called party number (and subaddress, if provided) are derived from the X.75 call request packet.
- The Q.931 bearer capability is coded as circuit mode.
- After establishment of the circuit switched bearer, a link connection will be established and the X.75 call request packet will be mapped by the IWF to an X.25 incoming call packet.
- Further procedures are as detailed in Recommendation X.31.

"Dialling in" considerations:

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

- The Q.931 called party number is the address of the IWF (port address).
- The Q.931 bearer capability is coded as circuit mode.
- After establishment of the circuit switched bearer, a link connection will be established.
- An X.25 call request packet will be mapped by the IWF to an X.75 call request packet.
- Further procedures are as detailed in Recommendation X.31.



Note 1 – For international interworking the internal network protocol does not apply.

Note 2 – The ISDN terminal (TE1) or DTE + TA is, in this case, different from a terminal connected to an ISDN supporting the ISDN virtual circuit bearer services as defined in Recommendation X.31.

Note 3 – In this case, which is an X.31 access to the data transmission services provided by the PSPDN, the IWF logically belongs to the PSPDN.

FIGURE 3/X.325

The data transmission services provided by PSPDNs interworking with ISDN where a circuit switched bearer is requested to the ISDN

Recommendation X.326

GENERAL ARRANGEMENTS FOR INTERWORKING BETWEEN PACKET SWITCHED PUBLIC DATA NETWORKS (PSPDNs) AND COMMON CHANNEL SIGNALLING NETWORK (CCSN)

(Melbourne, 1988)

The CCITT,

considering

(a) that Recommendation X.300 defines the general principles for interworking between public networks, and between public data networks and other networks for the provision of data transmission services;

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

(c) that Recommendation X.302 defines the general arrangements for internal network utilities within a subnetwork and between subnetworks for the provision of data transmission services;

(d) that Recommendation X.75 already specifies detailed procedures applicable to call control between two PDNs of the same type;

(e) that Recommendation X.10 describes categories of access to PSPDNs and ISDNs for the provision of data transmission services;

(f) that Recommendation X.213 describes the network service definition for open systems interconnection for CCITT applications;

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

(h) that Recommendations Q.711 to 716 describe the signalling connection control part (SCCP) for common channel signalling;

(i) the need to operate operations, administration and maintenance (OA and M) applications over a variety of networks, including CCSN and PSPDNs; and consequently the need for CCSN and PSPDNs to be able to interwork,

unanimously recommends

that arrangements for the interworking between PSPDNs and CCSN be in accordance with the principles and arrangements specified in this Recommendation.

CONTENTS

0 Introduction

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

This Recommendation describes the interworking arrangements between PSPDNs and CCSN. These interworking arrangements should include all the capabilities required to suport the network service for open systems interconnection for CCITT applications as described in Recommendation X.213.

1 Scope and field of application

1.1 Network operations, administration and maintenance (OA and M) applications need to be able to operate over a variety of networks, including public data networks.

1.2 This Recommendation describes the interworking between CCSN and packet switched public data networks (PSPDNs), which may be needed for the transmission of operational information between Administrations, as a means of data transmission between operational centres and/or terminals for those Administrations. This is illustrated in the following Figure 1/X.326.

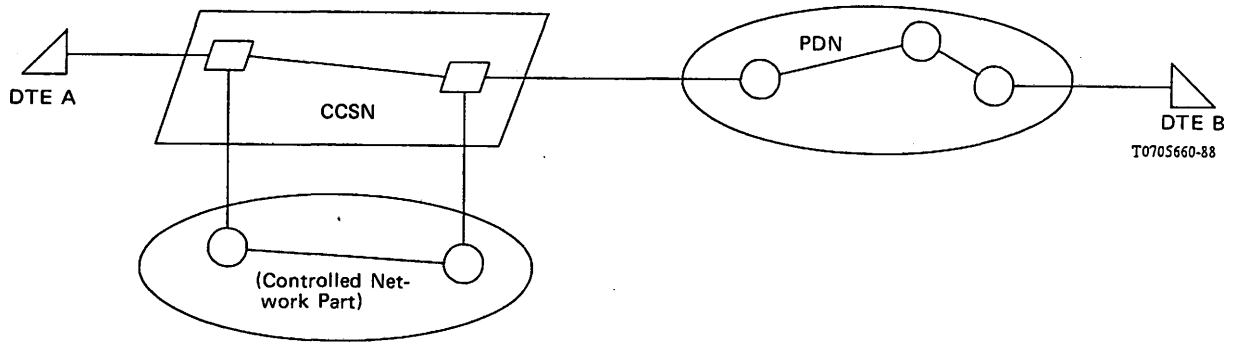


FIGURE 1/X.326

Interworking between PDN and CCSN

1.3 It should be noted that, when dealing with OA and M protocols, a great confusion may appear between:

- the network which is used to convey the OA and M information (e.g. CCSN or PDN in Figure 1/X.326 above);
- the network which is controlled by the CCSN, with the support of the OA and M applications.

It may furthermore happen that the controlled network interwork with a PDN, as illustrated in the following Figure 2/X.326. Such an interworking is not considered as interworking between CCSN and PDN; consequently it is not described in the present Recommendation.

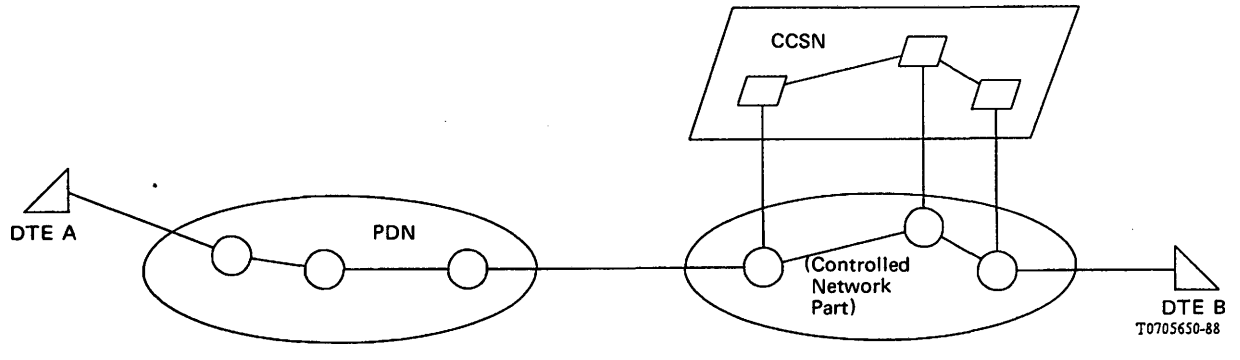


FIGURE 2/X.326

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

2 References

[1] Recommendation X.200 – Reference model of open systems interconnection for CCITT applications.

[2] Recommendation X.213 – Network layer service definition for open systems interconnection (OSI) for CCITT applications.

[3] Recommendation X.300 – General principles for interworking between public networks, and between public networks and other networks for the provision of data transmission services.

[4] Recommendation X.305 – Functionalities of subnetworks relating to the support of the OSI connection-mode network layer service.

[5] Recommendation Q.711 – Functional description of the SCCP.

[6] Recommendation Q.712 – Definitions and functions of SCCP messages.

[7] Recommendation Q.713 – SCCP formats and codes.

[8] Recommendation Q.714 – SCCP procedures.

[9] Recommendation Q.716 – SCCP performances.

3 Definitions

3.1 This Recommendation makes use of the following terms defined in Recommendations X.300 and X.305:

a) Type I subnetwork
b) Subnetwork
c) Interworking function (IWF)
d) OSI Network-connection
e) (OSI) Network layer
f) OSI) Network layer service

3.2 This Recommendation makes use of the following terms defined in Recommendations Q.711, Q.712, Q.713 and Q.714:

a) (SCCP) Message (see Note)
b) Message type
c) Local reference

Note – The use of the concept of "Message" in this Recommendation is not to be confused with other uses of the same term "Message" in different areas (e.g., in the context of Message Handling Systems – MHS – developed in the X.400-series Recommendations).

4 Abbreviations

CCSN	Common channel signalling network
PDN	Public data network
PSPDN	Packet switched public data network
IWF	Interworking function
OSI	Open systems interconnection
OA & M	Operations, administration and maintenance
DTE	Data terminal equipment
SCCP	Signalling connection control part
NC	Network connection
NS	Network layer service
NL	Network layer
QOS	Quality of service

5 General aspects of CCSN/PSPDN interworking

5.1 Interworking between CCSN and PSPDN, which is required for the transmission of operational information between Administrations, should provide the end systems with the connection-oriented network layer service defined in the context of the open systems interconnection (OSI).

5.2 For such interworking, the PSPDN should offer the full capability of the OSI network layer service, and could be considered globally as an abstract OSI relay system (or "Type I subnetwork" as described in Recommendation X.300).

5.3 For the interworking with PSPDN, the CCSN should, in association with any appropriate interworking function whenever it is necessary, offer the full capability of the OSI connection-oriented network layer service. In the context of the OSI, CCSN and associated interworking function(s) could be considered globally as an abstract OSI relay system (or "Type I subnetwork" as described in Recommendation X.300). Protocol class 3 of SCCP applies.

5.4 Consequently, the interworking between CCSN and PSPDN could be considered in the context of OSI as the interworking between two subnetworks, each one of them being fully capable of providing the OSI connection-oriented network layer service. The following Figure 3/X.326 illustrates such an OSI representation of the interworking.

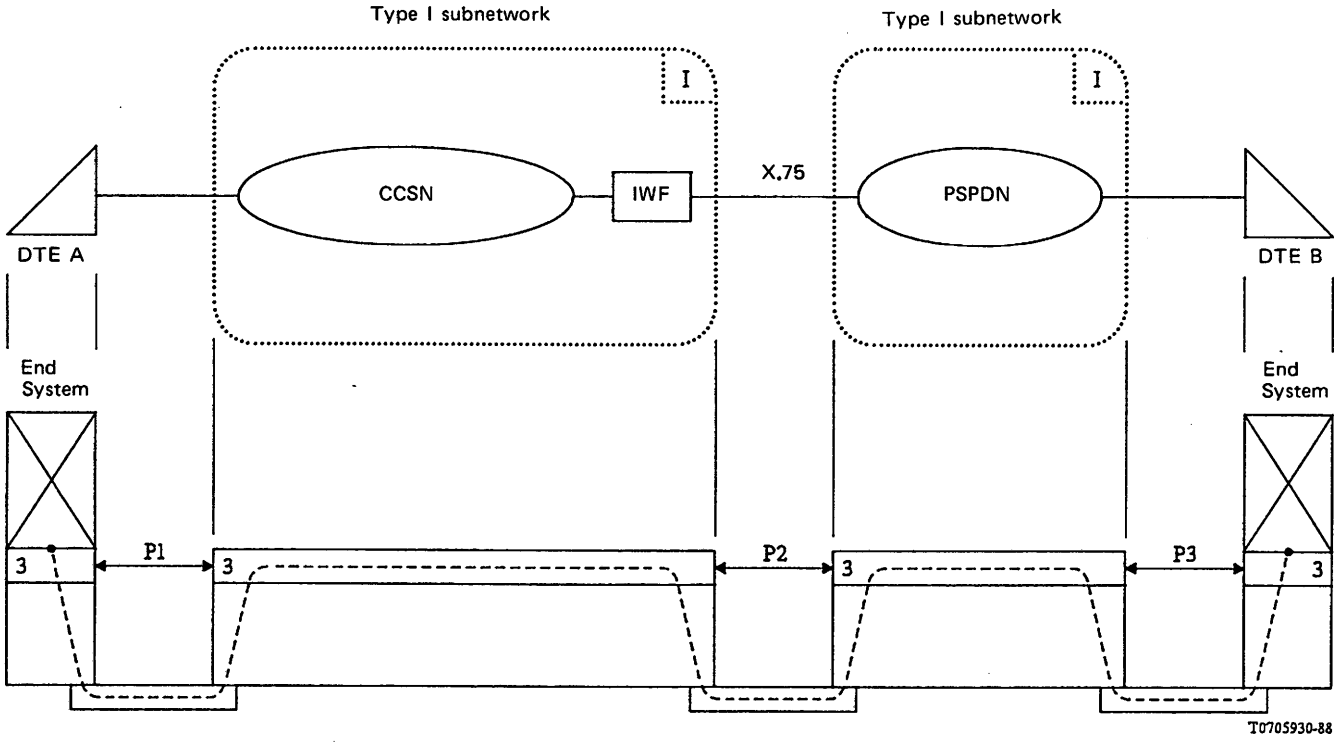


FIGURE 3/X.326

Interworking at the Network Layer between CCSN and PSPDN

5.5 The arrangements at the interface between both "Type I subnetwork" should be based on Recommendation X.75.

5.6 At that interface, a mapping needs to be done between SCCP messages used on the CCSN side, and X.25/X.75 packets used on PSPDN side. The following §§ 6 to 8 detail such a mapping, for each phase of the connection: connection establishment, connection release, data transfer. This mapping is related to the corresponding primitives of the OSI network layer service.

5.7 To each type of primitives of the OSI network layer service corresponds:

- a type of SCCP message, on CCSN side;
- a type of packet, on PSPDN side.

Each type is recognized by:

- the "message type" parameter, on CCSN (SCCP) side;
- the "packet type" parameter, on PSPDN side.

5.8 Each disconnection is identified by:

- Source and destination local reference number, on CCSN (SCCP) side;
- a logical channel number, on PSPDN side.

Note – On PSPDN side, a logical channel number is usually local to an X.25 or X.75 interface. On the same connection, its value usually changes between two interfaces.

6 Connection establishment phase

6.1 The following Tables 1/X.326 and 2/X.326 show the relationships between the primitives used during the establishment of an OSI network connection through interconnection CCSN (SCCP) and PSPDN, and the SCCP messages and X.25/X.75 packets associated with that connection establishment.

6.2 The actions and events at the interfaces to CCSN or PSPDN which correspond to those primitives are also described in § 6 of Recommendation X.305.

6.3 In the context of interworking between CCSN (SCCP) and PSPDN, Tables 1/X.326 and 2/X.326 describe a mapping to be performed between SCCP messages and X.25/X.75 packets in relation with the OSI network layer service.

6.4 Since protocol class 3 of SCCP applies to the interworking, any connection request SCCP message sent or received by the interworking function (IWF) should contain a "proposed protocol class" set to 3. The action to be taken by the interworking function (IWF) if receiving a connection request SCCP message which proposes a protocol class different from 3, is for further study.

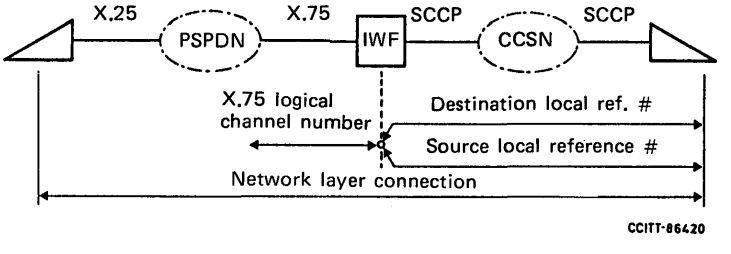
Any connection confirm (SCCP) message should contain a "selected protocol class" set to 3. The action to be taken by the interworking function (IWF) if receiving a connection confirm SCCP message selecting a protocol class less than 3 is for further study.

6.5 A connection request SCCP message sent or received by the interworking function (IWF) should convey OSI network layer addresses, as needed to identify the called and calling parties involved in the connection.

Note 1 – The extent of the requirement to support part or all of OSI network layer addresses is for further study in relation to the interworking between CCSN and PSPDNs.

Note 2 – The exact mapping of the OSI network layer addresses used at the interworking between CCSN and PSPDNs, into SCCP messages on one side, and into X.25/X.75 packets on the other side, is for further study.

6.6 Since several simultaneous connections may be required, it is necessary to identify each of these connections at the interworking between CCSN and PSPDN (see also § 5.8). In order to map the logical channel numbering schemes on both sides, the interworking function (IWF) should connect a logical circuit on one side to a logical circuit on the other side, as illustrated in Figure 4/X.326.



Note – Alternative mechanisms for mapping logical channel numbering, are for further study.

FIGURE 4/X.326

Interworking at the Network Layer between PSPDN and CCSN

6.7 During the establishment of a connection, quality of service (QOS) parameters are used to adjust the quality of the connection.

Note – The exact mapping between the mechanisms used to adjust QOS, in SCCP on one side, and in X.27/X.75 on the other side, is for further study.

7 Connection release phase

7.1 Tables 1/X.326 to 3/X.326 show the relationships between the primitives used during the release of an OSI network connection through the interconnected CCSN (SCCP) and PSPDN, and the SCCP messages and X.25/X.75 packets associated with that connection release.

7.2 The actions and events at the interfaces to CCSN or PSPDN which correspond to those primitives are also described in § 7 of Recommendation X.305.

7.3 In the context of interworking between CCSN (SCCP) and PSPDN, Table 3/X.326 describes a mapping to be performed between SCCP messages and X.25/X.75 packets in relation with the OSI network layer service.

Note – The exact mapping of OSI disconnect originators and reasons used at the interworking between CCSN and PSPDNs, into SCCP messages on one side, and into X.25/X.75 packets on the other side, is for further study.

TABLE 1/X.326

OSI network layer service	SCCP	X.25/X.75
PRIMITIVES: – Connect request – Connect indication	MESSAGES: – Connection request – Connection request	PACKETS: – Call request – Incoming call
PARAMETERS: – (a) Called address – (b) Calling address – (c) Receipt confirmation selection – (d) Expedited data selection – (e) QOS parameter set – (f) NS user data	PARAMETERS: – (a) Called party address – (b) Calling party address – (c) (for further study) – (d) (see Note) – (e) Credit, protocol class – (f) User-data	PARAMETERS (INCLUDING FACILITIES): – (a) Called DTE address Called address extension – (b) Calling DTE address Calling address extension – (c) General format identifier field – (d) Expedited data negotiation facility – (e) Throughput class negotiation facilities Transit delay negotiation facilities – (f) Call and called user data (fast select facility)

Note – Expedited data is an intrinsic capability for all class 3 connections; therefore there is no need to explicitly indicate it in the messages.

TABLE 2/X.326

OSI network layer service	SCCP	X.25/X.75
PRIMITIVES: – Connect response – Connect confirm	MESSAGES: – Connection confirm – Connection confirm	PAQUETS: – Call accepted – Call connected
PARAMETERS: – (a) Responding address – (b) Receipt confirmation selection – (c) Expedited data selection – (d) QOS parameter set – (e) NS user-data	PARAMETERS: – (a) Called party address – (b) (for further study) – (c) (for further study) – (d) Credit, protocol class – (e) User-data	PARAMETERS (INCLUDING FACILITY): – (a) Called DTE address Called address extension – (b) General format identifier field – (c) Expedited data negotiation facility – (d) Throughput class negotiation facilities Transit delay negotiation facilities – (e) User-data (fast select facility)

TABLE 3/X.326

OSI network layer service	SCCP	X.25/X.75
PRIMITIVES: – Disconnect request – Disconnect indication	MESSAGES: – Connection refused/released – Connection refused/released	PACKETS: – Clear request – Clear indication
PARAMETERS: – (a) Originator – (b) Reason – (c) NS user-data – (d) Responding address	PARAMETERS: – (a) } Refusal/release cause – (b) } + Diagnostic (for further study) – (c) User data – (d) Called party address	PARAMETERS (INCLUDING FACILITIES): – (a) } Cause code and – (b) } diagnostic code – (c) Clear user data – (d) Called DTE address Called address extension

8 Data transfer phase

8.1 Tables 4/X.326 to 6/X.326 show the relationships between the primitives used for the transfer of data on an OSI network connection through interconnected CCSN (SCCP) and PSPDN, and the SCCP messages and X.25/X.75 packets associated with that data transfer.

8.2 The actions and events at the interfaces to CCSN or PSPDN which correspond to those primitives are also described in § 8 of Recommendation X.305.

8.3 In the context of interworking between CCSN (SCCP) and PSPDN, Tables 4/X.326 to 6/X.326 describe a mapping to be performed between SCCP messages and X.25/X.75 packets in relation to the OSI network layer service.

TABLE 4/X.326

OSI network layer service	SCCP	X.25/X.75
PRIMITIVES: – Data request – Data indication	MESSAGES: – Data form – Data form	PACKETS: – Data – Data
PARAMETERS: – (a) NS user-data – (b) Confirmation request	PARAMETERS: – (a) User data – (b) Sequencing/segmenting (see Note)	PARAMETERS (INCLUDING FACILITIES): – (a) User data M-bit – (b) D-bit P(S)

Note – Since delivery confirmation is not provided, D-bit functions are not present in the parameter.

TABLE 5/X.326

OSI network layer service	SCCP	X.25/X.75
PRIMITIVES: – Reset request – Reset indication	MESSAGES: – Reset request – Reset request	PACKETS: – Reset request – Reset indication
PARAMETERS: – (a) Originator – (b) Reason	PARAMÈTRES: – (a) } Reset cause and diagnostic – (b) } (for further study)	PARAMETERS (INCLUDING FACILITIES): – (a) } Cause code and – (b) } diagnostic code
PRIMITIVE: – Reset response	MESSAGE: – Reset confirmation	PACKET: – Reset confirmation
PARAMETERS: No	–	–

TABLE 6/X.326

OSI network layer service	SCCP	X.25/X.75
PRIMITIVES: – Expedited data request – Expedited data indication	MESSAGES: – Expedited data – Expedited data	PACKETS: – Interrupt – Interrupt
PARAMETERS: – (a) NS-user data	PARAMETERS: – (a) User data	PARAMETERS (INCLUDING FACILITIES): – (a) Interrupt user data

8.4 On an OSI network layer connection established through the interworking between CCSN and PSPDNs, network service data units (NSDUs) or any size may need to be conveyed. Consequently, segmenting and reassembling is needed.

The mechanism used to perform such segmenting and reassembling are:

– the more data bit (M bit) on PSPDN side;

– the more data indicator (M bit) on CCSN (SCCP) side.

8.5 On an OSI network layer connection established through the interworking between CCSN and PSPDNs, a data flow control is exercised.

Note – The exact mapping between the flow control mechanisms used in SCCP protocol class 3 on one side, and X.25/X.75 on the other side, requires further study.

8.6 Resets may occur during the data transfer phase of a connection.

Note – The exact mappings of the OSI reset originators and reasons used at the interworking between CCSN and PSPDNs, into SCCP messages on one side, and into X.25/X.75 packets on the other side, is for further study.

Recommendation X.327

GENERAL ARRANGEMENTS FOR INTERWORKING BETWEEN PACKET SWITCHED PUBLIC DATA NETWORKS (PSPDNs) AND PRIVATE DATA NETWORKS FOR THE PROVISION OF DATA TRANSMISSION SERVICES

(Melbourne, 1988)

The CCITT,

considering

(a) that Recommendation X.300 defines the general principles for interworking between public networks, and between public networks and other networks for the provision of data transmission services;

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

(c) that Recommendation X.302 defines the general arrangements for internal network utilities within a subnetwork and between subnetworks for the provision of data transmission services;

(d) that Recommendation X.75 already specifies detailed procedures applicable to call control between two PSPDNs;

(e) that Recommendation X.10 describes categories of access to PSPDNs for the provision of data transmission services;

(f) that Recommendation X.213 describes the Network Service Definition for Open Systems Interconnection for CCITT applications;

(g) that Recommendation X.223 describes a mapping between X.213 and the X.25 Packet level protocol;

(h) that Recommendation X.305 describes functionalities of subnetworks relating to the support of the OSI Network Service;

(i) the need for arrangements when interworking between PSPDNs and Private Data Networks for the provision of data transmission services,

unanimously recommends

that arrangements for the interworking between PSPDNs and Private Data Networks for the provision of data transmission services be in accordance with the principles and arrangements specified in this Recommendation.

CONTENTS

0 Introduction

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

This Recommendation describes the interworking arrangements between PSPDNs and and Private Data Networks for the provision of data transmission services. These interworking arrangements should include all the capabilities required to support the Network Service for open systems interconnection for CCITT Applications as described in Recommendation X.213.

1 Scope and field of application

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

2 References

[1] Recommendation X.300

[2] Recommendation X.301

[3] Recommendation X.302

[4] Recommendation X.305

[5] Recommendation X.1

[6] Recommendation X.2

[7] Recommendation X.10

[8] Recommendation X.121

[9] Recommendation X.223

3 Definitions

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

a) transmission capability,

b) subnetwork,

c) data transmission service.

4 Abbreviations

CONS	Connection-mode Network Service
CSPDN	Circuit Switched Public Data Network
DTE	Data Terminal Equipment
ISDN	Integrated Services Digital Network
IWF	Interworking Function
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network
PvtDN	Private Data Network

5 General aspects

This Recommendation, in describing interworking arrangements between two subnetworks (a PSPDN and a PvtDN) for the provision of data transmission services, adheres to the general principles of Recommendation X.300. The environments of these two subnetworks are described in the following sections. Interworking should provide the connection-mode network layer service, as defined in Recommendation X.213.

5.1 *PSPDN*

The PSPDN provides packet switched data transmission services as defined in Recommendations X.1 and X.2 for the provision of data transmission services. The PSPDN may be accessed by DTEs by the categories of access C and D as defined in Recommendation X.10.

In addition, the PSPDN may also be accessed via other networks, i.e., PSTN (X.10 category L, P), CSPDN (X.10 category K, O), PSPDN (Recommendation X.75), Mobile systems (Recommendation X.324) or ISDN (Recommendation X.325), or Private data networks (this Recommendation).

The PSPDN could be considered globally as an abstract OSI relay system (or "Type I subnetwork" as described in Recommendation X.300).

5.2 *Private Data Network*

The Private Data Network provides data transmission services. In the context of this Recommendation, the Private Data Network may be one of the following:

a) a subnetwork providing packet switched data transmission services as defined in Recommendations X.1 and X.2 for the provision of data transmission services. The Private Data Network may be accessed by DTEs by the categories of access D as defined in Recommendation X.10;

b) a subnetwork providing circuit switched data transmission services as defined in Recommendations X.1 and X.2 for the provision of data transmission services. The Private Data Network may be accessed by DTEs by the category of access B as defined in Recommendation X.10;

c) a point-to-point subnetwork providing leased circuit data transmission services as defined in Recommendation X.1;

d) a subnetwork conforming to ISO 8802.

Furthermore, in the context of this Recommendation, DTEs accessing the Private Data Network make use at the Network Layer of the protocol defined in ISO 8208.

In the context of OSI, the PvtDN and associated IWF could be considered as an abstract OSI relay system (or "Type I subnetwork" as described in Recommendation X.300).

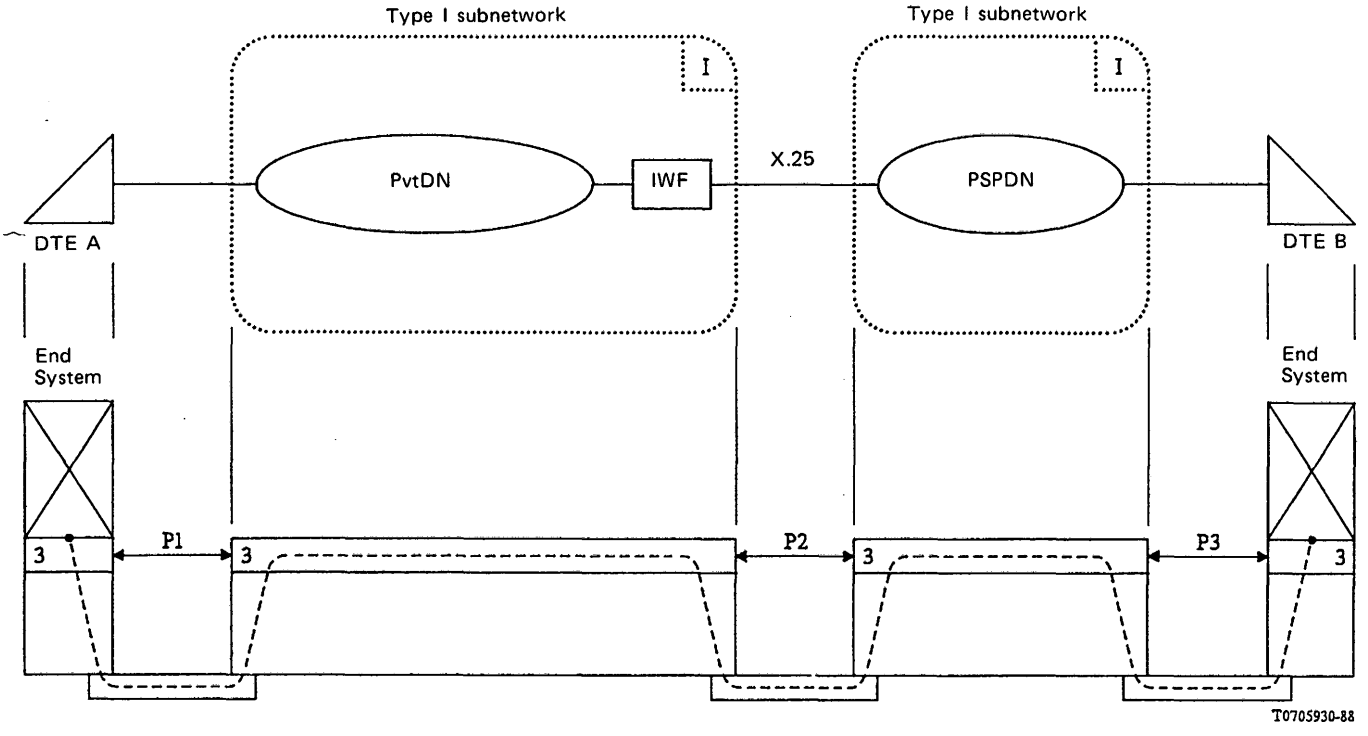


FIGURE 1/X.327

Interworking at the network layer between PvtDN and PSPDN

5.3 *General interworking arrangements*

The arrangements at the interface between both "Type I subnetworks" should be based on Recommendation X.25.

At that interface, a mapping needs to be done between X.25 packets used on each side of the IWF. § 6 deals such a mapping for each phase of the connection: connection establishment, connection release, data transfer. This mapping is related to the corresponding primitives of the OSI Network Layer Service.

In general, each type of primitive of the OSI Network Layer Service, corresponds to a type of packet on the PSPDN or the PvtDN side. Each type is recognized by the "packet type" parameter.

Each connection is identified by:

- a Logical Channel number, on the PvtDN;
- a Logical Channel number, on PSPDN side.

Note – A Logical Channel number is usually local to an X.25 interface. On the same connections, its value usually changes between two interfaces.

6 Specific interworking arrangements

6.1 *Connection establishment phase*

6.1.1 Table 1/X.327 shows the relationships between the primitives used during the establishment of an OSI Network Connection through interconnected PvtDN and PSPDN, and the X.25 packets associated with that connection establishment (see also Recommendation X.223).

6.1.2 The actions and events at the interfaces to PvtDN or PSPDN which correspond to those primitives are also described in § 6 of Recommendation X.305.

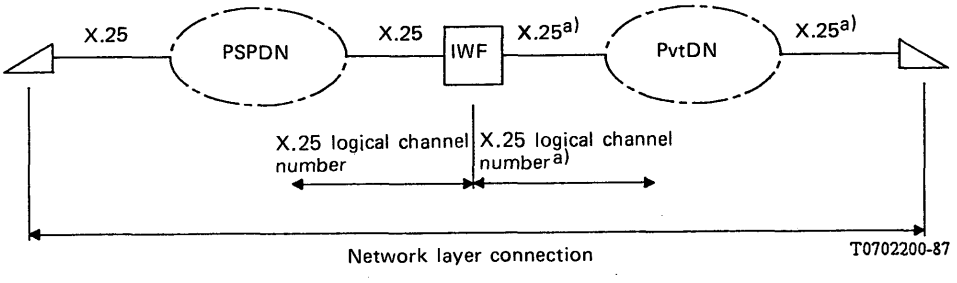
6.1.3 In the context of interworking between PvtDN and PSPDN, Table 1/X.327 describes a mapping to be performed between X.25 packets on each interface in relation with the OSI Network Layer service. In particular, the following mapping takes place:

a) a received incoming call packet results in a transmitted call request packet; and

b) a received call accepted packet results in a transmitted call connected packet.

6.1.4 Any call set-up packet sent or received by the IWF should convey OSI Network Layer addresses, as needed to identify the called and calling parties involved in the connection.

6.1.5 Since several simultaneous connections may be required, it is necessary to identify each of those connections at the interworking between PvtDN and PSPDN (see also § 5.3). In order to map the logical channel numbering schemes on both sides, the interworking function (IWF) should connect a logical channel on one side to a logical channel on the other side, as illustrated in Figure 2/X.327.



a) Depending on the type of PvtDN, the two X.25 interfaces shown to the PvtDN may actually be one X.25 interface.

FIGURE 2/X.327

6.1.6 During the establishment of a connection, quality of service (QOS) parameters are used to adjust the quality of the connection.

6.2 *Connection release phase*

6.2.1 Table 2/X.327 shows the relationships between the primitives used during the release of an OSI Network Connection through interconnected PvtDN and PSPDN, and the X.25 packets associated with that connection release (see also Recommendation X.223).

6.2.2 The actions and events at the interfaces to PvtDN or PSPDN which correspond to those primitives are also described in § 7 of Recommendation X.305.

6.2.3 In the context of interworking between PvtDN and PSPDN, Table 2/X.327 describes a mapping to be performed between X.25 packet on each interface in relation with the OSI Network Layer service. In particular, the following mapping takes place:

A received Clear Indication packet results in a transmitted Clear Request packet (see also § 6.4.1) and confirmation of the Clear Indication packet.

6.3 *Data transfer phase*

6.3.1 The following Tables 3/X.327 to 5/X.327 show the relationships between the primitives used for the transfer of data on an OSI Network Connection through interconnected PvtDN and PSPDN, and the packets associated with that data transfer (see also Recommendation X.223).

6.3.2 The actions and events at the inferfaces to PvtDN and PSPDN which correspond to those primitives are also described in § 8 of Recommendation X.305.

6.3.3 In the context of interworking between PvtDN and PSPDN, Tables 3/X.327 to 5/X.327 describe a mapping to be performed between X.25 packets in relation with the OSI Network Layer service. In particular, the following mappings take place:

a) a Received Data packet results in a transmitted Data packet (but see § 6.4.2);

b) a received Interrupt packet results in a transmitted packet;

c) a received Interrupt Confirmation packet results in a transmitted Interrupt Confirmation packet;

d) a received Reset Indication packet results in a transmitted Reset Request packet and confirmation of the Reset Indicated packet.

6.3.4 Resets may occur during the data transfer phase of a connection.

6.4 *Additional considerations*

6.4.1 *Restart*

In the context of interworking between a PvtDN and a PSPDN, the receipt of a Restart Indication packet on an interface:

a) in confirmed by a Restart Confirmation packet on that interface; and

b) results in clearing of each Virtual Call on the other interface.

6.4.2 *Packet sizes and window sizes*

There is no requirement that the packet sizes and window sizes used at one interface be the same as those used at the other interface. However, the integrity of complete packet sequences must be maintained through proper settings of the M-bit and D-bit.

6.4.3 *Flow control*

There is no requirement, in general, that flow control procedures on the two interfaces be coupled. However, receipt of a data packet with D-bit set to 1 shall not result in window rotation on one interface until rotation of the window on the other interface for all user data in the originally received Data packet.

TABLE 1/X.327

CONS: X.25/PLP mapping for the network connection establishment phase

CONS	X.25/PLP
Primitives:	**Packets:**
N-CONNECT request N-CONNECT indication N-CONNECT response N-CONNECT confirm	CALL REQUEST INCOMING CALL CALL ACCEPTED CALL CONNECTED
Parameters:	**Fields (including facilities)**
Called address	Called DTE address field Called address extension facility
Calling address	Calling DTE address field Calling address extension facility
Responding address	Called DTE address field Called address extension facility
Receipt confirmation selection	General format identifier
Expedited data selection	Expedited data negotiation facility
QOS-Parameter set	Throughput class negotiation facility [a] Minimum throughput class negotiation facility Transit delay selection and indication facility End-to-end transit delay negotiation facility
NS-User-data	Call and called user data field Fast select facility [b]

[a] For proper operation, this optional user facility shall also be agreed to for use on the interface.

[b] For proper operation, the Fast Select Acceptance Facility shall also be agreed to for use on the interface.

TABLE 2/X.327

CONS: X.25 /PLP mapping for the network connection release phase

CONS	X.25/PLP
Primitives: N-DISCONNECT request N-DISCONNECT indication	**Packets:** CLEAR REQUEST CLEAR INDICATION
Parameters: Originator and reason NS-User-data Responding address	**Fields (including facilities):** Cause code and diagnostic code fields Clear user data Called DTE address field Called address extension facility

TABLE 3/X.327

CONS: X.25/PLP mapping for the data transfer service

CONS	X.25/PLP
Primitives: N-DATA request N-DATA indication	**Packets:** DATA DATA
Parameters: NS-User-data Confirmation request	**Fields:** User data, M-bit D-bit, P(S)

TABLE 4/X.327

CONS: X.25/PLP mapping for the expedited data transfer service

CONS	X.25/PLP
Primitives: N-EXPEDITED DATA request N-EXPEDITED DATA indication	**Packets:** INTERRUPT INTERRUPT
Parameters: NS-User data	**Fields:** Interrupt user data

TABLE 5/X.327

CONS: X.25/PLP mapping for the reset service

CONS	X.25/PLP
Primitives: N-RESET request N-RESET indication N-RESET response N-RESET confirm	**Packets:** RESET REQUEST RESET INDICATION None None
Parameters: Originator and reason	**Fields:** Cause code and diagnostic code fields

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SECTION 2

MOBILE DATA TRANSMISSION SYSTEMS

Recommendation X.350

GENERAL INTERWORKING REQUIREMENTS TO BE MET FOR DATA TRANSMISSION IN INTERNATIONAL PUBLIC MOBILE SATELLITE SYSTEMS

(Malaga-Torremolinos, 1984; amended at Melbourne, 1988)

The CCITT,

considering

(a) that a maritime satellite service is being operated by the International Maritime Satellite Organization (INMARSAT);

(b) that data transmission services in the INMARSAT system should meet the provisions laid down for data transmission in general;

(c) that the mobile DTE may be connected to a PDN on a call-by-call basis;

(d) that mobile DTEs should have the capability of interfacing public data networks through all land earth stations even though they are located in different countries and interfacing different public data networks,

unanimously recommends

that the following general provisions should apply for data transmission in international public mobile satellite systems.

1 Definitions

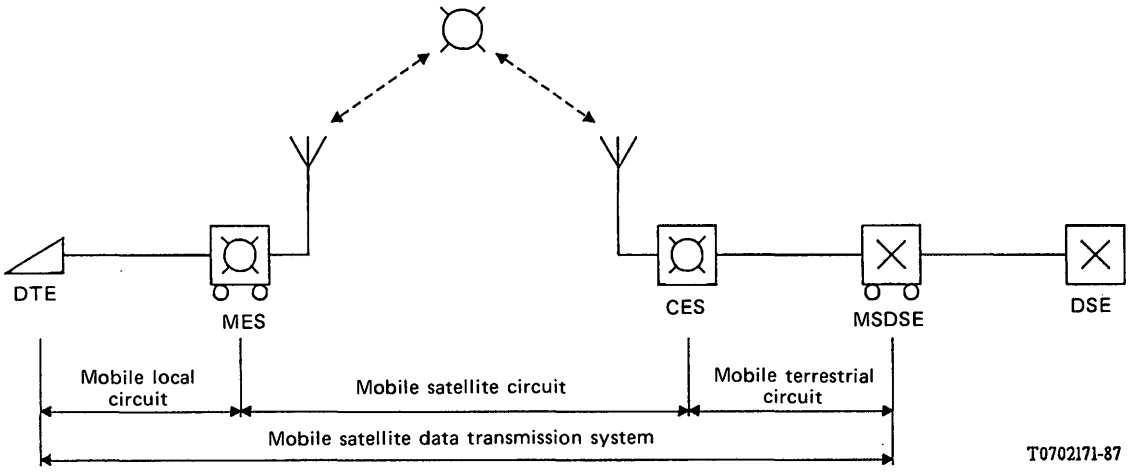
The following are definitions of terms used in relation with data transmission in public mobile satellite systems.

Note – A similar set of definitions for telephone interworking is contained in Recommendation M.1100.

1.1 **mobile satellite data transmission system** is a means for the establishment of temporary connections between a data switching exchange (DSE) in a public data network (PDN) and a mobile DTE. The maritime satellite data transmission system comprises a *mobile satellite circuit*, a *mobile local circuit*, a *mobile satellite data switching exchange (MSDSE)*, and a *mobile terrestrial circuit*. The general maritime mobile satellite configuration is shown in Figure 1/X.350. International aeronautical and land mobile satellite data transmission are not defined yet.

1.2 **mobile local circuit** is a circuit between the *mobile earth station* and a mobile DTE.

1.3 **mobile satellite circuit** is a circuit between the *mobile earth station* and the *land earth station*. It comprises all elements required for establishing, maintaining and clearing the mobile satellite circuit including the *network coordination station*.



MES = Mobile earth station
CES = Coast earth station
MSDSE = Mobile satellite data switching exchange
DSE = Data switching exchange

FIGURE 1/X.350

Composition of the maritime satellite data transmission system

1.4 **mobile terrestrial circuit** is a circuit between the *land earth station* and the *mobile satellite data switching exchange* if used.

1.5 **mobile earth station** is defined in [Article 1, § 4.9], of the Radio Regulations, ITU, Geneva 1982.

1.6 **coast earth station** is defined in Article 1, § 4.14, of the Radio Regulations, ITU, Geneva 1982.

aeronautical earth station is defined in Article 1, § 4.20 of the Radio Regulations, ITU, Geneva 1982.

land earth station is defined in Article 1, § 4.10A of the Radio Regulations, as modified by MOB-WARC 1987.

base earth station is defined in Article 1, § 4.11A of the Radio Regulations, as modified by MOB-WARC 1987.

1.7 **mobile satellite data switching exchange (MSDSE)** is the functional interface between the *public maritime satellite data transmission system* and a public data network.

The MSDSE provides the following functions:

- interworking between the signalling systems used in the *public mobile satellite data transmission system* and the PDN,
- routing and call control for calls to and from mobile stations,
- charging.

1.8 **network coordination station** is a station in the public mobile satellite system with the capability to coordinate, supervise and monitor the assignment and utilization of the maritime satellite circuits within a satellite coverage area. The network coordination station is designated and operated by the satellite system operator.

Note – The rest of this Recommendation applies to public maritime satellite data transmission systems. Its applicability for public aeronautical and land mobile satellite systems is for further study.

2 Choice of interface between a mobile DTE and the MSDSE

2.1 For data signalling rates at and above 600 bit/s two types of terminal mode of operation are defined (Recommendation X.1):

i) terminals operating in the synchronous mode for user classes of service 3 through 7 interfacing circuit switched PDNs using the interfaces defined in Recommendations X.21, X.21 *bis* and X.22;

ii) terminals operating in the packet mode for user classes of service 8 through 12 interfacing packet switched PDNs using the interface defined in Recommendation X.25.

2.2 Operation in the packet mode has several advantages as compared to operation in the synchronous mode:

i) operation in the packet mode permits the interconnection of DTEs operating in different user classes of service;

ii) the interface comprises layers 1, 2 and 3 of the Open system interconnection (OSI) protocol so that the higher layers may be built directly on top of the interface defined in Recommendation X.25;

iii) the link level protocol (level 2) provides link-by-link error protection using ARQ techniques.

Note – This error protection is additional to and independent of any forward error correction applied as part of level 1;

iv) the provision of PADs will also interconnect a mobile packet mode DTE with data subscribers of the public switched telephone network and with subscribers of circuit switched PDNs; the PAD may also be used for interconnection with leased lines;

v) it would be possible to operate with different data rates in the two directions of transmission over the satellite link.

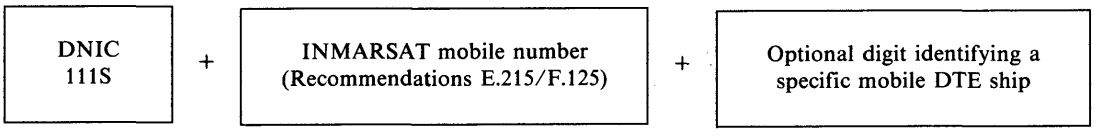
2.3 Based on the above considerations it is concluded that access to PDNs from the public maritime satellite systems should be provided for the packet mode of operation.

Interconnection with circuit switched PDNs may be offered on an optional basis.

2.4 The procedures for interworking between packet switched data networks and the maritime satellite data transmission system are given in Recommendation X.352.

3 International data number for a mobile DTE

The format of the international data number for a mobile DTE is defined in Recommendation X.121, and is composed as follows:



4 Data transmission prefixes

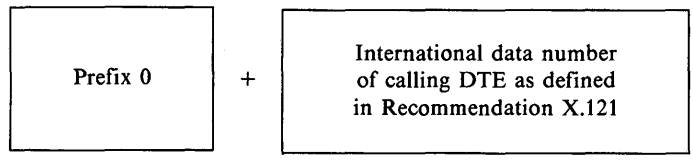
Prefixes to be used at the mobile DTE for calling a DTE of a PDN or a special termination located at the public maritime mobile satellite data switching exchange (MSDSE) or in a PDN are given in Annex A.

5 Transfer of address signal between the MSDSE and a mobile DTE

5.1 *Calls originating in a PDN*

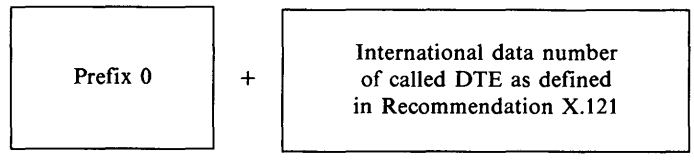
5.1.1 For an incoming call to a mobile DTE, the part of the called DTE address which includes the DNIC and the INMARSAT mobile number need not be transferred across the DCE/DTE interface since the coast earth station identifies the called mobile earth stations by procedures on the radio path. If present, the optional digit identifying a specific mobile DTE must be transferred transparently to the mobile earth station. [See also Recommendation X.352, § 2.3 ii).]

5.1.2 The calling DTE address transferred across the DCE/DTE interface should have the following format:



5.2 *Calls originating at a mobile earth station*

5.2.1 For a calling mobile DTE the called DTE address transferred across the DTE/DCE interface must have the following format irrespective of the location of the called DTE:

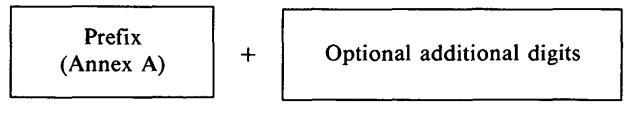


5.2.2 The calling DTE address consisting of the mobile INMARSAT number optionally followed by the digit identifying the particular mobile DTE should be tranferred across the DTE/DCE interface [see also Recommendation X.352, § 2.4 i)].

Note – As required by Recommendation X.300, the calling DTE address, if present, should be checked by the MSDSE before the call request packet is transmitted into a PDN. The DNIC of the ocean area in which the calling mobile earth station is located should be inserted by the MSDSE. If the calling DTE address is not present, it should be inserted by the MSDSE. The inserted address should consist of the DNIC followed by the mobile earth station number.

5.3 *Calls to special terminations*

For a mobile DTE calling a special termination defined by one of the prefixes (other than 0) given in Annex A, the called DTE address transferred across the DTE/DCE interface must have the following format:



5.4 *Sub-addressing*

The use of the shared address method for identifying a specific mobile DTE is given in § 3 above.

For identifying a specific mobile DTE by using the extended address method in the facility field, see Recommendation X.25.

6 User services and facilities

6.1 User services and facilities should be offered in accordance with Recommendation X.2.

6.2 The realization of user facilities is given in Recommendation X.300.

6.3 The default values for facilities and parameters may be independently fixed for each MSDSE.

Methods for negotiation of facilities and parameters on a per call basis are for further study.

See also Recommendation X.32.

7 Routing

The general principles for routing between PDNs are given in Recommendation X.110. Special routing requirements related to the mobile satellite service are given in Recommendation X.353.

8 Call progress signals and diagnostic codes

8.1 A subscriber of a PDN calling a mobile DTE may receive call progress signals and diagnostic codes in accordance with Recommendation X.96 and Annex E to Recommendation X.25, respectively. If the call progress signal (and diagnostic code) is returned from the MSDSE in case of unsuccessful call set-up of the mobile satellite circuit, Recommendation X.352 gives more precise information about the cause.

8.2 Call progress signals and diagnostic codes received at the mobile DTE as part of a clear indication packet will also be in accordance with Recommendation X.96 and Annex E to Recommendation X.25, respectively. Moreover, Recommendation X.352 suggests call progress signals to be returned to the mobile DTE for unsuccessful call set-up of the maritime satellite circuit.

9 Closed user groups

9.1 In accordance with Recommendation X.2 the closed user group is considered as an essential user facility and should therefore also be made available for ships.

9.2 Because mobile earth stations may set up and receive data calls through any MSDSE, a mobile earth station being part of a closed user group should be known as such on all MSDSEs in the mobile satellite service.

9.3 The principles and procedures for realizing closed user groups are given in Recommendation X.300.

9.4 Administrative arrangements for closed user groups are given in Recommendation X.180. See also Recommendation F.122 regarding administrative arrangements for including mobile earth stations in closed user groups.

10 Interface to PADs

10.1 A packet mode mobile DTE should access PADs on a PDN using the procedures defined in Recommendation X.29.

10.2 The procedures for a mobile DTE operating in the start-stop mode accessing a PAD should be in accordance with Recommendation X.351.

11 Transfer of C and I lead information

When required the mobile satellite circuit should include provisions for transferring the C and I leads (Recommendation X.21) between the mobile DTE/mobile earth station interface and the coast earth station/ MSDSE interface. If an envelope structure is used for this purpose, it must be ensured that non-standard envelopes are not passed into the PDN.

12 Handling of group calls (broadcast service)

12.1 The international public maritime mobile satellite system provides for a communication service (maritime group calls) where a calling DTE of a PDN may forward messages simultaneously to a given group of ships. There will be no return link from the ships (i.e. a simplex service) so that no acknowledgement will be given as to whether a given ship in the called group has received the message.

These maritime group calls are identified by the following international data number (see Recommendation E.215/F.125):

DNIC	INMARSAT mobile number for group calls
111S	0 X_2X_3 ..... X_8

where the first digit of the mobile earth station number has the fixed value 0. The remaining digits of the INMARSAT mobile number determine which group of ships is being addressed.

Group calls in other public mobile satellite systems are also defined in Recommendation E.215.

12.2 If maritime group calls are required through a PDN, the calls should be forwarded through a message handling system (MHS) at the MSDSE. The procedures to be used between a DTE of a PDN and the MHS should be in accordance with rules defined by the CCITT.

The MHS (or the MSDSE) must make sure that the calling DTE is authorized for maritime group calls, e.g. by use of the calling line identification facility or the closed user group facility. Calls from non-authorized DTEs must be barred.

12.3 Calls with a group address (other than those forwarded by the MHS) must be barred by the MSDSE or the coast earth station.

ANNEX A

(to Recommendation X.350)

Allocation of telephone prefixes, telex access codes and data transmission prefixes

A.1 Administrations should make the application for the allocation of new prefixes and access codes to the CCITT Secretariat. The application should contain a definition for the service, termination or facility to be accessed.

The CCITT Secretariat would be responsible for coordinating the allocation of new prefixes and access codes with the competent Study Groups. The allocation of new prefixes and access codes should be done in such a way as to ensure that equivalent services carried by means of telephone, telex or data circuits are given the same prefix.

The prefixes and access codes to be used for automatic calling should be as follows:

Telephone: For international calls the prefix should be 00 followed by the international telephone number of the called subscriber. As an option for national calls the prefix 0 followed by the national (significant) number of the called subscriber could be used.

Note – In the maritime satellite service only the international format is preferred.

Telex: For international calls the access code should be 00 followed by the international telex number of the called subscriber. As an option for national calls the access code 0 followed by the national telex number of the called subscriber could be used.

Note – In the maritime satellite service only the international format is preferred.

Data transmission: For data calls through a public data network the format should always consist of the prefix 0 followed by the international data number of the called subscriber (see § 5.2.1, Recommendation X.350).

A.2 Table A-1/X.350 contains a list of prefixes and access codes allocated so far for access to special destinations, services or facilities.

A.3 The facilities are defined in Annex B of Recommendation E.216.

TABLE A-1/X.350

(Note 1)

Allocation of telephone prefixes, telex access codes and data transmission prefixes

Category	Prefix or access code		Applications (Notes 2 and 3)	Telephone	Telex	Data
	Digit 1	Digit 2				
Operator	1	0	Spare	–	–	–
	1	1	International outgoing operator	A	A	NA
	1	2	International information service	A	A	FS
	1	3	National operator	A	A	NA
	1	4	National information service	A	A	FS
	1	5	Radiotelegram service	FS	A	NA
	1	6	Spare	–	–	–
	1	7	Booking of telephone calls (Note 4)	A	A	NA
	1	8	Spare	–	–	–
	1	9	Spare	–	–	–
Automatic facilities	2	0	Access to maritime PAD (Note 5)	A	NA	NA
	2	1	Store-and-forward (international)	NA	A	NA
	2	2	Store-and-forward (national)	NA	A	NA
	2	3	Abbreviated dialling (short code selection)	A	A	NA
	2	4	Telex letter service	NA	A	NA
	2	5	Access to PSPDN	Note 8	NA	Note 8
	2	6	Spare	–	–	–
	2	7		–	–	–
	2	8		–	–	–
	2	9		–	–	–
Specialized assistance (Note 6)	3	0	Spare	–	–	–
	3	1	Maritime enquiries	A	A	A
	3	2	Medical advice	A	A	A
	3	3	Technical assistance	A	A	A
	3	4	Person-to-person call	A	NA	NA
	3	5	Collect calls	A	NA	NA
	3	6	Credit card calls	A	A	NA
	3	7	Time and charges requested at end of call	A	A	NA
	3	8	Medical assistance	A	A	A
	3	9	Maritime assistance	A	A	A
Ship Reporting	4	0	Spare	–	–	–
	4	1	Meteorological reports	A	A	A
	4	2	Navigational hazards and warnings	A	A	A
	4	3	Ship position reports	A	A	A
	4	4	Spare	–	–	–
	4	5		–	–	–
	4	6		–	–	–
	4	7		–	–	–
	4	8		–	–	–
	4	9		–	–	–

TABLE A-1/X.350 *(cont.)*

Category	Prefix or access code		Applications (Notes 2 and 3)	Telephone	Telex	Data
	Digit 1	Digit 2				
Information retrieval	5	0	Spare	–	–	–
	5	1	Meteorological forecasts	FS	FS	FS
	5	2	Navigational warnings	FS	FS	FS
	5	3	Videotex (international)	FS	NA	FS
	5	4	Videotex (national)	FS	NA	FS
	5	5	News (international)	FS	FS	FS
	5	6	News (national)	FS	FS	FS
	5	7	Spare	–	–	–
	5	8		–	–	–
	5	9		–	–	–
Specialized use (Note 7)	6		Administration specialized use, e.g. leased lines	A	A	FS
	7		Spare	–	–	–
	8		Spare	–	–	–
Test	9	0	Spare	–	–	–
	9	1	Automatic test line	A	A	FS
	9	2	Commissioning tests	A	A	A
	9	3	Spare	–	–	–
	9	4	Spare	–	–	–
	9	5	Operational coordination	A	A	A
	9	6	Spare	–	–	–
	9	7		–	–	–
	9	8		–	–	–
	9	9		–	–	–

Note 1 – The same table is contained in Recommendations E.216, F.126 and X.350.

Note 2 – The entries in the columns under Telephone, Telex and Data have the following meanings:

A = Applicable for access by this service
NA = Not applicable for access by this service
FS = For further study.

Note 3 – The prefix or access code may be followed by an optional telephone country code, data country code (or data network identification code) or telex destination code, or other optional digits.

Note 4 – Via some coast earth stations it would be possible to book telephone calls using the telex service.

Note 5 – PAD = Packet Assembly/Disassembly facility. The prefix 20 should be followed by two digits indicating the required data rate (see Recommendation X.351).

Note 6 – The prefixes 34, 35, 36 and 37 may be followed by the international number of the called subscriber.

Note 7 – Digits following digit 6 will be allocated on a national basis.

Note 8 – The prefix is used for access to MSDSEs (see Recommendation X.350) for virtual call data services (Recommendation X.25) by means of telephone circuits in the INMARSAT system.

Recommendation X.351

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

(Malaga-Torremolinos, 1984; amended at Melbourne, 1988)

The CCITT,

considering

(a) that the PAD is defined in Recommendation X.3;

(b) that the DTE/DCE interface for a start-stop mode DTE accessing a PAD is defined in Recommendation X.28;

(c) that the procedures for the exchange of control information and user data between a PAD and a packet mode DTE are given in Recommendation X.29;

(d) that Recommendation X.350 gives the general requirements to be met for data transmission in the maritime satellite service;

(e) that start-stop mode DTEs are in use in the maritime satellite service;

(f) that it is desirable that such DTEs are offered access to and from packet switched public data networks via PADs located at or in association with coast earth stations or maritime satellite data switching exchanges (MSDSEs);

(g) that it is desirable to employ the same access procedures, service initiation and exchange of control information and characters in all PADs in the maritime satellite service (maritime PADs).

Note 1 – The term *maritime PAD* is used for PADs located at or in association with coast earth station in the maritime satellite service designed in accordance with this Recommendation.

Note 2 – This Recommendation does not specify PADs to be used on-board ships.

unanimously recommends

(1) that PADs in the Maritime Satellite Service (maritime PADs) should meet the requirements of this Recommendation in order to ensure full compatibility between PADs associated with different coast earth stations or mobile satellite data switching exchanges (MSDSEs) (see Recommendation X.350 for the definition of MSDSE). The general specifications of PADs are given in Recommendations X.3, X.28 and X.29;

(2) that the maritime PAD shall accept calls from any ship participating in the Maritime Satellite Service. Optionally, the maritime PAD may also offer the capability of setting up calls to ship board start-stop mode DTEs;

(3) that maritime PADs shall offer the initial standard profile given in Table 3/X.351;

(4) that maritime PADs will in addition offer other standard profiles defined in Recommendation X.28;

(5) that the user on board the ship should be advised to place the data call through the maritime PAD which is nearest to the called subscriber in order to avoid long terrestrial routes;

(6) that the protocol should enable access to and from unattended start-stop mode DTEs on-board ships and ensure efficient disconnection of the access information path at the end of a virtual call in order to avoid undue holding of the satellite circuit;

(7) that network user identification (NUI) facility is required for all calls set up from an on-board DTE in order to avoid fraudulent calls. The format of the NUI facility request signal is defined in Annex A;

(8) that maritime PADs may be located as shown in Annex B.

1 Procedures for establishing the access information path for ship originated calls

1.1 *DTE/DCE interface*

The access information path should be provided by the use of modems standardized for use in the public switched telephone network:

i) At the rate of 300 bit/s for full duplex operation in accordance with Recommendation V.21. Channel No. 1 is to be used in the direction from the ship to the PAD and channel No. 2 in the opposite direction. Tone disabling is required for disabling of echo suppressors.

ii) At the rate of 1200 bit/s for full duplex operation in accordance with Recommendation V.22, alternative B, mode ii) with 10 bits per character (i.e. one start bit, eight information bits and one stop bit) [§ 4.2.1 b) of Recommendation V.22]. The handshake procedure should be in accordance with Figure 4/V.22. The ship board modem shall transmit in the low channel and receive in the high channel. The modem of the PAD will have the opposite channel configuration. Tone disabling is required for disabling of echo suppressors.

iii) At the rate of 75/1200 bit/s in accordance with Recommendation V.23. The rate of 75 bit/s should be used for the direction from the on-board DTE to the PAD and the rate of 1200 bit/s should be used for the other direction. Tone disabling is required for disabling of echo suppressors.

Note 1 – The alternative given in ii) above is preferred.

Note 2 – Administrations may offer other additional data rates at the maritime PAD.

The particular interchange circuits provided, and their operation, shall be in accordance with Recommendation V.24 and clamping of circuit 104 should be implemented in accordance with Recommendation V.24, § 4.3.

1.2 *Procedures for setting up the access information path by the DTE*

1.2.1 *Setting up the satellite link*

The satellite link is established by using procedures defined within the INMARSAT system.

1.2.2 *Dialling procedures*

The dialling procedures for setting up telephone circuits in the INMARSAT system is given in Recommendation E.211.

Table 1/X.351 gives the dialling sequences which should be used for accessing the maritime PADs using the modems given in § 1.1.

TABLE 1/X.351

Dialling information for accessing the modems defined in § 1.1

Data signalling rate (bit/s)	Dialling sequence
300	2002
1200	2003
75/1200	2011

Table 2/X.351 gives the dialling sequences for other data rates of Recommendation X.3 which can be supported in the existing INMARSAT system. These data rates may be offered on an optional basis.

TABLE 2/X.351

Dialling information for additional data signalling rates

Data signalling rate (bit/s)	Dialling sequence
50	2010
75	2005
100	2009
110	2000
134.5	2001
150	2006
200	2008
600	2004
1 800	2007
2 400	2012
4 800	2013
9 600	2014
56 000	2017

The dialling sequences 2050 through 2099 are allocated for national use, e.g. access to PADs for special services such as videotex.

For access to PADs other than maritime PADs, national access procedures and access numbers should be used. The numbering and dialling procedures will then be as defined for calling a terrestrial telephone subscriber (see § 2.3.1 of Recommendation E.211).

1.2.3 *Routing and digit conversion at the coast earth station*

The routing of calls from the ship earth station to the maritime PAD is as shown in Annex B.

There may be a separate input port to the maritime PAD for each data rate, or several data rates may be accepted on one port. The coast earth station will route the call automatically to the appropriate port of the PAD.

If the maritime PAD is remotely connected to the coast earth station via the public switched telephone network [corresponding to case a) of Annex B], the coast earth station will convert the digits $20X_1X_2$ into the appropriate telephone access number allocated to the required input port of the PAD.

1.2.4 *Disabling of echo suppressors*

Echo suppressors are normally fitted at both ends of the satellite connection. Even though the echo suppressors in some cases may be disabled by signalling means, it is advisable that the disabling tone is sent by the modems whenever the access information path is being established.

2 Procedures for establishing the access information path for calls originating in a PDN

This point is for further study.

3 Procedures for disconnecting the access information path

Procedures for disconnecting the access information path, i.e. the maritime satellite telephone circuit, are given in §§ 1.1.3.2 and 1.1.3.4 of Recommendation X.28.

Note 1 – Since a maritime satellite telephone circuit is used for accessing the maritime PAD, charging of the call may take place until the circuit has been cleared forward (see the Q.1100 series of Recommendations for the relevant conditions). For calls set up from the on-board DTE, disconnection by the maritime PAD corresponds to clearback on the maritime satellite telephone circuit. The clearing procedures related to clearback of telephone circuits in the maritime satellite service are defined in the Q.1100 series of Recommendations.

Note 2 – The maritime PAD may be provided with control mechanisms for disconnecting the access information path during fault conditions, for example when no information has been passed between the DTE and the PAD for a given period of time.

Note 3 – When the maritime PAD detects that a clearing condition of layer 3 exists on the interface to the PDN and after the necessary control signals (e.g. the *clear indication PAD service* signal) have been passed to or received from the DTE, the PAD should disconnect the access information path.

4 Format of characters used in the exchange of control information

The start-stop mode DTE shall generate and be capable of receiving characters in accordance with International Alphabet No. 5 as described in Recommendation T.50. The general structure of characters should be in accordance with Recommendation X.4.

The following specific conditions should apply. The PAD will transmit and expect to receive 8-bit characters, where the 8th bit (i.e. the last bit preceding the stop element) shall be the parity bit. The maritime PAD will detect the parity from the *service request* signal.

If the transparent mode is selected during the call (see § 5.2 below), the PAD will ignore the parity bit and will pass octets transparently between the two interconnected DTEs.

The initial standard profile in Table 3/X.351 assumes that the even parity is used. However, the maritime PAD will also support the optional parameter values 1, 2 and 3 of parameter 21 (see Recommendation X.3). If the on-board start-stop mode DTE requires the use of a specific value for parameter 21, this value should be selected by a *set PAD command* (or a *set and read PAD command*) signal (e.g. SET 21:3) sent as soon as the *PAD identification PAD service* signal has been received [see § 5.2.1 ii)].

It is for further study whether specific standard profiles for maritime applications should be included in Table 3/X.351 for the purpose of parity treatment other than that provided with the initial standard profile.

5 Procedures for ship originated calls

5.1 *General*

5.1.1 *Initial standard profile for maritime PADs*

The initial standard profile for maritime satellite applications which will be offered in all maritime PADs is given in Table 3/X.351.

Parameters Nos. 1 through 12 and parameter No. 21 will be implemented in all maritime PADs. The remaining parameters may be offered on a national basis.

TABLE 3/X.351

PAD parameter settings for the initial standard profile for maritime PADs

Parameter reference number	Parameter description	Parameter setting for standard maritime satellite profile	Parameter value
1	PAD recall using a character	Set to possible	1
2	Echo	Set to no echo	0
3	Selection of data forwarding signal	Set to all characters in column 0 and 1 and character DEL	126
4	Selection of idle timer delay	Set to no time-out	0
5	Ancillary device control	Set to no use of X-ON and X-OFF	0
6	Control of PAD service signal	Set to service signals are sent	1
7	Selection of operation of PAD on receipt of break signal from the start-stop mode DTE	Set to reset	2
8	Discard output	Set to normal data delivery	0
9	Padding after carriage return	Set to no padding after carriage return	0
10	Line folding	Set to no line folding	0
11	Binary speed of start-stop mode DTE	Set to speed of DTE	See Rec. X.3
12	Flow control of the PAD by the start-stop mode DTE	Set to use of X-ON and X-OFF	1
13	Linefeed insertion after carriage return	Set to no linefeed insertion	0
14	Linefeed padding	Set to no padding after LF	0
15	Editing	Set to no editing	0
16	Character delete	Set to character 7/15 (DEL)	127
17	Line delete	Set to character 1/8 (CAN)	24
18	Line display	Set to character 1/2 (DC2)	18
19	Editing PAD service signals	Set to editing PAD service signals for printing terminals	1
20	Echo mask	Set to echo all characters	0
21	Parity treatment	Set to no parity detection or generation	0
22	Page wait	Set to page wait disabled	0

5.1.2 *Coding of PAD command signals and PAD service signals*

The coding of *PAD command* signals and *PAD service* signals are given in Recommendation X.28.

5.2 *Procedures*

5.2.1 Figure 1/X.351 shows the sequence of events for call establishment and call clearing for ship originated calls.

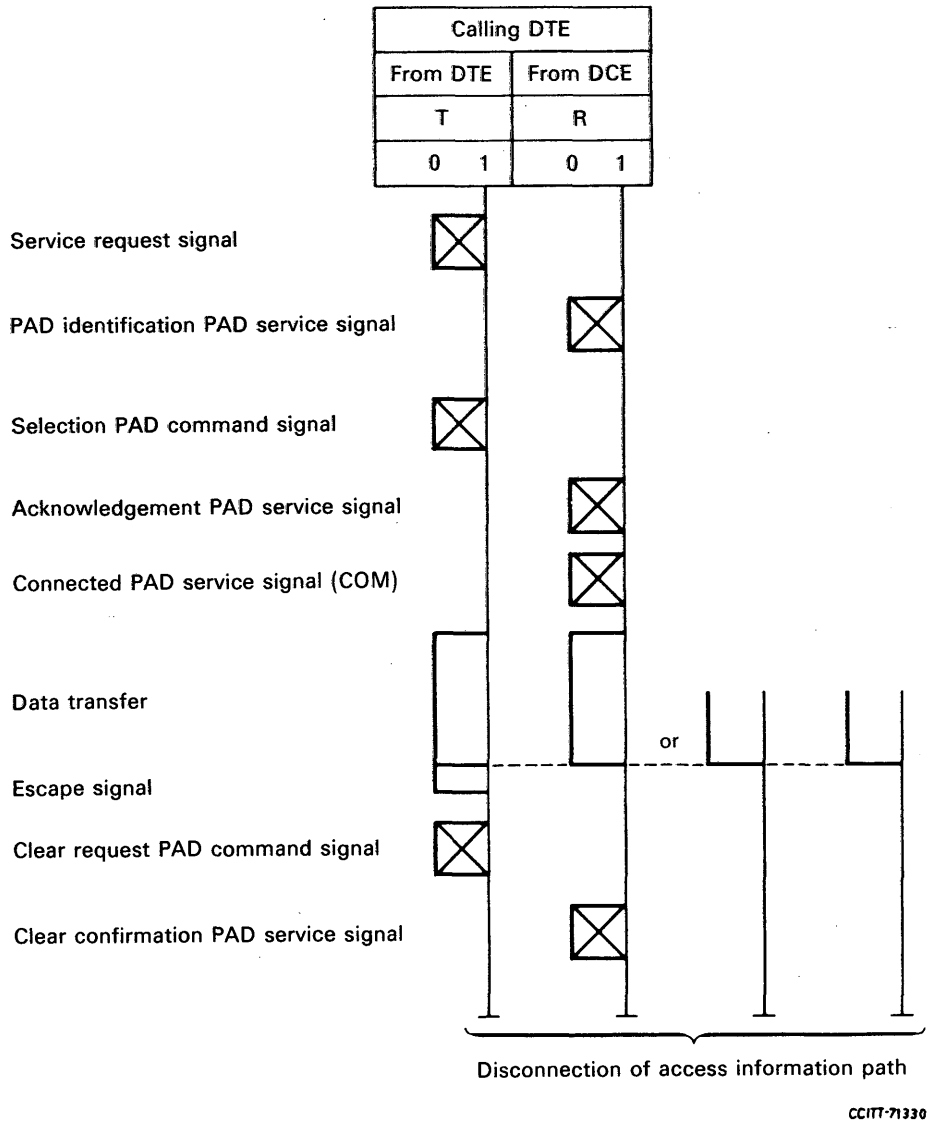


FIGURE 1/X.351

Sequence of events for ship originated calls

The following procedures will be supported in maritime PADs for virtual calls set up by the on-board start-stop mode DTE. These procedures are based on those given in Recommendation X.28, however, where the procedures given below deviate from those given in Recommendation X.28 or where Recommendation X.28 gives several alternative procedures, those given below should prevail.

i) The procedure should be initiated by the on-board start-stop mode DTE sending a *service request* signal consisting of the characters <2/14(·) 0/13(CR)> to the PAD.

The PAD will detect the parity and, if required, the data rate used from this signal.

ii) The PAD will respond within 10 seconds with the *PAD identification PAD service* signal with the following format:

PAD and/or port identification <(CR) (LF)>

[The signal <(CR) (LF)> is the format effector.]

On receipt of this signal the start-stop mode DTE shall send either:

- the *selection PAD command* signal, or
- a *set PAD command* (or *set and read PAD command)* signal for setting of specific PAD parameters followed by the *selection PAD command* signal, or
- a *standard profile selection PAD command* signal followed by the *selection PAD command* signal.

The format of the *selection PAD command* signal is given in Annex A.

If the NUI facility request signal contained in the *selection PAD command* signal is not accepted by the PAD, the PAD will transmit the *clear indication PAD service* signal <CLR NA> and disconnect the access information path.

If the first character of the *selection PAD command* signal has not been received within 60 seconds or the last character within 120 seconds, the PAD will transmit the *error PAD service* signal and disconnect the access information path.

iii) The PAD will acknowledge the *selection PAD command* signal within 10 seconds with the *acknowledgement PAD service* signal composed of the characters <0/13 (CR) 0/10 (LF)>.

iv) When the virtual call has been extended to the called DTE, the PAD will return the *PAD service* signal <COM> to the start-stop mode DTE. The interface will now be in the data transfer state where characters may be transferred using International Alphabet No. 5 except for the character <1/0 (DLE)> (which would be interpreted by the PAD as an escape from the data transfer state) and the characters <1/1 (DC1)> and <1/3 (DC3)> (which are used for flow control, see also Recommendation X.28, § 4.1).

If the start-stop mode DTE would require data to be transferred transparently through the PAD, the DTE should either send the *standard profile selection PAD command* signal <PROF91> or the *set PAD command* signal <SET 1:0, 3:0, 4:20, 6:0, 12:0> as soon as the *PAD service* signal <COM> has been received.

Selection of other PAD parameter values should be done in accordance with the procedures given in Recommendation X.28.

Note – When the transparent profile has been selected, the start-stop mode DTE will no longer be capable of escaping from the data transfer state and, since no *PAD service* signal will be given, a call control procedure needs to exist between the two communicating DTEs. For the packet mode DTE this would require a protocol at a layer above layer 3.

5.2.2 The general conditions for clearing are given in Recommendation X.28, § 3.2.2. However, the following should be noted:

a) When parameter 6 is not set to 0, the PAD will return the *clear confirmation PAD service* signal within 10 seconds after the receipt of a *clear request PAD command* signal from the ship-board DTE without awaiting a clear confirmation packet from the packet mode DTE. The start-stop mode DTE should be responsible for disconnecting the access information path. However, if the start-stop mode DTE does not disconnect the access information path or does not send the first character of a new *PAD command* signal within 20 seconds, the PAD should disconnect the access information path.

b) If parameter 6 is not set to 0, the PAD will send a *clear indication PAD service* signal to the start-stop mode DTE when receiving a clear indication packet from the PDN. The PAD should be capable of disconnecting the access information path within 20 seconds provided that
   - the on-board start-stop mode DTE has not disconnected the access information path,
   - a new *PAD command* signal has not been received from the on-board DTE, or
   - an incoming call packet to the same ship has not been received from the PDN within this time-out period.

c) If parameter 6 has been set to 0, the on-board DTE should disconnect the access information path at the end of the virtual call. If a clear indication packet is received from the PDN and the path has not been disconnected by the on-board DTE, the PAD should be capable of disconnecting the access information path.

5.2.3 Maritime PADs may offer initial profiles and procedures additional to those given in this Recommendation on a national basis.

6 Procedures for PDN originated calls

These procedures are for further study.

7 Procedures for exchange of user data

7.1 *General*

The procedures given in Recommendation X.28, § 4, should be used.

7.2 *Special conditions for the Maritime Satellite Service*

The following conditions relate to the long two-way transmission delay on the satellite circuit (approximately 0.6 seconds):

i) The PAD should be capable of storing more than one packet before a flow control signal is sent to the start-stop mode DTE.

ii) The parameter M in Recommendation X.28, § 4.6, must have the minimum values given in Table 4/X.351.

iii) The echo will be delayed by approximately 0.6 seconds. Therefore parameter 2 should normally be set to 0.

TABLE 4/X.351

Minimum values for the parameter M

Data signalling rate (bit/s)	Minimum value of M
300	18
1200	72

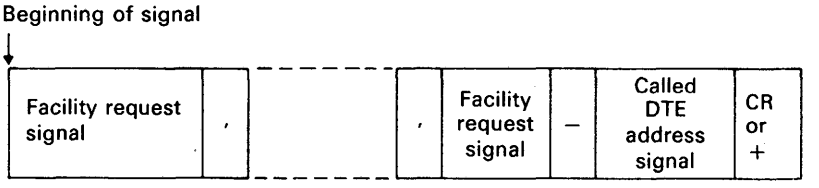
ANNEX A

(to Recommendation X.351)

Format of selection PAD command signal for maritime satellite applications

A.1 *General format*

The general format of the *selection PAD command* signal is given in Recommendation X.28 and is composed as follows:



The character 2/12 (,) is used as a separator between facility request signals and the character 2/13 (–) is used as a separator between the facility request block and the called DTE address signal. The *selection PAD command* signal is terminated by either of the characters 0/13 (CR) or 2/11 (+).

The facility request block must contain the NUI facility request signal. Other facility request signals are optional.

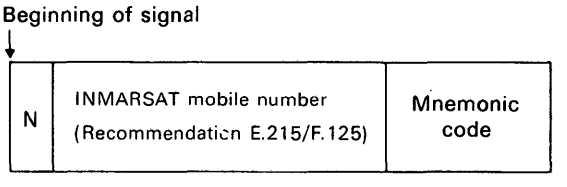
If the PAD receives a *selection PAD command* signal with a separator character 2/12 (,) followed by an empty facility request field, the signal will be accepted provided that the other fields of the signal are accepted.

The inclusion of user data in the *selection PAD command* signals is for further study.

A.2 *NUI facility request signal*

A.2.1 *Format of the NUI facility request signal*

The NUI facility request signal shall have the following format and be sent in the order shown:



N is the character 4/14 (N) of International Alphabet No. 5. The mnemonic code of the NUI facility request signal may consist of 1 to 4 characters in columns 2 to 7 of International Alphabet No. 5, except 2/0 (SP), 7/15 (DEL), 2/13 (–), 2/12 (,) and 2/11 (+).

A.2.2 *Validation of the NUI facility request signal*

The coast earth station will check the general authorization of the calling ship for access to the INMARSAT system. Therefore, validation of the NUI facility request signal may be limited to the mnemonic code. However, the possibility of fraudulent calling would be reduced if the INMARSAT mobile number is also included in the validation.

The INMARSAT mobile number may also be used for identifying the calling ship for charging purposes and for insertion in the calling DTE address field of the call request packet.

A.3 *Composition of the called DTE address signal*

A.3.1 *Calls to a DTE of a PDN*

The called DTE address signal shall consist of the prefix 0 followed by the full international number of the called DTE. This applies also when the called DTE is located in the same country as the maritime PAD.

A.3.2 *Calls to special destination*

Annex A of Recommendation X.350 defines two-digit prefixes for access to special destinations. For calls to such destinations the called DTE address shall consist of the two-digit prefix, optionally followed by additional digits.

A.4 *Optional facilities*

Facilities to be offered in a maritime PAD is to be determined by the Administration concerned.

The shipboard DTE may request available facilities in accordance with the procedures given in Recommendation X.28.

ANNEX B

(to Recommendation X.351)

Possible locations of PADs in the Maritime Satellite Service

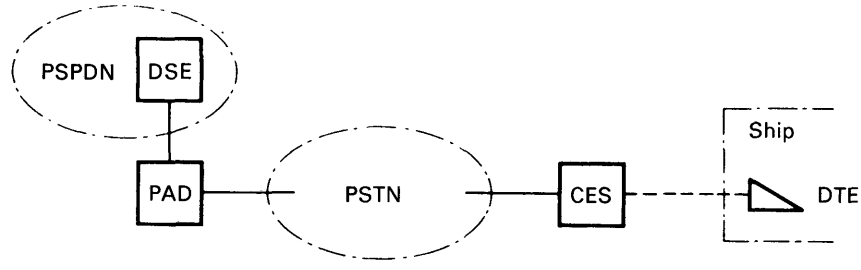
PADs in the Maritime Satellite Service may be located as shown in Figure B-1/X.351. The following cases have been identified:

a) The PAD is connected to a DSE in the country in which the coast earth station is located. In this case a call from a ship board start-stop mode DTE is routed from the maritime satellite telephone system via the telephone network to the PAD. For charging purposes a network user identification (NUI) signal must be used for identification of the calling ship.

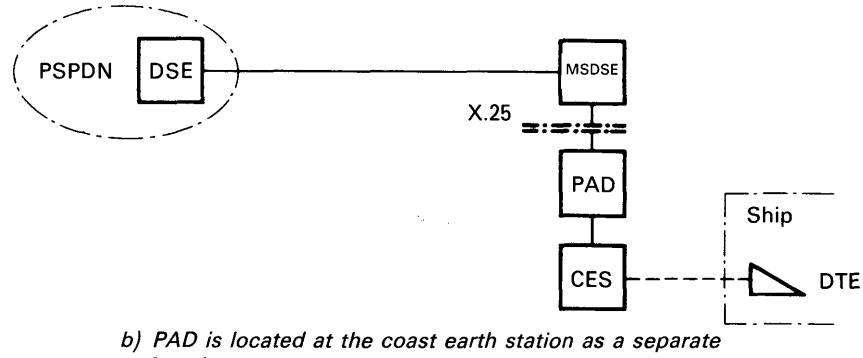
   This solution may be used irrespective of the telephone switching capabilities of the coast earth station. It is the only possible solution when the coast earth station does not incorporate a telephone switch.

b) The PAD is located at the coast earth station and is connected to the maritime satellite telephone system at the coast earth station and to the MSDSE on the interface defined in Recommendation X.25. In this case also, the NUI signal would be required.

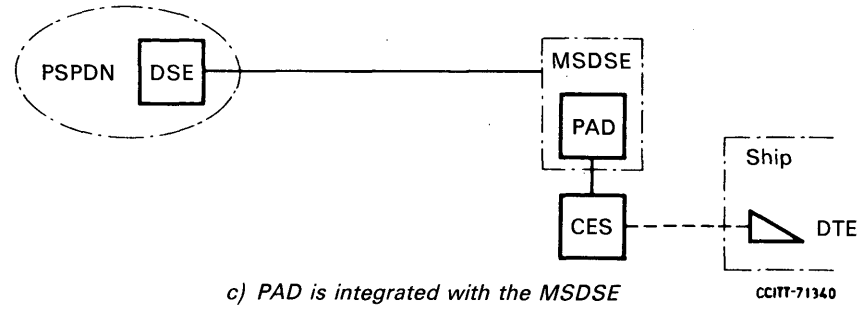
c) The PAD is integrated with the MSDSE and the interworking procedure defined in Recommendation X.352 is used for transferring the calling line identification from the coast earth station to the MSDSE. In this case the use of the NUI signal would not be required for identification purposes.



a) PAD is located at a DSE of a public data network



b) PAD is located at the coast earth station as a separate function



c) PAD is integrated with the MSDSE

CES = Coast earth station
DSE = Data switching exchange
PSPDN = Packet switched public data network
PSTN = Public switched telephone network
MSDSE = Maritime satellite data switching exchange

FIGURE B-1/X.351

Possible locations of the PAD

Recommendation X.352

INTERWORKING BETWEEN PACKET SWITCHED PUBLIC DATA NETWORKS AND PUBLIC MARITIME MOBILE SATELLITE DATA TRANSMISSION SYSTEMS

(Malaga-Torremolinos, 1984; amended at Melbourne, 1988)

The CCITT,

considering

(a) that the Maritime Satellite is now being operated by the International Maritime Satellite Organization (INMARSAT);

(b) that interworking between the Maritime Satellite Service and public data networks is required;

(c) that Recommendation X.350 specifies general interworking requirements for data transmission in Public Mobile Satellite Systems and Recommendation X.353 outlines the routing principles for interconnecting Public Mobile Satellite Systems with public data networks;

(d) that Recommendation X.25 specifies the interface between data terminals and data circuit-terminating equipment for terminals operating in the packet mode on public data networks, and that Recommendation X.75 specifies detailed procedures applicable to call control between public networks providing data transmission services;

(e) that the physical link between a mobile earth station and a data switching exchange (DSE) will only exist on a temporary basis, i.e. so long as a virtual call exists between the ship and the DSE;

(f) that Recommendation X.141 provides guidance with respect to general principles for the detection and correction of errors in public data networks,

unanimously recommends

that the following interworking principles and interface conditions should apply for operations at the network layer in the packet mode between a mobile DTE and a public data network.

1 Definitions

For definitions of terms used in relation with data transmission in public mobile satellite systems, see Recommendation X.350.

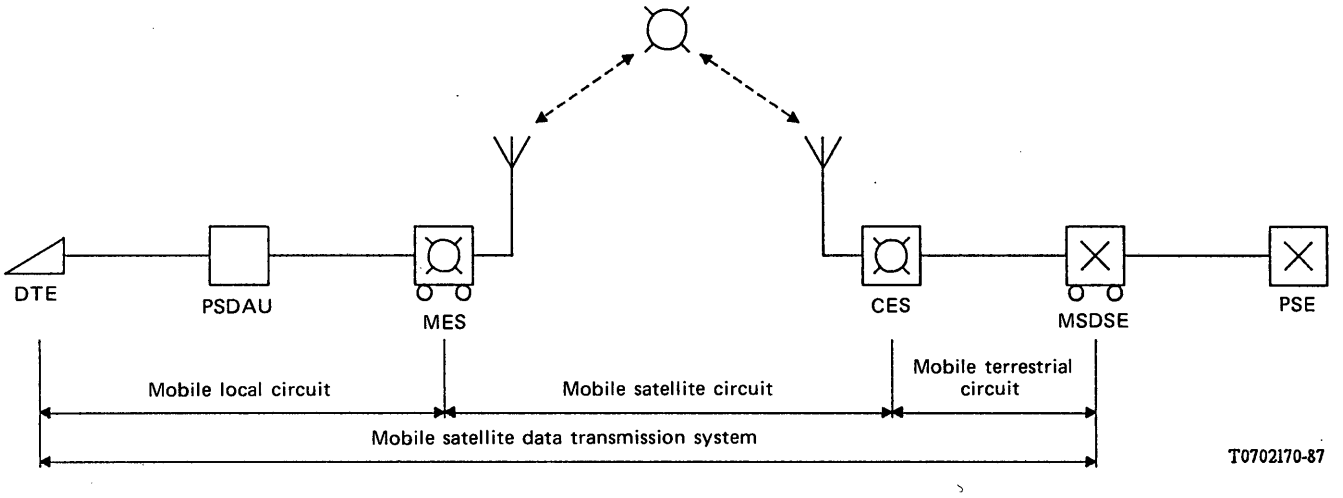
For the purpose of this Recommendation the **mobile satellite data switching exchange (MSDSE)** is defined as the functional interface between the public mobile satellite data transmission system and a packet switched public data network.

The MSDSE provides the following functions:

- interworking between the signalling systems used in the public mobile satellite data transmission system and the PSPDN;
- routing and call control for calls to and from mobile earth stations;
- charging.

The composition of the public maritime mobile satellite data transmission system for interconnection with a packet switched PDN is shown in Figure 1/X.352.

The Packet Switched Data Access Unit (PSDAU) provides a means of interconnecting a mobile DTE with the terrestrial packet switched public data network, through a mobile earth station and coast earth station equipped with packet switched data facility.

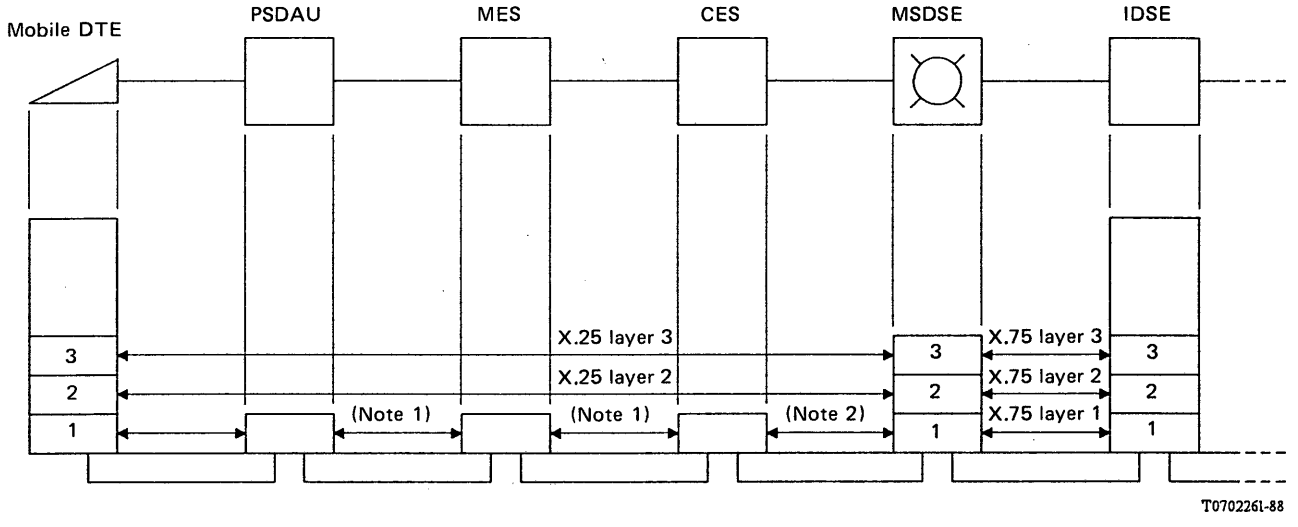


MES = Mobile earth station
CES = Coast earth station
MSDSE = Mobile satellite data switching exchange
PSDAU = Packet switched data access unit
PSE = Packet switching exchange

Note – See Recommendation X.350 for definitions.

FIGURE 1/X.352

Composition of the public maritime mobile satellite data transmission system for interconnection with a packet switched network



Note 1 – Signalling system and physical link as defined by the service provider.
Note 2 – Interworking between the CES and layer 3 of the protocol defined in Recommendation X.75.

FIGURE 2/X.352

Interfaces to be defined in the public maritime mobile satellite system

2 Interface conditions

The following interfaces need to be specified for interworking and call control purposes:

- the interface between the mobile DTE and the PSDAU (mobile local circuit);
- the interface between the PSDAU and the mobile earth station (mobile local circuit);
- the interface between the mobile earth station and the coast earth station including the interface to the network coordination station (mobile satellite circuit);
- the interface between the coast earth station and the MSDSE (mobile terrestrial circuit);
- the interface between the MSDSE and a packet switched PDN.

The interfaces are shown for layers 1, 2 and 3 in Figure 2/X.352.

2.1 *Interface between the mobile DTE and the Packet Switched Data Access Unit (PSDAU)*

2.1.1 Layer 1 (physical layer) between the mobile DTE and the PSDAU may be realised by the use of the interfaces defined in:

- Recommendation X.21;
- Recommendation X.21 *bis*;
- Recommendation V.24 and V.25.

The Recommendation X.21 interface should be included in new PSDAU designs. The Recommendation X.21 *bis* interface (or the Recommendation V.24 interface) may be used for existing designs.

The basic requirements of the layer 1 interface are:

i) For calls originating in the mobile DTE the interface should provide for the following functions:
   - it should enable the DTE to provide the mobile earth station with the address of the coast earth station through which the call is to be established, and the access-request code of the packet switched data service.

     Note 1 – The address of the call DTE is provided as part of the level 3 procedure.

     Note 2 – The PSDAU should provide an indication of call progress

     a) visually, for use by an operator; and/or

     b) as call progress signals to the DTE when the attempt to establish the mobile satellite circuit fails. The *call progress* signals to be used are given in § 6.1. Such call progress signals to the DTE may not be possible always, e.g. when the DTE interfaces the PSDAU in accordance with Recommendation V.24.

ii) For calls originating in a PDN the interface should allow for automatic connection of the mobile DTE to the circuit.

Interchange circuits shall be provided in order to meet these requirements. The required interchange circuits are defined in the Recommendations applicable to the interface used. The control of these interchange circuits shall be such as to ensure proper establishment and clearing of the mobile satellite circuit. It should also be observed that since mobile satellite circuit is established on a call by call basis, it must be ensured that the mobile DTE acquires synchronism to the element timing of the PDN before the full procedure on layer 2 is established. Until synchronism is obtained the DTE should send contiguous 1s.

See also Recommendation X.32.

2.1.2 Layer 2 should be in accordance with § 2 of Recommendation X.25. The extended control field (modulo 128) may be used if required.

Note – For reasons given in Recommendation X.141 it may be advantageous to use the selective reject (SREJ) command.

The mobile DTE should start sending the flag sequence as soon as synchronism with the MSDSE has been established.

2.1.3 Layer 3 should be in accordance with §§ 3 through 7 of Recommendation X.25.

Default values for network layer parameters such as number of virtual connections, use of extended packet sequence numbering, window size, packet size and throughput may be defined by the service provider.

Composition of the address field of the *call request* packet is given in § 4 of this Recommendation.

2.2 *Interface between the PSDAU and the mobile earth station*

This interface is to be defined under the responsibility of the service provider.

2.3 *Interface between the mobile earth station (mobile satellite circuit)*

The set-up and clearing procedures for the maritime satellite circuit are to be defined by the service provider in accordance with the interworking procedures defined in §§ 2.1 and 2.4.

The mobile earth station and the coast earth station must be transparent for layers 2 and 3 of Recommendation X.25.

Note – Forward error correction may be employed on the mobile satellite circuit in order to improve the bit error performance. See Recommendation X.141.

2.4 *Interface between the coast earth station and the MSDSE (mobile terrestrial circuit)*

The mobile terrestrial circuit must be transparent for layers 2 and 3 of Recommendation X.25.

Interworking between the coast earth station and the international circuit interconnecting the MSDSE with a PDN should take place as follows:

i) For mobile originated calls the coast earth station should provide the MSDE with the INMARSAT mobile number (see Recommendation E.215/F.125) of the calling mobile earth station for insertion in the calling DTE address field of the *call request* packet. This information will be provided to the coast earth station as part of the signalling procedure for setting up the mobile satellite circuit and will be available before layer 3 has been established between the mobile DTE and the MSDSE.

Note – If it is impractical to implement this procedure, the INMARSAT mobile number could be obtained from the calling DTE address in the *call request* packet.

The coast earth station must also give an indication to the MSDSE that the set-up of the mobile satellite circuit has been completed so that layers 2 and 3 of the protocol can be established.

ii) For incoming calls from a PDN the MSDSE must transfer the INMARSAT mobile number contained in the *call request* packet to the coast earth station in order to set up the mobile satellite circuit. When the mobile satellite circuit has been set up, the coast earth station must provide the MSDSE with a signal indicating that setting up of layers 2 and 3 may commence.

In the event of unsuccessful call set-up of the mobile satellite circuit, the coast earth station must indicate to the MSDSE the reason for call set-up failure so that the MSDSE may return the appropriate call progress signal (and diagnostic code) in the *clear request* packet. The call progress signals to be used are given in § 6.2.

iii) The MSDSE should start sending the flag sequence as soon as the coast earth station has indicated that the mobile satellite circuit has been established and through-connected by the coast earth station.

If the flag sequence has not been received from the mobile DTE within a given time-out period of 6 seconds, the MSDSE should initiate clearing of the satellite circuit.

In order to ensure full call control by the MSDSE also for mobile originated calls, the MSDSE may initialize layer 2 by sending the SABM command as soon as the flag sequence has been detected.

iv) If the mobile satellite circuit is interrupted (see § 7.2) or abnormally cleared (e.g. priority over-ride), an indication should be given to the MSDSE so that the terrestrial part of the virtual circuit may be cleared with an appropriate *call progress* signal.

The MSDSE must be capable at any time to receive an indication from the coast earth station that the satellite circuit has been cleared or interrupted.

v) the MSDSE must also be capable of indicating to the coast earth station that the mobile satellite circuit can be released.

2.5 *Interface between the MSDSE and a packet switched PDN*

This interface should correspond to Recommendation X.75.

3 Detailed call set-up and clearing procedures

Examples of call set-up and clearing procedures and interworking between various system elements are given in Annex A.

4 Composition of the call request packet at the mobile DTE

4.1 The general format of the *call request* packet shall be as defined in Recommendation X.25.

4.2 The called DTE address shall be composed as follows for calls to subscribers of a PDN:

- prefix 0;
- the international data number of the called DTE in accordance with Recommendation X.121.

4.3 The calling DTE address composed as defined in Recommendation X.350 should always be inserted in the *call request* packet.

4.4 For the maritime mobile service, the calling DTE address to be inserted by the MSDSE in the call request packet should be composed of the DNIC (111S) associated with the ocean area in which the ship is located and the relevant T digit followed by the INMARSAT mobile number and, if present, the optional digit specifying a specific mobile DTE.

4.5 Some MSDSEs may offer access to special terminations using abbreviated addresses. The called DTE address shall in such cases consist only of the abbreviated address (see Recommendation X.350). All such abbreviated addresses will have a first digit different from 0 in order to distinguish them from calls to an international data number. If the required termination is in a PDN the MSDSE must perform all necessary digit conversion to the international data number associated with the required termination before the call can be forwarded into a PDN.

5 Clearing of the mobile satellite circuit

If more than one virtual call exists, the MSDSE must not initiate clearing of the mobile satellite circuit when detecting a clearing condition for one of the virtual calls.

If only one virtual call exists when a clear packet is received from either of the parties, the MSDSE shall start clearing of the HDLC LAPB link as follows:

i) If the clearing was initiated by the PDN, clearing of the HDLC LAPB link should commence when either of the following conditions has been met:

   - a *DTE clear confirmation* or a *clear request* packet has been received from the mobile DTE;
   - timer T13 (Annex D to Recommendation X.25) has expired.

   Note 1 – Before clearing of the HDLC link the MSDSE may issue a clear indication packet with diagnostic code No. 50 (timer expired for clear indication).

   Note 2 – It is desirable to have a smaller value than 60 seconds on timer T13 for mobile satellite applications in order to reduce the traffic load on the satellite circuits. The minimum value is for further study.

ii) If the clearing was initiated by the mobile DTE, the MSDSE should forward the *clear request* packet into PDN and immediately return a *DCE clear confirmation* packet to the mobile DTE without awaiting the return of any *clear confirmation* packet from the PDN. As soon as the *clear confirmation* packet has been sent to the mobile DTE clearing of the HDLC link should commence.

   Note – In order to allow the DTE to place a new call immediately after clearing of the last existing virtual call, the clearing of the HDLC link may be delayed by a short time-out period. If the clearing was initiated from the PDN, the timer should be started when the *DTE clear confirmation* packet is received from the mobile DTE. If the clearing was initiated by the mobile DTE, the timer should be started when the *DCE clear confirmation* packet is sent to the mobile DTE. If a new *call request* packet is received from either of the parties during this time-out period, the satellite circuit should not be cleared. The time-out should be short in order to avoid undue holding of the satellite circuit in those cases where no further calling is intended.

An indication that the physical link may be cleared should be provided to the coast earth station as soon as the MSDSE has entered the disconnected phase. The actual clearing of the mobile satellite circuit would then be undertaken by the coast earth station.

Note – With the above procedures clearing of layers 1 and 2 is always initiated by the MSDSE and interworking between different layers would not be required in the mobile DTE. The procedures for handling clearing failures associated with the mobile satellite circuit are to be defined by the service provider.

6 Relationship between call progress signals, diagnostic codes and unsuccessful call events of the mobile satellite circuit

6.1 *Ship originated calls*

When consistent with the layer 1 capabilities of the interface to the PSDAU, the PSDAU should provide *call progress* signals to the mobile DTE in accordance with Table 1/X.352.

TABLE 1/X.352

Call progress signals to be provided by the mobile earth station to the mobile DTE

Event (see Note)	Call progress signal (Recommendation X.96)
Out of order (e.g. continuity check fails)	Out of order
Congestion	Network congestion
Request not acceptable	Access barred
No response to the request message	Network congestion

Note – Some of these events are detected by the mobile earth station and some are signalled from the coast earth station (or the network coordination station).

6.2 *Incoming call from a PDN*

The coast earth station should indicate to the MSDSE the reasons for unsucessful call set-up of the mobile satellite circuit. The *call progress* signal and diagnostic code to be returned by the MSDSE to the PDN is given in Table 2/X.352.

For coding of the clearing cause field see Recommendation X.25.

7 Satellite circuit interruption supervision

7.1 *General*

The satellite circuit may be interrupted due to several causes, e.g. antenna blockage at the mobile earth station, the mobile earth station is no longer within satellite coverage, the mobile earth station is faulty. The interruption condition is to be defined by the service provider.

Interruption supervision should be undertaken both by the mobile earth station and by the coast earth station (or by the MSDSE). The interruption supervision should be associated with each physical link.

TABLE 2/X.352

Satellite system event to be indicated by the coast earth station to the MSDSE and associated clearing cause and diagnostic code

Satellite system event	Clearing cause (*call progress* signal, Recommendation X.96)	Diagnostic code
Mobile station busy	Number busy	No additional information (No. 0)
Out of order (e.g. continuity check failure)	Out of order	No additional information (No. 0)
No response from the mobile station	Ship absent	No additional information (No. 0)
No DTE at the mobile station	Incompatible destination	No additional information (No. 0)
Non-existing number	Not obtainable	Invalid called address (No. 67)
Insufficient number of digits	Not obtainable	Invalid called address (No. 67)
Wrong format of called number	Not obtainable	Invalid called address (No. 67)
Access barred	Access barred	No additional information (No. 0)
Network congestion	Network congestion	No additional information (No. 0)
Congestion at coast earth station	Network congestion	No additional information (No. 0)
Priority override (see Note)	Network congestion	No additional information (No. 0)
Satellite system outage	Network congestion	No additional information (No. 0)
Coast earth station outage	Network congestion	No additional information (No. 0)

Note – Priority override indicates that the particular mobile satellite circuit has been cleared in order to service a call with distress priority.

7.2 *Actions to be taken by the MSDSE*

Upon detecting an interruption of the mobile satellite circuit the MSDSE shall send *clear request* packets on each virtual circuit affected with the clearing cause "network congestion" to the PDN. The *clear indication* packet should be sent to the mobile DTE in order to facilitate clearing if the interruption only exits in one direction of transmission. However, the MSDSE should not wait for a *DTE clearing confirmation* packet from the mobile DTE.

Since the MSDSE has no means of further monitoring of the mobile earth station (and the interruption condition), a subsequent call to that mobile DTE should be handled in the normal way. If the mobile earth station does not respond to the call, the clearing cause indication should be "ship absent" (see Table 2/X.352).

Note – Because of the reasons given above, the restart procedure of Recommendation X.25 does not apply.

7.3 *Actions to be taken by the mobile DTE*

For further study.

ANNEX A

(to Recommendation X.352)

Call set-up and clearing procedures for telephone type channels

A.1 *Introduction*

This annex describes possible procedures for call set-up and clearing of layers 1, 2 and 3 between a mobile DTE operating in the packet mode and an MSDSE using telephone type channels between the PSDAU and the coast earth station. Definition of procedures for this case is important becuase then packet switched data transmission may be offered with existing mobile earth station designs with only the addition of a PSDAU.

Since the physical link (layer 1) is subdivided into three parts (see Figure 1/X.352), information equivalent to that on the C and I leads (or the corresponding leads of the interface defined in Recommendation X.21 *bis*) needs to be provided also on the mobile satellite circuit so that the coast earth station can fully control the establishment and clearing of that circuit. This can be done in the INMARSAT standard-A system by using the inband continuity signals and clearing signals specified for telephony (both are single frequency tones with frequency 2600 Hz).

Even though the procedures defined below are based on telephone signalling, similar procedures would apply for data transmission on dedicated data channels (or combined digit channels for speech and data). The C and I lead information could then be provided as status bit multiplexed together with the digital data on the T and R circuits (see also Recommendation X.51). Continuity of the maritime satellite circuit could then be established before layer 1 is extended to the DTE and the MSDSE. Moreover, clearing of layer 1 can be done independently of the higher layers, enabling the coast earth station and the ship earth station to fully control establishment and clearing of the maritime satellite circuit.

A.2 *Mobile originated call in the INMARSAT Standard A*

Figure A-1/X.352 shows the full call set-up and clearing procedures for all layers of the call control and data transfer protocol between the MSDSE and a mobile DTE for a mobile DTE originated call in the INMARSAT Standard-A system.

The following signals are exchanged between the coast earth station, the mobile earth station and the network coordination station using the common channel signalling system defined by INMARSAT:

- *request message* (sent by the mobile earth station to the called coast earth station);
- *request for assignment* (sent by the called coast earth station to the network coordination station);
- *assignment message* (sent by the network coordination station to both the mobile earth station and the coast earth station for indicating the mobile satellite circuit on which the call is to be established).

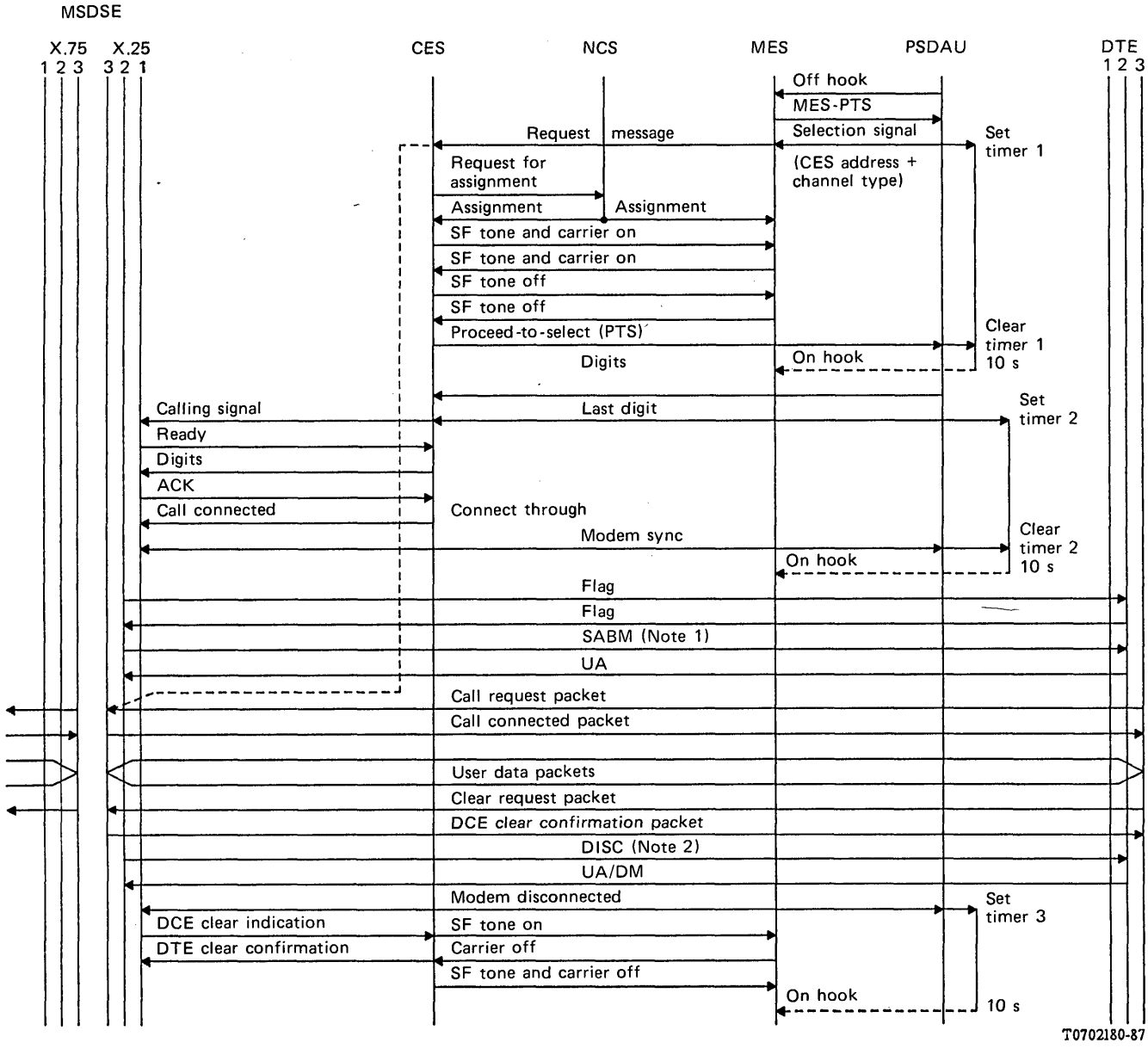
Note – The coast earth station and the network coordination station may send other messages in order to indicate unsuccessful call set-up e.g. access barred, congestion).

In order to verify the mobile satellite circuit, the coast earth station initiates a continuity check of the assigned circuit. The mobile terrestrial circuit should not be set up before the continuity test has been completed. If the continuity test fails, the circuit will be cleared by the coast earth station.

For the procedure between the coast earth station and the MSDSE only those signals required for transfer of interworking information are shown.

A.3 *Incoming call from a PDN to a Mobile earth station in INMARSAT standard-A*

Figure A-2/X.352 shows the call set-up and clearing procedures for an incoming call from a PDN.



Note 1 – Layer 1 is established by the MSDSE.

Note 2 – Layer 2 is cleared by the MSDSE.

FIGURE A-1/X.352

Call set-up and clearing for a mobile originated call

The address (i.e. the call mobile earth station number) as contained in the *call request* packet is transferred to coast earth station. The maritime satellite circuit is established by the method defined in the INMARSAT standard-asyth similar to those of § A.2. At the mobile earth station the continuity signal is turned off when the on-hook signal is returned by the PSDAU so that the *call connected* state can be signalled to the MSDSE.

The *call connected* packet is returned to the PDN when the *call accepted* packet is received from the mobile DTE.

An unsuccessful call may be detected by the coast earth station at several stages during call set-up:

- from indications given by the network coordination station (e.g. mobile station busy, congestion);
- failure to establish continuity of the mobile satellite circuit (e.g. no response from the ship).

The coast station should in such cases provide an appropriate indication to the MSDSE so that a *clear request* packet may be returned to the PDN.

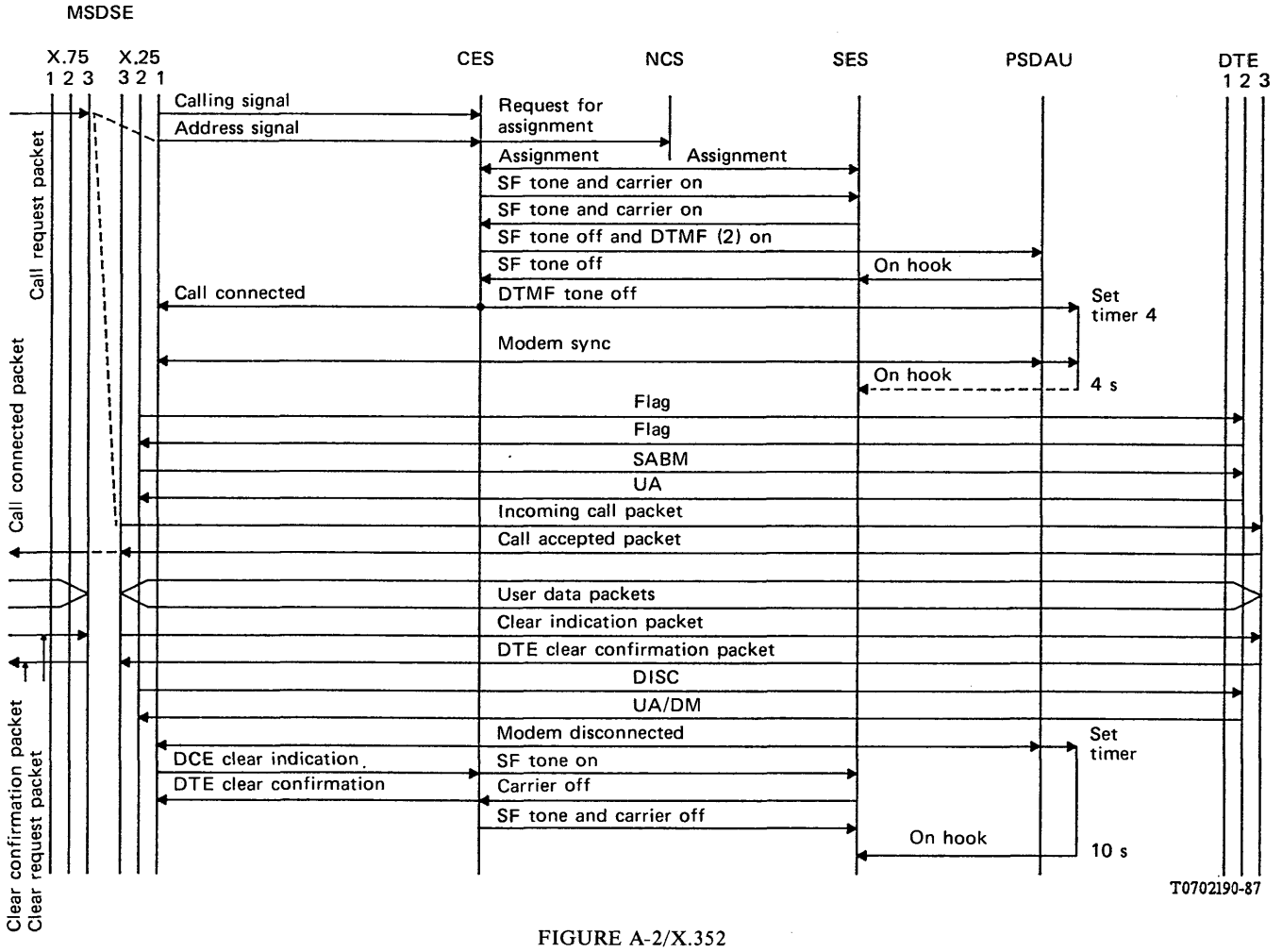


FIGURE A-2/X.352

Call set-up and clearing for an incoming call from a PDN

Recommendation X.353

ROUTING PRINCIPLES FOR INTERCONNECTING PUBLIC MARITIME MOBILE SATELLITE DATA TRANSMISSION SYSTEMS WITH PUBLIC DATA NETWORKS

(Malaga-Torremolinos, 1984; amended at Melbourne, 1988)

The CCITT,

considering

(a) that a Public Maritime Mobile Satellite Service is now being operated by the International Maritime Satellite Organization (INMARSAT);

(b) that the mobile subscribers may have access to the service through a number of coast earth stations located in different countries;

(c) that interworking between the mobile satellite data transmission systems and the public data networks is required;

(d) that Recommendation X.110 specifies routing principles for international data services, Recommendation X.121 specifies the international numbering plan for public data networks and Recommendation E.215/F.215 provides for internationally unique mobile earth station identification;

(e) that new mobile systems for maritime and aeronautical applications are being defined,

unanimously recommends

that the following routing principles should apply for setting up calls between subscribers of the public data networks and users of international public maritime mobile satellite data transmission systems.

1 General

1.1 *Definitions*

Figure 1/X.353 shows the composition of systems in the Public Maritime Mobile Satellite Service. For definition of the various elements see Recommendation X.350.

The mobile satellite data switching exchange (MSDSE) is defined in § 1.7 of Recommendation X.350.

1.2 *Role of the MSDSE*

A MSDSE will at the same time act as an international gateway and as an interface to the mobile earth stations. Within an ocean area a public maritime mobile earth station may set up or receive data calls from any MSDSE in that region. Each ocean area may contain a number of MSDSEs.

One MSDSE may have access to more than one satellite, and thus may serve more than one ocean area.

One MSDSE may serve one or more public maritime mobile systems.

The MSDSE may be connected to more than one international data switching exchange (IDSE) in a PDN. The MSDSE may also be connected to IDSEs in different PDNs.

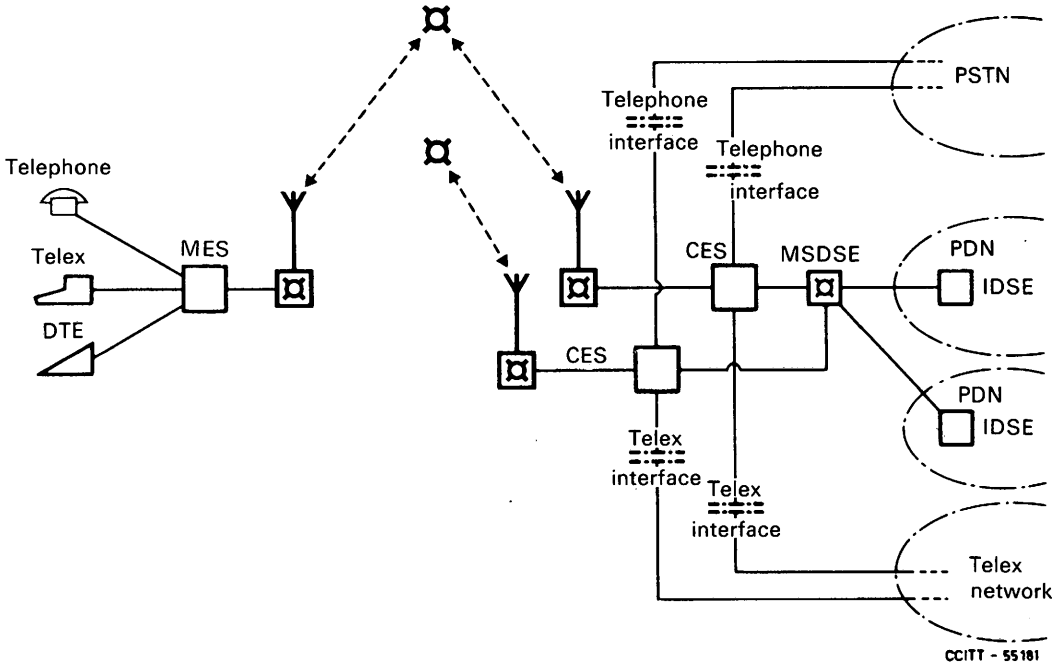
This Recommendation assumes that a PDN does not connect to more than one MSDSE serving the same ocean area and Public Maritime Mobile Satellite System (such as INMARSAT Standard A, B and C).

2 Routing of mobile earth station originated calls

2.1 *A public maritime mobile earth station calling a land network subscriber*

The mobile earth station selects one MSDSE in the ocean area by signalling procedures defined within the mobile satellite service. The mobile user should be advised to place the call through an MSDSE which is near to the called subscriber in order to avoid long terrestrial routes.

The public maritime mobile earth station subscriber provides the international data number of the called subscriber to the MSDSE which will forward the call through its associated IDSE (or through the most appropriate IDSE if the MSDSE is connected to more than one IDSE).



MES = Mobile earth station
CES = Coast earth station
MSDSE = Mobile satellite data switching exchange
IDSE = International data switching exchange

Note – In this example, the MSDSE is serving two ocean areas and is connected to two PDNs.

FIGURE 1/X.353

Main elements of the public maritime mobile satellite system

2.2 *A public maritime mobile earth station calling another mobile earth station*

If the two public maritime mobile earth stations are in the same ocean area or are in different ocean areas covered by the same MSDSE, the MSDSE sets up the call directly to the called public maritime mobile earth station so that only one MSDSE will be involved in the call.

Note – If the MSDSE does not have full switching capability, the call will first be routed to its associated IDSE and then back again to the MSDSE.

If the two public maritime mobile earth stations are in different ocean areas which are not both covered by the same MSDSE, the calling MSDSE will route the call in accordance with § 2.1 above.

2.3 *Routing of special service requests*

Certain services (e.g., access to data bases for navigational warnings, weather forecasts, etc.) may be accessed by use of special short number codes defined within the public maritime mobile satellite systems. Such abbreviated codes require conversion to the full international data number before the call can be forwarded from the MSDSE to a PDN.

2.4 *Information provided to mobile earth stations*

Administrations operating MSDSEs should prepare and maintain information for mobile earth stations with regard to the administration's routing capabilities towards various destinations.

3 Routing of land originated calls to public maritime mobile earth stations

3.1 *Routing principles*

According to Recommendation X.121, one DNIC is allocated for each ocean area. The structure of these DNICs is 111S where S specifies the ocean area. The values assigned are found in Recommendation X.121.

Further, the first digit of the following Network Terminal Number in the public maritime mobile-satellite system is the "T" digit defined in Recommendation E.215/F.125 which is used for discrimination between different public maritime mobile satellite systems.

A calling user can only indicate which ocean area and public maritime mobile satellite systems (such as INMARSAT Standard A, B and C) type is addressed, and cannot select a specified MSDSE. Therefore each originating and/or transit network has normally to route data calls within one of the public maritime mobile system DNICs to pre-determined MSDSE which serves the ocean area and system type as indicated by the DNIC and T digit according to bilateral agreement between the administration of origin and the administration operating the MSDSE. Thus, analysis of five digits of the called number is required for routing purposes.

Similar agreements need to be made with administrations operating transit networks which will be involved in establishing the connection.

Situations may arise when two administrations are using the same transit network for routing their calls to two different MSDSEs within the same ocean area, i.e., two MSDSEs with the same DNIC and T digit. This will be solved by routing the call according to the DNIC of the administration of origin.

3.2 *Routing on facility field information*

If the MSDSE (or the associated transit network) does not provide for a given facility, the administration may choose to set up calls requesting such a facility via another MSDSE or transit network than that normally used by the administration rather than barring the call.

3.3 *Re-routing of calls at the MSDSE*

MSDSEs that have access to two satellites may have the capability of re-routing calls between the coverage areas of the two satellites. The re-routing of calls by the MSDSE enables a land user to have calls re-routed to another data number (but to the same public maritime mobile earth station), which only differs in ocean area, when a mobile earth station is absent from the ocean area indicated by the original data number. The re-routing of a call between the two ocean areas covered by the MSDSE should be carried out only once.

The condition for re-routing is that the public maritime mobile earth station is included in the list of earth stations and is not barred from incoming access.

The DNIC to be returned as part of the called line identification, or whether a called line identification should be returned in such cases, is for further study.

General re-routing of calls based on the information contained in a mobile satellite location register is desirable. This may require changes to existing X-Series Recommendations and to the public maritime mobile satellite system specifications and is therefore left for further study.

Note – See also § 3.1.

4 Group calls

In general, calls with a group address (as defined in Recommendation E.215/F.125) should be barred. Such addresses are public maritime mobile earth station numbers with a T digit 0. The call should preferably be barred in the network of origin. However, the MSDSE must in any case be capable of barring such calls. (See also Recommendation X.350.)

5 Use of satellite links

The link between the coast earth station and a public maritime mobile earth station is always a satellite link.

To provide acceptable Quality of Service, a limited number of satellite links should be permitted on a data connection. (See Annex B to Recommendation X.110.)

Hence, for a call destined to a public maritime mobile earth station, all transit exchanges should recognize from the destination DNIC of 111S that the final link is a satellite link and perform routing so that the maximum permitted transit delay from the calling user to the called user is not exceeded.

Note – The mechanism for a transit network to determine the transit delay already experienced in setting-up a call is for further study.

SECTION 3

INTERNETWORK MANAGEMENT

Recommendation X.370

ARRANGEMENTS FOR THE TRANSFER OF INTERNETWORK MANAGEMENT INFORMATION

(Melbourne, 1988)

The CCITT,

considering

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

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

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

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

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

(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 may be used to support CCITT recommended services (in particular telematic services);

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

(i) that Recommendation X.213 defines the Network Layer service of open systems interconnection for CCITT Applications;

(j) that interworking with Common Channel Signalling Network (CCSN) needs to be considered, in view of the requirements for transferring operational information between Administrations;

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

(l) the need for general principles and arrangements for interworking between public data networks and between public data networks and other public networks;

(m) the need, 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 data networks;
- for compatibility and uniformity in the principles for realization of international user facilities and network utilities in public data networks,

unanimously recommends

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

– for arrangements for the transfer of internetwork management information be in accordance with the principles and procedures specified in this Recommendation.

CONTENTS

1 General conditions for transferring internetwork management information

The transfer of internetwork management information of public data networks should be done in accordance with the reference model for OSI applications defined by CCITT, as illustrated in Figures 1/X.370 and 2/X.370.

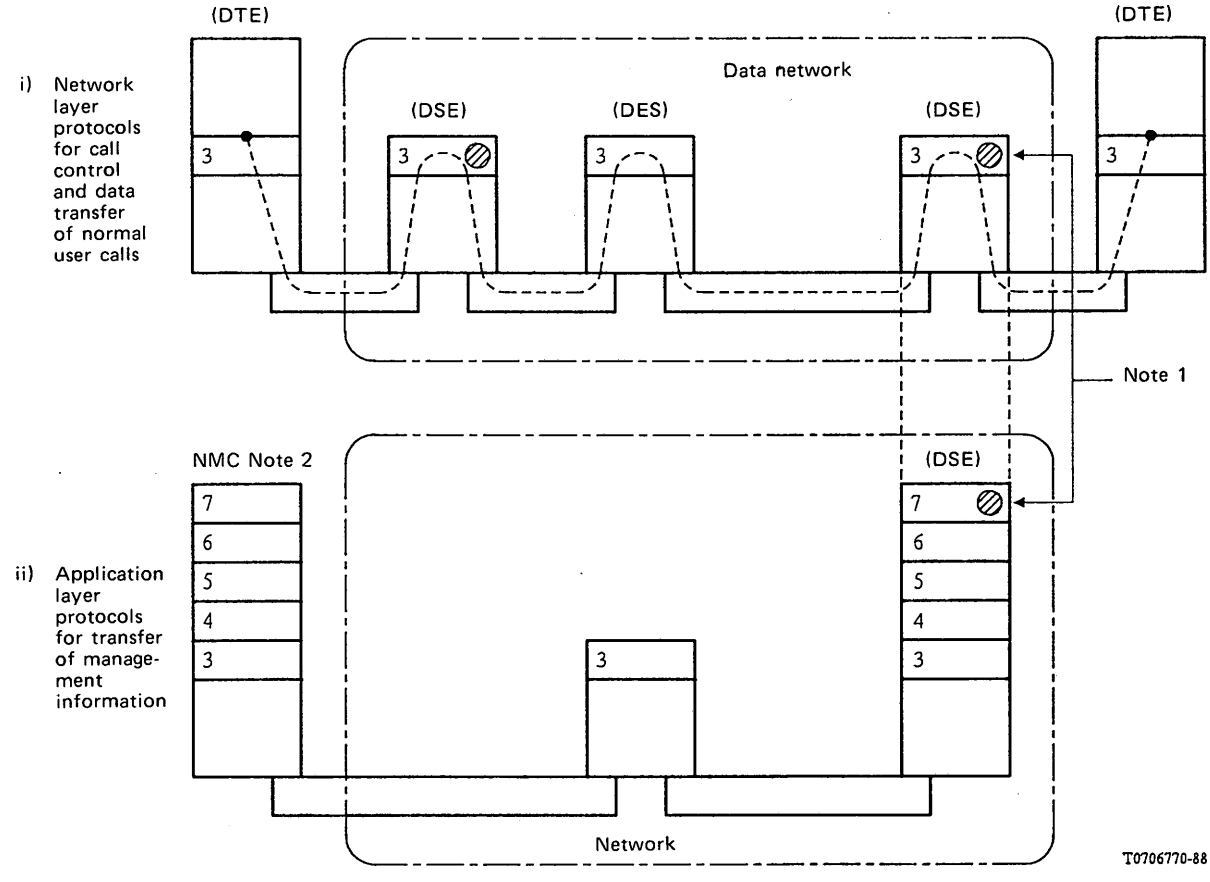


FIGURE 1/X.370

Transfer of management information between a DSE and an NMC

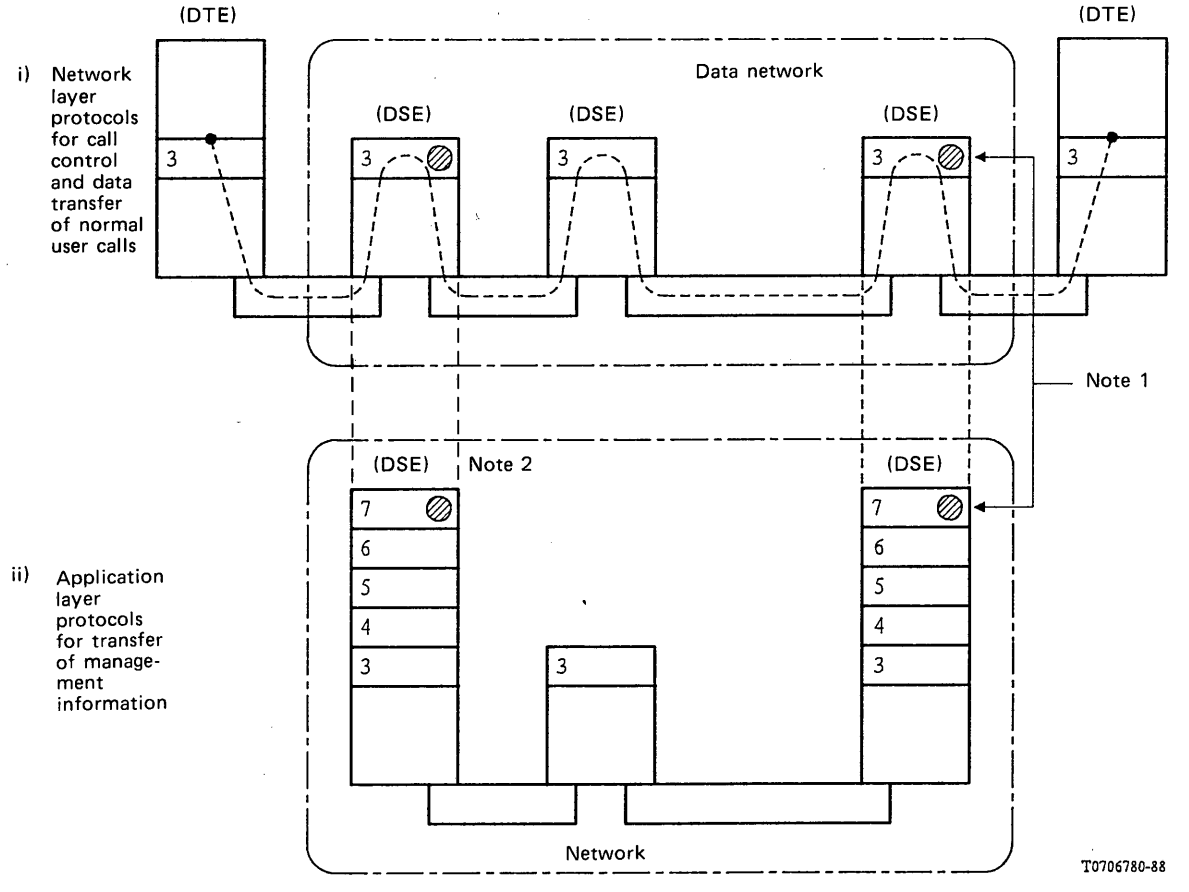


FIGURE 2/X.370

Transfer of management information between two DSEs

Notes associated with Figures 1/X.370 and 2/X.370

Note 1 – Two entities cooperating for call control and network management communicate for call control and data transfer on one side, and for transfer of management information on the other side. Consequently, the same two entities:

i) on one side exchange call control and data information;

ii) on another side, exchange internetwork management information; for this, specific protocols may be established at the application layer.

Note 2 – In some cases, a Network Management Centre (NMC) may be located (reside) within a DSE.

2 Detailed arrangements at the network layer for the transfer of internetwork management information

The OSI services considered at the network layer conform to Recommendation X.213.

To access those OSI services, protocols at the physical, link and network layers depend on the networks involved in the transfer of management information. The exact protocols to be used are as specified in the previous section of this Recommendation.

3 Detailed arrangements at the transport layer for the transfer of internetwork management information

The OSI services considered at the transport layer conform to Recommendation X.214.

The protocol to be used at the transport layer conforms to Recommendation X.224.

The exact characteristics of the transport layer protocol (i.e. class of transport protocol, etc.) applying to the transfer of management information, are for further study.

4 Detailed arrangements at the session layer

For further study.

The OSI services considered at the session layer conform to Recommendation X.215.

The protocol to be used at the session layer conforms to Recommendation X.225.

The exact characteristics of the services and protocol at the session layer, applying to the transfer of management information, are for further study.

5 Detailed arrangements at the presentation layer

For further study.

6 Detailed arrangements at the application layer

For further study.

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