INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

X.610

(09/92)

DATA COMMUNICATION NETWORKS

PROVISION AND SUPPORT OF THE OSI CONNECTION-MODE NETWORK SERVICE

Recommendation X.610

FOREWORD

The CCITT (the International Telegraph and Telephone Consultative Committee) is a permanent organ of the International Telecommunication Union (ITU). CCITT is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The Plenary Assembly of CCITT which meets every four years, establishes the topics for study and approves Recommendations prepared by its Study Groups. The approval of Recommendations by the members of CCITT between Plenary Assemblies is covered by the procedure laid down in CCITT Resolution No. 2 (Melbourne, 1988).

Recommendation X.610 was prepared by Study Group VII and was approved under the Resolution No. 2 procedure on the 10th of September 1992.

CCITT NOTE

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

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INTRODUCTION

This Recommendation is one of a set of Recommendations produced to provide a high level architectural overview of the provision and support of the OSI Connection-mode Network Service that is defined in Recommendation X.213. Other Recommendations in the X.610-Series deal with specific cases for providing the Connection-mode Network Service.

In some layers of the OSI Reference Model Architecture, it is possible to refer to a single layer protocol specification as the place in which all information necessary to understand how to provide the layer service can be found. This is not possible in the Network Layer since the number of different subnetwork technologies and interconnection strategies that must be accommodated is quite large. It is the intention of this Recommendation, therefore, to serve as a single point of reference for information concerning the ways in which Network Layer protocols can be used to provide the OSI Connection-mode Network Service in various environments.

This Recommendation describes the specifics for the provision and support of the OSI Connection-mode Network Service and the criteria for the inclusion of protocol combinations. It also describes the applicability of particular Network Layer protocol Recommendations to the provision and support of the Connection-mode Network Service.

Recommendation X.610

PROVISION AND SUPPORT OF THE OSI CONNECTION-MODE NETWORK SERVICE

(1992)

The CCITT,

considering

(a) that Recommendation X.200 defines the Reference Model of Open Systems Interconnection (OSI) for CCITT Applications;

(b) that Recommendation X.210 specifies the OSI Layer Service Definition Conventions for describing the services of the layers of OSI Reference Model;

(c) that Recommendation X.213 specifies the Network Service Definition for Open Systems Interconnection for CCITT Applications;

(d) that there exists a number of different network technologies (e.g. CSDN, ISDN, PSDN, PSTN) to support data transmission;

(e) that there is a need to specify the provision and support of the OSI Connection-mode Network Service in a unified fashion taking into account the various environments,

unanimously declares the view

that the architectural principles and framework and the protocol combinations contained within this Recommendation shall form the basis for the provision and support of the OSI Connection-mode Network Service.

1 Scope

This Recommendation provides an architectural overview of the OSI Connection-mode Network Service defined in Recommendation X.213.

This Recommendation

a) provides a general overview;

b) refers to those Recommendations which govern the provision of the Connection-mode Network Service;

c) defines terms which may be used in specifying the environments in which protocol combinations operate;

d) specifies principles and a framework for describing the support of the OSI Connection mode Network Service;

e) considers the rationale for the inclusion of protocol combinations in the other Recommendations in the X.610-Series.

Where a protocol combination does not support the OSI Connection-mode Network Service, it lies outside the scope of this Recommendation.

Note – The scope of this Recommendation only includes protocol combinations where all the mandatory (and inherent) elements of the OSI Connection-mode Network-Service as specified in Recommendation X.213 are fully supported.

2 References

– Recommendation I.430, *Basic User-Network Interface – Layer 1 Specification.*

– Recommendation I.431, *Primary Rate User-Network Interface – Layer 1 Specification.*

– Recommendation Q.921, *ISDN User-Network Interface Data Link Layer Specification.*

– Recommendation Q.931, *ISDN User-Network Interface Layer 3 Specification for Basic Call Control.*

– Recommendation V.25, *Automatic answering equipment and/or parallel automatic calling equipment on the General Switched Telephone Network including procedures for disabling of echo control devices for both manually and automatically established calls.*

– Recommendation V.25 *bis*, *Automatic calling and/or answering equipment on the General Switched Telephone Network (GSTN) using the 100-Series interchange circuits.*

– Recommendation X.21, *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for Synchronous Operation on Public Data Networks.*

– Recommendation X.21 *bis*, *Use on Public Data Networks of Data Terminal Equipment (DTE) which is designed for interfacing to Synchronous V-Series Modems.*

– 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.32, *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to 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.*

– Recommendation X.75, *Packet-Switched Signalling System between Public Networks providing Data Transmission Services.*

– Recommendation X.200, *Reference Model of Open Systems Interconnection for CCITT applications.*

– ISO 7498, *Information Processing Systems – Open Systems Interconnection – Basic Reference Model.*

– Recommendation X.210, *OSI Layer Service definitions conventions.*

– ISO TR 8509, *Information Processing Systems – Open Systems Interconnection – Service conventions.*

– Recommendation X.213, *Network Service Definition for Open Systems Interconnection for CCITT applications.*

– ISO 8348, *Information Processing Systems – Data Communications – Network Service Definition – Addendum 2: Network Layer Addressing.*

– Recommendation X.223, *Use of Recommendation X.25 to provide the OSI connection-mode network service for CCITT applications.*

– ISO 8878, *Information Processing Systems – Data Communications – Use of Recommendation X.25 to provide the OSI Connection Mode Network Service.*

– Recommendation X.305, *Functionalities of subnetworks relating the support of the OSI Connection-mode Network Service.*

– Recommendation X.612, *Provision of the OSI Connection-mode Network Service by Packet Mode Terminal Equipment connected to an Integrated Services Digital Network (ISDN) for CCITT applications.*

– ISO 9574, *Information Technology – Telecommunications and Information Exchange between Systems – Provision of the OSI Connection-mode Network Service by packet mode terminal equipment connected to an Integrated Services Digital Network (ISDN) – Addendum 1: Operation over an ISDN circuit-switched channel connecting directly to remote terminal.*

– Recommendation X.613, *Use of X.25 Packet Layer Protocol in conjunction with Recommendations X.21 and X.21 bis to provide the OSI Connection-mode Network Service.*

– ISO/IEC 10588, *Information Technology – Data Communications – Use of X.25 Packet Layer Protocol in conjunction with Recommendations X.21 and X.21 bis to provide the OSI Connection-mode Network Service.*

– Recommendation X.614, *Use of X.25 Packet Layer Protocol to provide the OSI Connection-mode Network Service over the telephone network.*

– ISO/IEC 10732, *Information Technology – Data Communications – Use of X.25 Packet Layer Protocol to provide the OSI Connection-mode Network Service over the Telephone Network.*

– ISO 7776, *Information Processing Systems – Data Communications – Description of X.25 LAPB-compatible DTE Data Link Procedures.*

– ISO 7776/Cor. 1:1989, *Information Processing Systems – Data communications – Description of X.25 LAPB-compatible DTE Data Link Procedures – Technical Corrigendum 1.*

– ISO 7776/Cor. 2:1989, *Information Processing Systems – Data communications – Description of X.25 LAPB-compatible DTE Data Link Procedures – Technical Corrigendum 2.*

– ISO/IEC 8208, *Information Technology – Data communications – X.25 Packet Layer Protocol for Data Terminal Equipment.*

– ISO/IEC 8880-2, *Information Technology – Data communications – Protocol combinations to provide and support the OSI Network Service – Part 2: Provision and support of the Connection mode Network Service, – Addendum 1: Addition of the ISDN environment when a packet handling function is present – Addendum 2: Addition of PSTN and CSDN environments.*

– ISO/IEC 10000-2, *Information Technology – Framework and taxonomy of International Standardized Profiles – Part 2: Taxonomy.*

3 Definitions

This Recommendation is based on the concepts developed in Recommendation X.200 and makes use of the following terms defined in that Recommendation:

a) Connection-mode;

b) End System;

c) OSI Network Layer;

d) OSI Network Service;

e) OSI Transport Layer;

f) Protocol;

g) Service.

Note – The use of the word "Network" to name the Network Layer of the OSI Reference Model should be-distinguished from the use of the word "network" to denote a communications network as conventionally understood.

Similarly, it is important to distinguish the specialized use of the term "Service" to refer to the abstract capability provided by one layer of the OSI Reference Model to the layer above it from its use elsewhere to describe the provision of a "service" by an organization such as an Administration.

4 Abbreviations

The following abbreviations are used in this Recommendation:

CONS Connection-mode Network Service

CSDN Circuit Switched Data Network

DCE Data Circuit-terminating Equipment

DTE Data Terminal Equipment

DTP Data Transfer Phase

ES End System

IS Intermediate System

ISDN Integrated Services Digital Network

NC Network Connection

NL Network Layer

NS Network Service

NSAP Network Service Access Point

OSI Open Systems Interconnection

PH Packet Handler

PDU Protocol Data Unit

PLP Packet Layer Protocol

PS Packet Switch

PSDN Packet Switched Data Network

PSTN Public Switched Telephone Network

STE Signalling Terminal

Note – The terms CSDN, ISDN and PSDN and PSTN, as used in this Recommendation, can denote either a public or a private network.

5 Principles and framework for describing the support of the OSI connection-mode network service

The OSI Network Service is the Service provided by the Network Layer to the Transport Layer at the boundary between the Network and Transport Layer of the OSI Reference Model as illustrated in Figure 1/X.610.

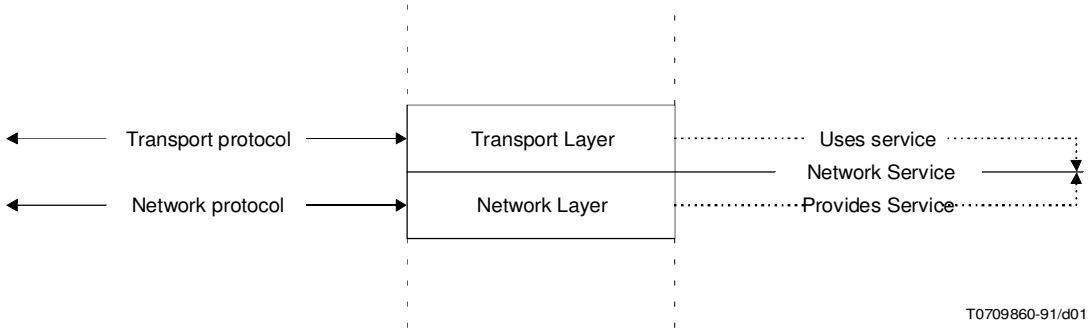


FIGURE 1/X.610

OSI Network Service

More specifically, the OSI Network Service is the service provided between NSAPs in two OSI end systems as illustrated in Figure 2/X.610.

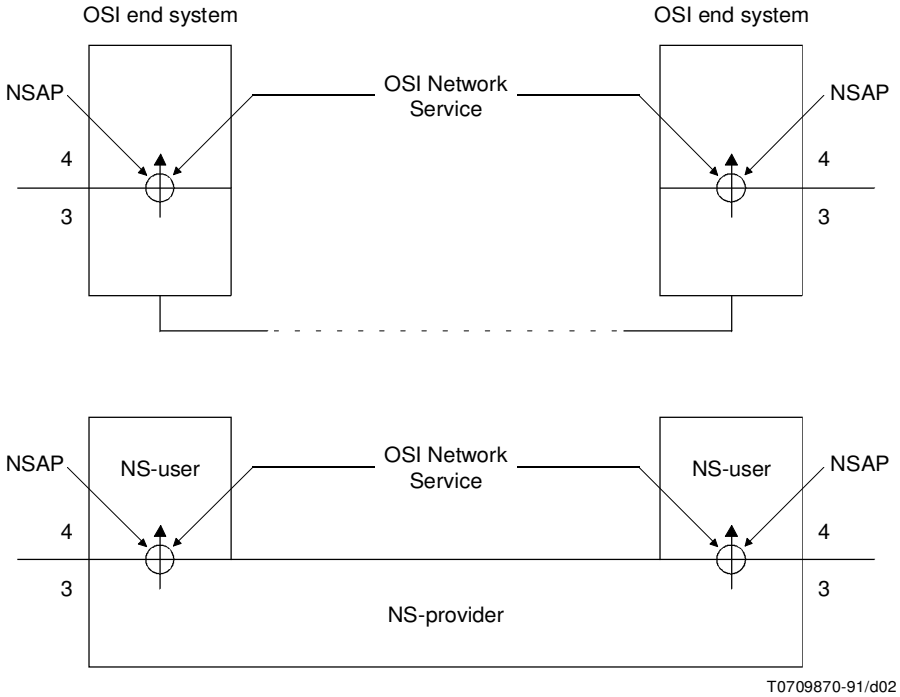
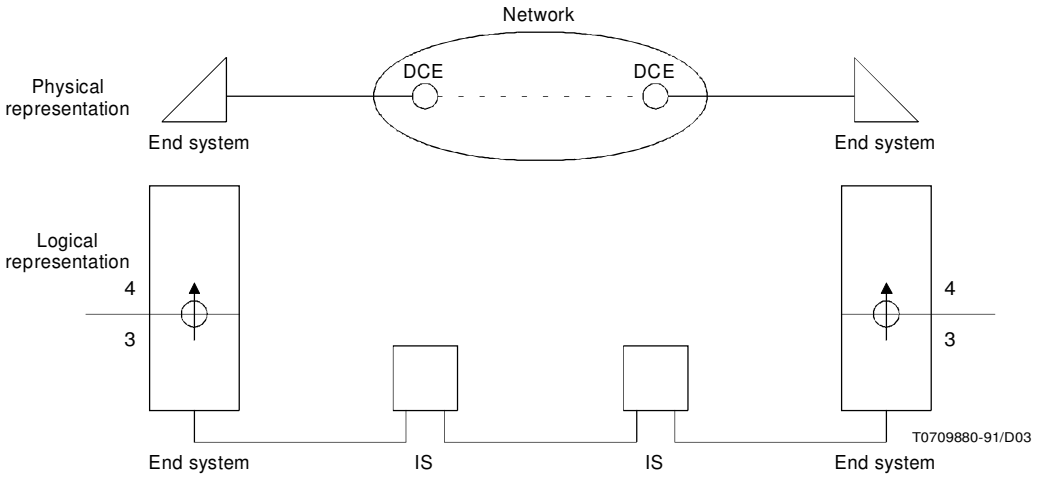


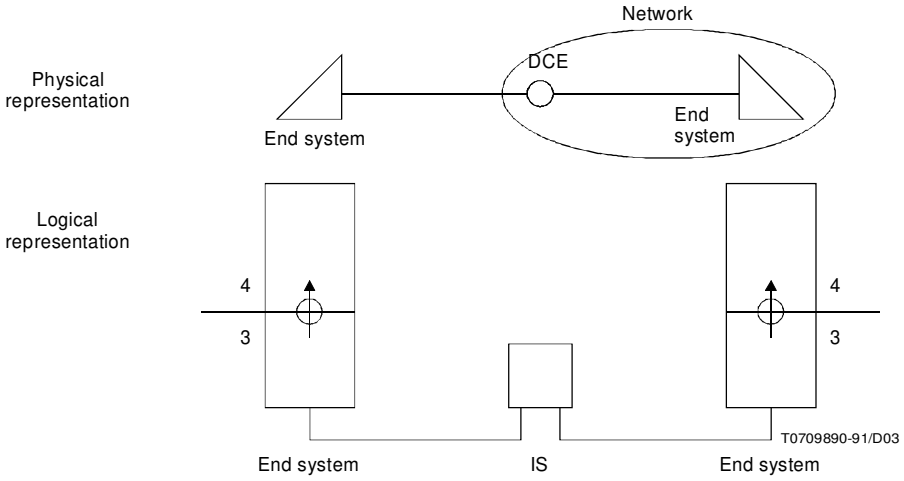
FIGURE 2/X.610

Provision of OSI Network Service

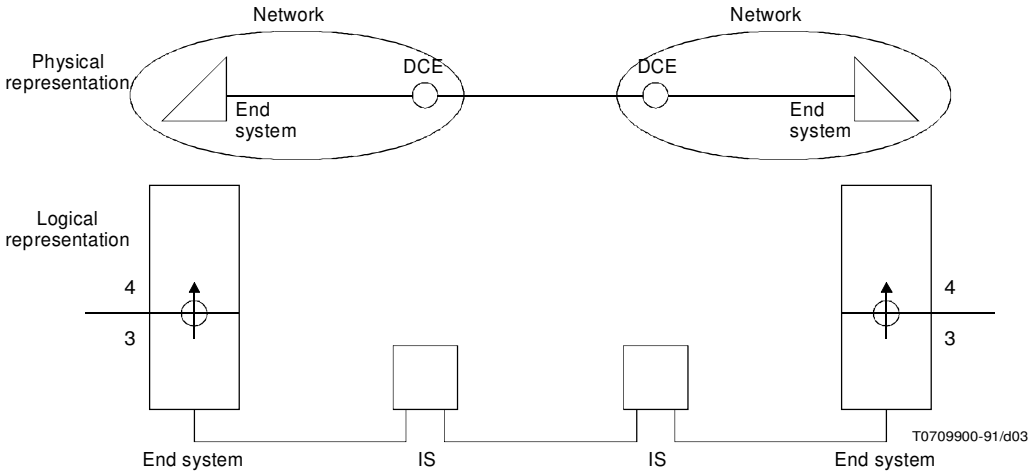
The OSI end systems may be either inside or outside a network as illustrated in Figure 3/X.610. This could be the situation, for example, for a MHS node.



a) End systems outside a network



b) End system inside and outside a network



c) End systems inside networks

FIGUR E 3/X.610

There are two types of OSI Network Service. This Recommendation is concerned with the support of the OSI Connection-mode Network Service (CONS).

The involvement of networks in support of CONS depends upon the particular situation as illustrated in Figure 4/X.610. In diagram a) of Figure 4/X.610, the network protocols are not involved in conveying the CONS semantics between the end systems. This conveyance is done by means of the X.25 PLP which is carried transparently by the CSDN. In diagram b) of Figure 4/X.610, the protocols of the CSDN are not involved but the protocols of the PSDN are involved. In diagram c) of Figure 4/X.610, the packet protocols of the ISDN and PSDN convey all the semantics of CONS and no additional protocol is needed.

Note – Recommendations X.25 and X.75 support the conveyance of all the semantics of CONS as inherent mandatory capabilities of the packet layer protocol. The non-support of these mandatory capabilities in actual implementations will result in inefficiencies since an additional convergence protocol will become necessary to make up for the non-support.

Where it is intended that network equipment (such as the packet switches shown in diagrams b) and c) of Figure 4/X.610 participate in the support of CONS, this equipment

a) must convey the semantics of CONS between the respective protocols (e.g. between X.25 protocol and the network internal protocol); and

b) if it operates on the semantics of one or more elements of the CONS (in contrast to just passing them transparently) then it must do so consistent with the procedures contained in Recommendation X.213.

These aspects are covered more fully in the X.300-Series Recommendations. In a way, the requirements of CONS can be viewed as a minimum set of connection-mode capabilities needed to support the OSI communications.

The OSI CONS specified in Recommendation X.213 consists of three phases:

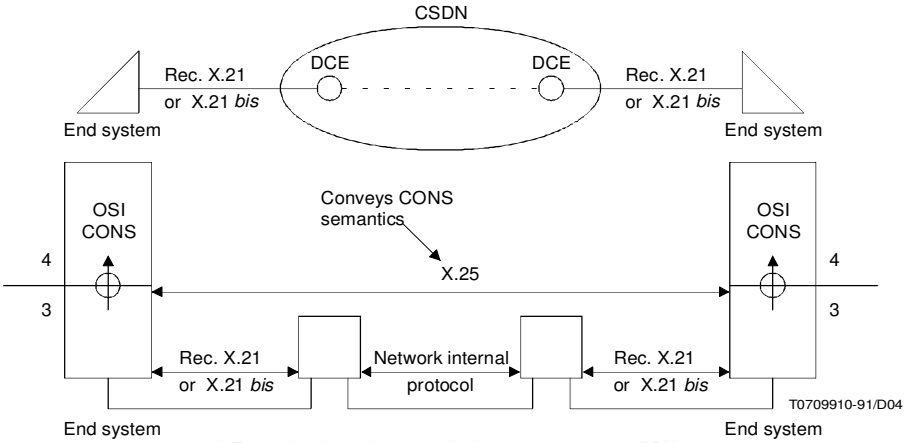
– Network Connection Establishment;

– Data Transfer; and

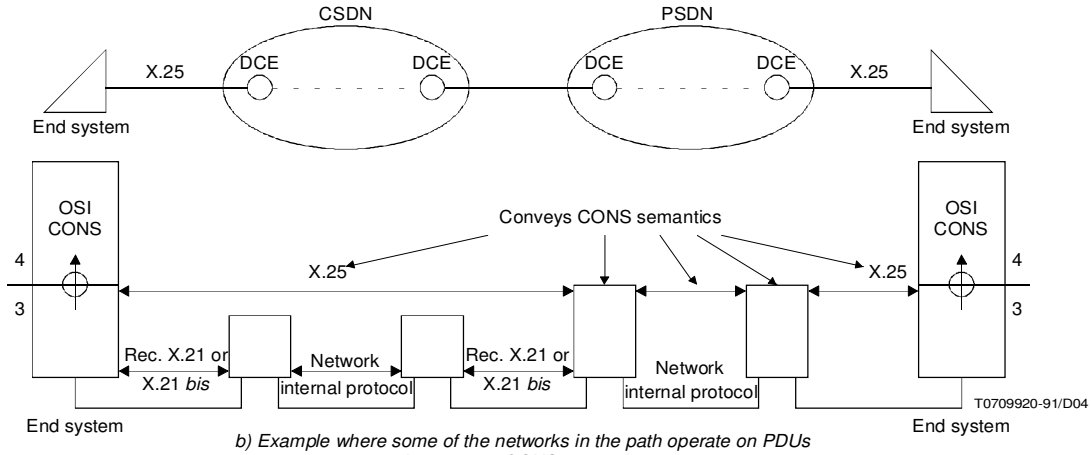
– Network Connection Release.

All three phases of CONS can be supported by a single Network Layer protocol (e.g. X.25 PLP). Alternatively, different phases of CONS can be supported by different protocols (e.g. the NC establishment and NC release phases could be supported by an augmented Q.931 protocol and the NC data transfer phase supported by X.25 DTP).

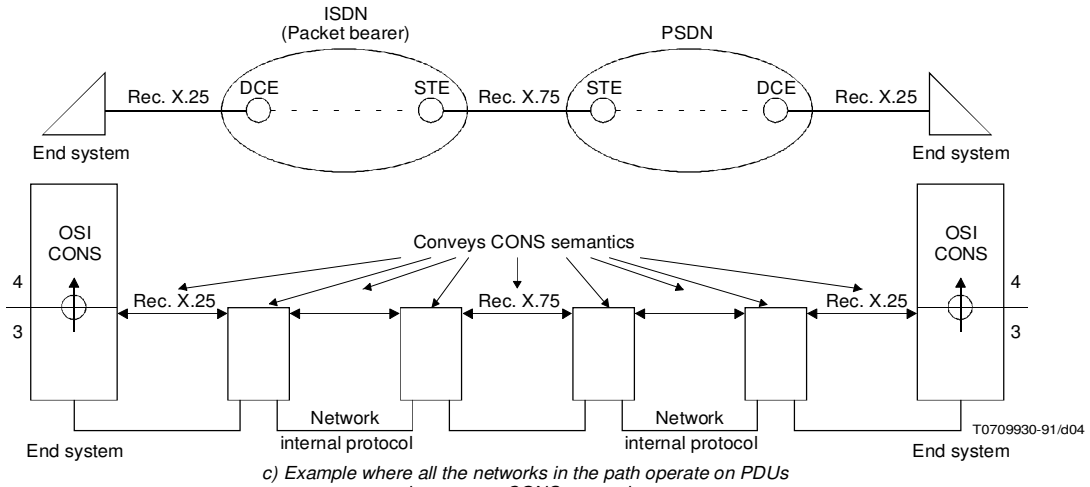
In order to support efficient data communications, future network designs should take into account the full support of the CONS NC establishment and NC release phases in the protocols used to establish network connections. This will avoid the need for two stage setup – one to setup the network connection and then another to setup the OSI NC over the network connection. Note that two-stage setup is necessary in the cases involving the use of a PSTN, CSDN or ISDN circuit switched connection. In these cases, the circuit switched connection is established first and then the OSI Network Connection is established over the circuit switched connection. This is necessary in the PSTN and CSDN cases since it is not practical to augment the network signalling protocols to support all the elements of the CONS NC establishment phase. In the ISDN case, it is necessary since Recommendation Q.931 presently lacks support for some of the elements of the CONS NC establishment phase.



a) Example where the network does not operate on PDUs that support CONS semantics



b) Example where some of the networks in the path operate on PDUs that support CONS semantics



c) Example where all the networks in the path operate on PDUs that support CONS semantics

FIGURE 4/X.610

Decoupling the protocol fields used to establish a circuit switched connection from the protocol fields used to establish OSI NCs may be desirable in order to permit traffic sharing of multiple NCs over the bandwidth provided by the circuit switched connection. Support of the CONS NCs by the X.25 PLP permits multiplexing of NCs over the underlying bandwidth in all environments.

6 Protocol combinations for the support of CONS

This section describes the provision and support of the Connection-mode Network Service in a unified fashion by identifying the protocol combinations to be used, and their applicability in various environments.

This description of the support of the OSI Connection-mode Network Service

a) recognizes that differences in the environments in which the Connection-mode Network Service is to be supported requires the use of different protocol combinations;

b) focuses on the use of a small set of protocol combinations; and

c) emphasizes the need to consider arrangements for interworking in the specification of how the Connection-mode Network Service is to be supported.

Emphasis has been placed on selecting protocol combinations for which interworking arrangements exist to support networking across various environments (see X.300-Series Recommendations).

The following subsections identify the environments which have been adopted for the support of CONS.

6.1 *Protocol combinations where CONS semantics are conveyed by the X.25 PLP*

Figure 5/X.610 and Table 1/X.610 provide an overview of the configurations where the virtual call service of the X.25 PLP is used to convey the semantics of the OSI CONS. Each configuration is further detailed in the following sections.

The protocol stacks for these 15 configurations are identical to the ones adopted by ISO/IEC in their International Standard ISO/IEC 8880-2, including its two addenda. This should enable widespread communications.

Note – The following scenarios are for further study:

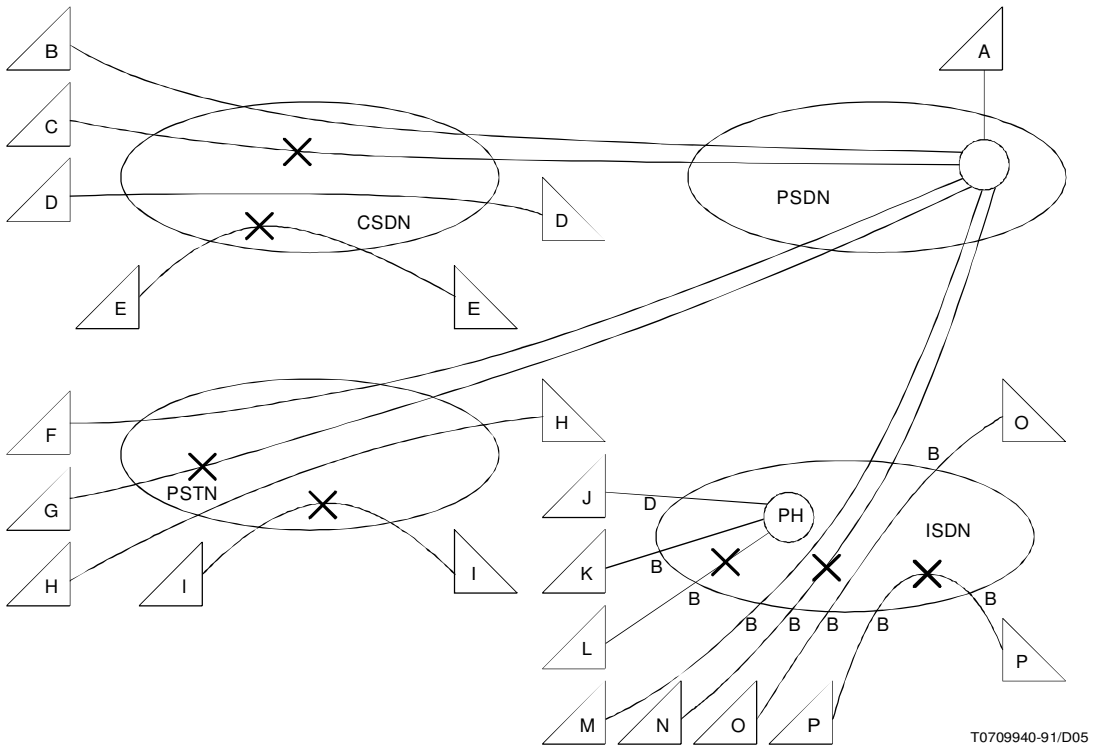
1) any additions, if appropriate, for interworking of circuit switched networks (see Figure 2 of Recommendation X.321);

2) application to ISDN R reference points;

3) inclusion of ISDN H-channels; and

4) inclusion of ISDN frame relay.

The other Recommendations in the X.610-Series Recommendations apply to specific environments; they further elaborate on the protocol combinations and the protocol elements that are applicable in each of these environments to provide the OSI Connection-mode Network Service. This does not preclude the use of the other protocol combinations, rather it ensures that a common basis for communication exists where systems claim to support the OSI Connection-mode Network Service in a particular environment.



Circuit switched (or demand) connection

End system

PH Packet handler
PS Packet switch

FIGURE 5/X.610

Configurations for which the support of the OSI CONS is defined

TABLE 1/X.610

Configurations supporting the OSI CONS

Figure 5/X.610 designation	ISO TR 10000 subnetwork designation	Description	Subclause
B or A	1121	CSDN leased line or digital data circuit access to PSDN	6.1.1
C	1221	CSDN switched access to PSDN	6.1.2
D	21	CSDN leased line connection	6.1.3
E	22	CSDN switched connection	6.1.4
F	1111	PSTN leased line access to PSDN	6.1.5
G	1211	PSTN switched access to PSDN	6.1.6
H	31	PSTN leased line connection	6.1.7
I	32	PSTN switched connection	6.1.8
J	4311	ISDN D-channel access to ISDN PH	6.1.9
K	4321	ISDN B-channel semi-permanent access to ISDN PH	6.1.10
L	4331	ISDN B-channel demand access to ISDN PH	6.1.11
M	1131	ISDN B channel semi-permanent access to PSDN	6.1.12
N	1231	ISDN B channel demand access to PSDN	6.1.13
O	4111	ISDN B channel semi-permanent connection	6.1.14
P	4211	ISDN B channel demand connection	6.1.15

6.1.1 *CSDN leased line or digital data circuit access to PSDN*

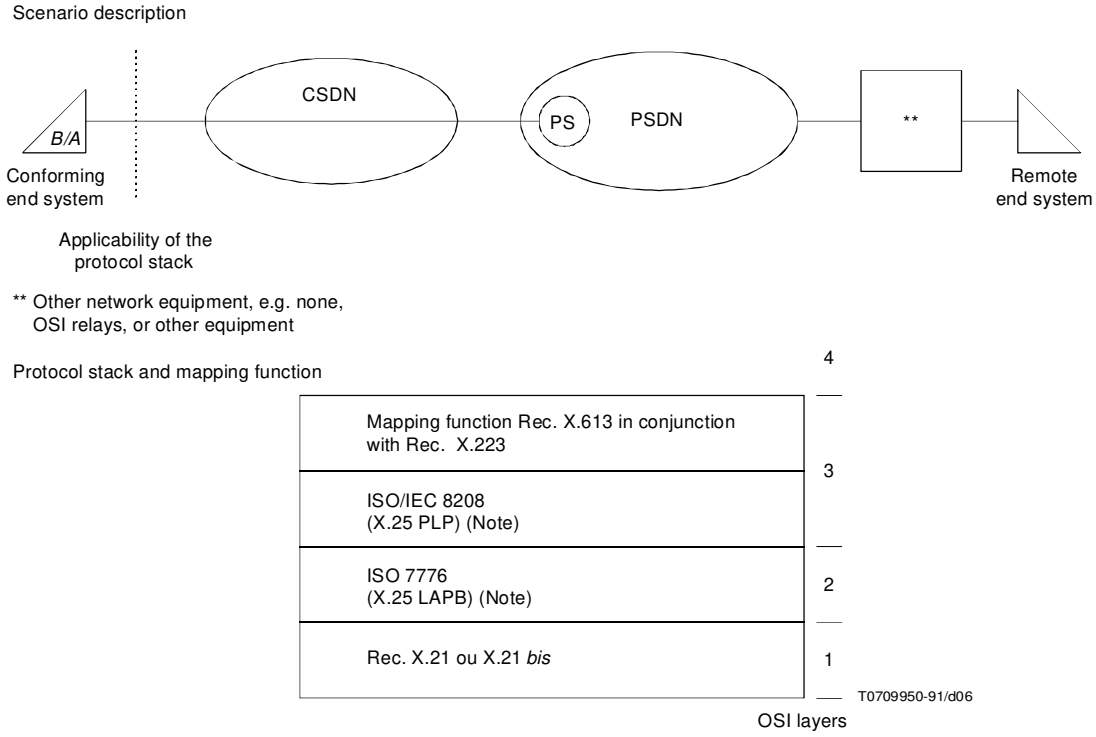
This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

This configuration is applicable at the point where a conforming end system is either

i) connected to a CSDN and accesses the PSDN over a CSDN leased line; or

ii) directly connected to a PSDN via a digital data circuit.

The scenario illustrates a remote end system which is accessed via the PSDN; it is either connected directly to the same PSDN or indirectly connected through equipment such as OSI relays and other subnetworks, whose existence and operation is not significant to this protocol stack.



Note – Operates in the DTE/DCE mode.

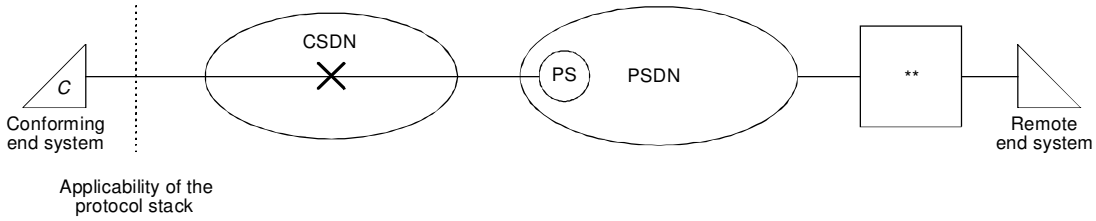
6.1.2 *CSDN switched access to PSDN*

This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

This configuration is applicable at the point where a conforming end system is connected to a CSDN and accesses the PSDN over a CSDN circuit-switched connection.

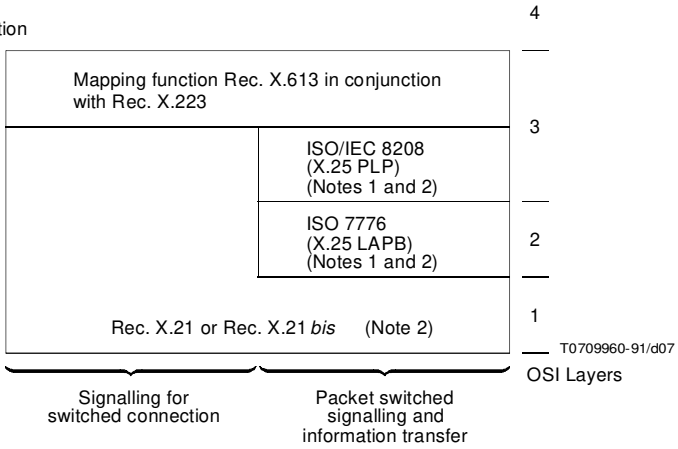
The scenario illustrates a remote end system which is accessed via the PSDN; it is either connected directly to the same PSDN or indirectly connected through equipment such as OSI relays and other subnetworks, whose existence and operation is not significant to this protocol stack.

Scenario description



** Other network equipment, e.g., none, OSI relays, or other equipment

Protocol stack and mapping function

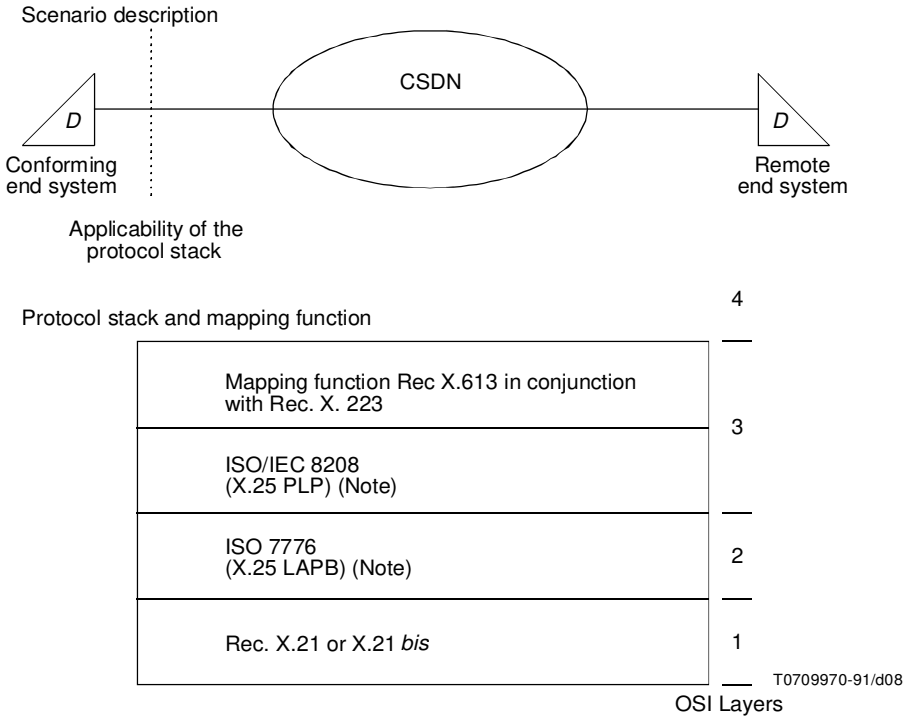


Note 1 – Operates in the DTE/DCE mode.
Note 2 – In addition, X.32 identification procedures may apply.

6.1.3 *CSDN leased line connection*

This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

This configuration is applicable at the point where a conforming end system is connected to a CSDN and communicates with the remote end system over a CSDN leased line.

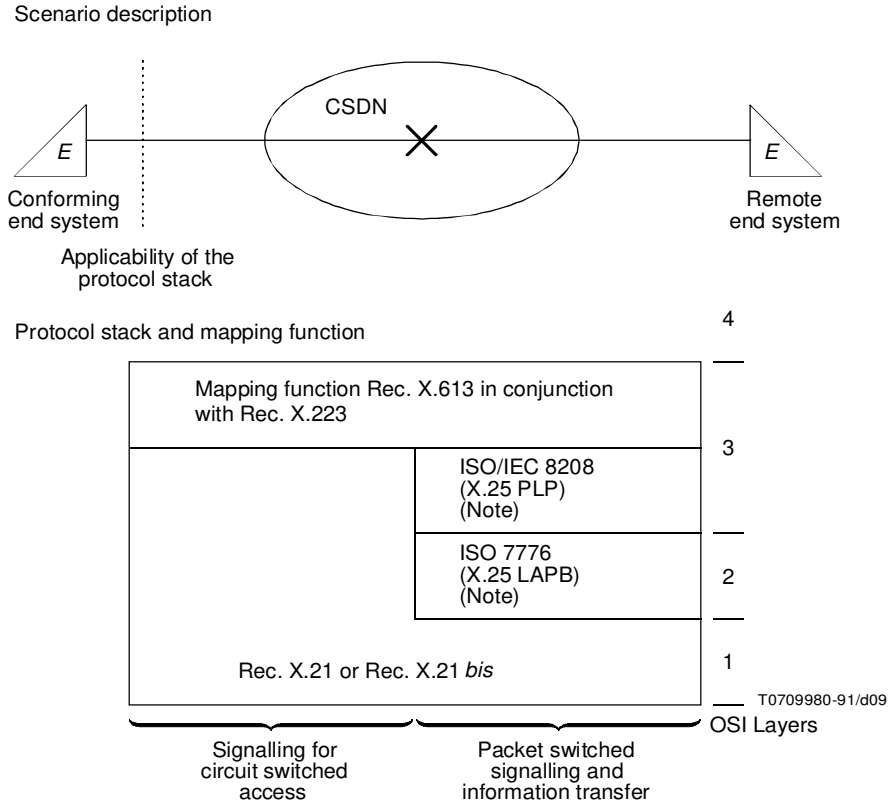


Note – Operates in the DTE/DTE mode.

6.1.4 *ISDN switched connection*

This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

This configuration is applicable at the point where a conforming end system is connected to a CSDN and communicates with the remote end system over a CSDN switched connections



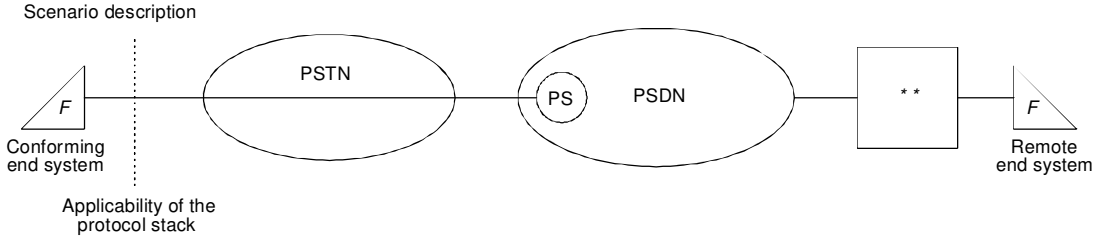
Note 1 – Operates in the DTE/DTE mode.

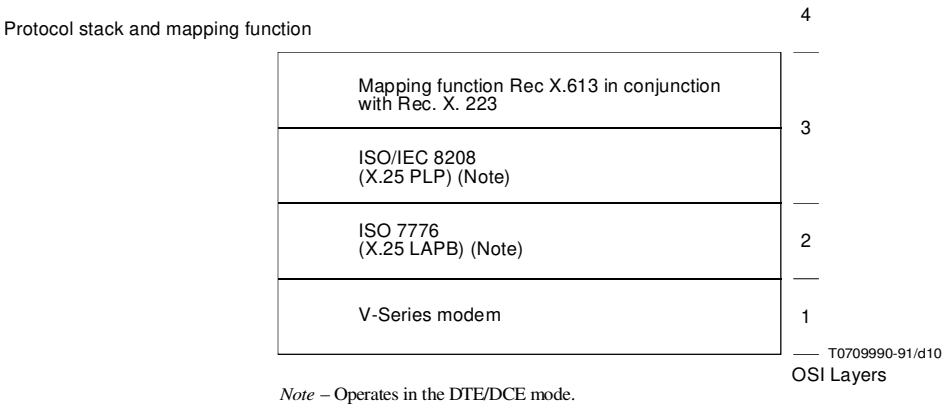
6.1.5 *PSTN leased line access to PSDN*

This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

This configuration is applicable at the point where a conforming end system is connected to a PSTN and accesses the PSDN over a PSTN leased line.

The scenario illustrates a remote end system which is accessed via the PSDN; it is either connected directly to the same PSDN or indirectly connected through equipment such as OSI relays and other subnetworks, whose existence and operation is not significant to this protocol stack.





Note – Operates in the DTE/DCE mode.

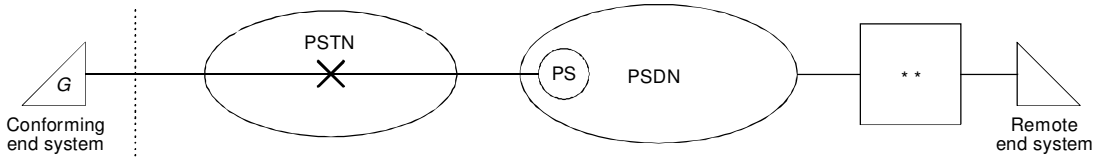
6.1.6 *PSTN switched access to PSDN*

This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

This configuration is applicable at the point where a conforming end system is connected to a PSTN and accesses the PSDN over a switched PSTN connection.

The scenario illustrates a remote end system which is accessed via the PSDN; it is either connected directly to the same PSDN or indirectly connected through equipment such as OSI relays and other subnetworks, whose existence and operation is not significant to this protocol stack.

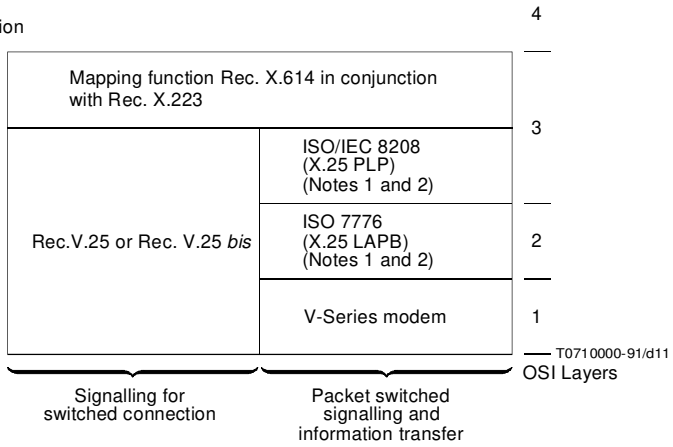
Scenario description



Applicability of the
protocol stack

** Other network equipment, e.g., none,
OSI relays, or other equipment

Protocol stack and mapping function

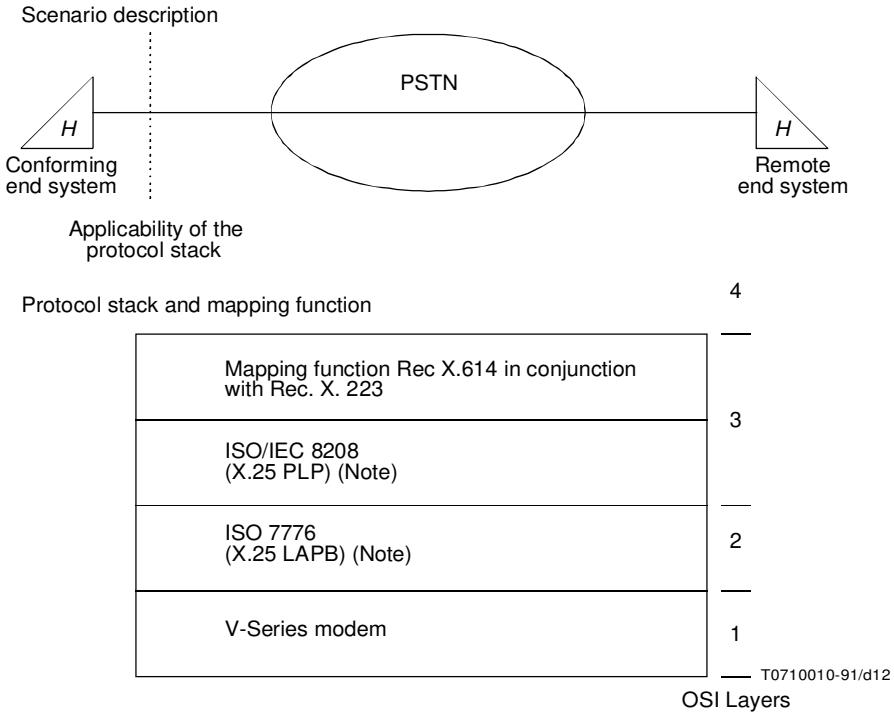


Note 1 – Operates in the DTE/DCE mode.
Note 2 – In addition, X.32 identification procedures may apply.

6.1.7 *PSTN leased line connection*

This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

This configuration is applicable at the point where a conforming end system is connected to a PSTN and communicates with the remote end system over a PSTN leased line.

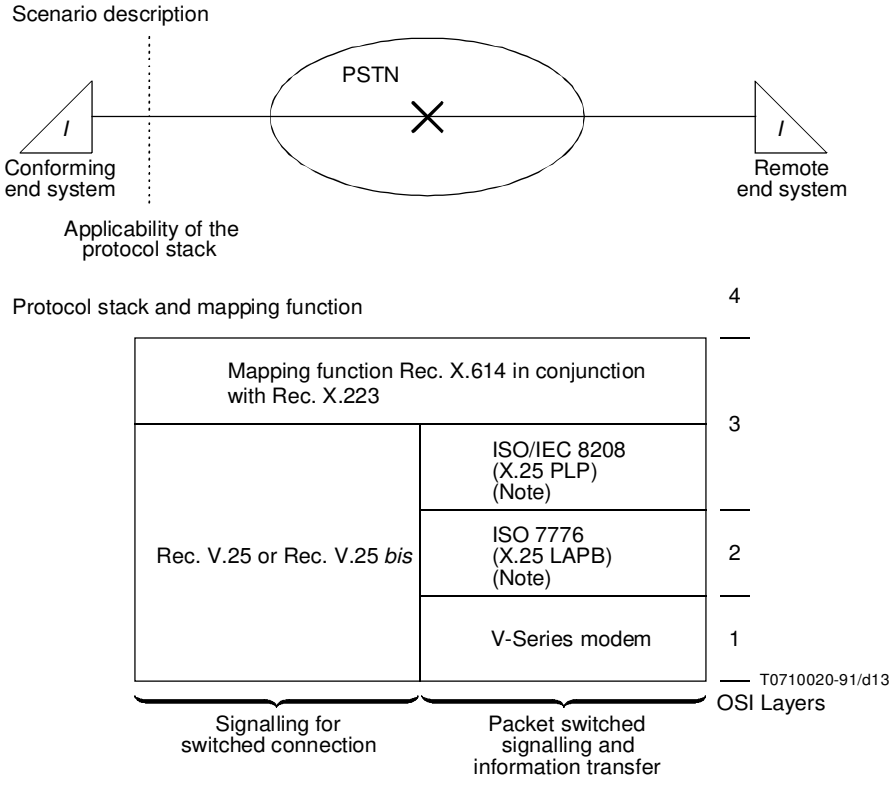


Note – Operates in the DTE/DTE mode.

6.1.8 *PSTN switched connection*

This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

This configuration is applicable at the point where a conforming end system is connected to a PSTN and communicates with the remote end system over a PSTN switched connection.



Note – Operates in the DTE/DTE mode.

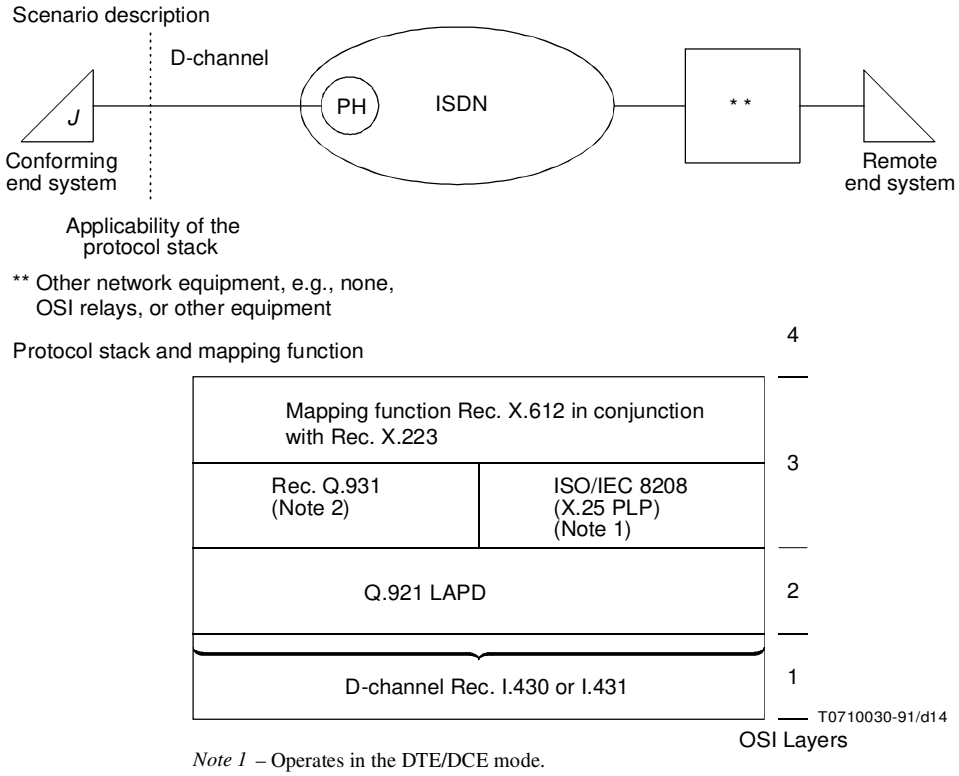
6.1.9 *ISDN D-channel access to ISDN packet handler*

This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

This configuration is applicable at the point where a conforming end system is connected to an ISDN and accesses the packet handling (PH) function of the ISDN over a D-channel.

In the case of subscribing to either the conditional notification class or the unconditional notification class, the Q.931 procedures for call offering are applicable. In the case of subscribing to the no notification class, the Q.931 procedures are not applicable.

The scenario illustrates a remote end system which is accessed via the ISDN; it is either connected directly to the same ISDN or indirectly connected through equipment such as OSI relays and other subnetworks, whose existence and operation is not significant to this protocol stack.



Note 1 – Operates in the DTE/DCE mode.
Note 2 – Not applicable for the case of no notification class.

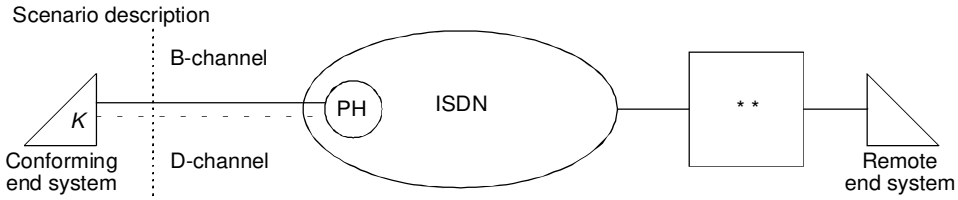
6.1.10 *ISDN B-channel semi-permanent access to ISDN packet handler*

This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

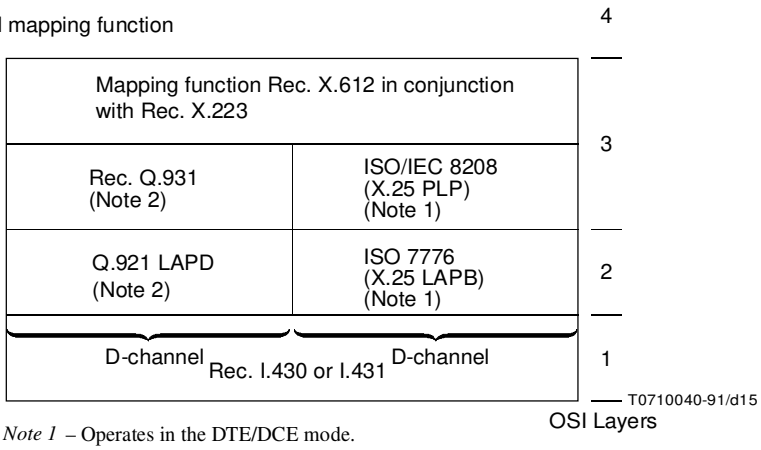
This configuration is applicable at the point where a conforming end system is connected to an ISDN and accesses the packet handling (PH) function of the ISDN over a B-channel which is semi-permanently connected the PH.

In the case of subscribing to either the conditional notification class or the unconditional notification class, the D-channel procedures for call offering are applicable. In the case of subscribing to the no notification class, the D-channel is not applicable.

The scenario illustrates a remote end system which is accessed via the ISDN; it is either connected directly to the same ISDN or indirectly connected through equipment such as OSI relays and other subnetworks, whose existence and operation is not significant to this protocol stack.



Protocol stack and mapping function



Note 1 – Operates in the DTE/DCE mode.
Note 2 – Not applicable for the case of no notification class.

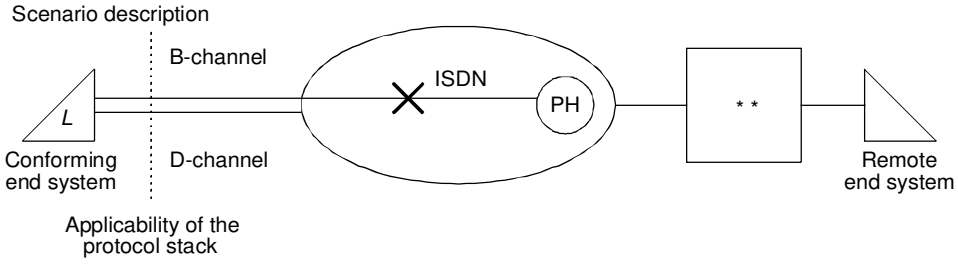
6.1.11 *ISDN B-channel demand access to ISDN packet handler*

This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

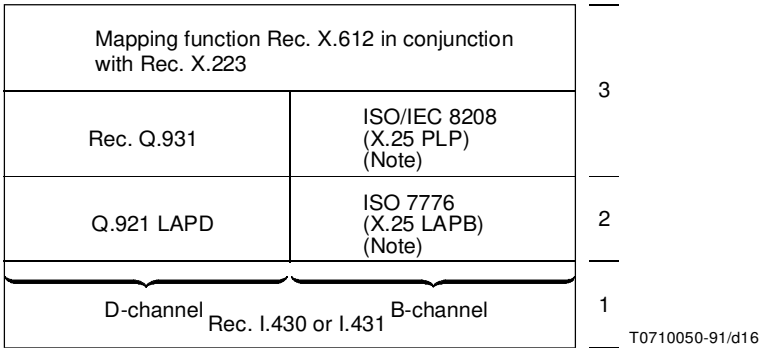
This configuration is applicable at the point where a conforming end system is connected to an ISDN and accesses the packet handling (PH) function of the ISDN over a demand access (i.e. circuit switched) B-channel.

In the case of subscribing to either the conditional notification class or the unconditional notification class, the Q.931 procedures are also used for call offering.

The scenario illustrates a remote end system which is accessed via the ISDN; it is either connected directly to the same ISDN or indirectly connected through equipment such as OSI relays and other subnetworks, whose existence and operation is not significant to this protocol stack.



Protocol stack and mapping function



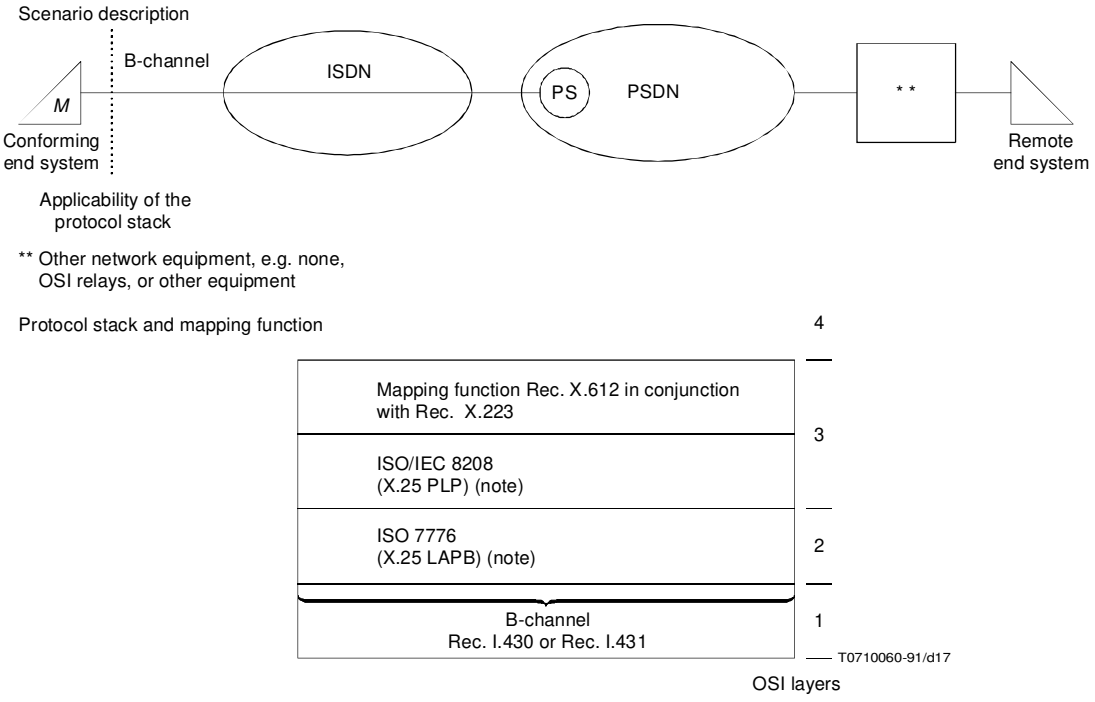
Note – Operates in the DTE/DCE mode.

6.1.12 *ISDN B-channel semi-permanent access to PSDN*

This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

This configuration is applicable at the point where a conforming end system is connected to an ISDN and uses a semi-permanent B-channel connection to access a packet handling (PH) function in a PSDN.

The scenario illustrates a remote end system which is accessed via the PSDN; it is either connected directly to the same PSDN or indirectly connected through equipment such as OSI relays and other subnetworks, whose existence and operation is not significant to this protocol stack.



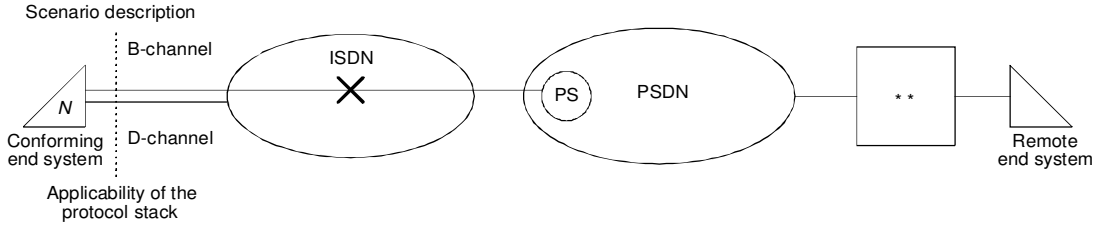
Note – Operates in the DTE/DCE mode.

6.1.13 *ISDN B-channel demand access to PSDN*

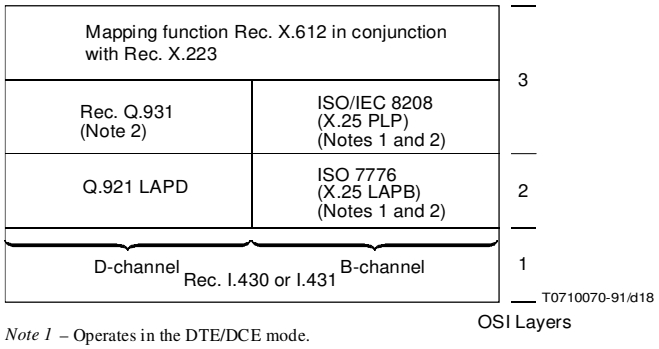
This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

This configuration is applicable at the point where a conforming end system is connected to an ISDN and accesses the PSDN over a demand access (i.e. circuit switched) B-channel.

The scenario illustrates a remote end system which is accessed via the PSDN; it is either connected directly to the same PSDN or indirectly connected through equipment such as OSI relays and other subnetworks, whose existence and operation is not significant to this protocol stack.



Protocol stack and mapping function

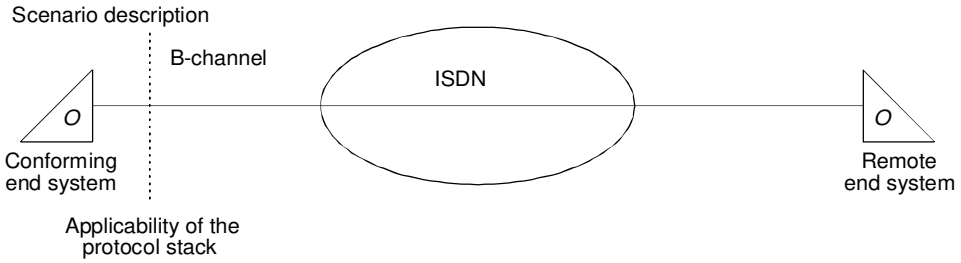


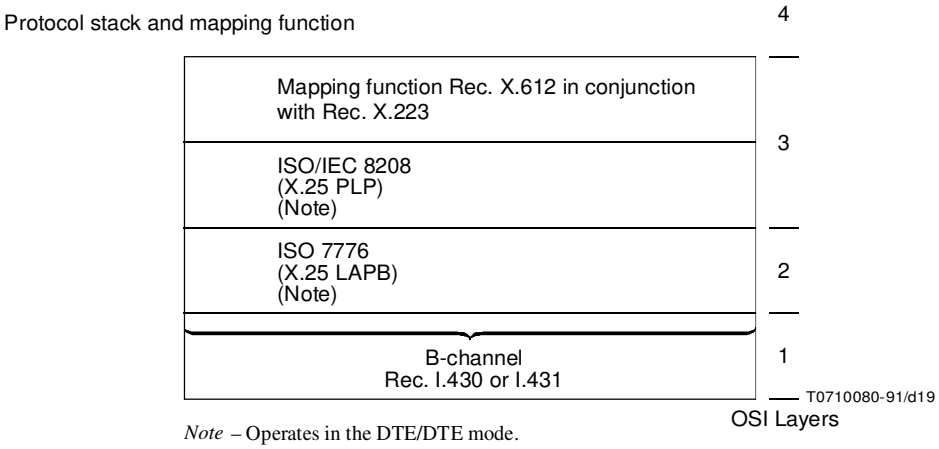
Note 1 – Operates in the DTE/DCE mode.
Note 2 – In addition, X.32 identification procedures may apply.

6.1.14 *ISDN B-channel semi-permanent connection*

This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

This configuration is applicable at the point where a conforming end system is connected to an ISDN communicates with the remote end system over a semi-permanent B-channel connection.



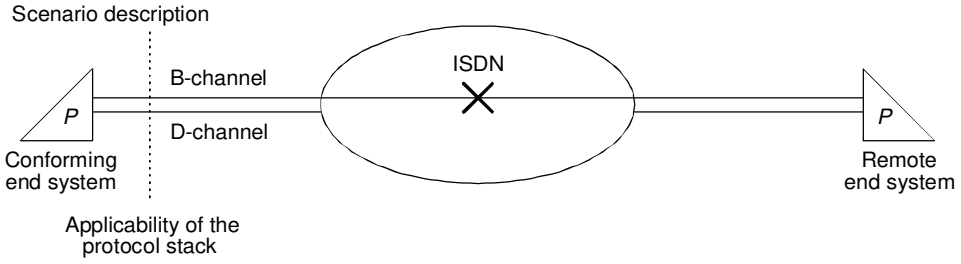


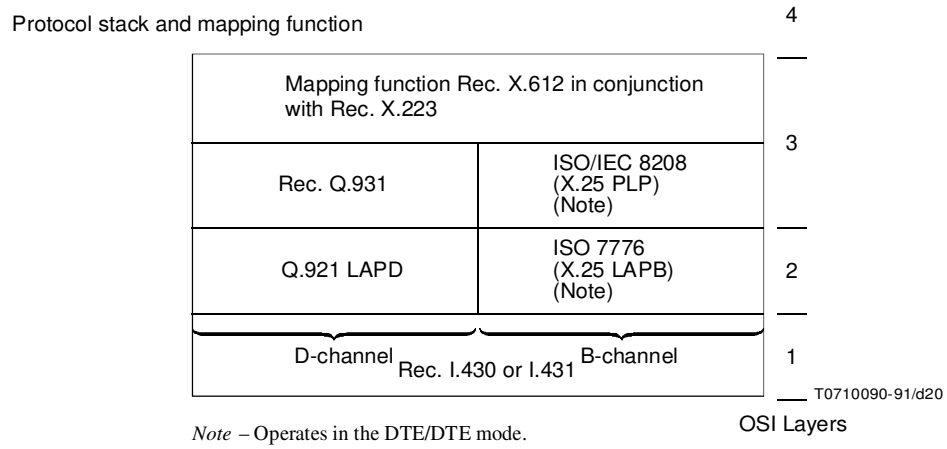
Note – Operates in the DTE/DTE mode.

6.1.15 *ISDN B-channel demand connection*

This configuration uses the virtual call service of the X.25 PLP to convey the semantics of the OSI CONS.

This configuration is applicable at the point where a conforming end system is connected to an ISDN and communicates with the remote end system over a demand (i.e. circuit switched) B-channel connections





Note – Operates in the DTE/DTE mode.