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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)

Technologies de l'information — Télécommunications et échange d'informations entre systèmes — Fourniture du service de réseau OSI en mode connexion par un terminal en mode paquet raccordé à un réseau numérique avec intégration des services (RNIS)



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Contents	Page
Foreword	iii
Section 1 : General	1
1.1 Scope	1
1.2 Normative references	1
1.3 Definitions	2
1.4 Abbreviations	2
1.5 Overview	2
Section 2 : Provision of the CONS in systems attached at the S/T reference point	4
2.1 Procedures for TE1s or TE2/TAs to provide CONS	4
2.2 Additional procedures for a TE1 or TE2/TA to provide the CONS when using the ISDN D channel	5
2.3 Additional procedures for a TE1 or TE2/TA to provide the CONS when using the ISDN B channel	5
Section 3 : Provision of the CONS in systems attached at the R reference point	8
3.1 Procedures for TE2s to provide the CONS at the R reference point	8
3.2 Additional procedures for a TE2 to provide the CONS at the R reference point	8
ANNEX	
A Bibliography	11

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) together form a system for world wide standardization as a whole. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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 approval before their acceptance as International Standards. They are approved in accordance with procedures requiring at least 75% approval by the national bodies voting.

International Standard ISO/IEC 9574 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

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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)

Section 1 : General

1.1 Scope

This 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 CCITT 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 8208 packet layer protocol (PLP) and connected to an ISDN at either the S or T reference point.

NOTE - The definitions of TE1, TE2 and TA equipment, and R, S, and T reference points are given in CCITT Recommendation I.411. This 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 International Standard addresses the provision of the CONS using Virtual Calls as described in CCITT Recommendation X.25, it does not address the use of X.25 Permanent Virtual Circuits.

NOTE - This 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 CCITT Recommendations for ISDN, and does not imply any change in the functionality of the layers from that defined in the Basic Reference Model for Open Systems Interconnection.

1.2 Normative references

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

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.*

NOTE - See also CCITT Recommendation X.25

ISO 8208 : 1987, *Information processing systems - Data communications - X.25 Packet Level Protocol for Data Terminal Equipment.*

NOTE - See also CCITT Recommendation X.25

ISO 8878 : 1987, *Information processing systems - Data communications - Use of X.25 to provide the OSI connection-mode network service.*

NOTE - See also CCITT Recommendation X.223

CCITT Recommendation I.231, *Circuit-mode bearer service categories.*

CCITT Recommendation I.232, *Packet-mode bearer service categories.*

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

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

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

CCITT Recommendation Q.931 (I.451), *ISDN User-Network Interface Layer 3 Specification.*

CCITT Recommendation V.25 bis, *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, *Interface Between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for Synchronous Operation on Public Data Networks.*

CCITT Recommendation X.21 bis, *Use on Public Data Networks of Data Terminal Equipment (DTE) which is Designed for Interfacing to Synchronous V-series Modems.*

CCITT Recommendation X.31 (I.462), *Support of Packet Mode Terminal Equipment by an ISDN.*

CCITT Recommendation X.32, *Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and accessing a packet switched public data network through a public switched telephone network or a circuit switched public data network.*

NOTE - All references to CCITT Recommendations refer to the text of these Recommendations as approved by the CCITT Plenary Assembly in 1988

1.3 Definitions

This International Standard makes use of the following terms.

1.3.1 Reference Model definitions (ISO 7498)

- a) Network connection
- b) Network Layer
- c) Network Service

1.3.2 Service conventions definitions (ISO/TR 8509)

- a) Network Service provider
- b) Network Service user

1.3.3 Network Service definitions (ISO 8348)

- a) N-CONNECT request
- b) N-DISCONNECT indication

1.3.4 X.25 definitions (ISO 8208)

- a) DATA packet
- b) Data terminal equipment
- c) INCOMING CALL packet
- d) Throughput class
- e) User data field

1.3.5 CCITT Recommendation X.31 Definitions

- 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 CCITT Recommendations for ISDN use the term 'permanent' to describe this feature.

1.3.6 CCITT Recommendation I.112 Definitions

- a) terminal equipment
- b) reference point

1.3.7 CCITT Recommendation I.411 Definitions

- a) R reference point
- b) S reference point
- c) T reference point
- d) Terminal adaptor

1.3.8 CCITT Recommendation I.412 Definitions

- a) B Channel
- b) D Channel

1.3.9 CCITT Recommendation X.121 Definitions

- a) prefix
- b) escape

1.4 Abbreviations

1.4.1 Reference Model abbreviations

- NS Network Service
- OSI Open Systems Interconnection

1.4.2 Network service abbreviations

- CONS Connection-mode Network Service
- QOS Quality of Service

1.4.3 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

1.4.4 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

1.5 Overview

1.5.1 ISDN environment

The support of the packet mode terminal equipment within the scope of this International Standard by an ISDN is described in CCITT Recommendation X.31. Throughout this International Standard references to CCITT Recommendation Q.931 procedures indicate their use as described in CCITT Recommendation X.31. Two cases for ISDN support of packet mode terminal equipment are defined in CCITT 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 CCITT Recommendation I.231. The sub-network functions available to the user are those of the PSDN described in CCITT Recommendation X.25 (semi-permanent access) and CCITT Recommendation X.32 (demand access), as well as in other X-Series CCITT Recommendations (e.g., X.2, X.121).

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

1.5.2 CONS in this ISDN environment

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 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 section two of this International Standard.

The requirements for providing CONS in X.25 DTEs presenting an X.21, X.21bis, or V.25bis interface at the R reference point and connected to an ISDN through a TA are specified in section three of this International Standard.

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

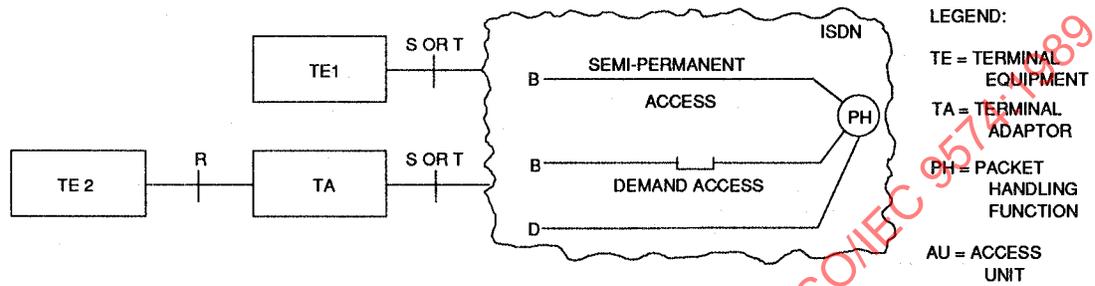


Figure 1a) - Configurations for case B access

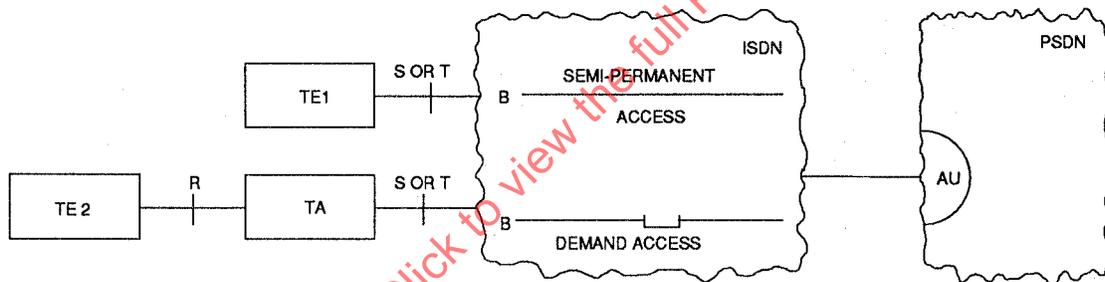


Figure 1b) - Configurations for case A access

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Section 2 : Provision of the CONS in systems attached at the S/T reference point

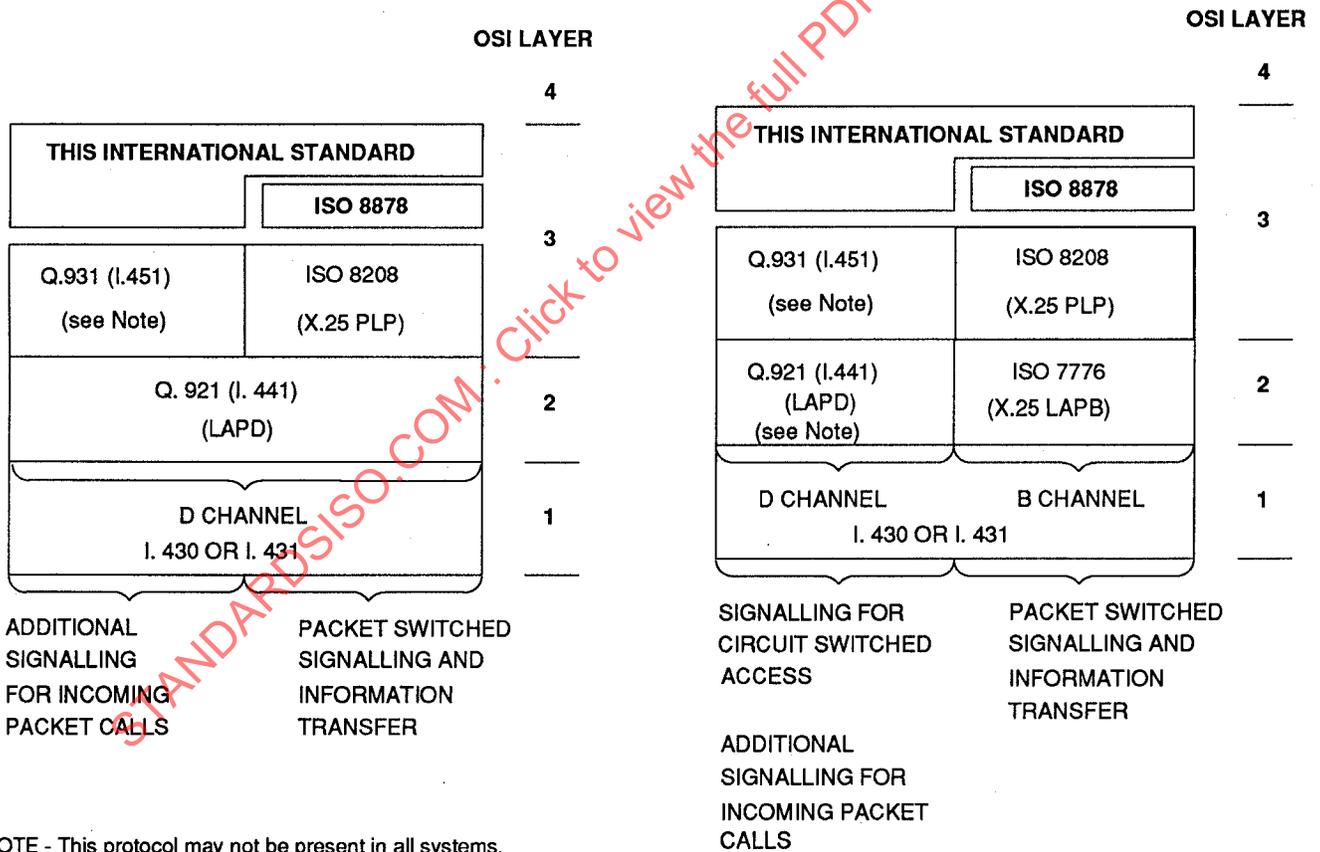
2.1 Procedures for TE1s or TE2/TAs to provide CONS

This section of this International Standard covers the three 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 as referenced in table 1.

The mapping of the elements of the CONS to the protocol and procedures of ISO 8208 shall be as required by ISO 8878 for a conforming implementation that does not use the X.25(1980) Sub-network Dependent Convergence Protocol. 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.

Table 1 - Cases covered by section two

Underlying connection perceived by the terminal equipment	Figure	Subclause
D channel	2	2.2
B channel : Semi-permanent	3	2.3.1
B channel : Demand	3	2.3.2



NOTE - This protocol may not be present in all systems.

NOTE - These two protocols may not be present in all systems.

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

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

2.2 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 CCITT Recommendations 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 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 8208 DATA packets shall not exceed 256 octets.
- b) The ISO 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.

2.2.1 Outgoing calls

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

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

2.2.2 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 8208 packets contain sub-network addresses that are valid for the ISDN.

2.2.2.1 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 8208 procedures shall be operated over the ISDN layer 2 procedures using a SAPI=16 as defined in CCITT Recommendation X.31. No additional procedures are required.

2.2.2.2 With call offering procedures

These additional procedures are used if the conditions in 2.2.2.1 do not apply (see note 1).

ISO 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 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 2 and 3). The ISDN call offering procedures (see notes 4 and 5) determine which TE1 or TE2/TA is to receive the call and are not visible to the NS user. The ISO 8208 procedures are then operated after the ISDN call offering procedures have been completed.

NOTES

1 This includes when the interface to which the TE1 or TE2/TA is connected has subscribed to the "Unconditional Notification class of service".

2 CCITT Recommendation X.31 states (note 4 to Section 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."

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

4 These procedures may use 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 (eg. a call should not be rejected because the HLC information element is not present).

5 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. Subclause 2.3 covers the case where a B channel is selected.

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

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 CCITT Recommendations 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 (I.441) 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 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 clause 2.1 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 8208 packets contain sub-network addresses that are valid for the ISDN. In case A the address fields of the ISO 8208 packets contain sub-network addresses that are valid for the PSDN.

2.3.1 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.

2.3.1.1 Virtual Call Originated by the TE1 or TE2/TA

No additional procedures are required.

2.3.1.2 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.

2.3.1.2.1 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".

2.3.1.2.2 With call offering procedures

These additional procedures are used for case B access if the conditions in 2.3.1.2.1 do not apply (see note 1).

The ISDN call offering procedures (see note 2) 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 8208 shall apply.

NOTES

- 1 This includes when the interface to which the TE1 or TE2/TA is connected has subscribed to the "Unconditional Notification class of service".
- 2 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 2.3.2 covers the case where a demand access B channel is selected. Subclause 2.2 covers the case where a D channel is selected.

2.3.2 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.

2.3.2.1 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 the 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 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 CCITT 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 CCITT Recommendation Q.931 Called party number information element is not used.

2.3.2.2 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.

2.3.2.2.1 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".

2.3.2.2.2 With call offering procedures

These additional procedures are used if the conditions in 2.3.2.2.1 do not apply (see note 1).

The ISDN call offering procedures (see notes 2 and 3) 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 8208 shall apply.

NOTES

- 1 This includes when the interface to which the TE1 or TE2/TA is connected has subscribed to the "Unconditional Notification class of service".
- 2 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 (eg. a call should not be rejected because the HLC information element is not present).
- 3 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 2.3.1 covers the case where a semi-permanent B channel is selected. Subclause 2.2 covers the case where a D channel is selected.

2.3.2.3 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.

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.

Section 3 : Provision of the CONS in systems attached at the R reference point

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

This section of this 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 8208 shall be as required by ISO 8878 for a conforming implementation. The X.25(1980) Sub-network Dependant Convergence Protocol shall only be used if the receiving system also implements this protocol. The remaining clauses in this section 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 section three

Underlying connection perceived by the terminal equipment	Subclause
Leased circuit	3.2.1
Direct call	3.2.2
Circuit switched	3.2.3

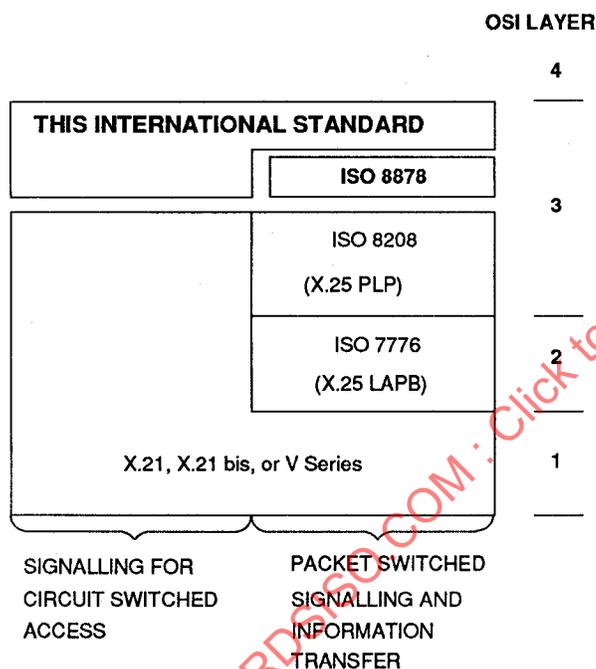


Figure 4 - Protocol layers at R reference point

3.2 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 procedures shall be used. At the network layer, ISO 8208 PLP shall be used.

The following sub-clauses 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 2.2).

3.2.1 Leased circuit connection

The X.21, X.21 bis, and V series interfaces 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.

3.2.2 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.

3.2.2.1 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 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.