
FOREWORD

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CCITT NOTE

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

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Recommendation X.612

PROVISION OF THE OSI CONNECTION-MODE NETWORK SERVICE BY PACKET MODE TERMINAL EQUIPMENT CONNECTED TO AN INTEGRATED SERVICES DIGITAL NETWORK (ISDN) FOR CCITT APPLICATIONS¹⁾

1 General

1.1 Introduction, scope and field of application

This Recommendation 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 the packet layer protocol (PLP) of Recommendation X.25 and connected to an ISDN at either the S or T reference point.

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

Note 2 – This Recommendation 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 addresses the provision of the CONS using virtual circuits as described in Recommendation X.25. It does not address the use of X.25 permanent virtual circuits (PVCs). The extension of this Recommendation to include the use of X.25 PVCs is for further study.

Note 3 – This Recommendation 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 for CCITT applications.

1.2 References

The following Recommendations contain provisions which, through reference in this text, constitute provisions of this Recommendation:

- | | |
|----------------------|--|
| Recommendation I.231 | – Circuit-mode bearer service categories; |
| Recommendation I.232 | – Packet-mode bearer service categories; |
| Recommendation I.430 | – Basic user-network interface layer 1 specification; |
| Recommendation I.431 | – Primary rate user-network interface layer 1 specification; |
| Recommendation Q.921 | – ISDN user-network interface data link layer specification; |

¹⁾ Recommendation X.612 and ISO 9574 (Information processing – Telecommunications interchange between systems – Provision of the OSI connection-mode network service by packet mode terminal equipment connected to an integrated service digital network) were developed in close collaboration and are technically aligned.

- Recommendation Q.931 – ISDN user-network interface layer 3 specification;
- Recommendation V.25 *bis* – Automatic calling and/or answering equipment on the general switched telephone network (GSTN) using the 100-series interchange circuits;
- Recommendation X.21 – Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for synchronous operation on public data networks;
- Recommendation X.21 *bis* – Use on public data networks of data terminal equipment (DTE) which is designed for interfacing to synchronous V-Series modems;
- Recommendation X.25 – Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit.

Note – This Recommendation is referred to solely in respect of its packet layer protocol description. However, this Recommendation fully specifies the behaviour of the DCE while specifying only a minimum set of requirements for the DTE. Additional guidance for the design of DTEs is available in International Standard ISO/IEC 8208. The development of a Recommendation describing X.25 DTE procedures for CCITT applications is for further study.

- Recommendation X.31 – Support of packet mode terminal equipment by an ISDN;
- 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 an integrated services digital network or a circuit switched public data network;
- Recommendation X.223 – Use of X.25 to provide the OSI connection-mode network service for CCITT applications (See also ISO 8878);

1.3 *Definitions*

1.3.1 *Recommendation X.200 definitions*

Network connection
 Network layer
 Network service

1.3.2 *Recommendation X.210 definitions*

Network service provider
 Network service user

1.3.3 *Recommendation X.213 definitions*

N-CONNECT request
 N-DISCONNECT indication

1.3.4 *Recommendation X.25 definitions*

DATA packet
 Data terminal equipment

INCOMING CALL packet

Throughput class

User data field

1.3.5 *Recommendation X.31 definitions*

Conditional notification class of service

ISDN Virtual Circuit Bearer Service

No notification class of service

Packet handling function

PSPDN service

Unconditional class of service

Semi-permanent access (see Note)

Demand access

Note – Some ISDN Recommendations use the term “Permanent” to describe this feature.

1.3.6 *Recommendation I.112 definitions*

Terminal equipment

Reference point

1.3.7 *Recommendation I.411 definitions*

R reference point

S reference point

T reference point

Terminal adaptor

1.3.8 *Recommendation I.412 definitions*

B-channel

D-channel

1.3.9 *Recommendation X.121 definitions*

Prefix

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

DTEData 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 Recommendation by an ISDN is described in Recommendation X.31. Throughout this Recommendation 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.200-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.

1.5.2 *CONS in this ISDN environment*

Recommendation X.223 specifies the method for providing the OSI-CONS through the use of the Recommendation X.25 PLP. When operating in an ISDN environment, a few requirements additional to those contained in Recommendation X.223 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 2.

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 Section 3.

This Recommendation uses the X.25 PLP to convey all elements of all three phases of the OSI-CONS.

TABLE 1

Cases covered by § 2
Fig. 1 = 14cm

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

2.1 Procedures for TE1s and TE2/TAs to provide CONS

This § 2 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 Recommendation X.25 shall be as required by Recommendation X.223. The remaining subsections of Section 2 specify the provisions required in addition to these mappings, by systems attached to an interface at the S/T reference point.

Underlying connection perceived by the terminal equipment	Figure	Subsection
D-channel	2	2.2

B-channel : semi-permanent	3	2.3.1
B-channel : demand	3	2.3.2

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

This section 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 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, X.25 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:

- 1) the maximum user data field length of X.25 data packets shall not exceed 256 octets;
- 2) the Recommendation X.25 throughput class used shall not exceed 16 kbit/s 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*

Recommendation X.25 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 Recommendation X.25 packets contain sub-network addresses that are valid for the ISDN (e.g. Recommendation E.164 for public ISDNs, where a valid Recommendation E.164 format address could be Escape Code + Recommendation X.121 number; a network dependant 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 Recommendation X.25 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 on which the TE1 or TE2/TA is connected has subscribed to the “no notification class of service”.

Recommendation X.25 procedures shall be operated over the ISDN layer 2 procedures using SAPI=16 as described in Recommendation X.31. No additional procedures are required.

2.2.2.2 *With call offering procedures*

These additional 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.

Recommendation X.25 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 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 Recommendation X.25 procedures are then operated after the ISDN call offering procedures have been completed.

Note 1 – Recommendation X.31 states (Note 4 of § 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.

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

Note 3 – 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 accepted on the basis of compatibility information unless this information identifies functionality that is not within the capability of the terminal. It is also suggested that incoming calls are accepted in the case where compatibility information is not present. Incoming calls can be rejected for other reasons. Care must be taken when connecting terminals operating according to this specification to a passive bus with other terminals that may accept incoming calls without compatibility information.

Note 4 – These procedures may require D-channel selection, or may offer the terminal a choice of D- or B-channels. No distinction is made between these ways of selecting the D-channel. Section 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 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 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 X.25 LAPB 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, the X.25 PLP shall be used over the B-channel for the packet layer protocol (see note).

The following sub-sections specify the additional provisions required in 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 Recommendation X.25 packets contain sub-network addresses that are valid for the ISDN. In Case A, the address fields of the Recommendation X.25 packets contain sub-network addresses that are valid for the PSPDN.

2.3.1 *Semi-permanent B-channel connection*

Both the basic interface and the primary rate interface provide for the 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 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 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 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, Recommendation X.25 layers 2 and 3 procedures 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. Paragraph 2.3.2 covers the case where a demand access B-channel is selected. Paragraph 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 be used if a B-channel is not already established between the TE1 or TE2/TA and the packet handling function, or 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 Note). Following successful establishment of this B-channel connection, including its entering the data transfer phase at layer 1, the procedures specified in Recommendation X.25 shall apply for layers 2 and 3. 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 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 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 – 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 retransfer this additional information.

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

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 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 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 entering the data transfer phase at layer 1, Recommendation X.25 layers 2 and 3 procedures shall apply.

Note 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 accepted on the basis of compatibility information unless this information identifies functionality that is not within the capability of the terminal. It is also suggested that incoming calls are accepted in the case where compatibility information is not present. Incoming calls can be rejected for other reasons. Care must be taken when connecting terminals operating according to this specification to a passive bus with other terminals that may accept incoming calls without compatibility information.

Note 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. Paragraph 2.3.1 covers the case where a semi-permanent B-channel is selected. Paragraph 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 are 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 the 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.

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 3 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 information elements of the CONS to the protocol and procedures of X.25 PLP shall be as required by Recommendation X.223 for a conforming implementation. The remaining subsections of Section 3 specify the provisions required in addition to these mappings, by systems attached to an interface at the R reference point.

TABLE 3

Cases covered in § 3

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

Fig. 4 = 9.5cm

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

TE2s implement all three protocol layers of Recommendation X.25 (see Figure 4). At the physical layer (and for signalling for a circuit switched connection), either X.21 or X.21 *bis* or V-Series interfaces may be used. At the data link layer, X.25 LAPB shall be used. At the network layer, the X.25 PLP shall be used.

The following subsections 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.

It is not visible to the TE2 whether Case A or Case B access is being used, 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 Recommendation 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, X.21 *bis* and V.25 *bis* interfaces provide for 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 subsections below apply.

3.2.2.1 *Direct call circuit switched connection originated by a 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, X.21 *bis* or 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, X.21 *bis* or V.25 *bis* procedures for entering the data transfer phase at layer 1, the procedures specified in Recommendation X.25 for layers 2 and 3 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.

3.2.2.2 *Circuit switched connection originated toward the TE2*

The Recommendation X.21 procedures need to be in the layer 1 *ready* state, the Recommendation X.21 *bis* procedures must have circuit 107 OFF, and the Recommendation V.25 *bis* procedures must have circuit 108/2 ON, 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 state at layer 1, the procedures specified in Recommendation X.25 shall apply at layers 2 and 3.

TABLE 4

Mapping of Recommendation 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

3.2.2.3 *Disconnection of the circuit switched procedures*

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 Recommendations X.25 and X.223 concerning the failure of layer 1 shall apply to the mapping to an N-DISCONNECT indication primitive 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, X.21 *bis* or V.25 *bis* procedures, of the circuit switched connection.

3.2.3 *Circuit switched connection*

The X.21, X.21 *bis* and 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 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 subsections below apply.

3.2.3.1 *Circuit switched connection originated by a 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, X.21 *bis* or V.25 *bis* procedures for circuit switching to

be used to establish the connection. Following the successful establishment of this connection, including its entering the data transfer phase at layer 1, the procedures specified in Recommendation X.25 for layers 2 and 3 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.

3.2.3.2 *Circuit switched connection originated toward the TE2*

The additional provisions of § 3.2.2.2 apply.

3.2.3.3 *Disconnection or failure of the circuit switched connection*

The additional provisions of § 3.2.2.3 apply.

ANNEX A

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

Bibliography

Recommendation E.164 – Numbering plan for the ISDN era.

Recommendation I.112 – Vocabulary of terms for ISDNs.

Recommendation I.411 – ISDN user-network interface – Reference configurations.

Recommendation I.412 – ISDN user-network interface – Interface structures and access capabilities.

Recommendation X.2 – International data transmission services and optional user facilities in public data networks.

Recommendation X.121 – International numbering plan for public data networks.

Recommendation X.200 – Reference model of open systems interconnection for CCITT applications (see also ISO 7498).

Recommendation X.210 – Open systems interconnection layer service conventions (see also ISO TR8509).

Recommendation X.213 – Network service definition for open systems interconnection for CCITT applications (see also ISO 8348 and ISO 8348/Add.2).