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CCITT

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DATA COMMUNICATION NETWORKS

INFORMATION TECHNOLOGY – PROVISION OF THE OSI CONNECTION-MODE NETWORK SERVICE BY PACKET-MODE TERMINAL EQUIPMENT CONNECTED TO AN INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

Recommendation X.612

Geneva, 1992

Foreword

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In some areas of information technology which fall within CCITT's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC. The text of CCITT Recommendation X.612 was approved on 10th September 1992. The identical text is also published as ISO/IEC International Standard 9574.

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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INTERNATIONAL STANDARD

CCITT RECOMMENDATION

INFORMATION TECHNOLOGY – PROVISION OF THE OSI CONNECTION-MODE NETWORK SERVICE BY PACKET-MODE TERMINAL EQUIPMENT CONNECTED TO AN INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

1 Scope

This Recommendation | International Standard specifies the method of providing the OSI Connection-mode Network Service (CONS) by packet mode terminal equipment connected to an Integrated Services Digital Network (ISDN) in accordance with the procedures described in Recommendation X.31. This is done by specifying the mapping of the CONS primitives and parameters to and from the elements of the protocols used by two types of packet mode terminal equipment:

a) an X.25 DTE (TE2) connected to an R reference point and accessing an ISDN; and

b) a packet mode ISDN terminal (TE1) operating ISO/IEC 8208 packet layer protocol (PLP) and connected to an ISDN at either the S or T reference point.

This Recommendation | International Standard is applicable:

a) when operating according to Recommendation X.31, either a TE1 or a TE2 is connected to a packet handler in an ISDN or an access unit to a packet-switched data network via an ISDN;

b) when using an ISDN circuit-switched channel, either TE1s and/or TE2/TAs are connected directly to each other (i.e. the terminals operate in DTE/DTE mode).

This Recommendation | International Standard does not address TE2s using TAs (at the R reference point) when using an ISDN circuit-switched channel with the terminals operating in DTE/DTE mode (see Recommendation X.613 | ISO/IEC 10588).

NOTES

1 The definitions of TE1, TE2 and TA equipment, and R, S, and T reference points are given in Recommendation I.411.

2 This Recommendation | International Standard applies to a TE1 or TE2/TA (i.e. an OSI End System) regardless of whether it is a physically separate system or embedded in other equipment such as a PBX.

This Recommendation | International Standard addresses the provision of the CONS using Virtual Calls as described in Recommendation X.25. It does not address the use of X.25 Permanent Virtual Circuits. The extension of this Recommendation | International Standard to include the use of X.25 PVCs is for further study.

NOTE – This Recommendation | International Standard uses numbers to identify layers, rather than their names. This is done to align the terminology of this document with the terminology of the related ISDN Recommendations, and does not imply any change in the functionality of the layers from that defined in the reference model of open systems interconnection.

2 Normative references

The following CCITT Recommendations and ISO/IEC 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. Parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent editions 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 currently valid CCITT Recommendations.

2.1 Identical Recommendations | International Standards

– CCITT Recommendation X.213 (1992) | ISO/IEC 8348: 1992, *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*.

2.3 Additional references

– CCITT Recommendation I.231 (1988), *Circuit-mode bearer service categories*.

– CCITT Recommendation I.232 (1988), *Packet-mode bearer service categories*.

– CCITT Recommendation I.430 (1988), *Basic User-Network Interface Layer 1 Specification*.

– CCITT Recommendation I.431 (1988), *Primary Rate User-Network Interface Layer 1 Specification*.

– CCITT Recommendation Q.921 (I.441) (1988), ISDN *User-Network Interface Data Link Layer Specification*.

– CCITT Recommendation Q.931 (I.451) (1988), *ISDN User-Network Interface Layer 3 Specification for Basic Call Control*.

– CCITT Recommendation V.25 *bis* (1988), *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*.

– CCITT Recommendation X.21 (1988), *Interface Between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) 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 (I.462) (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 (I.462) (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 ISDN or a circuit switched public data network.*

– ISO 7776:1986, *Information processing systems – Data communications – 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 Basic 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.

3.4 X.25 definitions

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

a) DATA packet;

b) Data terminal equipment;

c) INCOMING CALL packet;

d) Throughput class;

e) User data field;

3.5 X.31 definitions

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

a) Conditional notification class of service;

b) ISDN Virtual Circuit Bearer Service;

c) No notification class of service;

d) Packet handling function;

e) PSPDN Service;

f) Unconditional class of service;

g) Semi-permanent access (see Note);

h) Demand access.

NOTE – Some ISDN Recommendations use the term ‘permanent’ to describe this feature.

3.6 I.112 definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Recommendation I.112:

a) terminal equipment;

b) reference point.

3.7 I.411 definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Recommendation I.411:

a) R reference point;

b) S reference point;

c) T reference point;

d) Terminal adaptor.

3.8 I.412 definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Recommendation I.412:

a) B channel;

b) D channel.

3.9 X.121 definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Recommendation X.121:

a) prefix;

b) escape.

4 Abbreviations

4.1 Reference model abbreviations

OSI Open Systems Interconnection

NS Network Service

4.2 Network service abbreviations

CONS Connection-mode Network Service

QOS Quality of service

4.3 X.25 abbreviations

DCE Data circuit-terminating equipment

DTE Data terminal equipment

LAP link access procedure

PLP Packet layer protocol

PSDN Packet switched data network

RPOA Recognized private operating agency

4.4 ISDN abbreviations

AU Access unit

ISDN Integrated services digital network

PH Packet handling function

SAPI Service access point identifier

TA Terminal adaptor

TE Terminal equipment

HLC Higher layer compatibility

5 Overview

5.1 ISDN environment

The ISDN environment is characterised by two configurations. In the first, a packet mode terminal is connected to a packet mode service, as described in Recommendation X.31. In the second configuration, two packet mode terminals are connected directly by an ISDN circuit-switched B or H channel.

5.1.1 Use of a packet mode service

The support of the packet mode terminal equipment by an ISDN when a packet mode service is used is described in Recommendation X.31. In this case, references to Recommendation Q.931 procedures indicate their use as described in Recommendation X.31. Two cases for ISDN support of packet mode terminal equipment are defined in Recommendation X.31: one, the case where the support is via the ISDN Virtual Circuit service [see Figure 1a)], and the other where the support is via access to PSDN services [see Figure 1b)], respectively referred to as "case B" and "case A".

In case A an ISDN transparent circuit connection, either semi-permanent (i.e., non-switched) or demand (i.e., switched), is used. The corresponding ISDN bearer service is a 64 kbit/s service as described in Recommendation I.231. The sub-network functions available to the user are those of the PSDN described in Recommendation X.25 (semi-permanent access) and Recommendation X.32 (demand access), as well as in other X-Series Recommendations (e.g., X.2, X.121).

In case B the ISDN virtual circuit bearer service is used, as described in Recommendation I.232. The sub-network functions available are those described in the I.2xx-Series Recommendations.

In case A only B channels may be used to access the PSDN, while in case B both B and D channels may be used to access the ISDN packet handling function.

5.1.2 Direct circuit-switched connection

Two packet mode terminal equipment may be connected directly using an ISDN B or H channel. The channel used is either semi-permanent (i.e. non-switched) or demand (i.e. switched), see Figure 1c).

5.2 CONS in this ISDN environment

Recommendation X.223 | ISO 8878 specifies the method for providing the OSI Connection-mode Network Service (CONS) through the use of the X.25 packet layer protocol. When operating in an ISDN environment, a few requirements additional to those contained in Recommendation X.223 | ISO 8878 are necessary.

The requirements for providing CONS by terminal equipment connected to an ISDN at the S or T reference points are specified in clause 6.

The requirements for providing CONS in X.25 DTEs presenting an X.21, X.21 *bis*, or V.25 *bis* interface at the R reference point and connected to an ISDN through a TA are specified in clause 7.

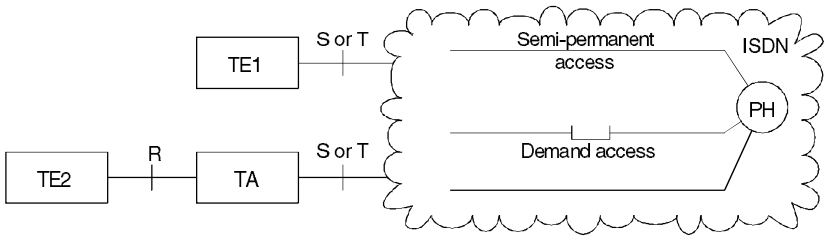
This Recommendation | International Standard uses the X.25 PLP to convey all elements, of all three phases, of the OSI Connection-mode Network Service.

6 Provision of the CONS in systems attached at the S/T reference point

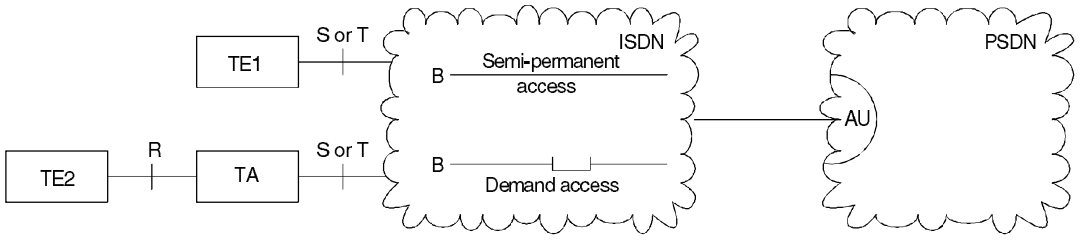
6.1 Procedures for TE1s or TE2/TAs to provide CONS

This clause of this Recommendation | International Standard covers the five cases that exist taking into account the various types of underlying connections that can be available to the packet mode TE1 or TE2/TA (see Table 1). The protocol layers applicable to these cases are given in Figures 2 and 3 and as referenced in Table 1.

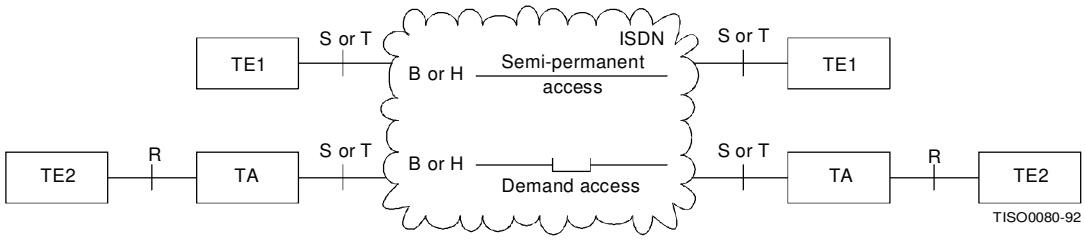
The mapping of the elements of the CONS to the protocol and procedures of ISO/IEC 8208 shall be as required by Recommendation X.223 | ISO 8878. The remaining clauses in this section specify the provisions required in addition to these mappings, by systems attached to an interface at the S/T reference point.



a) Configurations for case B access



b) Configurations for case A access



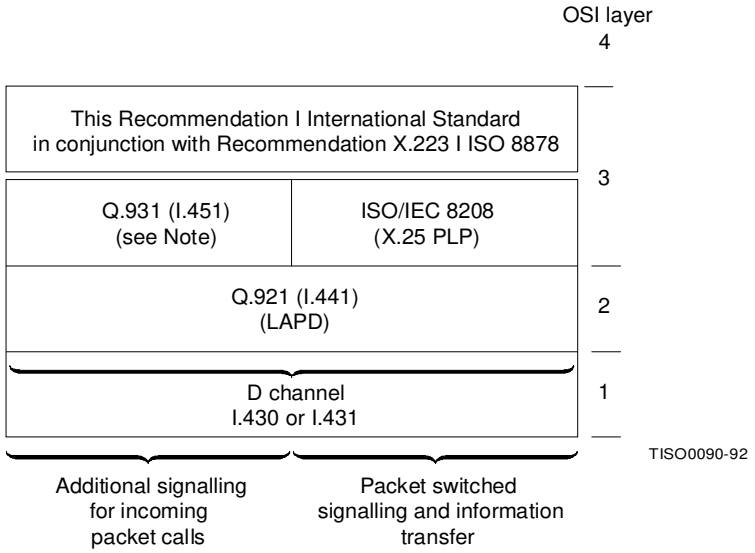
c) Configurations for direct connection by ISDN circuit-switched B or H channel

TE Terminal equipment
TA Terminal adaptor
PH Packet handling function
AU Access unit

Figure 1 – Cases covered by clause 6

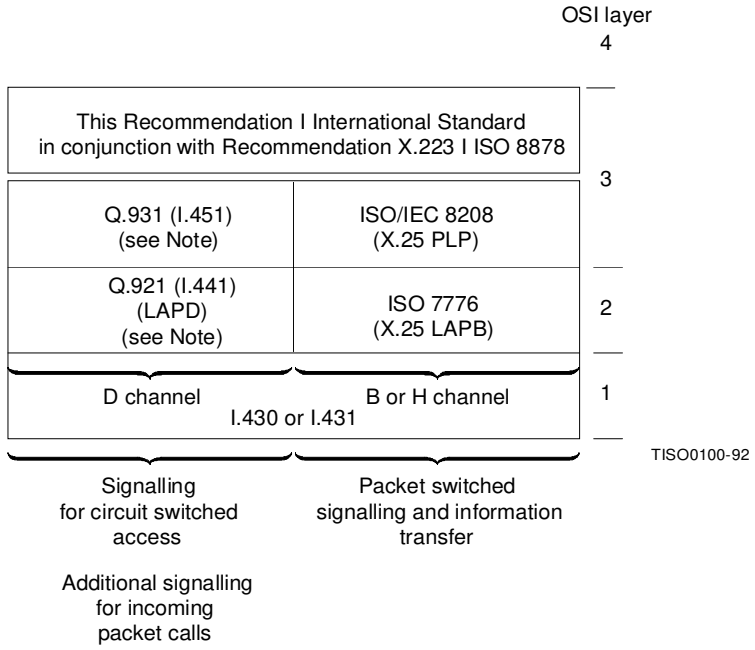
Table 1 – Cases covered by clause 6

Underlying connection perceived by the terminal equipment	Access to	Figure	Subclause
D channel	Packet Mode service	2	6.2
B channel : Semi-permanent	Packet Mode service	3	6.3.1
B channel : Demand	Packet Mode service	3	6.3.2
B or H channel : Semi-permanent	Remote terminal	3	6.4.1
B or H channel : Demand	Remote terminal	3	6.4.2



NOTE – This protocol need not be present in all systems.

Figure 2 – Protocol layers at S and T reference points when D channel is used in ISDN



NOTE – These two protocols need not be present in all systems.

Figure 3 – Protocol layers at S and T reference points when B channel or H channel is used in ISDN

6.2 Additional procedures for a TE1 or TE2/TA to provide the CONS when using the ISDN D channel

This clause is only applicable in case B access. TE1s and TE2/TAs supporting packet operation on the ISDN D channel present a stack of protocols at the S or T reference point in accordance with the Recommendations and International Standards indicated in Figure 2. At the physical layer, I.430 shall be used if the ISDN access is a basic interface and I.431 shall be used if the ISDN access is a primary rate interface. At the data link layer, Q.921 shall be used to provide the LAPD procedures. At the network layer, ISO/IEC 8208 shall be used to provide the packet layer protocol and Q.931 may be used to provide the "call-offering procedure" which, when present, takes place before the conveyance of X.25 incoming call packets. The Q.931 procedures enable terminal identification (basic access) and a determination of which channel (D or B) a specific incoming call packet is to be conveyed on. The following limitations shall apply :

a) the maximum user data field length of ISO/IEC 8208 data packets shall not exceed 256 octets;

b) the ISO/IEC 8208 throughput class used shall not exceed 16 kbits/sec on a basic interface.

The subscription and negotiated facilities in the X.25 call establishment packets shall be used, as necessary, to indicate values consistent with these restrictions.

6.2.1 Outgoing calls

ISO/IEC 8208 procedures shall be operated over the ISDN layer 2 procedures using SAPI=16 as defined in Recommendation X.31. No additional procedures are required.

NOTE – The address fields of the ISO/IEC 8208 packets contain sub-network addresses that are valid for the ISDN (e.g. Recommendation E.164 for public ISDNs, where a valid E.164 address could be Escape Code + Recommendation X.121 number. A network dependent prefix may also be required).

6.2.2 Incoming calls

The procedures applying to incoming calls vary according to whether the ISDN call offering procedures are used.

NOTE – The address fields of the ISO/IEC 8208 packets contain sub-network addresses that are valid for the ISDN.

6.2.2.1 Without call offering procedures

These procedures are used by the sub-network if

a) the interface to which the TE1 or TE2/TA is connected has subscribed to the "conditional notification class of service", and the network does not use the call offering procedures for this incoming call; or

b) the interface to which the TE1 or TE2/TA is connected has subscribed to the "no notification class of service".

ISO/IEC 8208 procedures shall be operated over the ISDN layer 2 procedures using a SAPI=16 as defined in Recommendation X.31. No additional procedures are required.

6.2.2.2 With call offering procedures

These procedures are used if

a) the interface to which the TE1 or TE2/TA is connected has subscribed to the "unconditional notification class of service", or

b) the interface to which the TE1 or TE2/TA is connected has subscribed to the "conditional notification class of service", and the network uses the call offering procedures for this incoming call.

ISO/IEC 8208 protocol procedures shall be used over the ISDN layer 2 procedures using SAPI=16. In addition the ISDN call offering procedures are also operated over the ISDN layer 2 procedures, using either SAPI=0 or SAPI=16. Systems conforming to this Recommendation | International Standard, that operate these ISDN call offering procedures, shall implement these procedures using SAPI=0 and may also implement these procedures using SAPI=16 (see Notes 1 and 2). The ISDN call offering procedures (see Notes 3 and 4) determine which TE1 or TE2/TA is to receive the call and are not visible to the NS user. The ISO/IEC 8208 procedures are then operated after the ISDN call offering procedures have been completed.

NOTES

1 Recommendation X.31 states (Note 4 to 6.2.2.3.1): "Networks providing packet mode call offering shall provide Q.931 signalling procedures for packet mode calls on SAPI=0. For an interim period, some networks, by subscription agreement, may offer SAPI=16 broadcast call offering procedures for providing Q.931 signalling. This option will use all Q.931 procedures for packet mode calls with the following restriction: All calls will be offered as "D-channel exclusive" and will not provide channel negotiation procedures. Terminals implementing SAPI=16 procedures shall also implement SAPI=0 procedures for portability."

2 In order to maximise terminal portability during the interim period identified in Note 1, systems should implement the call offering procedures on both SAPI=0 and SAPI=16.

3 These procedures may use, for example, Recommendation Q.931 addressing, sub-addressing, direct-dialling-in, multiple subscriber number and compatibility checking information elements, to determine which TE1 or TE2/TA is to receive the call. In order to avoid unnecessary connection failures, it is suggested that incoming calls are not rejected on the basis of compatibility information unless this information identifies as required, a functionality that the terminal is not capable of (e.g. a call should not be rejected because the HLC information element is not present).

4 These procedures may require D-channel selection, or may offer the terminal a choice of D or B channels. No distinction is made here between these ways of selecting the D channel. Sub-clause 6.3 covers the case where a B channel is selected.

6.3 Additional procedures for a TE1 or TE2/TA to provide the CONS when using the ISDN B channel and accessing a packet mode service.

TE1s and TE2/TAs supporting packet operation on the ISDN B channel present stacks of protocols at the S or T reference point in accordance with the Recommendations and International Standards indicated in Figure 3. One stack, which may be null, is used to support signalling on SAPI=0 for circuit switched access to the packet handling function and the "call offering procedure", and the other is used to support packet switched signalling and information transfer. At the physical layer, I.430 shall be used if the ISDN access is a basic interface, and I.431 shall be used if the ISDN access is a primary rate interface. At the data link layer, Q.921 shall be used over the D channel (signalling) and ISO 7776 shall be used over the B channel (information). At the network layer, Q.931 shall be used over the D channel to convey circuit switched signalling and for the ISDN call offering procedure. Also at the network layer, ISO/IEC 8208 shall be used over the B channel for the packet layer protocol (see Note).

The following sub-clauses specify the requirements in addition to those specified in 6.1 for the cases of an underlying semi-permanent connection, and an underlying demand access connection between the TE1 or TE2/TA and the packet handling function.

NOTE – In case B, the address fields of the ISO/IEC 8208 packets contain sub-network addresses that are valid for the ISDN. In case A, the address fields of the ISO/IEC 8208 packets contain sub-network addresses that are valid for the PSPDN.

6.3.1 Semi-permanent B-channel connection

Both the basic interface and the primary rate interface provide for semi-permanent connection of a B channel between the S or T reference point and the packet handling function.

6.3.1.1 Virtual call originated by the TE1 or TE2/TA

No additional procedures are required.

6.3.1.2 Virtual call originated toward the TE1 or TE2/TA

The procedures applying to incoming calls vary according to whether the ISDN call offering procedures are used. The use of call offering procedures cannot result in the selection of a semi-permanent B channel in case A access. Therefore no additional procedures are required for case A.

6.3.1.2.1 Without call offering procedures

No additional procedures are required for case B access if

a) the interface to which the TE1 or TE2/TA is connected has subscribed to the "conditional notification class of service", and the network does not use the call offering procedures for this incoming call; or

b) the interface to which the TE1 or TE2/TA is connected has subscribed to the "no notification class of service".

6.3.1.2.2 With call offering procedures

These procedures are used if

a) the interface to which the TE1 or TE2/TA is connected has subscribed to the "unconditional notification class of service", or

b) the interface to which the TE1 or TE2/TA is connected has subscribed to the "conditional notification class of service", and the network uses the call offering procedures for this incoming call.

The ISDN call offering procedures (see Note) determine which B channel is to be used. These procedures are not visible to the NS user. Following successful channel selection, the procedures specified in ISO 7776 and ISO/IEC 8208 shall apply.

NOTE – These procedures may offer the terminal a choice of B channels with, or without, the choice of the D channel. No distinction is made here between these ways of selecting a semi-permanent B channel. Subclause 6.3.2 covers the case where a demand access B channel is selected. Subclause 6.2 covers the case where a D channel is selected.

6.3.2 Demand access B-channel connection

Both the basic interface and the primary rate interface provide for demand access connection of a B channel between the S or T reference point and the packet handling function.

These additional procedures shall only be used if a B channel is not already established between the TE1 or TE2/TA and the packet handling function, if an additional B channel is needed to support the additional traffic, or if notification of an incoming call is required.

6.3.2.1 Demand access B-channel connection originated by the TE1 or TE2/TA

The receipt by layer 3 of an N-CONNECT request primitive shall first cause the ISDN D channel signalling procedure for demand access to be used to establish a B channel (see Note). Following successful establishment of this B-channel connection, including its entering the data transfer phase at layer 1, the procedures specified in ISO 7776 and ISO/IEC 8208 shall apply. Failure to establish the B channel connection is indicated to the NS user by means of an N-DISCONNECT indication primitive with the originator parameter indicating "NS provider" and the reason parameter as given in Table 2.

NOTE – For case A, a circuit-switched bearer service is requested, and the Recommendation Q.931 called party number information element contains the ISDN address of the PSDN Access Unit. For case B, a packet-switched bearer service is requested, and the Recommendation Q.931 called party number information element is not used.

Table 2 – Mapping of Q.931 causes to CONS reasons

Item	Q.931 cause		NS reason (see Note)
1	1	Unassigned or unallocated number	Connection rejection – NSAP unreachable – permanent
2	3	No route to destination	Connection rejection – NSAP unreachable – permanent
3	6	Channel unacceptable	Connection rejection – reason unspecified – transient
4	17	User busy	Connection rejection – reason unspecified – transient
5	18	No user responding	Connection rejection – reason unspecified – permanent
6	22	Number changed	Connection rejection – reason unspecified – permanent
7	27	Destination out of service	Connection rejection – reason unspecified – permanent
8	28	Invalid number format (incomplete number)	Connection rejection – reason unspecified – permanent
9	34	No circuit/channel available	Connection rejection – NSAP unreachable – transient
10	38	Network out of order	Connection rejection – reason unspecified – permanent
11	41	Temporary failure	Connection rejection – reason unspecified – transient
12	42	Switching equipment congestion	Connection rejection – reason unspecified – transient
13	44	Requested circuit or channel not available	Connection rejection – reason unspecified – transient
14	47	Resources unavailable – unspecified	Connection rejection – reason unspecified – transient
15	57	Bearer capability not authorised	Connection rejection – reason unspecified – permanent
16	58	Bearer capability not presently available	Connection rejection – reason unspecified – permanent
17	63	Service or option not available	Connection rejection – reason unspecified – permanent
18	65	Bearer service not implemented	Connection rejection – reason unspecified – permanent
19	66	Channel type not implemented	Connection rejection – reason unspecified – permanent
20	79	Service or option not implemented – unspecified	Connection rejection – reason unspecified – permanent
21	81	Invalid call reference value	Connection rejection – reason unspecified – permanent
22	82	Identified channel does not exist	Connection rejection – reason unspecified – permanent
23	88	Incompatible destination	Connection rejection – reason unspecified – permanent
24	95	Invalid message	Connection rejection – reason unspecified – permanent
25	96	Mandatory information element is missing	Connection rejection – reason unspecified – permanent
26	97	Message type non-existent or not implemented	Connection rejection – reason unspecified – permanent
27	98	Message not compatible with call state or message type non-existent or not implemented	Connection rejection – reason unspecified – permanent
28	99	Information element non-existent or not implemented	Connection rejection – reason unspecified – permanent
29	100	Invalid information element contents	Connection rejection – reason unspecified – permanent
30	101	Message not compatible with call state	Connection rejection – reason unspecified – permanent
31	111	Protocol error – unspecified	Connection rejection – reason unspecified – permanent
32	127	Interworking – unspecified	Connection rejection – reason unspecified – permanent

NOTE – The diagnostic field of the Q.931 cause information element may contain an indication of the permanence or transience of the condition. The NS Reason passed to the NS User may be modified to transfer this additional information.

6.3.2.2 Demand access B-channel connection originated toward the TE1 or TE2/TA

The procedures applying to incoming calls vary according to whether the ISDN call offering procedures are used.

6.3.2.2.1 Without call offering procedures

No additional procedures are required if

a) the interface to which the TE1 or TE2/TA is connected has subscribed to the “conditional notification class of service”, and the network does not use the call offering procedures for this incoming call; or

b) the interface to which the TE1 or TE2/TA is connected has subscribed to the “no notification class of service”.

6.3.2.2.2 With call offering procedures

These additional procedures are to be used if

a) the interface to which the TE1 or TE2/TA is connected has subscribed to the “unconditional notification class of service”, or

b) the interface to which the TE1 or TE2/TA is connected has subscribed to the “conditional notification class of service”, and the network uses the call offering procedures for this incoming call.

The ISDN call offering procedures (see Notes 1 and 2) determine which TE1 or TE2/TA is to receive the call (basic access) and which B channel is to be used. These procedures are not visible to the NS user. Following successful establishment of this B-channel connection, including its entering the data transfer phase at layer 1, the procedures specified in ISO 7776 and ISO/IEC 8208 shall apply.

NOTES

1 These procedures may use Recommendation Q.931 addressing, sub-addressing, and compatibility checking information elements, to determine which TE1 or TE2/TA is to receive the call. In order to avoid unnecessary connection failures, it is suggested that incoming calls are not rejected on the basis of compatibility information unless this information identifies as required, a functionality that the terminal is not capable of (e.g. a call should not be rejected because the HLC information element is not present).

2 These procedures may require a particular B channel, or may offer the terminal a choice of B channels with, or without, the choice of the D channel. No distinction is made here between these ways of selecting a demand access B channel. Subclause 6.3.1 covers the case where a semi-permanent B channel is selected. Subclause 6.2 covers the case where a D channel is selected.

6.3.2.3 Disconnection of the B channel

If one or more OSI Network connections are established or in the process of being established on an established B channel and that B channel is disconnected, this disconnection shall be indicated to the NS user by means of an N-DISCONNECT indication primitive with the originator parameter indicating “NS provider” and the reason parameter as given in Table 2 for each OSI Network connection established or in the process of being established.

It is a local matter as to under what conditions a TE1 or TE2/TA would initiate a disconnection of the B channel(s), using Q.931 procedures as specified in X.31.

6.4 Additional procedures for a TE1 or TE2/TA to provide the CONS when using the ISDN B or H channel and connecting directly to the remote terminal

TE1s and TE2/TA supporting packet operation on the ISDN B or H channel present stacks of protocols at the S or T reference point in accordance with Recommendations indicated in Figure 3. One stack, which may be null, is used to support signalling for circuit switched access to the remote terminal, and the other is used to support packet switched signalling and information transfer. At the physical layer, I.430 shall be used if the ISDN access is a basic interface, and I.431 shall be used if the ISDN access is a primary rate interface. At the data link layer, Q.921 (I.441) shall be used over the D channel (signalling) and ISO 7776 shall be used over the B or H channel (information). At the network layer, Q.931 shall be used over the D channel to convey circuit switched signalling. Also at the network layers, ISO/IEC 8208 shall be used over the B or H channel for the packet protocol.

The following sub-clauses specify the additional provisions required in the cases of an underlaying semi-permanent connection, and an underlying demand access connection between the TE1 or TE2/TA and the remote terminal.

6.4.1 Semi-permanent B- or H-channel connection

Both the basic interface and the primary rate interface provide for semi-permanent connection of a B or H (primary only) channel between the S or T reference point and the remote terminal.

No additional procedures are required.

6.4.2 Demand access B- or H-channel connection

Both the basic interface and the primary rate interface provide for demand access connection of a B or H (primary only) channel between the S or T reference point and the remote terminal.

6.4.2.1 Establishment of the B or H channel by TE1 or TE2/TA

The following additional procedures shall be used if a B or H channel is not already established between the TE1 or TE2/TA and the remote terminal, or if an additional B or H channel is needed to support the additional traffic.

The receipt by layer 3 of an N-CONNECT request primitive shall first cause the ISDN D-channel signalling procedure for demand access to be used to establish a B or H channel (see Note). Following successful establishment of this channel connection, including its entering the data transfer phase at layer 1, the procedures specified in ISO 7776 and ISO/IEC 8208 as constrained by 6.4.3 and 6.4.4 below shall apply.

Failure to establish the channel connection is indicated to the NS user by means of an N-DISCONNECT indication primitive with the originator parameter indicating “NS provider” and the reason parameter as given in Table 2.

NOTE – A circuit-switched bearer service is requested, and the Recommendation Q.931 called party number information element contains the ISDN address of the remote terminal.

6.4.2.2 Establishment of the B or H channel towards the TE1 or TE2/TA

The ISDN call offering procedures (see Note) determine which TE1 or TE2/TA is to receive the call (basic access) and which B channel is to be used. Following successful establishment of this B- or H-channel connection, including its entering the data transfer phase at layer 1, the procedures specified in ISO 7776 and ISO/IEC 8208 as constrained by 6.4.3 and 6.4.4 of this Recommendation | International Standard shall apply.

NOTE – These procedures may use the Q.931 addressing, sub-addressing, and compatibility checking information elements, to determine which TE1 or TE2/TA is to receive the call. In order to avoid unnecessary connection failures, it is suggested that incoming calls are not rejected on the basis of compatibility information unless this information identifies as required, a functionality that the terminal is not capable of (e.g. a call should not be rejected because the HLC information element is not present).

6.4.2.3 Disconnection of the B or H channel

If one or more OSI Network connections are established or in the process of being established on an established B or H channel and that channel is disconnected, this disconnection shall be indicated to the NS user by means of an N-DISCONNECT indication primitive with the originator parameter indicating “NS provider” and the reason parameter as given in Table 2 for each OSI Network connection established or in the process of being established.

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

NOTE – Care should be exercised to ensure that the connection is re-established to the same system.

It is a local matter as to under what conditions a TE1 or TE2/TA would initiate a disconnection of the B- or H-channel(s), using Q.931 procedures.

6.4.2.4 Identification

When establishing a 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 ISO/IEC 8208 operation.

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;

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

When an exchange of identification information is required, the method(s) of exchange will be selected from the methods given in Recommendation X.32 (see Note 1). The method(s) to be used is (are) agreed between the two DTEs on an *a priori* basis (see Note 2).

NOTES

1 Although X.32 specifies the procedures as DTE/DCE they are applied to the DTE/DTE case by this document.

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

6.4.3 Additional data link layer requirements

6.4.3.1 Mode of protocol

The basic mode (modulo 8) single link procedures of ISO 7776 shall be implemented. The extended mode (modulo 128) single link procedure may also be implemented.

6.4.3.2 Addressing

For operation over a demand access channel, the TE1 or TE2/TA that initiates establishment of the B or H channel shall use address "A" (as defined in ISO 7776) and the remote terminal shall use address "B", unless the assignment is known *a priori*.

For operation over semi-permanent channels, the address assignments shall be known *a priori*.

6.4.3.3 Parameter values

It is recommended that the ISO 7776 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.

6.4.3.4 Synchronization

It is recommended that the following procedure is followed to ensure that neither protocol implementation sends the first frame until the peer implementation is ready to receive it:

a) send a sequence of "1" bits until notified of B- or H-channel establishment;

b) activate receiver;

c) send sequence of flags;

d) wait until the first flag is received from the remote entity; and

e) consider the remote entity as active and start communication.

6.4.4 Additional network layer requirements

6.4.4.1 Addresses

The ISO/IEC 8208 packets shall not convey information in the address fields. The called and calling NSAP addresses are entirely conveyed in the ISO/IEC 8208 called and calling address extension facilities.

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

6.4.4.2 Throughput QOS parameter

The calling NL entity should have local knowledge of the bearer capability of the channel. This *a priori* knowledge is generally obtained by means of subscription information. This knowledge may be modified by Q.931 signalling.

This knowledge is used to determine the value of the throughput and to determine if a new channel is required to meet the NS user requirements.

6.4.4.3 Transit delay QOS parameter

The calling NL entity should have *a priori* knowledge of the transit delay of the channel. This knowledge may be modified by Q.931 signalling.

The value of the channel 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 Recommendation X.223 | ISO 8878).

6.4.4.4 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 links.

6.4.4.5 Logical channel range

The logical channel ranges to be used (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 registration packets as described in ISO/IEC 8208. In order to avoid collision of registration packets, the channel initiator is responsible for initiating the negotiation.

6.4.4.6 Role selection

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

7 Provision of the CONS in systems attached at the R reference point

7.1 Procedures for TE2s to provide the CONS at the R reference point

This clause of this Recommendation | International Standard covers the three cases that exist at the R reference point taking into account the various types of underlying connections that can be available to the TE2 (see Table 3). The protocol layers applicable to these cases are given in Figure 4.

The mapping of the elements of the CONS to the protocol and procedures of ISO/IEC 8208 shall be as required by Recommendation X.223 | ISO 8878 for a conforming implementation. The remaining sub-clauses in this clause specify the provisions required in addition to these mappings, by systems attached to an interface at the R reference point.

Table 3 – Cases covered by clause seven

Underlying connection perceived by the terminal equipment	Subclause
Leased circuit	7.2.1
Direct call	7.2.2
Circuit switched	7.2.3

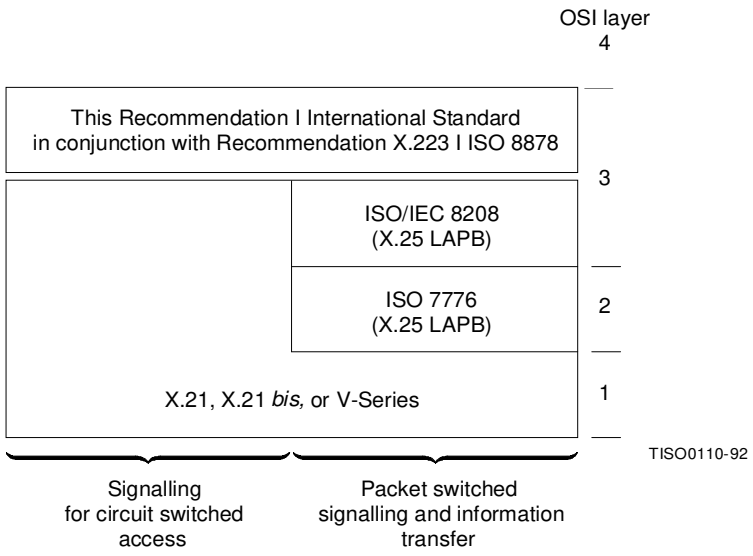


Figure 4 – Protocol layers at R reference point

7.2 Additional procedures for a TE2 to provide the CONS at the R reference point

TE2s implement all three protocol layers for access to an X.25 data network (see Figure 4). 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 shall be used. At the network layer, ISO/IEC 8208 PLP shall be used.

The following subclauses define the additional procedures required for each of the three types of underlying connections that can be perceived by the TE2 at the R reference point: leased circuit connection, direct call connection, and circuit switched connection.

Whether case A or case B access is being used is not visible to the TE2, except perhaps for quality of service (QOS) restrictions if the D channel is used. These QOS restrictions are caused by restrictions in packet sizes and throughput class (see 6.2).

7.2.1 Leased circuit connection

The X.21, X.21 *bis*, and V series Recommendations provide for a leased circuit connection at the R reference point. This leased circuit connection perceived by the TE2 may, by means of functions in the TA, use either the ISDN D channel, semi-permanent B channel, or demand access B channel to access the ISDN packet handling function or the PSDN Access Unit. This is not visible to the TE2, except perhaps for a few quality of service items.

No additional procedures are required.

7.2.2 Direct call connection

X.21 and X.21 *bis* (including V.25 *bis*) interfaces provide for a direct call connection at the R reference point. This direct call connection perceived by the TE2 may, by means of functions in the TA, use either the ISDN D channel, semi-permanent B channel, or demand access B channel to access the ISDN packet handling function or the PSDN Access Unit. This is not visible to the TE2, except perhaps for a few quality of service items.

The additional provisions contained in the subclauses below apply.

7.2.2.1 Direct call circuit switched connection originated by TE2 at the R reference point

If the circuit switched connection at the R reference point is not already established, the receipt by layer 3 of an N-CONNECT request primitive shall first cause the X.21 or X.21 *bis* (including V.25 *bis*) procedures for direct call 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 procedures specified in ISO 7776 and ISO/IEC 8208 shall apply.

Failure to establish the circuit switched connection is indicated to the NS user by means of an N-DISCONNECT indication primitive with the originator parameter indicating "NS provider" and the reason parameter as given in Table 4.

7.2.2.2 Circuit switched connection originated toward TE2

The Recommendation X.21 procedures need to be in the layer 1 "ready" state and the X.21 *bis* procedures must have circuit 107 OFF in order to enable a connection to be established towards the TE2. Once this connection is established and the X.21 or X.21 *bis* procedures have entered the data transfer phase at layer 1, the procedures specified in ISO 7776 and ISO/IEC 8208 shall apply.

7.2.2.3 Disconnection or failure 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 the circuit switched connection is disconnected (or fails), then the provisions of ISO/IEC 8208 and Recommendation X.223 | ISO 8878 concerning the failure of layer 1 shall apply to the mapping to an N-DISCONNECT indication primitive and the reason parameter as given in Table 4 for each OSI Network connection established or in the process of being established.

It is a local matter as to under what conditions a TE2 would initiate a disconnection, via X.21 or X.21 *bis* procedures, of the circuit switched connection.

7.2.3 Circuit switched connection

The X.21 and X.21 *bis* (including V.25 *bis*) interfaces provide for a circuit switched connection at the R reference point. This circuit switched connection perceived by the TE2 may, by means of functions in the TA, use either the ISDN D channel, or demand access B channel to access the ISDN packet handling function or the PSDN access unit. This is not visible to the TE2, except perhaps for a few quality of service items.

The additional provisions given in the subclauses below apply.

7.2.3.1 Circuit switched connection originated by TE2 at the R reference point

If the circuit switched connection at the R reference point is not already established, the receipt by layer 3 of an N-CONNECT request primitive shall first cause the X.21 or X.21 *bis* (including V.25 *bis*) procedures for circuit switching to be used to establish the connection. Following successful establishment of this connection, including its entering the data transfer phase at layer 1, the procedures specified in ISO 7776 and ISO/IEC 8208 shall be used.

Failure to establish the circuit switched connection is indicated to the NS user by means of an N-DISCONNECT indication primitive with the originator parameter indicating "NS provider" and the reason parameter as given in Table 4.

If the circuit switched connection is already established, then there are no additional procedures.

7.2.3.2 Circuit switched connection originated toward TE2

The additional provisions of 7.2.2.2 apply.

7.2.3.3 Disconnection or failure of the circuit switched connection

The additional provisions of 7.2.2.3 apply.

Table 4 – Mapping of X.21 progress signals to CONS reasons

Code	X.21 significance	NS reason
20	No Connection	Connection rejection – NSAP unreachable – transient
21	Number busy	Connection rejection – reason unspecified – transient
22	Selection signals procedure error	Connection rejection – reason unspecified – transient
23	Selection signals transmission error	Connection rejection – reason unspecified – transient
41	Access barred	Connection rejection – reason unspecified – permanent
42	Changed number	Connection rejection – reason unspecified – permanent
43	Not obtainable	Connection rejection – NSAP unreachable – permanent
44	Out of order	Connection rejection – reason unspecified – permanent
45	Controlled not ready or DTE inactive until....	Connection rejection – reason unspecified – permanent
46	Uncontrolled not ready	Connection rejection – reason unspecified – permanent
47	DCE power off	Disconnection – permanent
48	Invalid facility request	Connection rejection – reason unspecified – permanent
49	Network fault in local loop	Connection rejection – reason unspecified – permanent
51	Call information service	Connection rejection – reason unspecified – permanent
52	Incompatible user class of service	Connection rejection – reason unspecified – permanent
61	Network congestion	Connection rejection – reason unspecified – transient
71	Long-term network congestion	Connection rejection – reason unspecified – permanent
72	RPOA out of order	Connection rejection – reason unspecified – permanent

Annex A

Bibliography

(This Annex does not form an integral part of this Recommendation/International Standard.)

A.1 Additional references

– 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*.