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Information technology — Use of X.25 Packet Layer Protocol in conjunction with X.21/X.21 bis to provide the OSI connection-mode Network Service

Technologies de l'information— Utilisation du protocole X.25 *de couche de paquet conjointement avec* X.21/X.21 bis *pour fournir le service de réseau OSI en mode connexion*

Reference number
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Contents

	Page
1 Scope	1
2 Normative references	1
3 Definitions	2
4 Abbreviations	3
5 Overview	4
6 Control of underlying connections	5
7 Data link layer	8
8 Packet layer	8
Annexes	
A X.30 Terminal Adaptors for ISDN	10
B Bibliography	11

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Foreword

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In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 10588 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in collaboration with the CCITT. The identical text is published as CCITT Recommendation X.613.

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INTERNATIONAL STANDARD

CCITT RECOMMENDATION

INFORMATION TECHNOLOGY – USE OF X.25 PACKET LAYER PROTOCOL IN CONJUNCTION WITH X.21/X.21 *bis* TO PROVIDE THE OSI CONNECTION-MODE NETWORK SERVICE

1 Scope

This CCITT Recommendation | International Standard is applicable to the environments where Recommendation X.21 or X.21 *bis* is used and where the X.25 packet layer protocol (PLP), as standardized in ISO/IEC 8208, is operated during the X.21/X.21 *bis* data phase to provide the OSI Connection-mode Network Service (CONS). These environments include a CSDN and an ISDN Terminal Adaptor complying with Recommendation X.30 which provides an X.21 access. The X.25 PLP operates either in the DTE/DTE or DTE/DCE mode.

This provision is achieved by specifying the mapping of the CONS primitives and parameters to and from the elements of the protocols used (i.e. X.25 PLP and X.21).

2 Normative references

The following CCITT Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The CCITT Secretariat maintains a list of the currently valid CCITT Recommendations.

2.1 Identical Recommendations | International Standards

- CCITT Recommendation X.213 (1992) | ISO/IEC 8348:1993, *Information technology – Network service definition for Open Systems Interconnection*

2.2 Paired Recommendations | International Standards equivalent in technical content

- CCITT Recommendation X.200 (1988), *Reference Model of Open Systems Interconnection for CCITT Applications.*

  ISO 7498:1984, *Information processing systems – Open Systems Interconnection – Basic Reference Model.*

- CCITT Recommendation X.210 (1988), *Open Systems Interconnection Layer Service Definition Conventions.*

  ISO/TR 8509:1987, *Information processing systems – Open Systems Interconnection – Service conventions.*

- CCITT Recommendation X.223 (1988), *Use of X.25 to provide the OSI Connection-Mode Network Service for CCITT applications.*

  ISO 8878:1987, *Information processing systems – Data Communications – Use of X.25 to provide the OSI Connection-Mode Network Service.*

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2.3 Additional references

- CCITT Recommendation X.2 (1988), *International data transmission services and optional user facilities in public data networks and ISDNs.*
- CCITT Recommendation X.21 (1992), *Interface between data terminal equipment and data circuit-terminating equipment for synchronous operation on public data networks.*
- CCITT Recommendation X.21 *bis* (1988), *Use on public data networks of data terminal equipment (DTE) which is designed for interfacing to synchronous V-Series modems.*
- CCITT Recommendation X.25 (1988), *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.*
- CCITT Recommendation X.30 (1988), *Support of X.21, X.21 bis and X.20 bis based data terminal equipments (DTEs) by an integrated services digital network (ISDN).*
- CCITT Recommendation X.31 (1988), *Support of packet mode terminal equipment by an ISDN.*
- CCITT Recommendation X.32 (1988), *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.*
- ISO 7776:1986, *Information processing systems – Data communication – High-level data link control procedures - Description of the X.25 LAPB-compatible DTE data link procedures.*
- ISO/IEC 8208:1990, *Information technology – Data communications – X.25 Packet Layer Protocol for Data Terminal Equipment.*

3 Definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

3.1 Reference model definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Recommendation X.200 | ISO 7498:

a) Network Connection;

b) Network Layer;

c) Network Service.

3.2 Service conventions definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Recommendation X.210 | ISO/TR 8509:

a) Network Service provider;

b) Network Service user.

3.3 Network Service definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Recommendation X.213 | ISO/IEC 8348:

a) N-CONNECT request;

b) N-DISCONNECT indication.

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3.4 X.25 definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Recommendation X.25 and ISO/IEC 8208:

a) Data circuit-terminating equipment;

b) Data terminal equipment;

c) Registration packet;

d) Virtual call.

3.5 X.21 definitions

This Recommendation | International Standard makes use of the following term defined in CCITT Recommendation X.21:

Call progress signal.

3.6 ISDN definitions

This Recommendation | International Standard makes use of the following term defined in CCITT Recommendation X.31:

Terminal adaptor.

4 Abbreviations

4.1 Reference model abbreviations

NL	Network Layer
NS	Network Service
OSI	Open Systems Interconnection

4.2 Network service abbreviations

CONS	Connection-mode Network Service
NSAP	Network service access point
QOS	Quality of service
SNPA	Subnetwork point of attachment

4.3 X.25 abbreviations

DCE	Data circuit-terminating equipment
DTE	Data terminal equipment
HIC	Highest incoming channel
HOC	Highest outgoing channel
HTC	Highest two-way channel
LAPB	Link access procedure – balanced
LIC	Lowest incoming channel
LOC	Lowest outgoing channel
LTC	Lowest two-way channel
PLP	Packet layer protocol

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4.4 ISDN abbreviations

ISDN	Integrated services digital network
IWF	Interworking function
TA	Terminal adaptor
TE	Terminal equipment

4.5 Other abbreviations

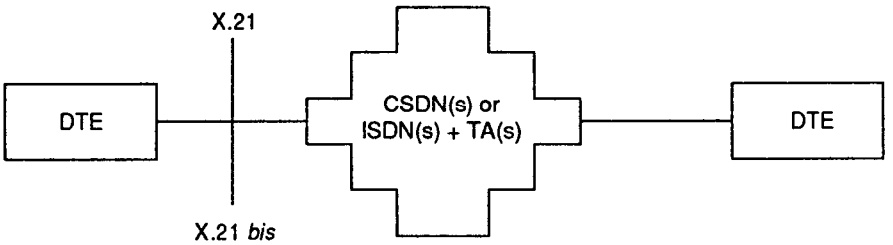
CSDN	Circuit switched data network (public or private)
PSDN	Packet switched data network (public or private)

5 Overview

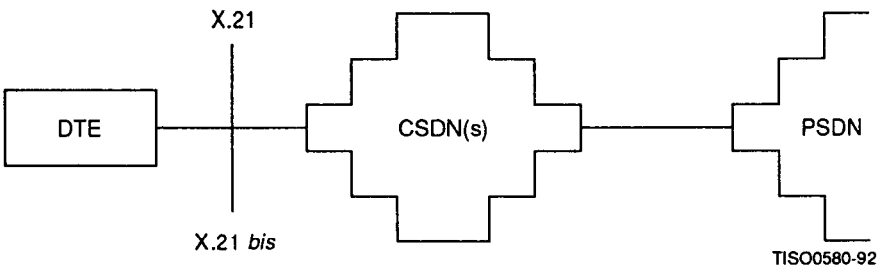
There are two basic configurations where the X.25 packet layer protocol (PLP), as standardized in ISO/IEC 8208, may be operated over an X.21 connection to provide the OSI Connection-mode Network Service (CONS) defined in CCITT Rec. X.213 | ISO/IEC 8348.

The first configuration is shown in Figure 1a) where two X.25 DTEs are directly connected by one or more concatenated CSDNs, or by one or more ISDNs and one or two X.30 TAs (see Annex B). In this case each DTE operates the DTE/DTE mode of ISO/IEC 8208 (X.25 PLP) and ISO 7776 (X.25 LAPB). The connection may be permanent or switched.

The second configuration is shown in Figure 1b) where an X.25 DTE access a PSDN. In this case the DTE operates the DTE/DCE mode of ISO/IEC 8208 (X.25 PLP) and ISO 7776 (X.25 LAPB). When the connection is permanent this configuration is a regular X.25 scenario, while it relates to X.32 and X.31 when the connection is switched.



a) Configuration for DTE-TO-DTE operation



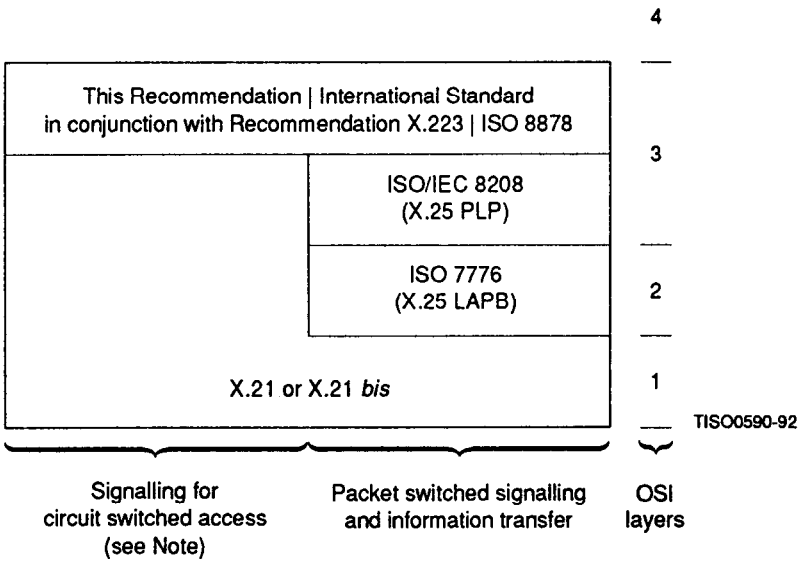
b) Configuration for DTE-TO-PSDN operation

Figure 1 – Configurations

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CCITT Rec. X.223 | ISO 8878 specifies the method for providing the OSI Connection-mode Network Service (CONS) through the use of the X.25 PLP directly connected to another DTE or directly connected to a packet switched data network. When a circuit switched (semi-permanent, hot line, or full circuit switched) connection is introduced into the path between the DTEs or between the DTE and a PSDN, a few provisions additional to those contained in CCITT Rec. X.223 | ISO 8878 are necessary. These additional provisions for a DTE connected to a CSDN, or to an ISDN via a TA, are specified by this Recommendation | International Standard.

The applicable protocol stack is given in Figure 2. The X.25 PLP is used to convey all elements of all three phases of the OSI CONS. CCITT Rec. X.223 | ISO 8878 applies with regard to the mapping of the CONS primitives and parameters to the elements of the X.25 PLP. However, in certain cases discussed in the clauses below, additional provisions apply before these mappings can take place (e.g., to cover establishment of a circuit switched connection) or in addition to these mappings (e.g., to cover an unexpected disconnection of the circuit switched connection).



NOTE – These procedures are not used in the leased circuit case.

Figure 2 – Protocol stack

At the physical layer (and for signalling for a circuit switched connection), either X.21 or X.21 *bis* may be used.

At the data link layer ISO 7776, as constrained by clause 7 of this Recommendation | International Standard, is used.

At the network layer ISO/IEC 8208, as constrained by clause 8 of this Recommendation | International Standard, is used.

The mapping of the elements of the CONS to the protocol and procedures of ISO/IEC 8208 shall be as required by CCITT Rec. X.223 | ISO 8878. The remaining clauses of this Recommendation | International Standard specify the provisions required in addition to these mappings.

6 Control of underlying connections

The following clauses cover the two types of underlying connections that can be operated : leased circuit connection, and circuit switched connection including direct call.

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6.1 Leased circuit connection

Both the X.21 and X.21 *bis* interfaces provide for a leased circuit connection.

No additional procedures are required.

6.2 Circuit switched connection (including direct call)

Both the X.21 and X.21 *bis* interfaces provide for a circuit switched connection.

6.2.1 Circuit switched connection originated by DTE

The following additional procedure shall be used if a circuit switched connection is not already established or if an additional circuit switched connection is needed to support the additional traffic.

The receipt by layer 3 of an N-CONNECT request primitive shall first cause the X.21 or X.21 *bis* procedures to be used to establish the connection. Following the successful establishment of this connection and the X.21 or X.21 bis procedures for entering the data transfer phase at layer 1, the ISO 7776 and ISO/IEC 8208 procedures shall apply as constrained by clauses 7 and 8 of this Recommendation | International Standard.

Failure to establish the connection is indicated to the NS user by means of a N-DISCONNECT indication primitive with the originator parameter indicating "NS provider" and the reason parameter as given in Table 1.

Table 1 – Mapping of the X.21 call progress signals associated with clearing to the CONS Reasons

X.21 code	CONS Reason parameter
20	Connection rejection-NSAP unreachable/transient
21	Connection rejection-reason unspecified/transient
22	Connection rejection-reason unspecified/transient
23	Connection rejection-reason unspecified/transient
41	Connection rejection-reason unspecified/permanent
42	Connection rejection-reason unspecified/permanent
43	Connection rejection-NSAP unreachable/permanent
44	Connection rejection-reason unspecified/permanent
45	Connection rejection-reason unspecified/permanent
46	Connection rejection-reason unspecified/permanent
47	Disconnection/permanent
48	Connection rejection-reason unspecified/permanent
49	Connection rejection-reason unspecified/permanent
51	Connection rejection-reason unspecified/permanent
52	Connection rejection-reason unspecified/permanent
61	Connection rejection-reason unspecified/transient
71	Connection rejection-reason unspecified/permanent
72	Connection rejection-reason unspecified/permanent
NOTES 1 For all the above X.21 codes, the CONS Originator parameter indicates "NS provider". 2 X.21 codes not shown are either unassigned or not applicable.	

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6.2.2 Circuit switched connection originated toward DTE

The X.21 or X.21 *bis* procedures need to be in the layer 1 "ready" state in order to enable a connection to be established towards the DTE. Once this connection is established and the X.21 or X.21 *bis* procedures have entered the data transfer phase at layer 1, the ISO 7776 and ISO/IEC 8208 procedures shall apply as constrained by clauses 7 and 8 of this Recommendation | International Standard.

6.2.3 Disconnection of the circuit switched connection

If one or more OSI Network Connections are established or in the process of being established on an established circuit switched connection and this circuit switched connection is disconnected or has failed (e.g., a failure occurred and a recovery might have been attempted but was not possible), then the provisions of ISO/IEC 8208 and CCITT Rec. X.223 | ISO 8878 concerning the failure of layer 1 apply to the mapping to an N-DISCONNECT indication primitive for each OSI Network Connection established or in the process of being established.

As a local matter, the system may attempt to reestablish the connection. If this attempt is successful, the NS-user is not made aware of the original loss of the circuit.

Note that care must be exercised to ensure that the circuit is reestablished to the same system.

It is a local matter as to under what conditions a DTE would initiate a disconnection, via X.21 or X.21 *bis* procedures, of the circuit switched connection (e.g., upon clearing of the last virtual call).

It is also a local matter whether the data link connection is released prior to the release of the physical circuit switched connection.

6.2.4 Identification

When establishing a circuit switched connection, it may be necessary to exchange identification information for various reasons (e.g., for billing or security purposes). The need for, and method(s) of, identification exchange will, in general, be known *a priori* and depend on the mode of operation.

For the mode of operation where a circuit switched connection is used to connect two DTEs directly, there are three cases governing the need for identification exchange:

a) no exchange is ever needed between the two DTEs;

b) an exchange is always needed between the two DTEs; or

c) the need, or lack of need, of an exchange depends on other factors known to the two DTEs.

For the mode of operation where a circuit switched connection is used to connect a DTE and a DCE, the need for an identification exchange is governed by the PSDN requirements and the PSDN services the DTE desires to use (services are defined in Recommendation X.32).

When an exchange of identification information is needed, the method(s) of exchange will be selected from the methods given in Recommendation X.32 (see Note 1). For DTE-to-DTE operation, the method is agreed between the two DTEs on an *a priori* basis (see Note 2). For DTE-to-DCE operation, the requirements of the PSDN will govern which method is to be used.

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NOTES

1 Although Recommendation X.32 specifies the identification procedures as DTE-to-DCE, they are applied to the DTE-to-DTE case by this Recommendation I International Standard.

2 One of the identification methods allowed by Recommendation X.32 is use of the capabilities of the switched network for identification. When using such an identification method, the specific protocol mechanism must also be agreed among the two DTEs and the switched network.

7 Data link layer

7.1 Mode of protocol

The basic mode (modulo 8) single link procedures shall be implemented. The extended mode (modulo 128) single link procedure may also be implemented.

7.2 Address assignment

For DTE-to-DTE operation over a switched connection, and for DTE access to a PSDN via a switched connection, the A and B addresses of ISO 7776 shall be determined as follows: the calling end is assigned address A and the called end is assigned address B unless the assignment is known *a priori.*

For access to a PSDN via a leased circuit, the A and B addresses shall be as specified in Recommendation X.25. For DTE-to-DTE operation over a leased circuit, the A and B addresses shall be known *a priori.*

7.3 Parameter values

It is recommended that the T1 timer be capable of being set to a value of 5 s in order to cope with multiple satellite links.

It is recommended that 1031 octet frames be supported in order to accommodate satellite connections.

NOTE – In addition to these recommendations, the use of large windows, requiring the use of extended mode (modulo 128) operation may be advisable, particularly if multiple satellite hops are likely.

8 Packet layer

8.1 General

In general the features defined in CCITT Rec. X.223 I ISO 8878 apply with regards to the QOS parameters and addressing. However, the procedures defined in Recommendation X.21 imply the operation of some specific mechanisms as defined in Recommendations X.25, X.32 and X.31 when a PSDN is involved.

8.2 Addressing

8.2.1 Direct DTE-to-DTE configuration

The X.21 addressing elements are used to establish the X.21 connection between the two concerned SNPAs.

The X.25 Address Field is not used (i.e., it is empty) in this case, and the Called and Calling NSAP addresses are entirely conveyed in the Called and Calling Address Extension facilities.

If packets are received which contain addressing information in the Address Field, this information shall be ignored.

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8.2.2 DTE-to-DCE configuration

The X.21 addressing elements are used to establish the X.21 connection between the two concerned SNPAs (i.e., the DTE and the PSDN).

The X.25 Address Field, and the Called and Calling Address Extension facilities are used as defined in CCITT Rec. X.223 | ISO 8878.

8.3 QOS parameters

8.3.1 Throughput QOS parameters

The calling NL entity should have an *a priori* knowledge of the data signalling rate of the X.21 connection. This *a priori* knowledge is generally obtained by means of subscription information.

This knowledge is used to determine the value of the throughput and to determine if a new connection is to be established to meet the NS user requirements.

8.3.2 Transit delay QOS parameter

Due to the limited signalling capabilities of X.21, the calling NL entity should have an a priori knowledge of the transit delay of the X.21 connection. This *a priori* knowledge may be obtained via knowledge of the network topology or via monitoring of the connection characteristic.

The value of the X.21 connection transit delay is used as part of the calculation in determining the cumulative transit delay carried in the End-to-End Transit Delay Negotiation facility (see CCITT Rec. X.223 | ISO 8878).

8.4 Window size and packet size parameters

If only one virtual circuit is to be used, an appropriate window size should be supported. It is recommended that 1024 octet data packets be supported in order to accommodate satellite connections.

8.5 Logical channel ranges

The logical channel ranges (LIC, HIC, LTC, HTC, LOC and HOC in ISO/IEC 8208) to be used are determined by local knowledge if available. If local knowledge is not available, then only a single two-way logical channel is available and LTC and HTC shall be set to 1.

If additional logical channels are required, they may be negotiated by using the Registration packet as described in ISO/IEC 8208. In order to avoid collision of Registration packets, the circuit initiator is responsible for initiating the negotiation.

8.6 Role selection

In the absence of *a priori* knowledge, the Restart procedure shall be used for role selection as described in ISO/IEC 8208.

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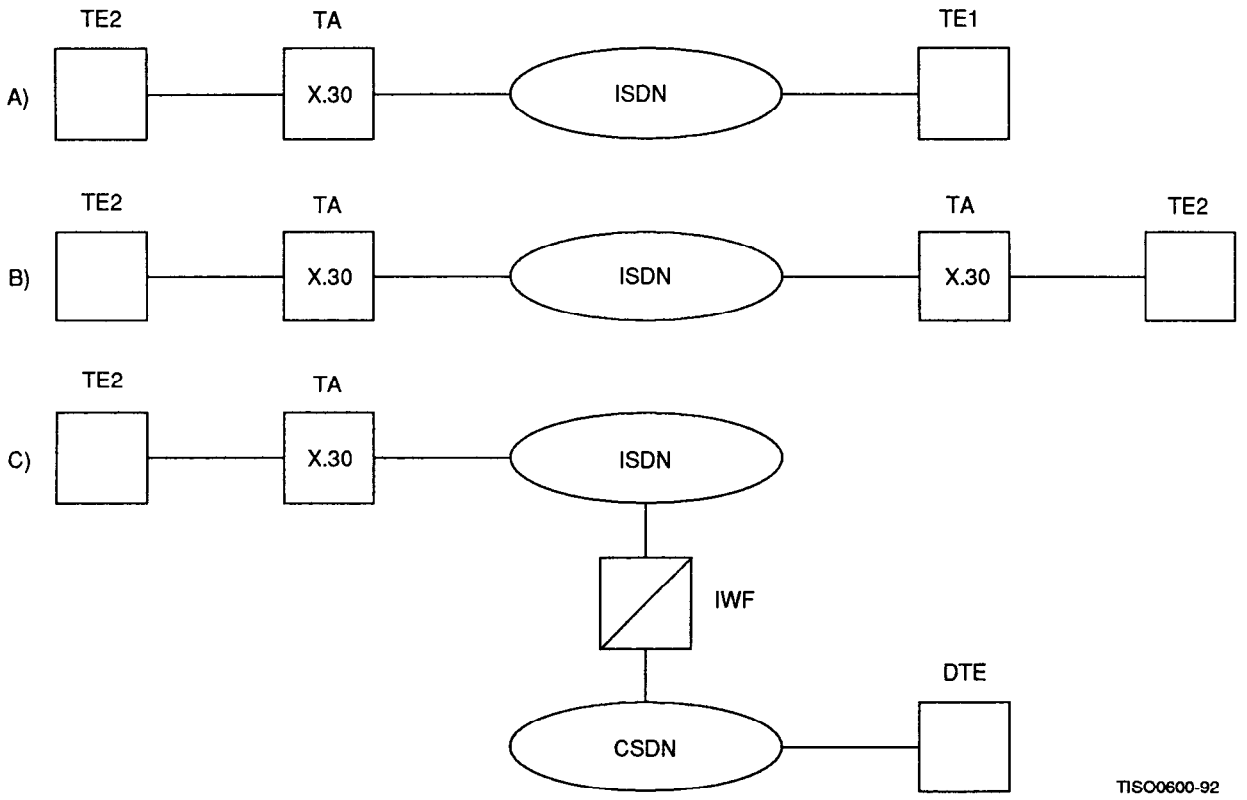
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Annex A

X.30 Terminal adaptors for ISDN

(This annex does not form an integral part of this Recommendation I International Standard.)

Recommendation X.30 defines the requirements of a TA to support X.21, X.21 *bis*, and X.20 *bis* DTEs at the R reference point. It recognizes three possible interworking scenarios:



Scenario A is only valid when the TA is providing 64 kbit/s to the TE2 (User Class of Service 19 as defined in Recommendation X.1). For all other user classes of service the ISDN is being used as a core network to provide a CSDN service.

When User Class of Service 19 is used at the R Reference point, the ISDN can provide interworking between a system conforming to this Recommendation I International Standard and a system conforming to CCITT Rec. X.612 I ISO/IEC 9574.

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Annex B

Bibliography

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B.1 Identical Recommendations | International Standards

- CCITT Recommendation X.612 (1992) | ISO/IEC 9574 : 1992, *Information technology – Provision of the OSI Connection-mode network service by packet-mode terminal equipment connected to an integrated service digital network (ISDN).*

B.2 Additional references

- CCITT Recommendation X.1 (1988), *International user classes of service in public data networks and integrated services digital networks (ISDN).*
- CCITT Recommendation X.20 *bis* (1988), *Use on public data networks of data terminal equipment (DTE) which is designed for interfacing to asynchronous duplex V-Series modems.*
- CCITT Recommendation X.610 (1992), *Provision and support of the OSI connection-mode network service.*
- ISO/IEC 8880-2:1992, *Information technology – Telecommunications and information exchange between systems – Protocol combinations to provide and support the OSI Network Service – Part 2: Provision and support of the connection-mode Network Service.*

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