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SERIES X: DATA NETWORKS AND OPEN SYSTEM COMMUNICATIONS

Public data networks – Interfaces

Access to FRDTS via B-ISDN

ITU-T Recommendation X.46

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION X.46

ACCESS TO FRDTS VIA B-ISDN

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 frame relay data transmission service via the B-ISDN. Procedures defined in this Recommendation are based on the Network interworking scenario and port access method of interworking.

Source

ITU-T Recommendation X.46 was prepared by ITU-T Study Group 7 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 25th of September 1998.

FOREWORD

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The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

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As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

Recommendation X.46

ACCESS TO FRDTS VIA B-ISDN

(Geneva, 1998)

1 Scope

This Recommendation defines the procedures of access to Frame Relay Data Transmission Service (FRDTS) via a B-ISDN. It includes two cases:

a) FRPDN provides the FRDTS.

b) ISDN provides the FRDTS.

The Interworking scenario used in this Recommendation is the Network interworking scenario as specified in Recommendation I.555, and the port access method of interworking as specified in the X.300-series Recommendations.

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] ITU-T Recommendation E.164 (1997), *The international public telecommunication numbering plan.*

[2] ITU-T Recommendation E.166/X.122 (1998), *Numbering plan interworking for the E.164 and X.121 numbering plan.*

[3] ITU-T Recommendation I.211 (1993), *B-ISDN service aspects.*

[4] ITU-T Recommendation I.356 (1996), *B-ISDN ATM layer cell transfer performance*.

[5] ITU-T Recommendation I.361 (1995), *B-ISDN ATM layer specification.*

[6] ITU-T Recommendation I.362 (1993 – withdrawn in 1997), *B-ISDN ATM adaptation layer (AAL) functional description.*

[7] ITU-T Recommendations I.363.X. series, *B-ISDN ATM adaptation layer specification*.

[8] ITU-T Recommendation I.365.1 (1993), *B-ISDN ATM adaptation layer sublayers*: *Frame Relaying Service Specific Convergence Sublayer (FR-SSCS).*

[9] ITU-T Recommendation I.413 (1993), *B-ISDN user-network interface*.

[10] ITU-T Recommendation I.430 (1995), *Basic user-network interface – Layer 1 specification.*

[11] ITU-T Recommendations I.431 (1993), *Primary rate user-network interface – Layer 1 specification.*

[12] ITU-T Recommendations I.432.X series, *B-ISDN user-network interface – Physical layer specification.*

[13] ITU-T Recommendation I.580 (1995), *General arrangements for interworking between B-ISDN and 64 kbit/s based ISDN.*

[14] ITU-T Recommendation I.610 (1995), *B-ISDN operation and maintenance principles and functions.*

[15] ITU-T Recommendation Q.933 (1995), *Signalling specifications for frame mode switched and permanent virtual connection control and status monitoring.*

[16] ITU-T Recommendation Q.2110 (1994), *B-ISDN ATM adaptation layer – Service Specific Connection Oriented Protocol (SSCOP).*

[17] 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).*

[18] ITU-T Recommendation Q.2761 (1995), *Functional description of the B-ISDN user part (B-ISUP) of Signalling System No.7.*

[19] ITU-T Recommendation Q.2931 (1995 – modified by Q.2971, 1995), *Digital Subscriber Signalling System No. 2 – User Network Interface (UNI) layer 3 specification for basic call/connection control.*

[20] ITU-T Recommendation Q.2933 (1996), *Digital subscriber signalling system No. 2 – Signalling specification for frame relay service.*

[21] ITU-T Recommendation Q.2961.2 (1997), *Digital subscriber signalling system No. 2 – Additional traffic parameters: Support of ATM transfer capability in the broadband bearer capability information element.*

[22] ITU-T Recommendation V.25 *bis* (1996), *Synchronous and asynchronous automatic dialling procedures on switched networks.*

[23] 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).*

[24] CCITT Recommendation X.21 (1992), *Interface between Data Terminal Equipment and Data Circuit-terminating Equipment for synchronous operation on public data networks.*

[25] CCITT Recommendation X.21 *bis* (1988), *Use on public data networks of Data Terminal Equipment (DTE) which is designed for interfacing to synchronous V-series modems.*

[26] 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.*

[27] ITU-T Recommendation X.30/I.461 (1993), *Support of X.21, X.21 bis and X.20 bis based Data Terminal Equipments (DTEs) by an Integrated Services Digital Network (ISDN).*

[28] 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.*

[29] ITU-T Recommendation X.36 (1995), *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for public data networks providing frame relay data transmission service by dedicated circuit.*

[30] ITU-T Recommendation X.76 (1995), *Network-to-network interface between public data networks providing the frame relay data transmission service.*

[31] ITU-T Recommendation X.121 (1996), *International numbering plan for public data networks.*

[32] ITU-T Recommendation X.122/E.166 (1998), *Numbering plan interworking for the E.164 and X.121 numbering plans.*

[33] ITU-T Recommendation X.213 (1995) | ISO/IEC 8348:1996, *Information technology – Open Systems Interconnection – Network service definition.*

[34] ITU-T Recommendations X.300 series, *Interworking between networks.*

3 Terms and definitions

The Recommendation defines the following terms:

3.1 FR SSCS (Frame Relay Service Specific Convergence Sublayer): FR SSCS is used at the TE and AU to interworking between AAL and LAPF.

4 Abbreviations

The Recommendation uses the following abbreviations:

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 Adapter 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
FH	Frame Handler
FRBS	Frame Relay Bearer Service
FRDTS	Frame Relay Data Transmission Service
FRPDN	Frame Relay Public Data Network
ISDN	Integrated Services Digital Network
IWF	InterWorking Function
NT	Network Termination
PVC	Permanent Virtual Circuit
QoS	Quality of Service
SSCS	Service Specific Convergence Sublayer
SVC	Switched Virtual Call
TA	Terminal Adapter
TE	Terminal Equipment
VCI	Virtual Channel Identifier
VPCI	Virtual Path Connection Identifier

5 General service aspects

Frame Relay Data Transmission Services (FRDTSs) are provided by Frame Relay Public Data Networks (FRPDNs) or by Integrated Services Digital Networks (ISDNs). These FRDTSs may be accessed by users of Broadband ISDNs (B-ISDNs).

a) This Recommendation defines the aspects of frame relay data transmission services provided by an FRPDN 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 frame relay data transmission services provided by an FRPDN or an ISDN in alignment with Recommendations Q.2931, X.36 or Q.933, respectively.

c) This Recommendation defines the procedures at the user-network interface of a B-ISDN to access frame relay data transmission services provided by an FRPDN or an ISDN in alignment with Recommendations I.432, I.361, I.363, I.365.1, Q.2110 and Q.2130.

d) This Recommendation defines the Terminal Adaptation functions to adapt existing frame relay terminals for use at the user-network interface of a B-ISDN in order to access frame relay data transmission services provided by an FRPDN or an ISDN.

6 Reference configurations

There are two reference configurations:

Type-A: Access to the Frame Relay Data Transmission Service (FRDTS) provided by a Frame Relay Public Data Network (FRPDN) using the B-ISDN.

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

In the configurations given below, a Terminal Equipment (TE) with frame relay and ATM capabilities is equivalent to a combination consisting of a Frame Relay Data Terminal Equipment (FR DTE) and a Terminal Adapter (TA) with ATM capabilities.

NOTE 1 – ATM capabilities are in accordance with Recommendations I.211, I.432, I.361, I.363, I.365.1, Q.2110 and Q.2130 for TEs/TAs attached to a B-ISDN.

In this Recommendation, every reference to the combination of an FR DTE and its TA should always be considered as being applicable to a TE with X.36 or Q.933, and also TA and TE should support AAL type 5 function (CPCS + FR-SSCS) to convey X.36 or Q.933 frames.

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

In cases where AAL type 5 is used, AAL type 5 message mode service will be available. The functionality of the FR 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 follows:

– CPCS-LP: set to either "0" or "1".

– CPCS-CI : set to "0".

– CPCS-UU: set to "0".

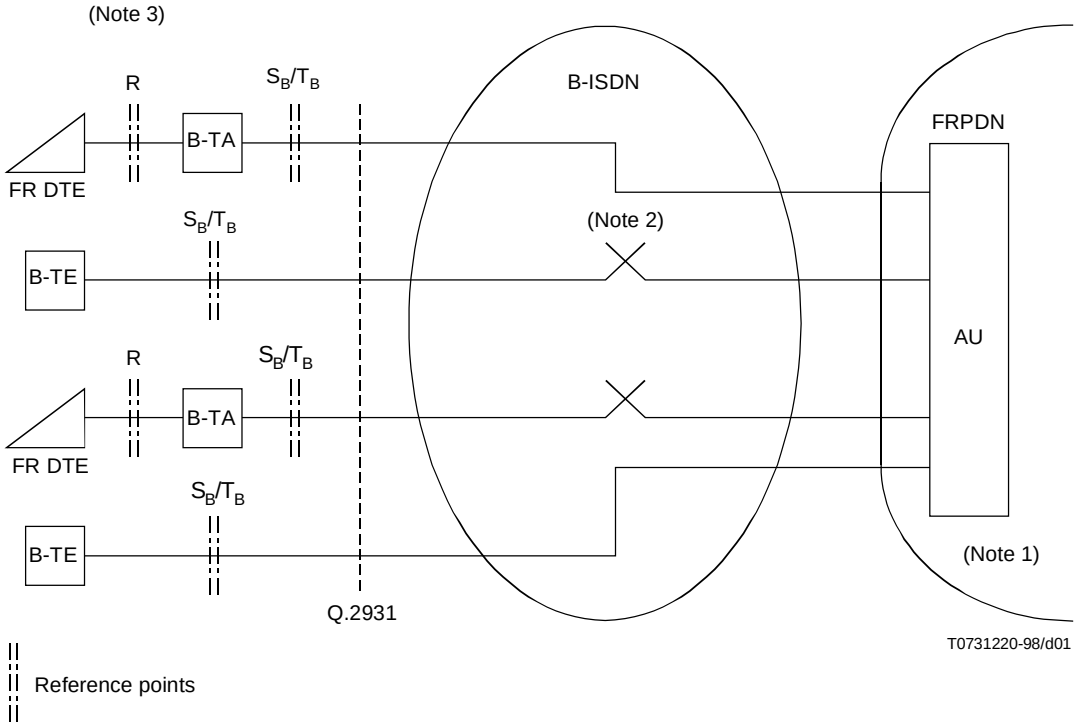
NOTE 3 – The definition of these parameters is specified in Recommendation I.363.

6.1 Configuration when accessing FRPDN via a B-ISDN

This configuration (Figure 6-1) refers to the case where the FRDTS provided by an FRPDN is accessed using the B-ISDN. In this case, a TE/FR DTE+TA accesses the FRDTS of the FRPDN 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 FRPDN 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 FRPDN and the B-ISDN. An AU also supports the necessary processing functions for ATM virtual channel connections and frame relay virtual circuits. The same AAL as that of TEs/TAs is also applicable for AU.

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



AU Access Unit
DTE Data Terminal Equipment
B-TA Terminal Adapter for Broadband ISDN
B-TE Broadband Terminal Equipment with ATM capabilities (see text)

NOTE 1 – The AU logically belongs to the FRPDN.
NOTE 2 – ATM demand channel connection.
NOTE 3 – Reference points S_B, T_B and R are defined in Recommendation I.413.

Figure 6-1/X.46 – Reference configuration for access to FRDTS in FRPDN using B-ISDN

It is important to note that the procedures for accessing FRDTS 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 FRPDN, may be physically located either in the FRPDN or in the B-ISDN.

The ATM connection between a TE/FR DTE+TA and an AU function (see Recommendation I.432) must be established by procedures beyond the scope of this Recommendation before the ATM virtual channel connection procedures specified in this Recommendation can be used. Over that ATM connection, ATM Permanent Virtual Channel connections (PVCs) and/or ATM Switched Virtual Channel connections (SVCs) may be established between the TE/FR 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, frame relay virtual circuits (or FR PVCs) may be established between the TE/FR DTE+TA and a remote DTE supported by the FRPDN. More than one frame relay virtual circuit 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 (see Recommendations X.300 series)*

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/FR 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.36 or Q.933 (Case A). For an outgoing call from a TE/FR DTE+TA, the address of the AU is contained in the Q.2931 SETUP message. For an incoming call to a TE/FR DTE+TA, the AU is able to set up an ATM SVC through the B-ISDN. In the second step, frame relay virtual circuits are established between the TE/FR DTE and the remote DTE. More than one frame relay virtual circuit may be established over the ATM Switched virtual channel connection.

NOTE 3 – No frame relay PVCs are established over an ATM SVC.

For an outgoing call from a TE/FR DTE+TA, the address of the remote called DTE is contained in the called address field of the X.36 or Q.933 SETUP message. For an incoming call to a TE/FR DTE+TA, the address of the TE/FR DTE+TA is contained in the called address field of the X.36 or Q.933 SETUP message. The AU acts as a relay for X.36 or Q.933 information flows.

The detailed procedures are specified in clause 10.

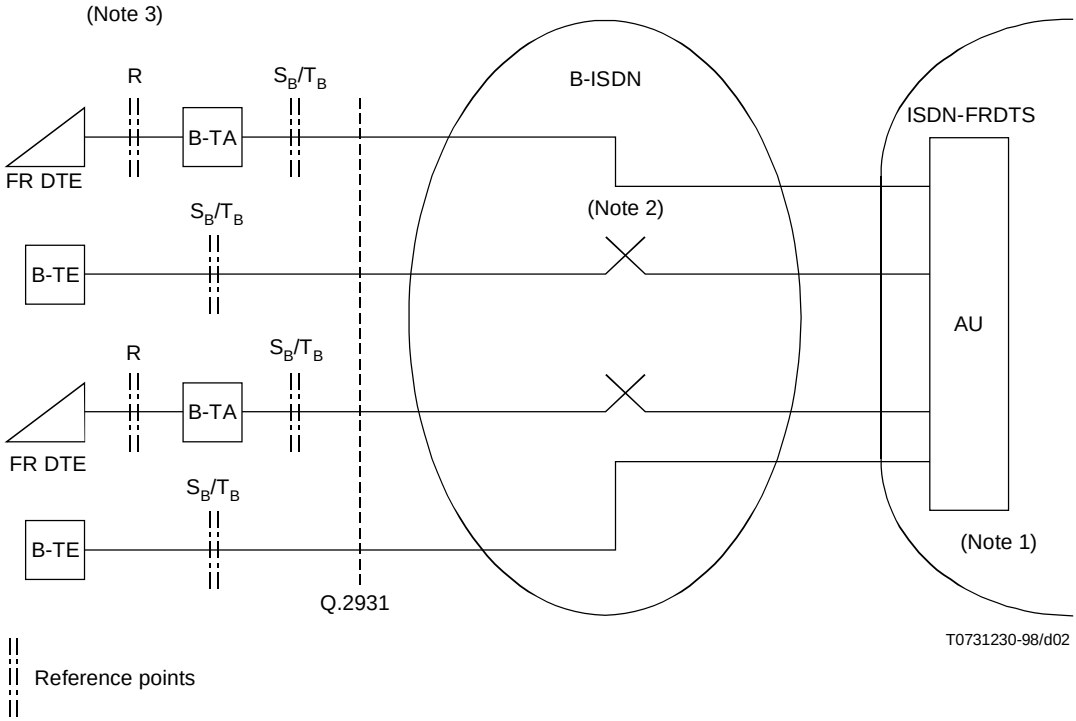
– *Interworking By Call Control Mapping (see Recommendations X.300 series)*

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 Frame Handler (FH) 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 specified in Recommendation Q.2933.

6.2 Configuration when accessing the frame relay data transmission services of an ISDN via a B-ISDN

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



AU Access Unit
DTE Data Terminal Equipment
B-TA Terminal Adapter for Broadband ISDN
B-TE Broadband Terminal Equipment with ATM capabilities (see text)

NOTE 1 – The AU logically belongs to the ISDN.
NOTE 2 – ATM demand channel connection.
NOTE 3 – Reference points S_B, T_B and R are defined in Recommendation I.413.

Figure 6-2/X.46 – Reference configuration for access to FRDTS in ISDN using B-ISDN

For the following procedures:

– the establishment and disconnection of ATM PVCs between a TE/FR DTE+TA and the ISDN AU function; and

– the establishment and disconnection of ATM SVCs between a TE/FR DTE+TA and the ISDN AU function,

The considerations specified in 6.1 above apply.

7 Service aspects

7.1 General

The following subclauses apply for both access to FRDTS provided by an FRPDN and access to FRDTS provided by an ISDN using B-ISDN.

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: see Recommendations X.300 series) that may be used to access FRDTS.

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

  The "TE/FR DTE+TA identity" is a means of referring to the TE/FR DTE+TA. The TE/FR DTE+TA identity is either explicitly agreed to between the TE/FR 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 paragraphs.

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

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

  a) The TE/FR 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/FR DTE+TA and that authority (i.e. not explicitly).

  b) The TE/FR 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/FR 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/FR 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/FR 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/FR DTE+TA, the AU sets the subparameter of the ATM Traffic Descriptor information element in the Q.2931 SETUP message to TE/FR DTE+TA-specific values.

– In the port access case, FRDTS is provided by an FRPDN (type A) or an ISDN (type B).

  In type A, FRPDN services are provided including optional user facilities. In the case where DTE is not subscribing to the FRPDN, it will be provided with a limited set of FRPDN facilities (see Recommendation X.32). QoS characteristics for this case will be that of X.36, but limited by the QoS characteristics of the B-ISDN (see Recommendation I.356).

  In type B, ISDN Frame Relay Bearer Services are provided including supplementary services. 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 that of ISDN, but limited by the QoS characteristics of the B-ISDN.

  NOTE 3 – In type B, the relationship between X.36 optional user facilities and B-ISDN supplementary services is for further study.

  NOTE 4 – 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/FR DTE+TA by the AU.

Every TE/FR DTE+TA will be associated with one or more B-ISDN numbers (E.164 numbers).

The TE/FR DTE+TA may also be associated with one or more X.121 or E.164 numbers assigned by the FRPDN in case of access to FRDTS of FRPDN, and with one or more E.164 numbers assigned by the ISDN in case of access to FRDTS of ISDN. The method for X.36 or Q.933 messages to convey numbers from the two numbering plans is specified in Recommendations X.122 and E.166.

7.3 User access capabilities

NOTE – Definition of corresponding service classes and categories of access Recommendation X.1 is for further study.

7.4 Basic rules

A distinction is made between the two methods of interworking (i.e. port access, call control mapping: see Recommendations X.300 series) that may be used when accessing FRDTS.

– In the port access method of interworking, access to FRDTS will be established by separating the establishment phase of the ATM SVC and the control phase of the X.36 or Q.933 virtual circuits using X.36 or Q.933, respectively. The ATM SVC will employ the Q.2931 signalling procedure (see Recommendation Q.2931).

– In the call control mapping method of interworking, access to FRDTS will be established in a single step. The establishment phase of the ATM SVC and the control phase of the X.36 or Q.933 virtual circuits are integrated into a single procedure. The detailed specification of this procedure is specified in Recommendation Q.2933.

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

8 Addressing and routing aspects

The following subclauses apply for both access to FRDTS provided by an FRPDN (type A) and access to FRDTS provided by an ISDN (type B) using B-ISDN, except where stated otherwise.

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 FRDTS.

– In the port access method of interworking, the responsibility to invoke the AU is with the calling TE/FR DTE+TA. If an ATM virtual channel connection (PVC or SVC) is not established between the calling TE/FR DTE+TA and the AU, it is the responsibility of the calling TE/FR DTE+TA to establish the ATM virtual channel connection to the AU before being able to establish any frame relay virtual circuit to a remote DTE.

– In the call control mapping method of interworking, it is the network’s responsibility to invoke the AU, if needed. The calling TE/FR 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.36 or Q.933 protocol procedures.

8.1.2 Addressing scheme

An AU port will be assigned a 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.36 or Q.933 SETUP message 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 FRDTS (e.g. FRPDN or ISDN) is connected to other networks, the guidelines outlined below may be used to select an AU to complete an incoming X.36 or Q.933 virtual circuit to the called TE/FR DTE+TA.

8.2.1.1 Access unit selection by FRPDN (Type A)

The following criteria may be used by FRPDN to complete an incoming X.36 virtual circuit to the called TE/FR DTE+TA:

– If the called address is an X.121 address assigned by the FRPDN, two cases are considered:

1) The called DTE connected to the B-ISDN is assigned an address according to the E.164 numbering plan. In this case, no AU is selected and the FRPDN applies its normal routing procedures to complete the incoming X.36 virtual circuit.

2) The called DTE connected to the B-ISDN is assigned an address according to the X.121 numbering plan and shares the Data Network Identification Code (DNIC) with the FRPDN.

a) If the called DTE is registered with the FRPDN and the subscription parameters indicate "Frame Mode", no AU is selected and the FRPDN applies its normal routing procedures.

b) If DTE is registered with the FRPDN and the subscription parameters indicate "ATM", the FRPDN selects an AU (with functionality as specified in this Recommendation) to complete the incoming call to the B-ISDN. The procedures in 10.2 apply.

c) If the called DTE is not registered with the FRPDN, the FRPDN selects an AU to complete the incoming call to the B-ISDN and the procedures in 10.2 apply.

– If the called address is an E.164 address assigned by the FRPDN, the following cases are considered:

1) The called DTE connected to the B-ISDN is assigned an address according to the E.164 numbering plan.

The following criteria may be used to select the AU:

a) If the called DTE is registered with the FRPDN and the subscription parameters indicate "Frame Mode", no AU is selected and the FRPDN applies its normal routing procedures.

b) If the called DTE is registered with the FRPDN and the subscription parameters indicate "ATM", the FRPDN selects an AU (with functionality as specified in this Recommendation) to complete the incoming call to the B-ISDN. The procedures in 10.2 apply.

c) If the called DTE is not registered with the FRPDN, the FRPDN selects an AU to complete the incoming call to the B-ISDN and the procedures in 10.2 apply.

2) The called DTE connected to the B-ISDN is assigned an address according to the X.121 numbering plan. In this case, no AU is selected and the FRPDN applies its normal routing procedures to complete the incoming X.36 virtual circuit.

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

8.2.1.2 Access unit selection by ISDN (Type B)

The following criteria may be used by ISDN to complete an incoming Q.933 virtual circuit to the called TE/FR DTE+TA:

– In this case, the called address is an E.164 address assigned by the ISDN, and the criterion that may be used to select the AU is the following:

- The called DTE connected to the B-ISDN is assigned an address according to the E.164 numbering plan.

The following criteria may be used to select the AU:

a) If the called DTE is registered with the ISDN and the subscription parameters indicate "Frame Mode", no AU is selected and the ISDN applies its normal routing procedures.

b) If the called DTE registered with the ISDN and the subscription parameters indicate "ATM", the ISDN selects an AU function (with functionality as specified in this Recommendation) and the procedures specified in 10.2 below apply.

c) If the called DTE is not registered with the ISDN, the ISDN selects an AU to complete the incoming call to the B-ISDN and the procedures in 10.2 apply.

NOTE – More global resolution (e.g. definition of a separate Recommendation) may need to be studied with respect to the selection of AU in the case of an incoming call when a network providing FRDTS 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 a Q.2931 SETUP message contains the address of the called TE/FR DTE+TA. The calling party number information element of the SETUP message may contain the address of the AU. An X.36 or Q.933 SETUP message sent over the ATM SVC contains the calling address of the remote DTE and may contain the address of the called TE/FR DTE+TA.

– 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/FR 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/FR DTE+TA interface selection

The subclause describes the information necessary to select a compatible TE/FR 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/FR DTE+TA for compatibility checking purposes.

In general, a B-ISDN number identifies one or more B-ISDN user-network interfaces. However, some networks may allow a B-ISDN user-network interface to be allocated more than one ISDN number; this allows the identification of a given terminal within a B-ISDN user-network interface.

NOTE – Additional description may be needed regarding B-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 (see Recommendations X.300 series) is possible.

This Recommendation specifies the procedures for interworking by the port access method. Interworking by the call control mapping method is specified in Recommendation Q.933.

9.2 Access to FRDTS via a B-ISDN

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

NOTE – Definition of Interworking Recommendation under the X.300 series is for further study.

In some implementations, the AU function logically belonging to the network providing the FRDTS 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 FRDTS is effected through the use of an X.76 interface or a functionally equivalent internal network protocol.

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

10 Procedures

The following subclauses apply for both access to FRDTS provided by an FRPDN (Type A) and access to FRDTS provided by an ISDN (Type B) using B-ISDN, except where stated otherwise.

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 specified in Recommendation Q.2933.

As described in 6.2 above, an ATM virtual channel connection is established between the TE/FR 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.36 or Q.933 procedures are performed between TE/FR DTE and the AU using the ATM virtual channel connection via the AAL type 5 and FR SSCS functions performed at TE/TA and the AU.

NOTE 2 – Use of AAL type 1 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/FR DTE+TA).

10.2 Procedures

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

The physical access connection between a TE/FR DTE+TA and an AU function (see Recommendation I.432) must be established by procedures beyond the scope of this Recommendation before the ATM virtual channel connection procedures specified in this Recommendation can be used.

Within the physical access connection, 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 Recommendations Q.2100 series.

NOTE – VCI value for Q.2931 point-to-multipoint procedures 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/FR DTE+TA, wishing to set up an X.36 or Q.933 virtual circuit 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.

NOTE 1 – If an ATM virtual channel connection is not established through the B-ISDN to the AU, the calling TE/FR DTE+TA uses the procedures specified in 10.2.1.1 below before setting up the X.36 or Q.933 virtual circuit.

NOTE 2 – If an ATM PVC is established through the B-ISDN, then frame relay PVCs as well as frame relay virtual circuits may be established between the calling TE/FR DTE+TA and remote DTEs.

NOTE 3 – No frame relay PVCs are allowed over an ATM SVC.

10.2.1.1 Outgoing ATM switched virtual channel connection

A calling TE/FR 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/FR DTE+TA:

   i) The Called Party Address information element contains the address of the AU.

      NOTE 1 – The procedure for overlap sending specified in 6.5.2/Q.2931 does not apply.

   ii) The Broadband Bearer Capability information element shall be encoded as follows:

      – bearer class set to "BCOB-C";

      – 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".

NOTE 2 – See Recommendation Q.2961.2.

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

– Recommendation X.36 or Q.933.

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

– Recommendation Q.933 core layer.

NOTE 3 – The usage of other values 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 frame relay virtual circuit setup and release

The X.36 or Q.933 procedures specified in Recommendation X.36 or Q.933 apply.

NOTE – A DLCI number is unique within an ATM virtual channel connection.

10.2.2 Incoming call

The AU delivers an incoming X.36 or Q.933 virtual circuit over an established ATM virtual channel connection to the called TE/FR DTE+TA. If more than one ATM virtual channel connection is established to the called TE/FR DTE+TA, the AU selects one of these ATM virtual channel connections to deliver the incoming X.36 or Q.933 virtual circuit. 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/FR DTE+TA, the AU initiates the procedures specified below for establishing an ATM SVC before delivering the incoming X.36 or Q.933 virtual circuit.

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/FR DTE+TA:

i) The Called Party Address information element in the SETUP message contains the address of the called TE/FR 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/FR DTE+TA. The user information layer 3 protocol (octet 7 of the Broadband Low Layer information element) is encoded as follows:

– Recommendation X.36 or Q.933.

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

– Recommendation Q.933 core layer.

NOTE – The usage of other values is for further study.

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

– If the called TE/FR DTE+TA is administratively registered with the Administration of the network providing the FRDTS 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 FRPDN AU to the called TE/FR DTE+TA are set to the TE/FR DTE+TA specific values determined at subscription time.

– If the called TE/FR 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/FR DTE+TA are set to default values determined by the FRPDN.

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 frame relay virtual circuit setup and release

The X.36 or Q.933 procedures specified in Recommendation X.36 or Q.933 apply, respectively.

NOTE – A DLCI number is unique within an ATM virtual channel connection.

10.3 ATM switched virtual channel connection clearing

10.3.1 Clearing initiated by the TE/FR DTE+TA

The TE/FR 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/FR 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 FRDTS AU

The FRDTS AU follows the procedures specified in 5.4.4/Q.2931 to clear an ATM switched virtual channel connection.

ATM PVC cannot be cleared by the FRDTS 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 frame relay data transfer phase, the frame relay virtual circuits shall be treated as follows:

– For switched virtual channel connections, an X.36 or Q.933 DISCONNECT message shall be sent with cause #9, "out of order", and diagnostic #0, "no additional information".

– For any frame relay virtual circuits 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 and cause information mapping between DSS1 and DSS2 specified in 6.3.5/Q.2931 and 6.4.5/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 frame relay virtual circuits still exist on ATM switched virtual channel connection, the AU clears the corresponding frame relay virtual circuit(s) with cause #58 "Bearer capability not presently available".

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 frame relay virtual circuits still exist on the ATM switched virtual channel connection, the AU also clears the corresponding frame relay virtual circuit(s) with cause #58 "Bearer capability not presently available".

3) If the establishment of an ATM SVC that is triggered by an incoming frame relay virtual circuit is rejected by the called TE/FR DTE+TA using Q.2931 messages on the Virtual Channel Identified by VCI = 5, the AU clears the incoming frame relay virtual circuit using an appropriate cause from Annex E/X.36.

4) If a condition exists that prevents a Q.2931 SETUP message that is triggered by an incoming frame relay virtual circuit from being delivered to the called TE/FR DTE+TA on the Virtual Channel Identified by VCI = 5, the AU clears the incoming frame relay virtual circuit in the network providing FRDTS with a cause that is selected appropriate to the condition from Annex E/X.36.

5) If a Q.2931 SETUP message is sent as a result of an incoming frame relay virtual circuit on a Virtual Channel Identified by VCI = 5 to the called TE/FR 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 frame relay virtual circuit on a Virtual Channel Identified by VCI = 5 to the called TE/FR 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 frame relay virtual circuit in the network providing FRDTS using the appropriate cause from Annex E/X.36 relative to the cause sent in the clearing message.

7) If an X.36 or Q.933 DISCONNECT message is received from the originating user by the AU prior to the delivery of the X.36 or Q.933 SETUP message to the called TE/FR DTE+TA (premature clearing), the AU shall send a RELEASE message 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 that is selected from Annex E/X.36 and mapped according to 6.3.5/Q.2931; and

   – 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).

10.7 ATM status monitoring procedure

Status monitoring procedure for ATM semi-permanent virtual channel connections is 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 FR DTEs at the S_B/T_B reference points of a B-ISDN (see Figure 11-1).

Figure 11-1/X.46 – Reference configuration of a TA

NOTE – A TA function supports only one FR 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;

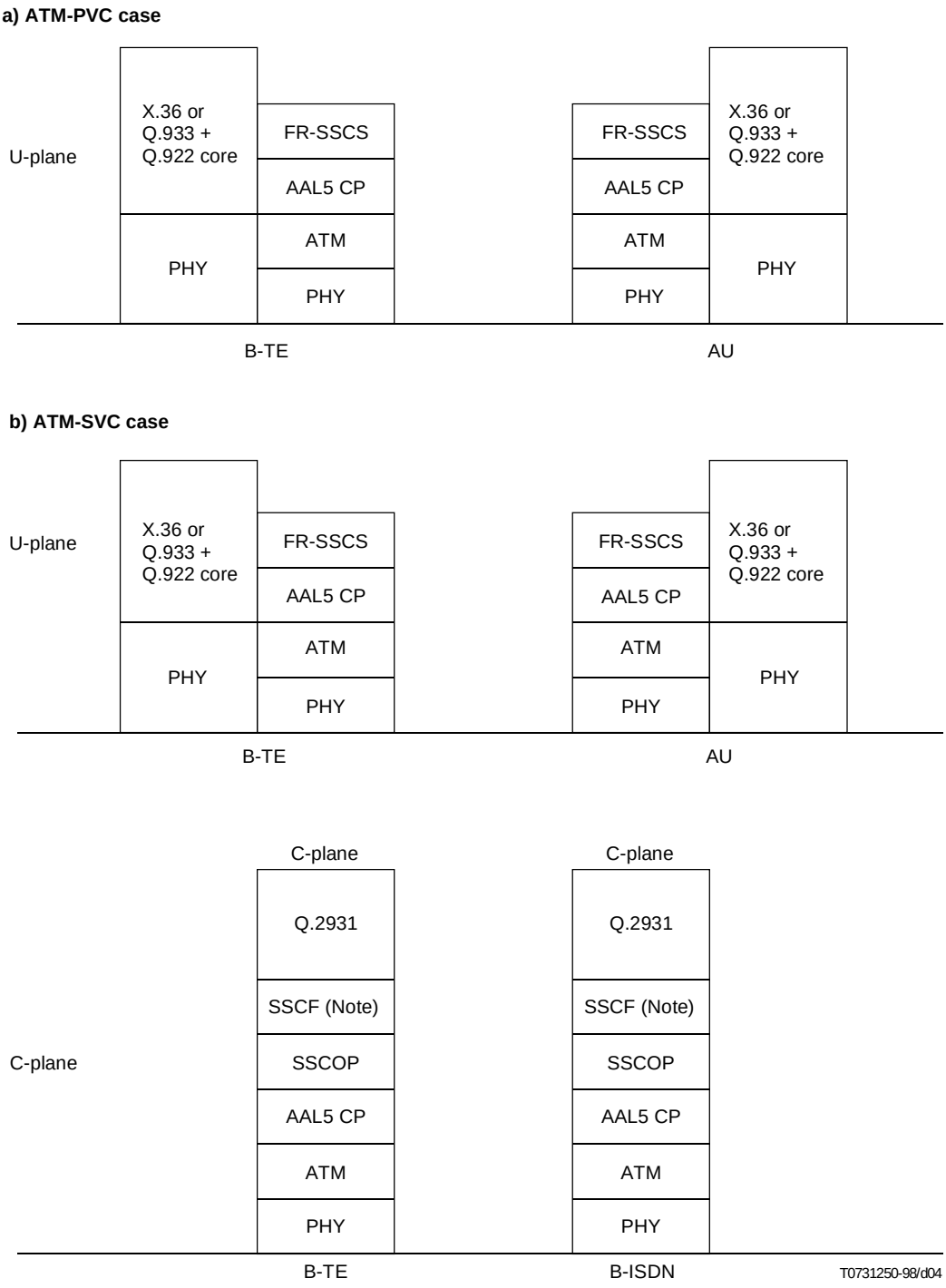
– synchronization;

– maintenance.

In the following, these main functionalities are described.

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

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



NOTE – See Recommendation Q.2130.

Figure 11-2/X.46 – Reference protocol stack model

11.2 Access to FRDTS 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.36. The physical interfaces supported at the S_B/T_B reference point are those defined in Recommendation I.432.

11.2.2 Rate adaption

In this case, frame relay terminals operating at data signalling rates lower than the physical access rate of B-ISDN at the R reference point can no longer be distinguished by the network from frame relay terminals operating at the same data rate as the physical access rate of B-ISDN at the R interface.

Therefore, the signalling procedures at the S_B/T_B reference point will indicate the data signalling rate of that reference point rather than the user data signalling rate at the R reference point. In addition, frame relay parameters (e.g. CIR) 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 appropriate AAL functions.

11.2.3 Layer 2 adaption

TA provides the layer 2 adaption function between LAPF frames on the R reference point and frames or cells on the S_B/T_B reference point. On the S_B/T_B reference point, TA uses AAL type 5 (CPCS + FR-SSCS) to convey frame relay frames.

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

In cases where type 5 is used, AAL type 5 message mode service will be available. The functionality of the FR-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 follows:

– CPCS-LP: may be set to either "0" or "1".

– CPCS-CI: may be set to "0".

– CPCS-UU: may be set to "0".

NOTE 2 – The definition of these parameters is specified in Recommendation I.363.

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 FRDTS network. After the ATM connection has been established, TA shall act transparent to X.36 layer 2 control part and layer 3.

11.2.4.1 Outgoing call

In the 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 categorise 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 the 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 FRPDN or the ISDN providing FRDTS.

i) For X.25 layer 1 interfaces – A transition from OFF to ON on the control lead (in the case of X.21 leased circuit procedure) or circuit 108 (in the 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 (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 FRPDN or the ISDN-FRDTS port, and full X.36 or Q.933 procedures must be used following the establishment of the ATM connection to identify the called frame relay DTE.

In the 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 FRPDN or the ISDN providing FRDTS.

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.46 – 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	X.25	X.21 leased circuit	DTE sets C = ON	Subclause 1.1/X.25
		X.21 *bis*	DTE sets circuit 108 = ON	Subclause 1.2/X.25
		V-series interfaces	DTE sets circuit 108 = ON	Subclause 1.3/X.25
	X.21 circuit-switched		DTE signals direct call	Subclause 4.4/X.21
	X.21 *bis* direct call		DTE signals direct call	Subclause 2.3.1/X.21 *bis*
	V.25 *bis* direct call		DTE uses direct call mode (Note)	Clause 5/V.25 *bis*
Full circuit-switched access	X.21 addressed call		DTE enters call control phase	Clause 4/X.21
	X.21 *bis* addressed call		DTE performs automatic address call	Subclause 2.3.2 iii)/X.21 *bis*
	V.25 *bis* addressed call		DTE uses address call mode	Clause 4/V.25 *bis*
NOTE – The difference between the V.25 *bis* 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 FRPDN or ISDN-FRDTS port to the TA

Four options exist to handle address information of the FRPDN or the ISDN-FRDTS 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 is 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.46 – TA functionality to control ATM connection establishment

	TA function		**Description of procedures**
	Conditions for initiation of an ATM virtual channel connection establishment (Subclause 11.2.4.1.1)	**Transfer of address information to the TA (Subclause 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 FRPDN or the ISDN-FRDTS. When the ATM connection is completely established at the S_B/T_B 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 FRPDN or the ISDN-FRDTS. 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 conditions b2)	Option b)	When 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 nor signalling functions for layer 1 are therefore required by the TA.

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 FRPDN port or the ISDN-FRDTS port will be introduced as the destination in the Q.2931 message.

11.2.4.1.5 X.36 or Q.933 procedures

In the data transfer phase, the TA may be transparent to layer 2 control part and layer 3 of the X.36 or Q.933 procedures. However, some realisations of FR terminals may require full or partial termination of layer 2 within the TA to accommodate existing LAPF 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.36 or Q.933 procedures

In the data transfer phase, the TA may be transparent to layer 2 control part and layer 3 of the X.36 or Q.933 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 circuit 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 ATM 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 points (see 11.2.3) 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 points 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 points 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 frame relay virtual circuit (X.36 or Q.933 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.

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