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SERIES X: DATA NETWORKS AND OPEN SYSTEM
COMMUNICATION

Public data networks – Interfaces

**Access to packet switched data transmission
services via B-ISDN**

ITU-T Recommendation X.34

(Previously "CCITT Recommendation")

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FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (ITU). The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

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NOTE

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

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SUMMARY

This Recommendation defines services available and signalling procedures operated at the S_B/T_B reference point of a B-ISDN for access to packet switched data transmission service via the B-ISDN.

ACCESS TO PACKET SWITCHED DATA TRANSMISSION SERVICES VIA B-ISDN

(Geneva, 1996)

1 SCOPE

This Recommendation defines the procedures of access to PSDTS via a B-ISDN. It includes two cases;

- a) PSPDN provides the PSDTS.
- b) ISDN provides the PSDTS.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision: all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of Currently valid ITU-T Recommendations is regularly published.

- [1] CCITT Recommendation E.164 (1991), *Numbering plan for the ISDN era.*
- [2] ITU-T Recommendation E.166/X.122 (1996), *Numbering plan interworking for E.164 and X.121 numbering plans.*
- [3] ITU-T Recommendation I.211 (1993), *B-ISDN service aspects.*
- [4] ITU-T Recommendation I.361 (1995), *B-ISDN ATM layer specification.*
- [5] ITU-T Recommendation I.362 (1993), *B-ISDN ATM adaptation layer (AAL) functional description.*
- [6] ITU-T Recommendation I.363 (1993), *B-ISDN ATM adaptation layer (AAL) specification.*
- [7] ITU-T Recommendation I.413 (1993), *B-ISDN user-network interface.*
- [8] ITU-T Recommendation I.430 (1995), *Basic user-network interface – Layer 1 specification.*
- [9] ITU-T Recommendation I.431 (1993), *Primary rate user-network interface – Layer 1 specification.*
- [10] ITU-T Recommendation I.432 (1993), *B-ISDN user-network interface – Physical layer specification.*
- [11] ITU-T Recommendation I.580 (1995), *General arrangements for interworking between B-ISDN and 64 Kbit/s based ISDN.*
- [12] ITU-T Recommendation Q.2110 (1994), *B-ISDN ATM adaptation layer – Service Specific Connection Oriented Protocol (SSCOP).*
- [13] ITU-T Recommendation Q.2130 (1994), *B-ISDN signalling ATM adaptation layer – Service specific coordination function for support of signalling at the user-network interface (SSCF at UNI).*
- [14] ITU-T Recommendation I.610 (1995), *B-ISDN operation and maintenance principles and functions.*

- [15] ITU-T Recommendation Q.2931 (1995), *Broadband Integrated Services Digital Network (B-ISDN) – Digital Subscriber Signalling System No. 2 (DSS 2) – user network – interface (UNI) layer 3 specification for basic call/connection control.*
- [16] ITU-T Recommendation X.1 (1996), *International user classes of service in, and categories of access to, public data networks and Integrated Services Digital Networks (ISDNs).*
- [17] ITU-T Recommendation X.25 (1996), *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.*
- [18] ITU-T Recommendation X.31 (1995), *Support of packet mode terminal equipment by an ISDN.*
- [19] ITU-T Recommendation X.32 (1996), *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.*
- [20] ITU-T Recommendation X.75 (1996), *Packet switched signalling system between public networks providing data transmission services.*
- [21] ITU-T Recommendation X.121 (1996), *International numbering plan for public data networks.*
- [22] ITU-T Recommendation X.213 (1995), *Information technology – Open Systems Interconnection – Network service definition.*
- [23] ITU-T Recommendation I.365.4 (1996), *Service specific convergence sublayer for HDLC applications.*

3 Terms and definitions

For the purposes of this Recommendation, the following definition applies.

3.1 HDLC applications SSCS (HDLC Applications Service Specific Convergence Sublayer, see Recommendation I.365.4): HDLC Applications SSCS is used at the TE and AU for interworking between AAL and X.25 LAPB.

4 Abbreviations

For the purposes of this Recommendation, the following abbreviations are used.

AAL	ATM Adaptation Layer
ATM	Asynchronous Transfer Mode
AU	Access Unit
BCOB	Broadband Connection Oriented Bearer class
B-ET	Exchange Terminal for Broadband ISDN
B-ISDN	Broadband ISDN
B-NT	Network Termination for Broadband ISDN
B-TA	Terminal Adaptor for Broadband ISDN
CH	Cell Handler
CPCS	Common Part Convergence Sublayer
CPCS-CI	CPCS-Congestion Indication
CPCS-LP	CPCS-Loss Priority
CPCS-UU	CPCS-User to User indication
DNIC	Data Network Identification Code
DTE	Data Terminal Equipment
ISDN	Integrated Services Digital Network

IWF	InterWorking Function
NT	Network Termination
PH	Packet Handler
PMBS	Packet Mode Bearer Service
PSPDN	Packet Switched Public Data Network
PSDTS	Packet Switched Data Transmission Services
PVC	Permanent Virtual channel Connection
QOS	Quality of Service
SSCS	Service Specific Convergence Sublayer
SVC	Switched Virtual channel Connection
TA	Terminal Adapter
TE	Terminal Equipment
VCI	Virtual Channel Identifier
VPCI	Virtual Path Connection Identifier

5 General service aspects

Packet Switched Data Transmission Services (PSDTSs) are provided by Packet Switched Public Data Networks (PSPDNs) or by Integrated Services Digital Networks (ISDNs). These PSDTSs may be accessed by users of Broadband ISDNs (B-ISDNs).

- a) This Recommendation defines the aspects of packet switched data transmission services provided by a PSPDN or an ISDN to the users of B-ISDN in accordance with the services defined in Recommendations I.211 and X.1.
- b) This Recommendation defines the procedures at the user-network interface of a B-ISDN to access packet switched data transmission services provided by a PSPDN or an ISDN in alignment with Recommendations Q.2931 and X.25.
- c) This Recommendation defines the procedures at the user-network interface of a B-ISDN to access packet switched data transmission services provided by a PSPDN or an ISDN in alignment with Recommendations I.432, I.361, I.362, I.363, Q.2110 and Q.2130.
- d) This Recommendation defines the Terminal Adaptation functions to adapt existing X.25 terminals for use at the user-network interface of a B-ISDN in order to access packet switched data transmission services provided by a PSPDN or an ISDN.

6 Reference configurations

There are two reference configurations:

Type A: Access to the Packet Switched Data Transmission Service (PSDTSs) provided by a Packet Switched Public Data Network (PSPDN) using the B-ISDN.

Type B: Access to the PSDTS provided by an ISDN using the B-ISDN.

In the configurations given below, a Terminal Equipment (TE) with X.25 and ATM capabilities is equivalent to a combination consisting of an X.25 Data Terminal Equipment (DTE) and a Terminal Adapter (TA) with ATM capabilities.

NOTE 1 – ATM capabilities are in accordance with Recommendations I.361, I.362, I.363, I.432, Q.2110 and Q.2130 for TEs/TAs attached to a B-ISDN.

In this Recommendation, every reference to the combination of an X.25 DTE and its TA should always be considered as being applicable to a TE with X.25 and also TA and TE should support AAL type 5 function (CPCS + HDLC Applications SSCS) to convey X.25 frames. (See Recommendation I.365.4).

NOTE 2 – Use of AAL type 1 with HDLC framing instead of AAL type 5 should not be precluded.

In case AAL type 5 is used, AAL type 5 message mode service will be available. The functionality of the HDLC Applications SSCS only provides for the mapping of the equivalent primitives of AAL to CPCS and vice versa. The CPCS-UNITDATA primitive parameters should be set by SSCS as specified in 7.4/I.365.4.

6.1 Configuration when accessing PSPDN via a B-ISDN

This configuration (Figure 6-1) refers to the case where the PSDTS provided by a PSPDN is accessed using the B-ISDN. In this case, a TE/X.25 DTE+TA accesses the PSDTS of the PSPDN by means of an ATM virtual channel connection established through the B-ISDN. The ATM virtual channel connection is routed, within the B-ISDN, to an access port of the PSPDN referred to as "Access Unit (AU)".

An ATM virtual channel connection is set up to/from an AU port. An AU supports the possible path setting-up functions for Layer 1 and possible rate adaptation between the PSPDN and the B-ISDN. An AU also supports the necessary processing functions for ATM virtual channel connections and X.25 virtual calls. The same AAL as that of TEs/TAs are also applicable for AU.

NOTE 1 – The PSDTS may be provided by physically the same network as B-ISDN.

It is important to note that the procedures for accessing PSDTS through a B-ISDN user-network interface are independent of where the service provider chooses to locate the AU function. The AU function, logically belonging to the PSPDN, may physically be located either in the PSPDN or in the B-ISDN.

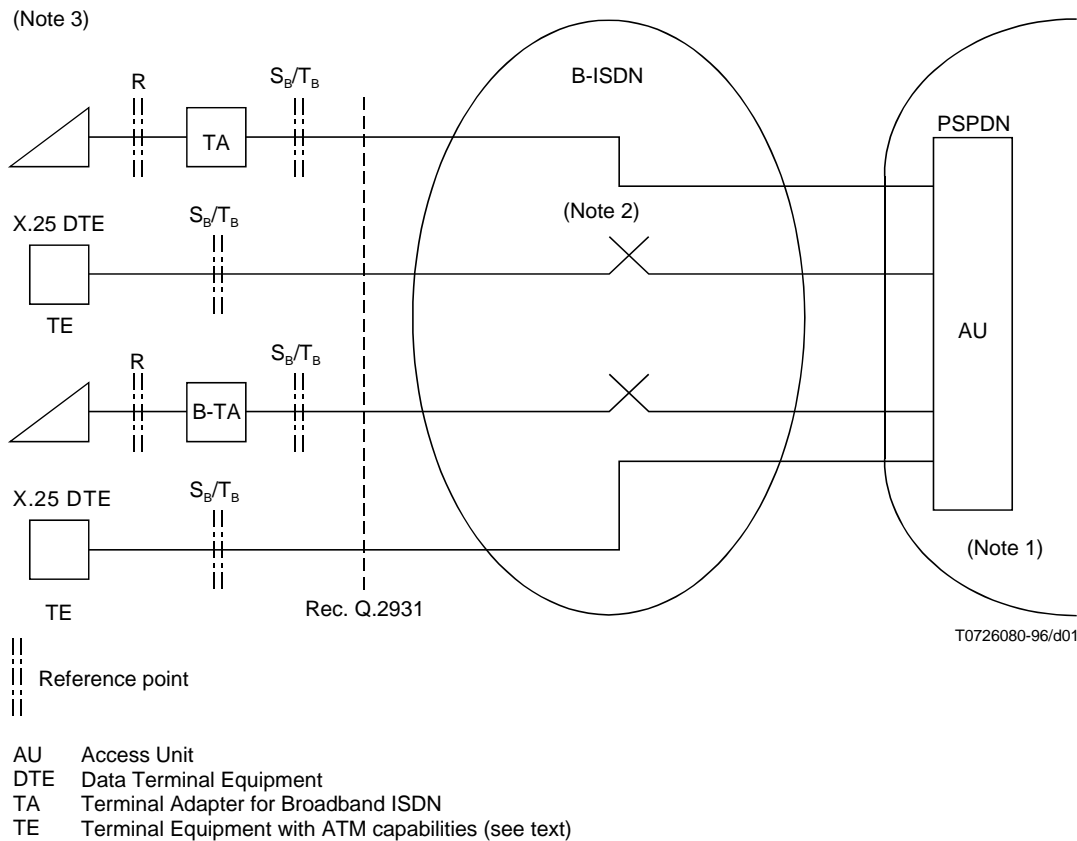


FIGURE 6-1/X.34

Reference configuration for access to PSDTS in PSPDN using B-ISDN

ATM Permanent Virtual channel Connections (PVCs) and/or ATM Switched Virtual channel Connections (SVCs) may be established between the TE/X.25 DTE+TA and the AU.

The procedures used to establish and disconnect ATM PVCs are beyond the scope of this Recommendation (e.g. administrative, management procedures).

Over the ATM PVC, X.25 virtual calls (or X.25 PVCs) may be established between the TE/X.25 DTE+TA and a remote DTE supported by the PSPDN. More than one X.25 virtual calls may be established over the ATM PVC.

The procedures used to establish and disconnect ATM SVCs are categorized according to two cases:

- *Interworking by port access*

NOTE 2 – Definition of B-ISDN related interworking recommendations under X.300-Series is for further study.

The establishment of a call between a TE/X.25 DTE+TA and a remote DTE is based on a two-step approach. In the first step, an ATM SVC is established between the TE/TA and the AU using Q.2931 procedures prior to starting X.25. For an outgoing call from a TE/X.25 DTE+TA, the address of the AU is contained in the Q.2931 SETUP message. For an incoming call to a TE/X.25 DTE+TA, the AU is able to set up an ATM SVC through the B-ISDN. In the second step, X.25 virtual calls are established between the TE/X.25 DTE and the remote DTE. More than one X.25 virtual call may be established over the ATM Switched virtual channel connection.

NOTE 3 – No X.25 PVCs are established over an ATM SVC.

For an outgoing call from a TE/X.25 DTE+TA, the address of the remote called DTE is contained in the called address field of the X.25 *call request packet*. For an incoming call to a TE/X.25 DTE+TA, the address of the TE/X.25 DTE+TA is contained in the called address field of the X.25 *incoming call packet*. The AU acts as a relay for X.25 information flows.

The detailed procedures are specified in clause 10.

- *Interworking by call control mapping*

In this interworking scenario, the AU also provides an InterWorking Function (IWF) referred to as AU/IWF. In this case, the AU/IWF consists of an ATM Cell Handler (CH) function, a Packet Handler (PH) function and the necessary functions to interwork them. The interworking component of the AU/IWF performs the mapping between the corresponding protocol procedures at the interfaces on its two sides.

The detailed procedures for the case of interworking by call control mapping are for further study.

6.2 Configuration when accessing the packet switched data transmission services of an ISDN via a B-ISDN

This configuration (Figure 6-2) refers to the case where the ISDN packet switched data transmission services of an ISDN are accessed via B-ISDN. In this case, a TE/X.25 DTE+TA uses an ATM virtual channel connection to access a PH function within the ISDN via an Access Unit (AU).

For the following procedures, the considerations specified in 6.1 above apply.

- The establishment and disconnection of ATM PVCs between a TE/X.25 DTE+TA and the ISDN AU function.
- The establishment and disconnection of ATM SVCs between a TE/X.25 DTE+TA and the ISDN AU function.

7 Service aspects

7.1 General

The following subclauses apply for both access to PSDTS provided by a PSPDN and access to PSDTS provided by an ISDN using B-ISDN.

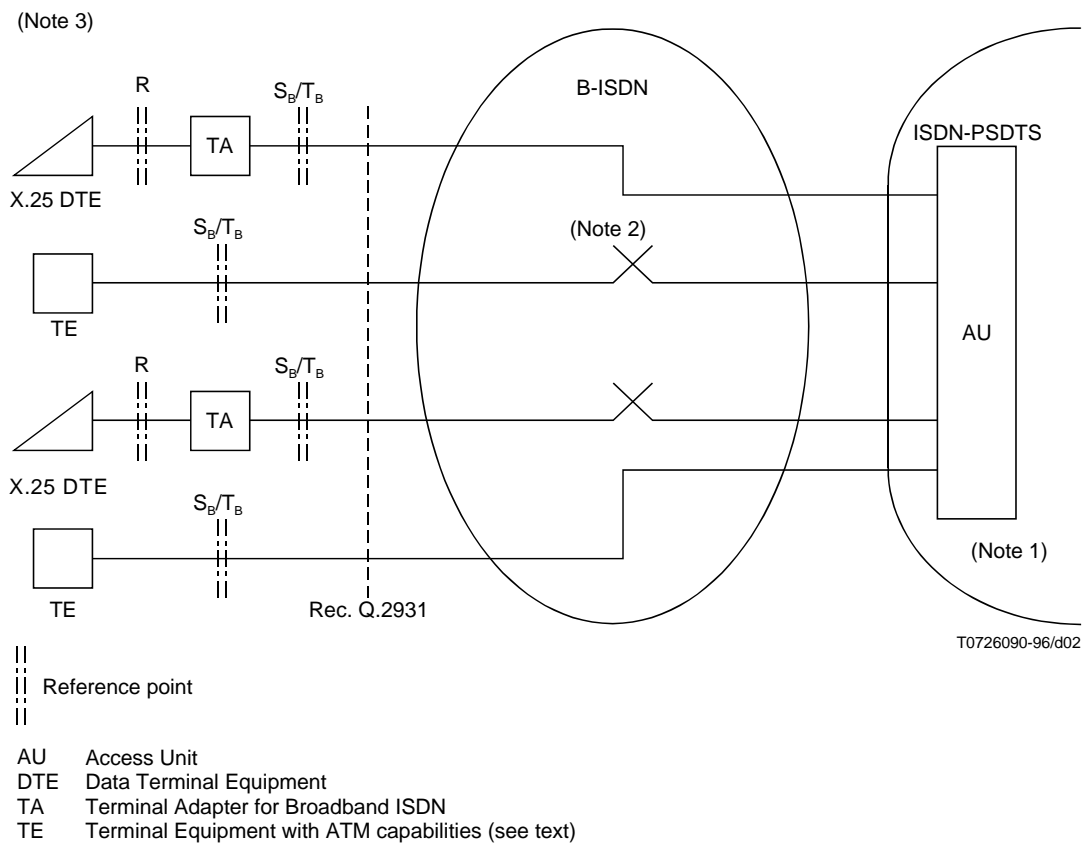


FIGURE 6-2/X.34
Reference configuration for access to PSDTS in ISDN using B-ISDN

In general, B-ISDN has no knowledge of the customer's terminal equipment or configurations.

Interworking considerations are defined in clause 9.

7.2 Service characteristics

In this case, the B-ISDN offers an ATM PVC or SVC with AAL functions of class C between a TE/TA and an AU port. In the ATM SVC case, the AU must be selected by the called party number information element of an Q.2931 SETUP message used on a signalling Virtual Channel identified by VCI=5 at the B-ISDN user-network interface when the TE/TA sets up the ATM SVC to the AU. In the ATM PVC access case, Q.2931 signalling protocol messages are not used.

NOTE 1 – Support of Point-to-Multipoint access arrangement in B-ISDN is for further study (VCI = 5 is for Point-to-Point access case only).

A distinction in service characteristics is made between the two methods of interworking (i.e. port access, call control mapping) that may be used to access PSDTS.

- In the port access method of interworking, there is a requirement for identification of the TE/X.25 DTE+TA to the AU function when the TE/X.25 DTE+TA accesses the AU through the B-ISDN or when the TE/X.25 DTE+TA is accessed by the AU through the B-ISDN.

The “TE/X.25 DTE+TA identity” is a means of referring to the TE/X.25 DTE+TA. The TE/X.25 DTE+TA identity is either explicitly agreed to between the TE/X.25 DTE+TA and the Administration providing the AU function or is implicitly acceptable to the AU Administration through agreements with other Administrations, organizations or authorities (see Recommendation X.32).

NOTE 2 – The Administration providing the AU function will be referred to as the “AU Administration” in the following description.

The characteristics of the service which a TE/X.25 DTE+TA obtains will depend upon whether the AU considers the TE/X.25 DTE+TA identified for each ATM SVC.

Two components are required in order for a TE/X.25 DTE+TA to be considered identified (see Recommendation X.32):

- a) the TE/X.25 DTE+TA is administratively registered either:
 - 1) through direct arrangement with the AU Administration (i.e. explicitly); or
 - 2) through pre-arrangement between the AU Administration and the B-ISDN Administration or another authority, and direct arrangement between the TE/X.25 DTE+TA and that authority (i.e. not explicitly);
- b) the TE/X.25 DTE+TA identity is made known to the AU when setting up the ATM SVC using one of the methods described in 2.4/X.32.

The service offered for an unidentified TE/X.25 DTE+TA is as specified in 2.3.2.1/X.32. In addition when establishing an ATM SVC through the B-ISDN to an unidentified TE/X.25 DTE+TA, the AU sets the subparameters of the ATM Traffic Descriptor information element in the Q.2931 SETUP message to network-specific default values.

The service offered for an identified TE/X.25 DTE+TA is as specified in 2.3.2.2/X.32. In addition when establishing an ATM SVC through the B-ISDN to an identified TE/X.25 DTE+TA, the AU sets the subparameters of the ATM Traffic Descriptor information element in the Q.2931 SETUP message to TE/X.25 DTE+TA specific values.

In the port access case, PSDTS is provided by a PSPDN (Type A) or an ISDN (Type B).

In Type A, PSPDN services are provided including optional user facilities. In the case where DTE is not subscribing to the PSPDN, it will be provided with a limited set of PSPDN facilities (see Recommendation X.32). QOS characteristics for this case will be those of Recommendation X.25, but limited by the QOS characteristics of the B-ISDN.

NOTE 3 – The QOS characteristics of the B-ISDN are according to Recommendation I.356.

In Type B, ISDN Virtual Circuit Bearer Services are provided including facilities. Existing features of the X-Series Recommendations may be enhanced and additional features may also be developed taking into account new ISDN customer capabilities. QOS characteristics of this case will be those of ISDN, but limited by the QOS characteristics of the B-ISDN.

NOTE 4 – In type B, the relationship between X.25 optional user facilities and B-ISDN supplementary services is for further study.

NOTE 5 – In both Type A and Type B, definition of a Recommendation specifying QOS is for further study.

- In the call control mapping method of interworking, it is for further study to determine the need for a requirement to identify the TE/X.25 DTE+TA by the AU.

In general, the TE/X.25 DTE+TA will be associated with one or more B-ISDN numbers (E.164 numbers). The TE/X.25 DTE+TA may also be associated with one or more X.121 numbers assigned by the PSPDN in case of access to PSDTS of PSPDN. X.121 numbers shall not be conveyed in Q.2931 messages whereas both X.121 and E.164 numbers may be conveyed in X.25 call request and incoming call packets. The method for X.25 packets to convey numbers from the two numbering plans are specified in Recommendation X.122/E.166.

7.3 User access capabilities

In type A, DTEs belonging to user classes of service 30 to 61 of Recommendation X.1 (categories of access BIA1 to BIA32 and BIB1 to BIB32) can be supported with no restrictions on the use of Recommendation X.25.

In type B, DTEs belonging to user classes of service 30 to 61 of Recommendation X.1 (categories of access BIC1 to BIC32 and BID1 to BID32) can be supported with no restrictions on the use of Recommendation X.25.

8 Addressing and routing aspects

The following subclauses apply for both access to PSDTS provided by a PSPDN (type A) and access to PSDTS provided by an ISDN (type B) using B-ISDN except clearly stated.

8.1 Outgoing calls

8.1.1 Access unit selection

A distinction is made between the two methods of interworking that may be used to access PSDTS.

- In the port access method of interworking, the responsibility to invoke the AU is with the calling TE/X.25 DTE+TA. If an ATM virtual channel connection (PVC or SVC) is not established between the calling DTE/X.25 DTE+TA and the AU, it is the responsibility of the calling TE/X.25 DTE+TA to establish the ATM virtual channel connection to the AU before being able to establish any X.25 virtual call to a remote DTE.
- In the call control mapping method of interworking, it is the network responsibility to invoke the AU, if needed. The calling TE/X.25 DTE+TA establishes an ATM SVC towards the remote called DTE without being aware that an AU may be required to complete the call to its destination. The AU which is invoked by the network, if needed, provides the mapping between the ATM protocol procedures and the X.25 protocol procedures.

8.1.2 Addressing scheme

An AU port will be assigned an B-ISDN address.

- In the port access method of interworking, the called party number information element of the Q.2931 SETUP message contains the address of the AU. An X.25 *call request packet* sent over the ATM SVC contains the address of a remote called DTE.
- In the call control mapping method of interworking, the called party number information element of the Q.2931 SETUP message contains the address of the remote called DTE.

8.2 Incoming calls

8.2.1 Access unit selection

When the network providing PSDTS (e.g. PSPDN or ISDN) is connected to other networks, the guidelines outlined below may be used to select an AU to complete an incoming X.25 virtual call to the called TE/X.25 DTE+TA.

8.2.1.1 Access unit selection by PSPDN (Type A)

Typically the PSPDN, based on arrangements with the B-ISDN, will have knowledge regarding the bearer services supported by the B-ISDN. If the called DTE is registered with the PSPDN and the called DTE subscription parameters indicate "ATM", the PSPDN selects an AU function (with functionality as specified in this Recommendation) and the procedures specified in 10.2.2 below apply.

8.2.1.2 Access unit selection by ISDN (Type B)

The following criteria may be used by ISDN to complete an incoming X.25 virtual call to the called TE/X.25 DTE+TA:

- The ISDN determines from the called address that the called TE/X.25 DTE+TA is one of its endpoints. If the called DTE subscription parameters indicate "ATM", the ISDN offers the incoming X.25 virtual call to the called DTE using the procedures specified in Recommendation Q.2931.
- The ISDN determines from the called address that the called TE/X.25 DTE+TA is one of its endpoints. If the called DTE subscription parameters indicate "Packet Mode", the ISDN offers the incoming X.25 virtual call to the called DTE using the procedures for Case B of Recommendation X.31.
- The ISDN determines from the called address that interworking with an adjacent ISDN is required. Based on arrangements with the adjacent ISDN, the ISDN will have knowledge regarding the bearer services supported by the adjacent ISDN. The ISDN may then use the criteria described in 8.2.1.1 to select an AU to complete the call.

NOTE – More global resolution (e.g. definition of a separate Recommendation) may need to be studied with respect to the selection of AU in case of incoming call when a network providing PSDTS is connected to multiple networks including ISDN-CS, ISDN-PS, ISDN-FR and B-ISDN. It is for further study.

8.2.2 Addressing scheme

- In the port access method of interworking, the called party number information element of an Q.2931 SETUP message contains the address of the called TE/X.25 DTE+TA. The calling party number information element of the SETUP message may contain the address of the AU. An X.25 *incoming call packet* sent over the ATM SVC may contain the address of the called TE/X.25 DTE+TA and contains the calling address of the remote DTE.
- In the call control mapping method of interworking, the called party number information element of the Q.2931 SETUP message contains the address of the called TE/X.25 DTE+TA. The calling party number information element of the SETUP message may contain the address of the remote DTE.

8.2.3 Called TE/X.25 DTE+TA interface selection

This subclause describes the information necessary to select a compatible TE/X.25 DTE+TA for the completion of an incoming ATM SVC.

It is envisaged that a B-ISDN would identify, by means of an ISDN address, a specific interface within the subscriber premises. The transmission capability information may be used by the called TE/X.25 DTE+TA for compatibility checking purposes.

In general, a B-ISDN number identifies one or more ISDN user-network interfaces. However, some networks may allow a B-ISDN user-network interface to be allocated more than one ISDN number, thus allowing the identification of a given terminal within a B-ISDN user-network interface (see Recommendation Q.2951.2).

NOTE – Further study is required for TE selection in the B-ISDN user premises. (e.g. Point-To-Multipoint configuration)

9 Interworking with dedicated networks

9.1 General

Interworking by both port access and call control mapping is possible.

This Recommendation specifies the procedures for interworking by the port access method. Interworking by the call control mapping method is for further study.

9.2 Access to PSDTS via a B-ISDN

A TE/X.25 DTE+TA accesses the access port, referred to as AU, in the network providing the PSDTS by means of an ATM virtual channel connection through the B-ISDN. The AU belongs to the network providing the PSDTS and is functionally equivalent to an IWF.

NOTE – Definition of interworking Recommendation under X.300-Series is for further study.

In some implementations, the AU function logically belonging to the network providing the PSDTS may reside physically in a node in the B-ISDN. The service provided by this B-ISDN is still B-ISDN_services and the interworking between it and the network providing the PSDTS is effected through use of an X.75 interface or a functionally equivalent internal network protocol.

Note that in some implementations the same ISDN may be providing both the PSDTS and the B-ISDN services.

10 Procedures

The following subclauses apply for both access to PSDTS provided by a PSPDN (Type A) and access to PSDTS provided by an ISDN (Type B) using B-ISDN except clearly stated.

10.1 General

The procedures specified in this Recommendation are based on the port access method of interworking.

NOTE 1 – Procedures based on the call control mapping of interworking are for further study.

As described in 6.2 above, an ATM virtual channel connection is established between the TE/X.25 DTE+TA and the AU. An ATM SVC is established using the procedures specified in 10.2.2. The ATM virtual channel connection may be either a PVC or an SVC. An ATM PVC is established by means which are beyond the scope of this Recommendation.

X.25 procedures are performed between TE/X.25 DTE and the AU using the ATM virtual channel connection via the AAL type 5 and HDLC Applications SSCS functions performed at TE/TA and the AU.

NOTE 2 – Use of AAL type 1 with HDLC framing, instead of type 5 should not be precluded.

In this Recommendation, the terms "outgoing" and "incoming" are used to describe the call as viewed by the user side of the ISDN user-network interface (i.e. as viewed by the TE/X.25 DTE+TA).

10.2 Procedures

A TE/X.25 DTE+TA accesses PSDTS by setting up an ATM virtual channel connection through the B-ISDN to the AU.

In-channel signalling as specified in Recommendation Q.2931 is used to establish ATM SVCs. In-channel signalling is employed on the virtual channel identified by the Virtual Channel Identifier (VCI) = 5. The ATM Adaptation Layer protocol employed on the VCI=5 channel is Signalling ATM Adaptation Layer (SAAL) protocol which is specified in Q.2100-Series Recommendations.

NOTE – VCI value for Q.2931 point-to-multipoint procedure needs to be added once defined in this Recommendation.

ATM PVCs may also be used. The procedures used to establish and disconnect ATM PVCs are beyond the scope of this Recommendation (e.g. administrative, management procedures).

10.2.1 Outgoing call

A calling TE/X.25 DTE+TA, wishing to set up an X.25 virtual call to a remote DTE, uses an ATM virtual channel connection that is established through the B-ISDN to the AU. The ATM virtual channel connection is established on a Virtual Channel available for support of user information on the B-ISDN user-network interface as defined in clause 5/Q.2931. The ATM virtual channel connection may be either a PVC or an SVC.

NOTES

1 If an ATM virtual channel connection is not established through the B-ISDN to the AU, the calling TE/X.25 DTE+TA uses the procedures specified in 10.2.1.1 below before setting up the X.25 virtual call.

2 If an ATM PVC is established through the B-ISDN, then X.25 PVCs as well as X.25 virtual calls may be established between the calling TE/X.25 DTE+TA and remote DTEs.

3 No X.25 PVCs are allowed over an ATM SVC.

10.2.1.1 Outgoing ATM switched virtual channel connection

A calling TE/X.25 DTE+TA uses the following procedures:

- 1) The procedures specified in 5.1.1/Q.2931 for the ATM connection setup. In the SETUP message sent by the calling TE/X.25 DTE+TA:
 - i) The Called Party Address information element contains the address of the AU.
 - ii) The Broadband Bearer Capability information element shall be encoded as follows:
 - bearer class set to “BCOB-C”;
 - traffic type set to “Variable bit rate”;
 - timing requirements set to “End-to-end timing not required”;
 - susceptibility to clipping set to “not susceptible to clipping”;
 - user plane connection configuration set to “Point-to-Point”.
 - iii) The Broadband Low Layer Information element is included to pass compatibility information from the calling TE/X.25 DTE+TA to the AU. The user information layer 3 protocol (octet 7 of the Broadband Low Layer Information element) is encoded as follows:
 - X.25 packet layer.The user information layer 2 protocol (octet 6 of the Broadband Low Layer information element) is encoded as follows:
 - X.25 link layer.

NOTE – The usage of other values (e.g. X.25 multilink) is for further study.
- 2) The procedures specified in 5.1.2/Q.2931 for connection identifier (VPCI/VCI) allocation and selection.
- 3) The procedures specified in 5.1.3/Q.2931 to request a certain Quality of Service (QOS).

10.2.1.2 Outgoing X.25 virtual call setup and release

The X.25 procedures specified in Recommendation X.25 apply.

NOTE – A logical channel number is unique within a VCI.

10.2.2 Incoming call

The AU delivers an incoming X.25 virtual call over an established ATM virtual channel connection to the called TE/X.25 DTE+TA. If more than one ATM virtual channel connection is established to the called TE/X.25 DTE+TA, the AU selects one of these ATM virtual channel connections to deliver the incoming X.25 virtual call. The AU may use the occupancy levels of these ATM virtual channel connections to perform the selection. If the selection procedure is unsuccessful or if no ATM virtual channel connection is established to the called TE/X.25 DTE+TA, the AU initiates the procedures specified below for establishing an ATM SVC before delivering the incoming X.25 virtual call.

10.2.2.1 Incoming ATM switched virtual channel connection

The network uses the following procedures:

- 1) The procedures specified in 5.2.1/Q.2931 for the ATM connection setup. In the Q.2931 SETUP message sent by the B-ISDN to the called TE/X.25 DTE+TA:
 - i) The Called Party Address information element in the SETUP message contains the address of the called TE/X.25 DTE+TA.
 - ii) The Broadband Bearer Capability information element shall be encoded as specified in 10.2.1.1 above.

iii) The Broadband Low Layer information element is included, as received from the AU, to pass compatibility information from the AU to the called TE/X.25 DTE+TA. The user information layer 3 protocol (octet 7 of the Broadband Low Layer information element) is encoded as follows:

- X.25 packet layer.

The user information layer 2 protocol (octet 6 of the Broadband Low Layer information element) is encoded as follows:

- X.25 link layer.

NOTE – The usage of other values (e.g. X.25 multilink) is for further study.

iv) The characteristics of the ATM SVC may be determined from subscription time agreements information.

- If the called TE/X.25 DTE+TA is administratively registered with the Administration of the network providing the PSDTS and is successfully identified to the AU, the subparameters of the ATM Traffic Descriptor information element in the Q.2931 SETUP message sent by the PSPDN AU to the called TE/X.25 DTE+TA are set to the TE/X.25 DTE+TA specific values determined at subscription time.
- If the called TE/X.25 DTE+TA is not registered or is registered but is not successfully identified to the AU, the subparameters of the ATM Traffic Descriptor information element in the Q.2931 SETUP message sent by the AU to the called TE/X.25 DTE+TA are set to default values determined by the PSPDN.

2) The procedures specified in 5.2.2/Q.2931 for compatibility check.

3) The procedures specified in 5.2.3/Q.2931 for connection identifier(VPCI/VCI) allocation and selection.

10.2.2.2 Incoming X.25 virtual call setup and release

The X.25 procedures specified in Recommendation X.25 apply.

NOTE – A logical channel number is unique within a VCI.

10.3 ATM switched virtual channel connection clearing

10.3.1 Clearing initiated by the TE/X.25 DTE+TA

The TE/X.25 DTE+TA follows the procedures specified in 5.4.3/Q.2931 to clear an ATM SVC.

ATM PVC cannot be cleared by the TE/X.25 DTE+TA using Q.2931 clearing procedures. It is cleared by procedures (e.g. administrative, management procedures) which are beyond the scope of this Recommendation.

10.3.2 Clearing initiated by the PSDTS AU

The PSDTS AU follows the procedures specified in 5.4.4/Q.2931 to clear an ATM switched virtual call.

ATM PVC cannot be cleared by the PSDTS AU using Q.2931 clearing procedures. It is cleared by procedures (e.g. administrative, management procedures) which are beyond the scope of this Recommendation.

10.4 ATM switched virtual channel connection clear collision

The clear collision procedures specified in 5.4.5/Q.2931 apply.

10.5 Restart procedures

The Restart procedures specified in 5.5/Q.2931 apply.

If a Q.2931 RESTART message is received by the AU during the X.25 data transfer phase, the X.25 virtual calls shall be treated as follows :

- For switched virtual channel connections, an X.25 *clear indication packet* shall be sent with cause #9, “out of order” and diagnostic #0, “no additional information”.
- For any X.25 virtual calls which are established on a permanent virtual channel connection to the AU, no action shall be taken.

10.6 Handling of error conditions

The procedures for handling of error conditions specified in 5.6/Q.2931 apply.

In addition, the following rules apply in order of decreasing probability for determining the appropriate cause to be used:

- 1) If a Q.2931 clearing message is received from the B-ISDN by the AU to clear ATM switched virtual channel connection while X.25 virtual calls still exist on ATM switched virtual channel connection, the AU clears the corresponding X.25 virtual call(s) with cause #17 “remote procedure error” and diagnostic code #64 “call setup, call clearing, or registration problem”.
- 2) If a Q.2931 RESTART message is received by the B-ISDN and an ATM switched virtual channel connection is released as a result while X.25 virtual calls still exist on the ATM switched virtual channel connection, the AU also clears the corresponding X.25 virtual call(s) with cause #9 “out of order” and diagnostic code #0 “no additional information”.
- 3) If the establishment of an ATM SVC that is triggered by an incoming X.25 virtual call is rejected by the called TE/X.25 DTE+TA using Q.2931 messages on the Virtual Channel Identified by VCI=5, the AU clears the incoming X.25 virtual call using an appropriate cause from Table 11-5/X.31.

NOTE 1 – In Table 11-5/X.31, Q.931 is replaced with Q.2931. See also Annex A.

- 4) If a condition exists that prevents a Q.2931 SETUP message that is triggered by an incoming X.25 virtual call from being delivered to the called TE/X.25 DTE+TA on the Virtual Channel Identified by VCI=5, the AU clears the incoming X.25 virtual call in the network providing PSDTS with a cause that is selected appropriate to the condition from Table 11-5/X.31.
- 5) If a Q.2931 SETUP message is sent as a result of an incoming X.25 virtual call on a Virtual Channel Identified by VCI=5 to the called TE/X.25 DTE+TA and no response is received prior to the second expiry of Timer T303, rule 4) above applies.
- 6) If a Q.2931 SETUP message is sent as a result of an incoming X.25 virtual call on a Virtual Channel Identified by VCI=5 to the called TE/X.25 DTE+TA and a response other than a call rejection is received which results in the clearing of the ATM SVC, the AU clears the incoming X.25 virtual call in the network providing PSDTS using the appropriate cause from Table 11-5/X.31 relative to the cause sent in the clearing message.
- 7) If an X.25 *clear request packet* is received from the originating user by the AU prior to the delivery of the X.25 *incoming call packet* to the called TE/X.25 DTE+TA (premature clearing), the AU shall send a *clear confirmation packet* to the calling user and the ATM SVC, when and if established shall be treated as either of the following two options;
 - The ATM SVC shall be cleared. The Q.2931 clearing message shall contain the appropriate cause as described in Table 11-6/X.31.
 - The ATM SVC is established and T14 is started. Upon expiry of T14, the ATM SVC is cleared with cause #102, “recovery on timer expiry ” and diagnostic indicating timer T14 (see Recommendation X.32).

NOTE 2 – In Table 11-6/X.31, Q.931 is replaced with Q.2931.

10.7 ATM PVC management procedure

The ATM PVC, semi-permanent virtual connection, management procedures are defined in Appendix III/Q.2931. This procedure applies.

11 Terminal adapter functionalities

11.1 General

Terminal Adapter (TA) functions are needed to support the access of X.25 DTEs at the S_B/T_B reference points of an B-ISDN (see Figure 11-1).

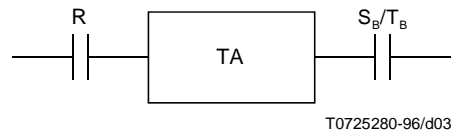


FIGURE 11-1/X.34

Reference configuration of TA

NOTE – A TA function supports only one X.25 DTE (simple or complex, e.g. LAN-gateway) at Reference point R.

Main functionalities which are provided by the TA are the following:

- Rate adaption.
- Mapping of signalling information and procedures between the S_B/T_B , and the R reference point.
- Synchronization.
- Maintenance.

In the following, these main functionalities are described.

The procedures at the reference points of the user-network interface for an B-ISDN are described in clause 10.

The reference protocol stack model is shown in Figure 11-2.

11.2 Access to PSDTS via a B-ISDN

11.2.1 Physical interfaces

The physical interfaces supported at the R reference point are those defined in clause 1/X.25, and Recommendation X.32. The physical interfaces supported at the S_B/T_B reference point are those defined in Recommendation I.413.

11.2.2 Rate adaption

In this case, packet mode terminals operating at data signalling rates lower than 64 kbit/s at the R reference point can no longer be distinguished by the network from packet mode terminals operating at a data rate of 64 kbit/s at the R interface.

Therefore, the signalling procedures at the S_B/T_B reference point will indicate the data signalling rate at that reference point rather than the user data signalling rate at the R reference point. In addition, a throughput class may be indicated in the incoming call signalling procedures at the S_B/T_B reference point.

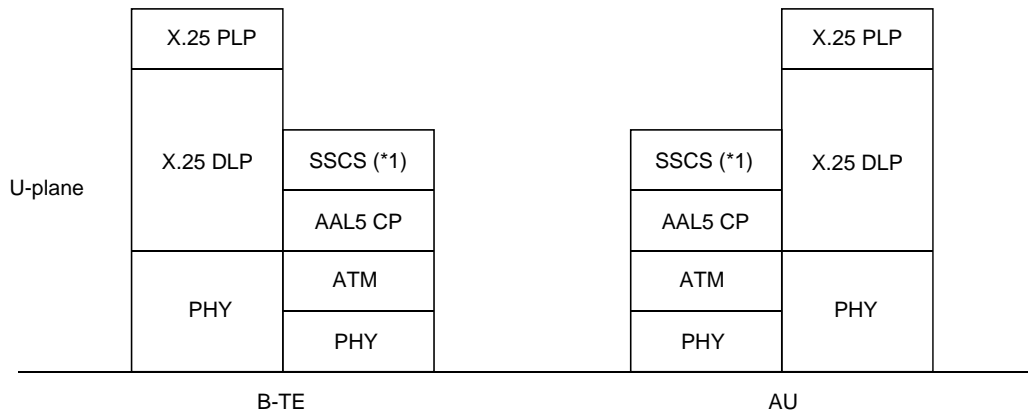
It should be noted that the frame handling in the B-ISDN will be done by an appropriate AAL functions at the rates defined in the ATM sections in Recommendation X.1.

11.2.3 Layer 2 adaption

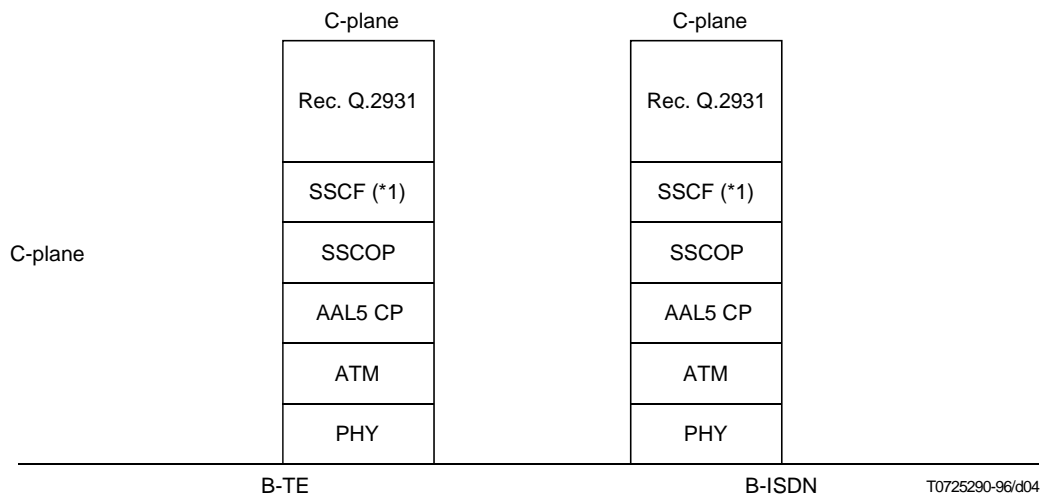
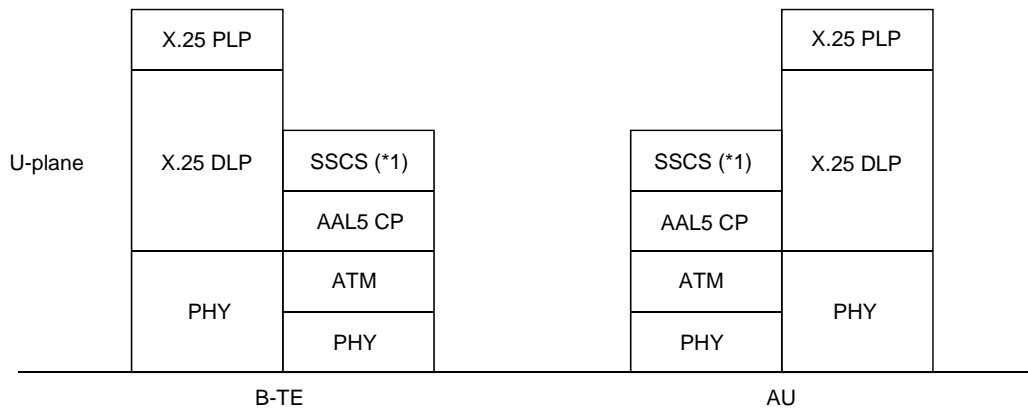
TA provides the layer 2 adaption function between LAPB frames on the R reference point and frames conveyed by cells on the S_B/T_B reference point. On the S_B/T_B reference point, TA uses AAL type 5 (CPCS+HDLC Applications SSCS) to convey X.25 frames.

NOTE – Use of AAL type 1 with HDLC framing instead of AAL type 5 should not be precluded.

a) ATM PVC case



b) ATM SVC case



(*1) HDLC Applications SSCS is defined in Recommendation I.365.4

NOTE – See Recommendation Q.2130.

FIGURE 11-2/X.34
Reference protocol stack model

In case AAL type 5 is used, AAL type 5 message mode service will be available. The functionality of the null-SSCS only provides for mapping of the equivalent primitives of AAL to CPCS and vice versa. The CPCS-UNITDATA primitive parameters should be set by SSCS as specified in 7.4/I.365.4.

11.2.4 Signalling

This part defines the functionalities to be supported by the TA to establish, maintain and release an ATM connection to the AU port of PSDTS network. After the ATM connection has been established, TA shall act transparent to X.25 layer 2 control part and layer 3.

11.2.4.1 Outgoing call

In case of access via a B-ISDN, there must be an established physical channel between the TA and the AU. To provide an ATM connection by means of the pre-established physical channel to the AU, the TA shall provide:

- a method to indicate that the TA should start the ATM connection establishment procedure at the S_B/T_B reference point. The options available are described in 11.2.4.1.1.
- a method to transfer address information to the TA which is needed by the ATM connection establishment procedure. The options available are described in 11.2.4.1.2.

11.2.4.1.1 Conditions for initiating ATM connection establishment

Two situations can be identified to categorize the conditions which may cause the TA to attempt to establish a ATM connection.

a) ATM PVC

In this case, the ATM connection is always available. No TA functionality is required to initiate the establishment of the ATM connection.

b) ATM connection establishment is initiated by actions at the R reference point (DTE/TA interface).

Two conditions are possible. See Table 11-1.

b1) *Hot-line access at the R reference point*

In case of hot-line access at the R reference point, the detection of the following appropriate interface conditions shall cause the TA to establish the ATM connection to the PSPDN or the ISDN providing PSDTS.

- i) For X.25 layer 1 interfaces – a transition from OFF to ON on the control lead (in case of X.21 leased circuit procedures) or circuit 108 (in case of X.21 *bis* or V-Series interface procedures).
- ii) For X.21 interfaces – direct call signal (C=ON). The DTE will wait for I=ON before starting transmission.
- iii) For the X.21 *bis* interface – direct call signal (108=ON). The DTE will wait for 107=ON before starting transmission.
- iv) For the V.25 *bis* interface – direct call signal (108=ON). The DTE will wait for 107=ON before starting transmission.

b2) *Full circuit switched selection access*

Full circuit switched selection procedure (Recommendations X.21, X.21 *bis* or V.25 *bis*) may be used at the DTE/TA interface to request the establishment of the ATM connection to an AU. The TA will establish the ATM connection in accordance with the procedures described in clause 10. The address provided may be used to identify the PSPDN or the ISDN-PSDTS port and full X.25 procedures must be used following the establishment of the ATM connection to identify the called packet mode DTE.

In case of full circuit switched selection, the following operating modes of Recommendations X.21, X.21 *bis* and V.25 *bis* at the DTE/TA interface shall cause the TA to establish the ATM connection to the PSPDN or the ISDN providing PSDTS.

- i) For X.21 circuit switched interfaces – X.21 call control phase.
- ii) For X.21 *bis* circuit switched interfaces – use of X.21 *bis* automatic address call facility.
- iii) For V.25 *bis* circuit switched interfaces – V.25 *bis* addressed call mode.

NOTE – The user may cause the TA to attempt to establish an ATM connection by manual actions (e.g. by pressing a button) at the human/machine interface of the TA. Subsequently the TA may emulate the incoming call towards the DTE.

TABLE 11-1/X.34

DTE/TA Layer 1 specifications and procedures to initiate ATM connection establishment

Condition	DTE/TA layer 1 specification		Events at the R reference point	Procedures according to:
Hot-line access	Rec. X.25	X.21 leased circuit	DTE sets C = ON	1.1/X.25
		Rec. X.21 <i>bis</i>	DTE sets circuit 108 = ON	1.2/X.25
		V-Series interfaces	DTE sets circuit 108 = ON	1.3/X.25
	X.21 circuit switched		DTE signals direct call	4.4/X.21
	X.21 <i>bis</i> direct call		DTE signals direct call	2.3.1/X.21 <i>bis</i>
	V.25 <i>bis</i> direct call		DTE uses direct call mode (Note)	clause 5/V.25 <i>bis</i>
Full circuit switched access	X.21 addressed call		DTE enters call control phase	clause 4/X.21
	X.21 <i>bis</i> addressed call		DTE performs automatic address call	2.3.2 iii) / X.21 <i>bis</i>
	V.25 <i>bis</i> addressed call		DTE uses address call mode	clause 4/V.25 <i>bis</i>
NOTE – The difference between the V.25 <i>bis</i> direct call mode and operation according to 1.3/X.25 (V-Series interfaces) is for further study.				

11.2.4.1.2 Options for transferring the address of the PSPDN or ISDN-PSDTS port to the TA

Four options exist to handle address information of the PSPDN or the ISDN-PSDTS port at the TA:

- a) ATM PVC at the S_B/T_B reference point.
In this case the TA has no need for address information, i.e. no functionality is required in the TA to obtain an address.
- b) The address is conveyed across the R reference point.
In this case the circuit switched procedures described in 11.2.4.1.1 b2) are required.
- c) The address is conveyed across the human/machine interface of the TA.
Manual procedures are used (e.g. by means of a keypad) at the human/machine interface of the TA. The address may be input each time the ATM connection is requested. Alternatively the address may be stored at the TA (e.g. in the case of hot line operation at the R reference point).
- d) The address is downloaded by the network via the S_B/T_B reference point.
The need for this option is for further study.

NOTE – The address information may be for example a full E.164 address and abbreviated E.164 address, which is used by hot-line access procedures at the S_B/T_B reference point, or an abbreviated address which is interpreted by the TA and expanded to an (abbreviated) E.164 address using pre-recorded information in the TA.

11.2.4.1.3 Mapping of procedures

The list of supported combinations and the appropriate procedures are given in Table 11-2.

Following the establishment of the connection, the TA should place the R reference point in the appropriate condition for data transfer at layer 1.

TABLE 11-2/X.34

TA functionality to control ATM connection establishment

	TA function		Description of procedures
	Conditions for initiation of ATM connection establishment (11.2.4.1.1)	Transfer of address information to the TA (11.2.4.1.2)	
1	Condition a)	Option a)	ATM PVC connection. No signalling functions for layer 1 are needed in the TA
2	Condition b1) i)	Option c)	The DTE sets C=ON or circuit 108=ON. When C (or circuit 108) becomes ON, and the manual selection has been made at the TA, the TA then initiates the establishment of an ATM connection to provide a connection to the PSPDN or the ISDN-PSDTS. When the ATM connection is completely established at the S/T reference point, the TA sets I=ON (or circuit 107=ON)
3	Any of conditions b1) ii), iii), iv)	Option c)	When the manual selection has been made at the TA, the TA may emulate an incoming call at the R reference point. If the DTE accepts this incoming call, the TA places the R reference point in the DCE waiting state at layer 1 and then initiates the establishment of an ATM connection to provide a connection to the PSPDN or the ISDN-PSDTS. When the ATM connection is completely established at the S _B /T _B reference point, the TA signals ready for data at the R reference point
	See Note in 11.2.4.1.1	Option c)	
4	Any of condition b2)	Option b)	When the DTE has requested the layer 1 connection and the DTE has requested the layer 1 connection and provided address information to the TA, the TA initiates the establishment of an ATM connection. When the ATM connection is completely established at the S _B /T _B reference point the TA signals ready for data, using the appropriate procedure at the R reference point.
5	Condition b1)	Option a)	In the case hot-line access is applied at the R reference point as well as the S _B /T _B reference point. No address information is therefore required by the TA. When the DTE presents the call request, the TA attempts to establish an ATM connection. When the ATM connection is completely setup, the TA signals ready for data at the R reference point

11.2.4.1.4 Mapping of the Q.2931 messages

The procedures between the TA and the network are the same as described in clause 10. The choice of the requested service will be made by the appropriate coding of the bearer capability.

The B-ISDN address of the PSPDN port or the ISDN-PSDTS port will be introduced as the destination in the Q.2931 message.

11.2.4.1.5 X.25 procedures

In the data transfer phase, the TA may be transparent to layer 2 control part and layer 3 of the X.25 procedures. However, some realizations of X.25 terminals may require full or partial termination of layer 2 within the TA to accommodate existing LAPB establishment procedures.

11.2.4.2 Incoming call

11.2.4.2.1 Q.2931 call offering

The incoming call is first offered using Q.2931 procedures for setting up the ATM connection.

11.2.4.2.2 Actions at the R reference point

The TA shall not accept an incoming call from the network unless the R reference point is in one of the following states:

- The ready state for an R reference point conforming to X.21 circuit switched procedures;
- the ready or send data state for an R reference point conforming to X.21 leased circuit procedures;
- circuits 125 and 108 ON with 107 OFF for an R reference point conforming to X.21 *bis* procedures.

If the R reference point is in, or can be placed in, the appropriate state defined above, the TA shall respond to the SETUP message (when compatibility checking has been successful) by returning a CONNECT message in accordance with the procedures of clause 10 and shall then wait for either a CONNECT ACKNOWLEDGE or RELEASE signalling message from the network. (The TA may also reject the SETUP message by responding with a RELEASE COMPLETE message.)

NOTE 1 – Recommendation Q.2931 does not oblige the TA to return an ALERTING message prior to the return of a CONNECT.

If the R reference point is not and cannot be placed in the appropriate states defined above, then the TA shall respond to the SETUP message in accordance with the negative response to the incoming call procedures defined in clause 10.

The receipt of a CONNECT ACKNOWLEDGE message causes the TA to initiate the appropriate procedures described in Recommendation X.30/I.461 leading to the placing of the R reference point into the appropriate condition for data transfer, and to begin transmission of information in the ATM connection.

NOTE 2 – The DTE/TA interface shall not be placed in the data transfer state before the ATM connection is completely set up at the S_B/T_B reference point (see 11.2.5).

11.2.4.2.3 X.25 procedures

In the data transfer phase, the TA may be transparent to layer 2 control part and layer 3 of the X.25 procedures.

11.2.4.3 Call clearing

To initiate the clearing of the ATM connection, it is necessary to detect the clearing of the last virtual call on the ATM connection. Three parties can detect the clearing of the ATM connection:

- 1) the DTE-initiating clearing via the R reference point;
- 2) the network (AU)-initiating clearing via the S_B/T_B reference point;
- 3) the user-initiating clearing manually via the human/machine interface.

11.2.4.3.1 initiation of call clearing by the DTE

The conditions of the R reference point which cause the TA to attempt to disconnect the B-channel connection are;

- for X.21 circuit switched interface – DTE clear request signal;
- for X.21 leased circuit interface – a transition from ON to OFF on the control lead;
- for X.21 *bis* interface – DTE clear request signal (circuit 108 from ON to OFF).

When one of these conditions occurs, the TA will disconnect the internal rate adapting connection between the R and the S_B/T_B reference point (see 11.2.2) and will try to disconnect the ATM connection applying the procedures of 10.3.

11.2.4.3.2 Initiation of call clearing by the network

For the clearing of the ATM connection the network applies the procedures of 10.3. The receipt of a DISCONNECT or RELEASE message shall cause the TA to disconnect the internal rate adapting connection between the R and the S_B/T_B reference point and to take on the R reference point interface the appropriate action as described below:

- for X.21 circuit switched interface – signal a DCE clear indication;
- for X.21 leased circuit interface – signal a DCE ready condition;
- for X.21 *bis* interface – set circuit 107 OFF.

See Recommendation X.30 for further details.

11.2.4.3.3 Initiation of call clearing by the user

After the manual notification of the clearing of the last virtual call by the user, the TA disconnects the internal connection between the R and S_B/T_B reference point and applies the procedures of 10.3 for the clearing of the ATM connection. On the R reference point it takes the appropriate action as described below:

- for X.21 circuit switched interface – signal a DCE clear indication;
- for X.21 leased circuit interface – signal a DCE ready condition;
- for X.21 *bis* interface – set circuit 107 OFF.

See Recommendation X.30 for further details.

11.2.5 Synchronization

The TA should effect synchronization between the VCI=5 channel (Q.2931 activities) and the ATM connection (X.25 activities) activities.

Synchronization between TA and AU is provided by the cell synchronization mechanism specified in Recommendation I.361.

11.2.6 Maintenance

The functionalities specified in Recommendation I.610 apply.

Annex A

The mappings Q.2931 cause field to Recommendation X.25

(This annex forms an integral part of this Recommendation)

Introduction

This annex specifies the mapping of Q.2931 cause field to X.25 cause field.

Cause mappings defined in Table 11-5/X.31, with Q.931 is replaced with Q.2931, are applicable. In addition the following cause mappings are applicable.

Q.2931 cause	Code	Q.931 diagnostics	X.25 cause	Code	X.25 diagnostics	Code
VPCI/VCI unacceptable	10	None	Remote procedure error	17	Call setup, call clearing or registration problem	64
Requested VPCI/VCI not available	35	None	Number busy	1	No logical channel available	71
VPCI/VCI assignment failure	36	None	Number busy	1	No logical channel available	71
No VPCI/VCI available	45	None	Network congestion	5	No additional information	0
User cell rate not available	51	Identified subfield identifier	Network congestion	5	No additional information	0
Unsupported combination of traffic parameters	93	None	Remote procedure error	17	Call setup, call clearing or registration problem	64
Incompatible destination	88	Incompatible parameters	Incompatible destination	33	No additional information	0
AAL parameters cannot be supported	93	None	Remote procedure error	17	Call setup, call clearing or registration problem	64

Appendix I

Example of sequence diagrams

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

I.1 Example sequence diagrams

Examples of the procedures for the use of B-ISDN connection are summarized in Figures I.1 to I.6.

These figures are intended to complement the description in the preceding text and do not illustrate all possible situations.

I.2 Key to the figures

X.25 layer 3 messages

Any layer 3 message preceded by X.25 indicates an X.25 layer 3 packet (e.g. X.25 CR means X.25 call request).

- CA *call accepted*
- CC *call connected*
- CR *call request*
- CLR *clear request*
- CLI *clear indication*
- CLC *clear confirmation*

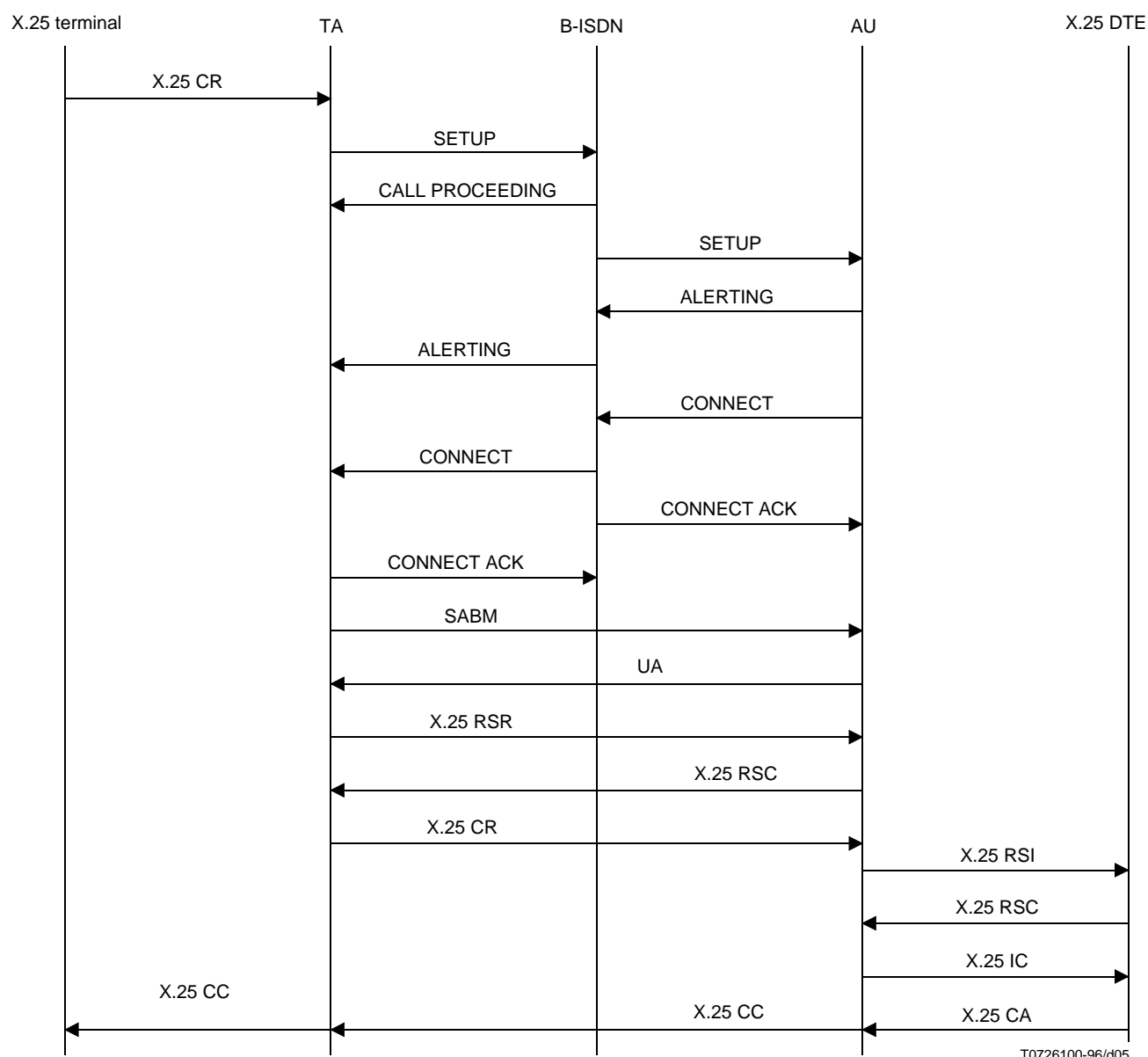
- IC *incoming call*
- RSR *restart request*
- RSC *restart confirmation*
- RSI *restart indication*

Layer 2 frames

- SABM *Set asynchronous balance mode*
- UA *Unnumbered acknowledgement frame*

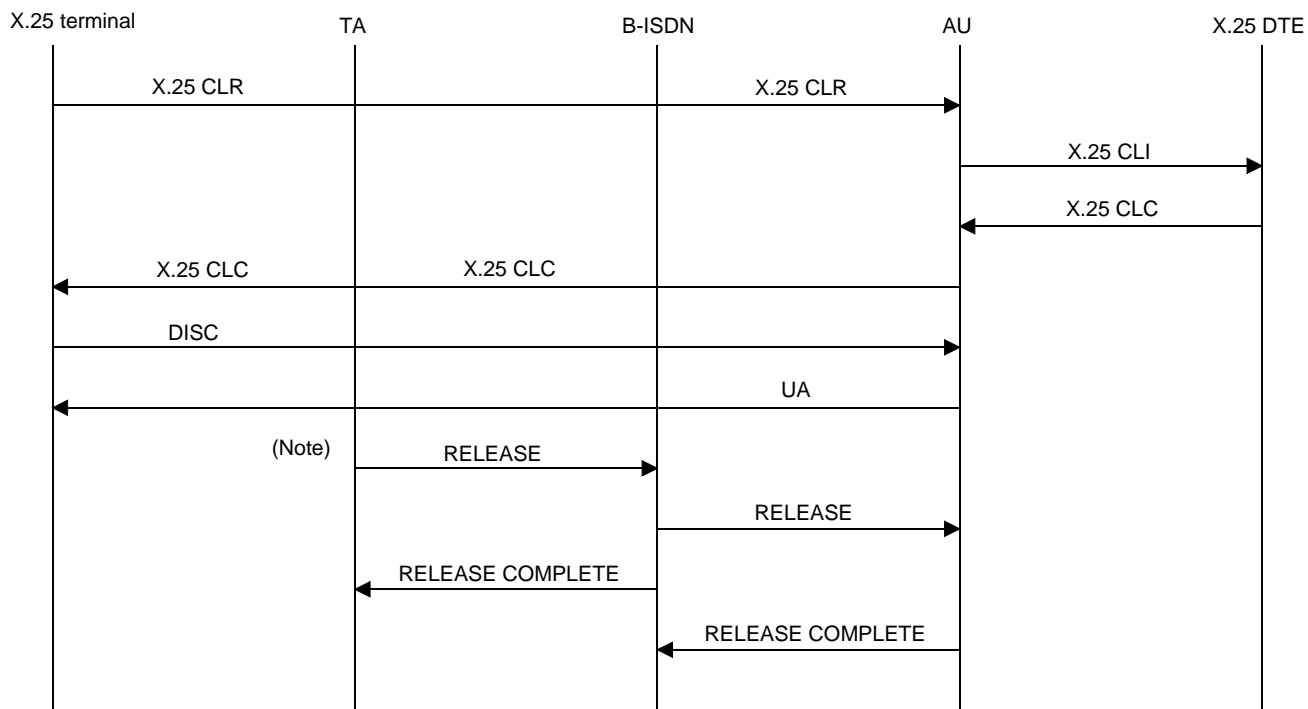
I.3 Example of sequence diagrams

See Figures I.1 to I.6.



T0726100-96/d05

FIGURE I.1/X.34
Example message sequence for CALL SETUP



T0726110-96/d06

NOTE – Triggers for this message are as described in 11.2.4.3.1 and 11.2.4.3.3.

FIGURE I.2/X.34
Example message sequence for CALL CLEARED

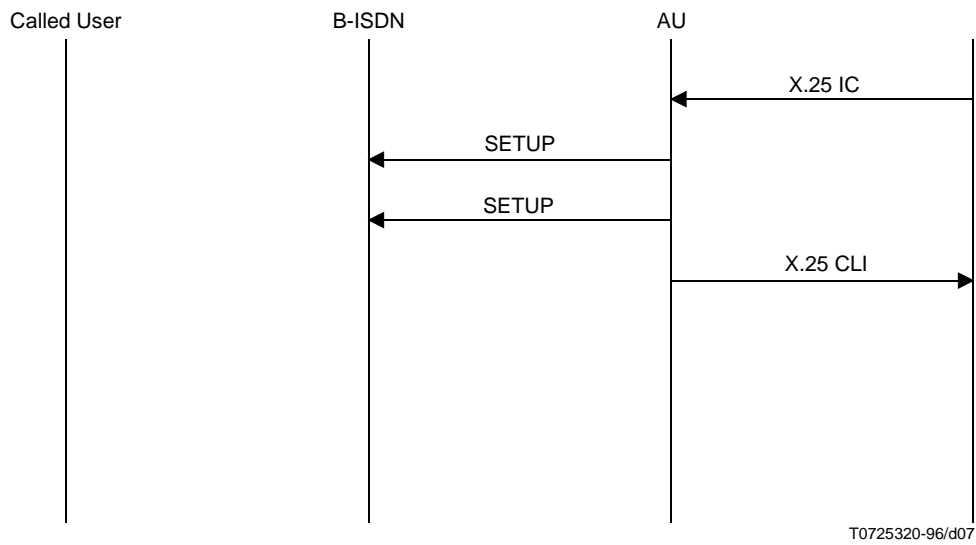


FIGURE I.3/X.34
User no response

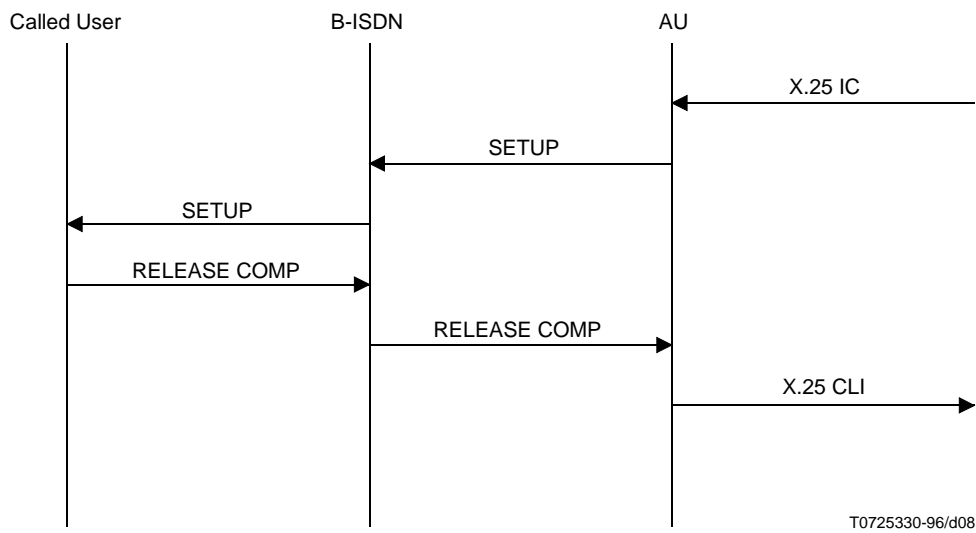
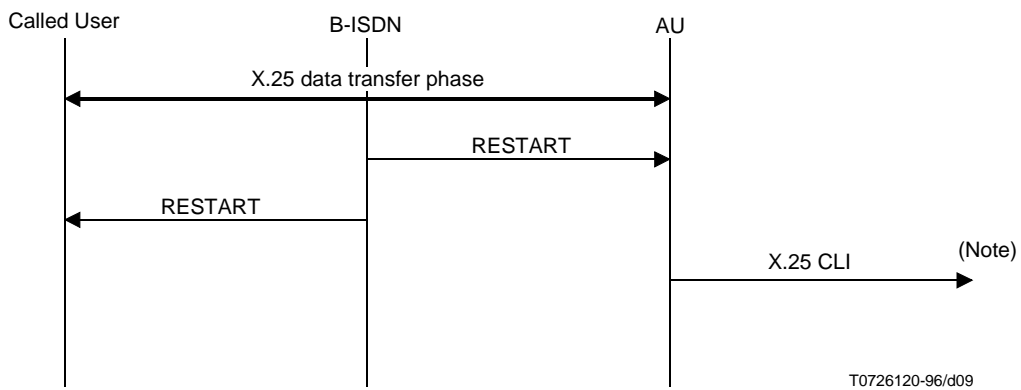
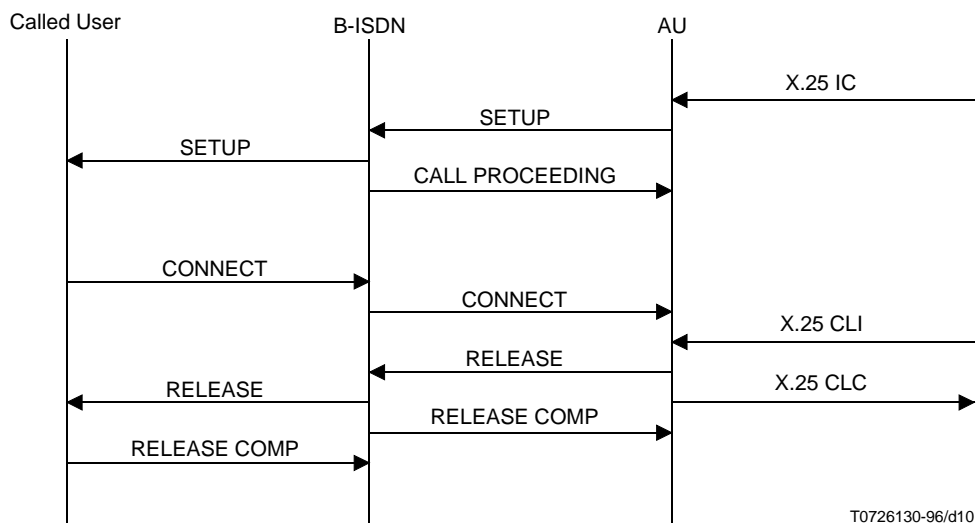


FIGURE I.4/X.34
Call failure by called user



NOTE – When ATM SCV is used.

FIGURE I.5/X.34
Q.2931 RESTART during X.25 data transfer phase



NOTE – After CONNECT message is received by the AU, there exists X.25 data link SETUP and restart procedures that are not shown in this diagram.

FIGURE I.6/X.34
Premature clearing

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