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**Broadband Integrated Services Digital Network (B-ISDN);
Specific interworking functionalities with B-ISDN**

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Foreword

This ETSI Technical Report (ETR) has been produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI).

ETRs are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature, relating to the use or the application of ETs or I-ETs, or which is immature and not yet suitable for formal adoption as an ETS or an I-ETS.

In order to allow the definition of general service provision scenarios involving the Broadband Integrated Services Digital Network (B-ISDN) and other public and private networks (e.g. Narrowband Integrated Services Digital Network (N-ISDN), Packet Data Network (PDN), European public Metropolitan Area Network (MAN), private Asynchronous Transfer Mode (ATM) network) for the communication between users requiring the same bearer service, the definition of the interworking between the B-ISDN and the others networks is needed.

This ETR defines a framework in which the description of the specific aspects for the interworking between the B-ISDN and a number of selected networks is provided. This ETR is structured analysing the interworking on a per-service basis.

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1 Scope

This ETSI Technical Report (ETR) describes some cases, considered to be handled with highest priority, of network interworking between Broadband Integrated Services Digital Network (B-ISDN) and another network, for the support of a given bearer service.

The networks identified for the interworking with B-ISDN are the Narrowband Integrated Services Digital Network (N-ISDN), Packet Data Network (PDN), Metropolitan Area Network (MAN), Public Land Mobile Network (PLMN), private Asynchronous Transfer Mode (ATM) network.

The case of interworking between the B-ISDN and the other network when they support different bearer services is outside the scope of this ETR, as well as the interworking for teleservice and supplementary service.

This ETR is organized per class of services supported by the B-ISDN, as they are defined in ITU-T Recommendations F.811 [8] and F.812 [9].

For each class, the relevant networks for the interworking with B-ISDN for particular services in that class are selected; the interworking reference configurations are provided; the Interworking Unit (IWU) functional architecture is defined with the specification of the transport technique conversion and data transfer protocols functional mapping, the definition of the interactions between the control/management procedures for call/connection handling and the identification of addressing, routing and resources handling interworking requirements.

2 References

This ETR incorporates by dated and undated reference, provisions from other publications. These references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETR only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- [1] DE/NA-010019: "Network Aspects (NA); Broadband Connection Oriented Bearer (BCOB) service category".
- [2] Draft ITU-T Recommendation I.5GA: "General arrangement of B-ISDN Interworking".
- [3] DTR/NA-023218: "Broadband Integrated Services Digital Network (B-ISDN); Narrowband Integrated Services Digital Network (N-ISDN); General principles and functional requirements for interworking between B-ISDN and N-ISDN".
- [4] ETR 149: "Network Aspects (NA); Interworking between Metropolitan Area Networks (MANs) and Asynchronous Transfer Mode (ATM) networks for the Connectionless Broadband Data Service (CBDS)".
- [5] ETS 300 405: "Network Aspects (NA); Metropolitan Area Network (MAN); Interconnection of MAN Switching Systems (MSS) based on an Asynchronous Transfer Mode (ATM) interface".
- [6] ETS 300 455: "Broadband Integrated Services Digital Network (B-ISDN); Broadband Virtual Path Service (BVPS)".
- [7] I-ETS 300 353: "Broadband Integrated Services Digital Network (B-ISDN); Asynchronous Transfer Mode (ATM); Adaptation Layer (AAL) specification - type 1".
- [8] ITU-T Recommendation F.811: "Broadband connection-oriented bearer service".
- [9] ITU-T Recommendation F.812: "Broadband connectionless data bearer service".

- [10] ITU-T Recommendation G.703: "Physical/electrical characteristics of hierarchical digital interfaces".
- [11] ITU-T Recommendation G.704: "Synchronous frame structures used at 1544, 6312, 2048, 8488 and 44 736 kbit/s hierarchical levels".
- [12] ITU-T Recommendation I.230: "Definition of bearer service categories".
- [13] ITU-T Recommendation I.231: "Circuit-mode bearer service categories".
- [14] ITU-T Recommendation I.363: "B-ISDN ATM adaptation layer (AAL) specification", including ITU-T Recommendation I.363 Add (November 1993).
- [15] ITU-T Recommendation I.430: "Basic user-network interface - Layer 1 specification".
- [16] ITU-T Recommendation I.431: "Primary rate user-network interface - Layer 1 specification".
- [17] ITU-T Recommendation I.580: "General arrangements for interworking between B-ISDN and 64 kbit/s based ISDN".
- [18] ITU-T Recommendation Q.2110: "B-ISDN ATM adaptation layer - Service specific connection oriented protocol (SSCOP)".
- [19] ITU-T Recommendation Q.2130: "B-ISDN signalling ATM adaptation layer - Service specific coordination function for support of signalling at the user-network interface (SSCF at UNI)".
- [20] ITU-T Recommendation Q.2140: "B-ISDN ATM adaptation layer - Service specific coordination function for signalling at the network node interface (SSCF AT NNI)".
- [21] ITU-T Recommendation Q.2931: "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".
- [22] ITU-T Recommendation Q.921: "ISDN user-network interface - Data link layer specification".
- [23] ITU-T Recommendation Q.922: "ISDN data link layer specification for frame mode bearer services".
- [24] ITU-T Recommendation Q.923: "Specification of a synchronization and coordination function for the provision of the OSI connection-mode network service in an ISDN environment".
- [25] ITU-T Recommendation Q.931: "Digital subscriber Signalling System No. 1 (DSS 1) - ISDN user-network interface layer 3 specification for basic call control".
- [26] ITU-T Recommendation Q.933: "ISDN Digital Subscriber Signalling System No. 1 (DSS 1) - Signalling specification for frame mode basic call control".
- [27] ETS 300 467: "Broadband Integrated Services Digital Network (B-ISDN); Support of Frame Relay Bearer Service (FRBS) in B-ISDN and frame relay interworking between B-ISDN and other networks".

3 Abbreviations

For the purposes of this ETR, the following abbreviations apply:

AALn	ATM Adaptation Layer type n
ACF	ATM Control Functions
ATF	ATM Termination Functions
ATM	Asynchronous Transfer Mode
B-ISDN	Broadband Integrated Services Digital Network
B-ISUP	B-ISDN User Part
BCF	Broadband Control Functions
BMF	Broadband Management Functions
BTF	Broadband Termination Functions
CBR	Constant Bit Rate
CPCS	Common Part Convergence Sublayer
DLCI	Data Link Control Identifier
FR	Frame Relay
FR-SSCS	Frame Relay Service Specific Convergence Sublayer
FRBCF	Frame Relay Broadband Control Functions
FRBTF	Frame Relay Broadband Termination Functions
FRNCF	Frame Relay Narrowband Control Functions
FRNTF	Frame Relay Narrowband Termination Functions
FRSF	Frame Relay Service Function
ISUP	ISDN User Part
IWF	Interworking Function
IWU	Interworking Unit
LLC	Logical Link Control
MAN	Metropolitan Area Network
MTP	Message Transfer Part (of Signalling System No.7)
N-ISDN	Narrowband Integrated Services Digital Network
NCF	Narrowband Control Functions
NMF	Narrowband Management Functions
NTF	Narrowband Termination Functions
PDN	Packet Data Network
PDU	Protocol Data Unit
PLMN	Public Land Mobile Network
PMF	PVC Mapping Functions
PVC	Permanent Virtual Channel
RCF	Relaying and Conversion Functions
SCF	Signalling Coordination Functions
SVC	Switched Virtual Channel
TE	Terminal Equipment
UNI	User Network Interface
VC	Virtual Channel
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier
VP	Virtual Path
VPI	Virtual Path Identifier

4 General interworking configuration

The general interworking configuration is shown in figure 1.

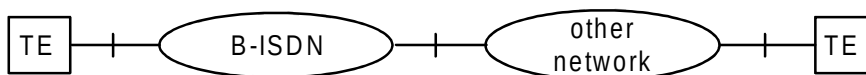


Figure 1

5 Interworking functional requirements for B-ISDN services

5.1 Interworking for class A services

5.1.1 B-ISDN/N-ISDN interworking for constant bit rate services

5.1.1.1 Introduction

The general interworking scenarios are defined in DTR/NA-023218 [3], based on ITU-T Recommendation I.580 [17].

Starting from these scenarios, this ETR addresses the definition of the specific interworking functionalities between B-ISDNs and N-ISDNs when the N-ISDN supports the circuit mode bearer service categories as defined in ITU-T Recommendations I.230 [12] and ITU-T Recommendation I.231 [13], and the B-ISDN provides Constant Bit Rate (CBR) connection oriented services as defined in ITU-T Recommendation F.811 [8] and in DE/NA-010019 [1] and ETS 300 455 [6].

5.1.1.2 Services for N-ISDN/B-ISDN interworking

This ETR considers service categories as defined in ITU-T Recommendations I.230 [12] and I.231 [13] on the N-ISDN side and in ITU-T Recommendation F.811 [8] on the B-ISDN side.

In particular, on the N-ISDN side, the following CBR services are considered:

- circuit-mode 64 kbit/s unrestricted 8 kHz structured bearer service category;
- circuit-mode 64 kbit/s 8 kHz structured bearer service category usable for speech information transfer;
- circuit-mode 64 kbit/s 8 kHz structured bearer service category usable for 3,1 kHz audio information transfer;
- circuit-mode alternate speech/64 kbit/s unrestricted 8 kHz structured bearer service category;
- circuit-mode 2 x 64 kbit/s unrestricted 8 kHz structured bearer service category;
- circuit-mode 384 kbit/s unrestricted 8 kHz structured bearer service category;
- circuit-mode 1 536 kbit/s unrestricted 8 kHz structured bearer service category;
- circuit-mode 1 920 kbit/s unrestricted 8 kHz structured bearer service category,

on the B-ISDN side, the sub-categories A, CBR services are considered:

- sub-category A-1, that provides circuit transport of unstructured data;
- sub-category A-2, that supports the 64 kbit/s base ISDN service category usable for speech;
- sub-category A-3, that supports the 64 kbit/s base ISDN service category usable for 3,1 kHz audio;
- sub-category A-4, that supports the 64 kbit/s base ISDN service category 64 kbit/s unrestricted;
- sub-category A-5, that supports the 64 kbit/s base ISDN service category multiple rate;
- sub-category A-6, that provides video signal transport.

5.1.1.3 User plane (layer of interworking between user plane protocols on both sides)

The protocol stacks shown in this subclause are related to the general interworking configuration shown in figure 2. The protocol stacks for the other possible configurations (e.g. interconnection of two N-ISDNs through a B-ISDN and vice versa, as presented in DTR/NA-023218 [3]) may be easily derived from this configuration.

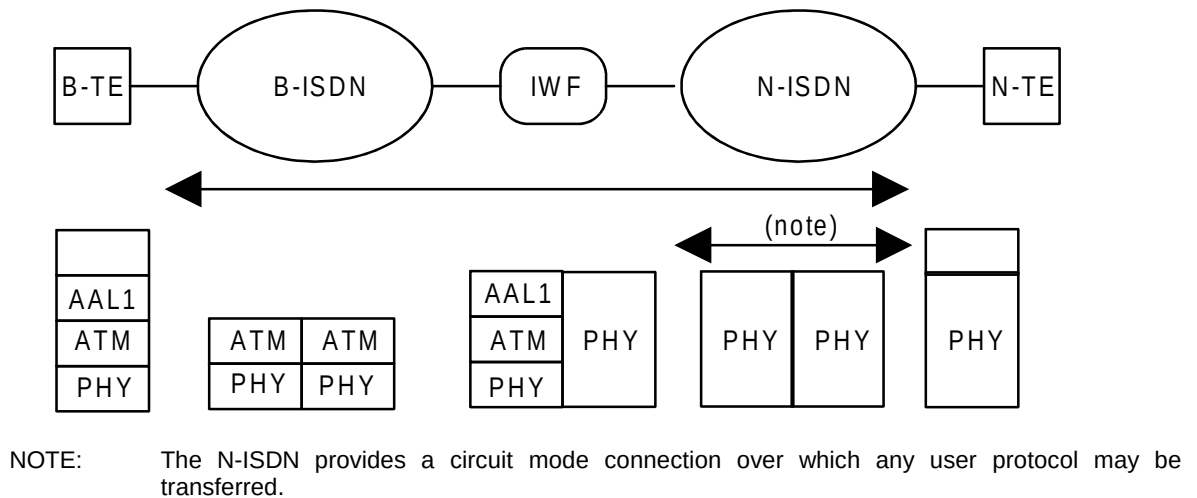


Figure 2: User plane protocol stacks

At the N-ISDN side there is a circuit connection; at the B-ISDN side a circuit connection is emulated. The ATM Adaptation Layer type 1 (AAL1) level adapts the ATM flow to the characteristics of the circuit connection (synchronization, delay handling, etc.). The AAL1 and its functions are defined in ITU-T Recommendation I.363 [14] and I-ETS 300 353 [7].

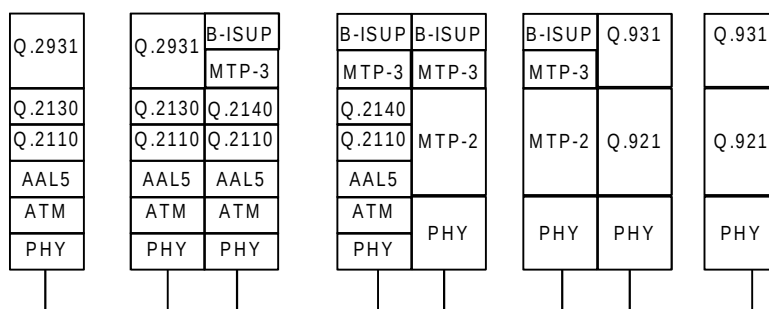
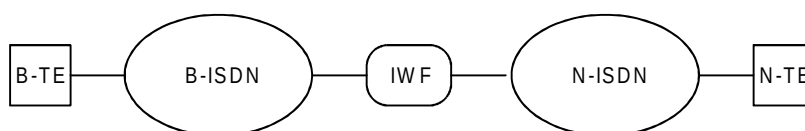
5.1.1.4 Signalling interworking requirements for call/connections handling in both network

For the control plane interworking procedure the network interworking scenario is considered (see figure 3).

In the network interworking scenario the B-ISDN supports the N-ISDN services; the IWU maps the B-ISDN network protocols and the N-ISDN network protocols.

The B-ISDN transparent access to the N-ISDN services (B-ISDN doesn't support the N-ISDN services) is considered in DTR/NA-023218 [3], but is not considered in this ETR because the B-ISDN control plane release 1 protocols already include the support of CBR services.

The access interworking scenario as a transitory solution of the control plane solution is presented in annex A.



Q.921: ITU-T Recommendation Q.921 [22]. Q.2130: ITU-T Recommendation Q.2130 [19].
 Q.931: ITU-T Recommendation Q.931 [25]. Q.2140: ITU-T Recommendation Q.2140 [20].
 Q.2110: ITU-T Recommendation Q.2110 [18]. Q.2931: ITU-T Recommendation Q.2931 [21].

Figure 3: Control plane protocol stacks: network interworking scenario

5.1.1.5 IWU functional description

Figure 4 shows a general functional description of the IWU (network element supporting the Interworking Function (IWF)), without any link with the service supported. This is a functional description, it does not imply any particular implementation.

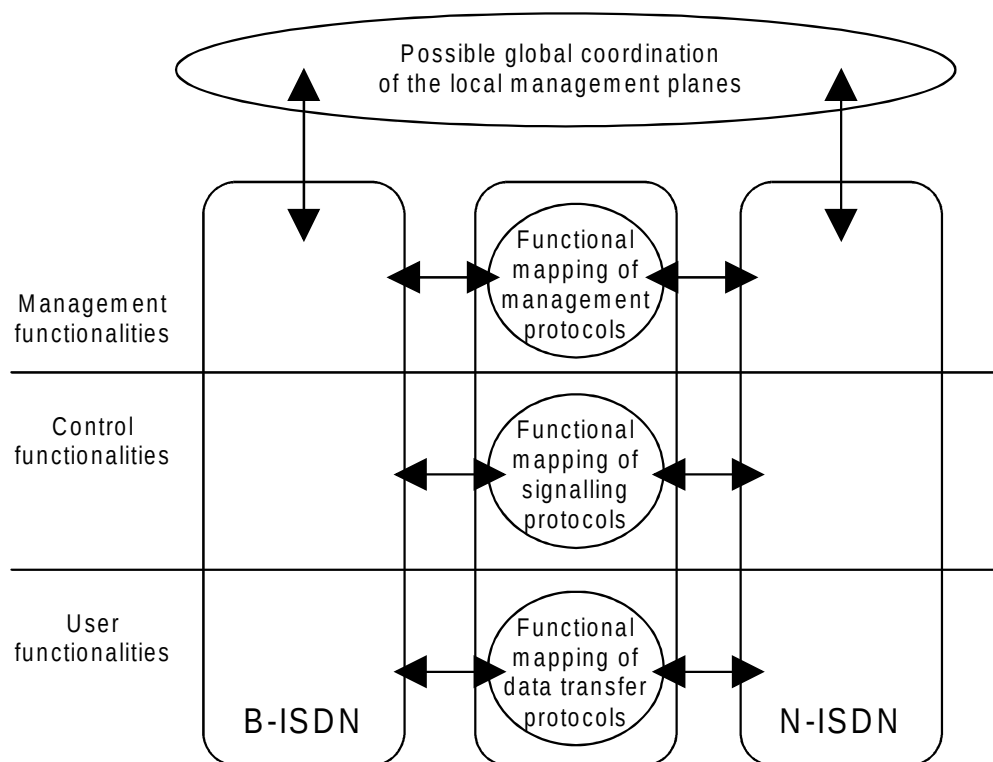


Figure 4: IW general functional description

In the following, the functions implemented by the IWU between N-ISDN and B-ISDN for CBR services are explained, using the functional scheme given in figure 4.

5.1.1.5.1 N-ISDN termination functions

Control functions:

- Narrowband Control Functions (NCF): they provide the signalling functions for the establishment of circuit switched connection (B, H, N*64) between the Terminal Equipment (TE) and the IWU. They are based on ITU-T Recommendations Q.931 [25]/Q.921 [22] protocols for CBR services operating on the D-channel in the access interworking scenario, or on ISDN User Part/Message Transfer Part 3/Message Transfer Part 2 (ISUP/MTP-3/MTP-2) for CBR services in the network interworking scenario.

Management functions:

To be defined.

Data termination functions:

- Narrowband Termination Functions (NTF):
 - (B-ISDN → N-ISDN): these provide the channelling of the ITU-T Recommendation G.704 [11] information flow, using the information and parameters determined by the Relaying and Conversion Functions (RCF);
 - (N-ISDN → B-ISDN): these receive the ITU-T Recommendation G.704 [11] information flow, perform the necessary service specific functions and send it to the RCF;
 - the NTF includes the N-ISDN clock recovery function.

5.1.1.5.2 B-ISDN termination functions

Control functions:

- Broadband Control Functions (BCF): these provide the signalling functions for the establishment of ATM Virtual Path/Virtual Channel (VP/VC) and the corresponding AAL1 connection between the IWU and the TE/CBR server. They are based on ITU-T Recommendations Q.2931 [21]/Q.2130 [19], Q.2110 [18]/AAL5 protocols in the access interworking scenario or on B-ISUP/MTP-3/ITU-T Recommendations Q.2140 [20]/Q.2110 [18]/AAL5 in the network interworking scenario.

Management functions:

To be defined.

Data termination functions:

- Broadband Termination Functions (BTF): these provide the transmission / reception of the CBR data unit; they are based on AAL1/ATM protocols;

(N-ISDN → B-ISDN): these provide the transmission of the CBR data unit, using the information and parameters determined by the RCF;

(B-ISDN → N-ISDN): these receive the CBR data unit, perform the necessary service specific functions and send it to the RCF.

The BTF include:

- blocking/deblocking of user information;
- handling of cell delay variation;
- handling of lost and misinserted cells;
- timing information transfer;
- structure information transfer;
- handling of error correction.

5.1.1.5.3 Central interworking functions

Control functions:

- Signalling Coordination Functions (SCF): these provide the conversion between broadband and narrowband data transfer protocols; in particular, they adapt ITU-T Recommendations Q.931 [25]/Q.921 [22] protocols to ITU-T Recommendations Q.2931 [21]/Q.2130 [19]/Q.2110 [18]/AAL5 protocols and vice versa in access interworking, and ISUP/MTP-3/MTP-2 protocols to B-ISUP/MTP-3/ITU-T Recommendations Q.2130 [19]/Q.2110 [18]/AAL5 and vice versa in the network interworking. Other control plane interworking definitions for CBR services are given in annex E of ITU-T Recommendation Q.2931 [21].

Management functions:

To be defined.

Data functions:

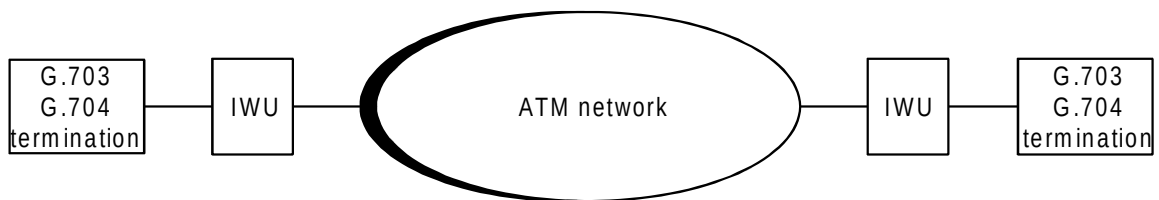
- RCF: these provide the conversion between broadband and narrowband data transfer protocols; they adapt the N-ISDN CBR flow to AAL1 protocols and vice versa. In particular, RCF include the functions that associate the N-ISDN channels with the B-ISDN VP/VC.

5.1.2 Interworking between B-ISDN and G.703/704 PDH terminations

Figure 5 shows the configuration related to the interworking between a network element supporting ITU-T Recommendations G.703 [10]/G.704 [11] interfaces and an ATM network providing class A circuit transport services. Cases such as circuit transport of the unstructured ITU-T Recommendation G.703 [10] signals or user plane interworking between B-ISDN and 64 kbit/s based ISDN in terms of B/H channel transport are examples of the involved class A circuit transport services. The IWF functional block provides the interworking between ITU-T Recommendations G.703 [10]/G.704 [11] terminations and an ATM network. ITU-T Recommendations G.703 [10]/G.704 [11] terminations are considered to terminate the links independently of the specific network element (TE, 64 kbit/s based ISDN node, etc.). The IWF function can also be physically implemented inside the ATM switch or inside the ITU-T Recommendations G.703 [10]/G.704 [11] terminations.

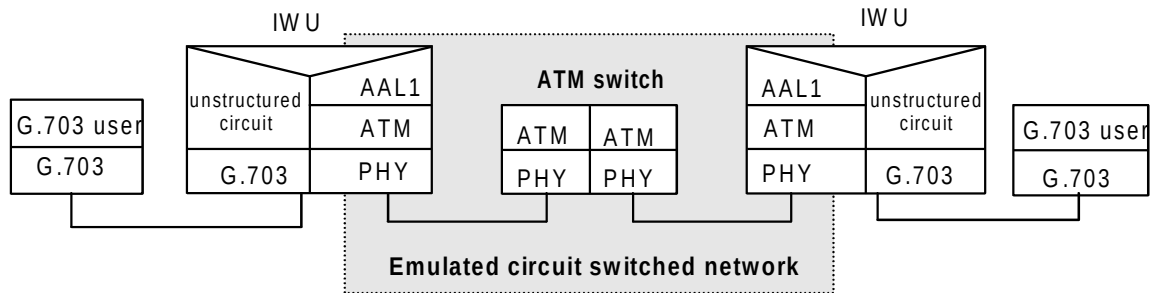
The corresponding unstructured circuit transport interworking model is shown in figure 6. The unstructured circuit transport service provides the transports of unstructured ITU-T Recommendation G.703 [10] signals independently from the overlaying frame structure, if any. The ATM network encompassed between the two corresponding AAL1 involved entities acts, from the service point of view, as an emulated circuit switched network.

The corresponding structured circuit transport interworking model is shown in figure 7. The structured circuit transport service provides the transport of single 64 kbit/s channels or groups of $n \times 64$ kbit/s. The ATM network encompassed between the two corresponding AAL1 involved entities acts, from the service point of view, as an emulated circuit switched network.



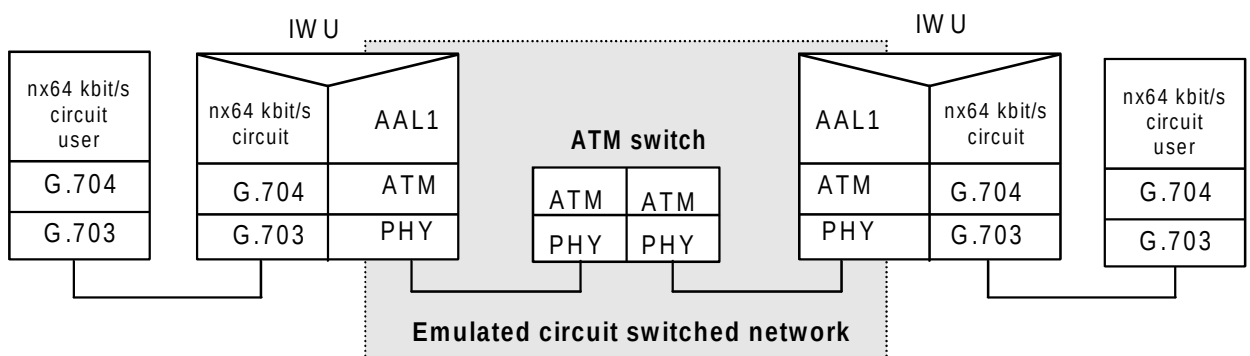
G.703: ITU-T Recommendation G.703 [10]. G.704: ITU-T Recommendation G.704 [11].

Figure 5: Interworking configuration



G.703: ITU-T Recommendation G.703 [10].

Figure 6: Unstructured circuit transport interworking model



G.703: ITU-T Recommendation G.703 [10]. G.704: ITU-T Recommendation G.704 [11].

Figure 7: Structured circuit transport interworking model

5.2 Interworking for class B services

For further study.

5.3 Interworking for class C services

5.3.1 B-ISDN/N-ISDN interworking for frame relay

The interworking between N-ISDN/B-ISDN for the Frame Relay (FR) service is considered in this subclause. Two hypotheses are assumed and are shown in the following:

a) two interworking scenarios are considered:

- 1) in the first scenario, the B-ISDN does not support the FR;
- 2) in the second scenario the B-ISDN supports the FR.

The N-ISDN does not support the FR in either scenario. This comes from the fact that, in Europe, only the transparent access to FR is foreseen for the N-ISDN, but for the B-ISDN all possibilities are still under consideration;

b) the ITU-T Recommendations present two types of signalling for FR:

- 1) two step signalling for N to one (N:1) mapping; and
- 2) integrated signalling for one to one (1:1) mapping.

In this ETR, only the two step signalling procedures are considered because they do not require the definition of new signalling recommendations and can be applied in the near future;

c) in this ETR it is assumed:

on B-ISDN side:

- N:1 mapping when multiple FR connections, with different Data Link Control Identifier (DLCI) values, are multiplexed in one ATM connection;
- 1:1 mapping when only one FR connection lies on an ATM connection, using DLCI=0 for status report and any other DLCI for user connection;

on N-ISDN side:

- N:1 mapping when multiple FR connections, with different DLCI value, are multiplexed in one circuit connection;
- 1:1 mapping when only one FR connection lies on a circuit connection.

5.3.1.1 Interworking scenarios

Scenario (a): end-to-end communication between B-ISDN and N-ISDN TEs using FR:

In this case neither B-ISDN nor N-ISDN provide Frame Relay Service Functions (FRSFs) within the network. This scenario is presented in ITU-T Recommendation I.580 [17]. It is not included in subclause 7.3 of ETS 300 467 [27], but it is proposed as a realistic short term interworking solution.

A transparent connection of the ATM layer, either permanent, reserved or on-demand, is used between the B-ISDN User Network Interface (UNI) (at reference point S_B/T_B) and the IWF.

On the N-ISDN side, a transparent channel (B, H, N*64) is used between the reference point S_N/T_N and the IWF.

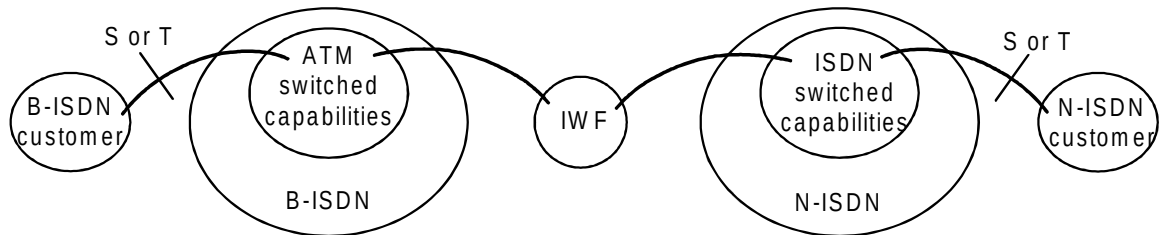


Figure 8: Scenario (a)

The FR data transfer protocols are implemented in B-ISDN TEs and N-ISDN TEs and at the IWF.

The IWF supports user plane data transfer protocol conversion as defined in subclauses 7.1 and 7.2 of ETS 300 467 [27], and the mapping of access signalling/management procedures applied in the two networks.

The FR service will become generally available if these IWFs are an integrated part of a FR service network.

Scenario (b): access to B-ISDN FR service via N-ISDN capabilities:

In this case the FRSF is provided within the B-ISDN. This case corresponds to the one described in subclause 7.3.1.4 of ETS 300 467 [27]. The FRSF handles FR protocols and routes data according to routing information provided during FR connection establishment.

As in the scenario (a), the N-ISDN does not provide FRSFs.

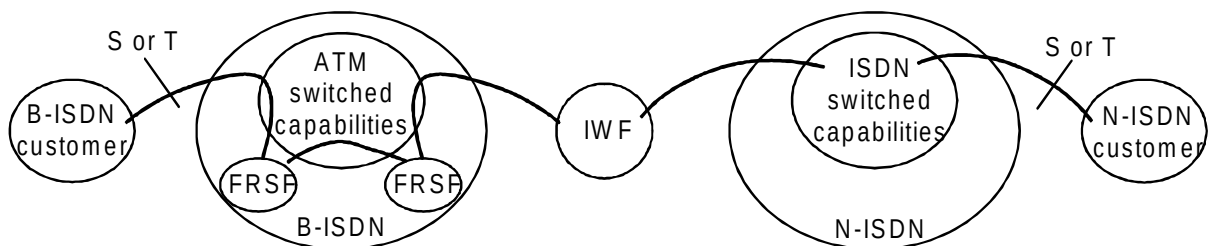


Figure 9: Scenario (b)

The FR data transfer protocols are implemented in B-ISDN and N-ISDN TEs, at IWF and at FRSF.

The IWF supports user plane data transfer protocol conversion as defined in subclauses 7.1 and 7.2 of ETS 300 467 [27], and the mapping of signalling/management procedures applied in the two networks.

5.3.1.2 Interworking requirements for permanent virtual channel handling

On the N-ISDN side, the procedure used for Permanent Virtual Channel (PVC) handling are those described in annex A of ITU-T Recommendation Q.933 [26]; these procedures are bi-directional.

On the B-ISDN side, the procedure used for PVC handling are those described in annex A of ETS 300 467 [27]; these procedures are bi-directional.

The connection is established and released through management entities. The IWF will provide the mapping functionalities on the user plane between the information received by the interfaces, no control plane functions are required. The IWF will provide the correlation between the information on the status of the PVC segment at the N-ISDN side and the corresponding information for the PVC segment at the B-ISDN side, collecting the information received across each interface in a database.

5.3.1.3 Interworking requirements for switched virtual channel handling

Two kinds of signalling procedures may be applied, in principle, on both the N-ISDN and the B-ISDN side, for the establishment of frame relay connections between the terminals and the IWF:

- **two step signalling procedures (only applicable in case of N:1 mapping in B-ISDN side):**
 - 1) at first, a circuit switched/ATM VP/VC connection is established by means of out-of-band signalling procedures (on the D-channel or the signalling Virtual Path Identifier/Virtual Channel Identifier (VPI/VCI) respectively);
 - 2) then, the frame relay connection is established by means on ITU-T Recommendation Q.933 [26] in-band signalling procedures (on the bearer channel or the ATM VP/VC previously established);
- **integrated signalling procedures (only applicable in case of 1:1 mapping in B-ISDN side):**
 - both the circuit switched/ATM VP/VC connection and the frame relay connection are established in parallel by means of out-of-band signalling procedures (on the D-channel or the signalling VPI/VCI respectively).

When integrated frame handling functionalities are not provided in the N-ISDN, the two step approach has to be applied (ITU-T Recommendation Q.933 [26] Case A). for B-ISDN, the two step signalling procedure is limited to the N:1 mapping case (allowing a single connection to be established) and the integrated signalling procedure is limited to 1:1 mapping (DLCI=0 may be used for layer management defined in ITU-T Recommendation Q.933 [26]).

The interworking functionalities are defined only for the two step approach in this ETR.

Scenario (a):

On the N-ISDN side, the procedures used for the connection establishment are those defined in ITU-T Recommendation Q.933 [26] as Case A. A two step signalling procedure is adopted:

- 1) first, a circuit switched connection between the originating user (outgoing call) and the IWF is established (or from the IWF to the called user for incoming calls); this is done by means of ITU-T Recommendation Q.931 [25] procedures on the D-channel, for the setup of a B, H or N*64 bearer channel. In the setup message on the D-channel, the called party address information element is coded with the address of the IWU and the Bearer capability information element is coded with:
 - information transfer capability set to "unrestricted digital information";
 - transfer mode set to "circuit mode";
 - information transfer rate set to the bit rate of the bearer channel.

- 2) secondly, the originating user (or the IWF) proceeds with the establishment of the frame mode connection by means of the ITU-T Recommendation Q.933 [26] procedures on the logical link identified by DLCI=0 within the bearer channel between itself and the IWF.

Similar two step signalling procedures will be applied on the B-ISDN side:

- a) first, an ATM VP/VC is established between the originating user and the IWF (or vice versa for an incoming call). This is done by means of ITU-T Recommendation Q.2931 [21]/B-ISUP procedures on the signalling VC, the signalling link is defined as a Virtual Channel Connection (VCC) with VCI=5, at the ATM layer; this signalling link conforms to ITU-T Recommendation Q.2931 [21] which only supports negotiation of other VCI values in the same VP. The following minimum set of parameters needs to be negotiated using ITU-T Recommendation Q.2931 [21] to set up the ATM link:
- destination address (IWU);
 - originating address (IWU);
 - bearer service: ATM;
 - Logical Link Control (LLC): Frame Relay Service Specific Convergence Sublayer (FR-SSCS);
 - VCI value for the connection (the VPI value will be implicit);
 - ATM level traffic parameters (peak cell rate, etc.);
 - quality of service parameter;
 - mapping options (DE - CPCS/LP, FECN/BECN-CPCS/CI, etc.).
- b) secondly, the originating user (or the IWF) proceeds with the establishment of the frame mode connection by means of ITU-T Recommendation Q.933 [26] procedures on the logical link identified by DLCI=0 within the ATM VP/VC previously established between itself and the IWF. ITU-T Recommendation Q.933 [26] only supports negotiation of other DLCI values within the same ATM VCC. The following minimum set of parameters needs to be negotiated using ITU-T Recommendation Q.933 [26] to set up the frame relay link:
- destination address;
 - originating address;
 - bearer service: frame relay;
 - DLCI value for the connection (the VPI/VCI values will be implicit);
 - frame relay traffic parameters (CIR, BC, BE, etc.).

Figure 10 shows the user and control planes protocol stacks for this interworking scenario.

Scenario (b):

On the N-ISDN side, the procedures used for the connection establishment are those described for scenario (a).

On the B-ISDN side, the procedures used for the connections establishment are those described for scenario (a), but applied between the B-ISDN TE and the first FRSF, between two FRSFs, and between the FRSF and the IWF.

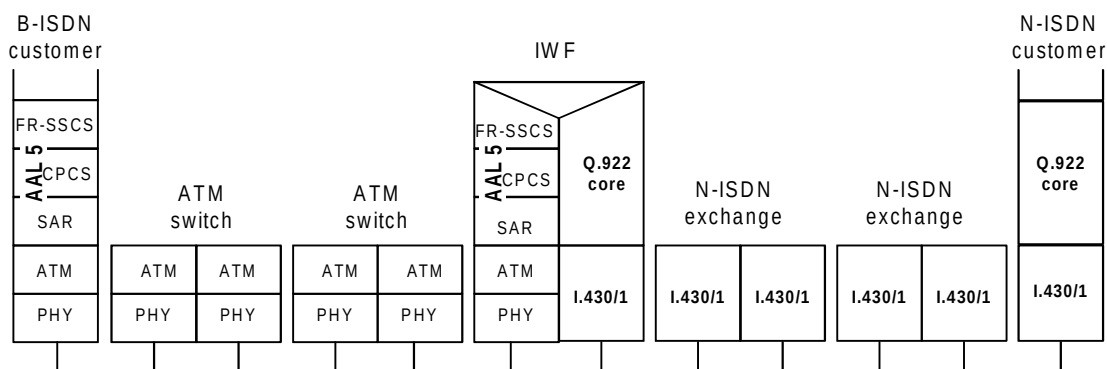
The user plane and control plane protocol stacks are the same of those shown in figure 1 for scenario (a), but applied on the B-ISDN side, between the B-ISDN TE and the first FRSF, between two FRSFs, and between the FRSF and the IWF.

IWF:

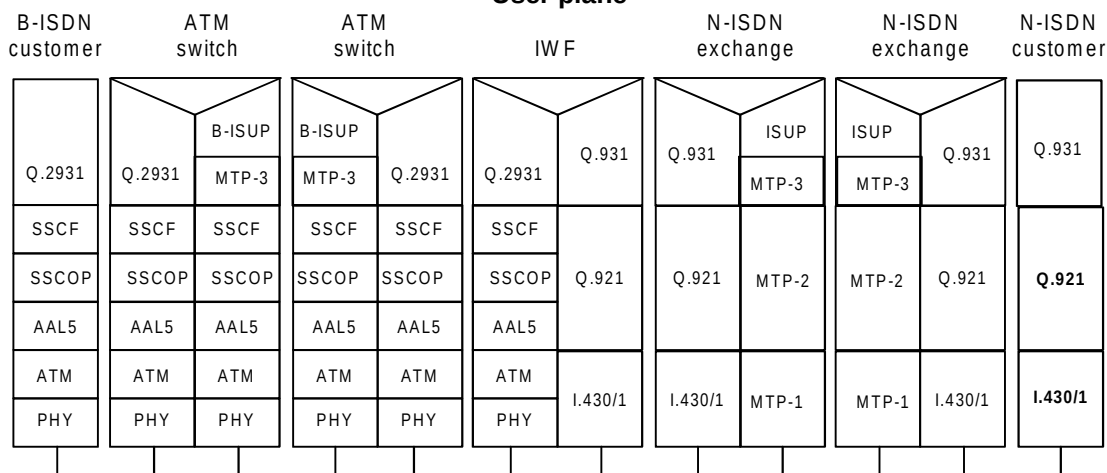
If the call is originated on the N-ISDN side, the IWF will first support the setup of the circuit switched connection with the N-ISDN TE, and will then receive from the N-ISDN TE the request for the establishment of the frame mode connection with the B-ISDN TE. The IWF will provide the mapping of this request first into a request for an ATM VP/VC to the destination user (scenario (a)), or to the appropriate FRSF on the path towards the destination user (scenario (b)), and then into a request for a frame mode connection within the previously established VPC/VCC.

Analogous but reversed steps are applied for calls originated on the B-ISDN side.

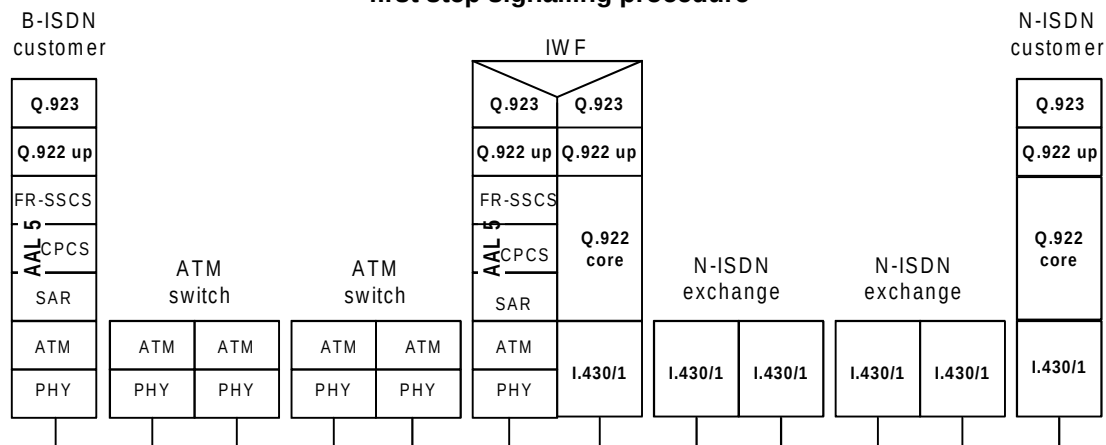
During the data transfer phase the IWF will provide the protocol conversion functions and the association between the bearer channel and DLCI value on the N-ISDN side, and will provide the physical link, the VPI/VCI value and the DLCI value on the B-ISDN side, established during the connection setup phase.



User plane



first step signalling procedure



second step signalling procedure

Control plane

I.430/1:	ITU-T Recommendations I.430 [15] and I.431 [16].	Q.922:	ITU-T Recommendation Q.923 [24].
Q.921:	ITU-T Recommendation Q.921 [22].	Q.931:	ITU-T Recommendation Q.931 [25].
Q.922:	ITU-T Recommendation Q.922 [23].	Q.2931:	ITU-T Recommendation Q.2931 [21].

Figure 10

5.3.1.4 IWU description

Figure 11 shows a general functional description of the IWU (network element supporting the IWF), without any link with the service supported. This is a functional description: it does not imply any particular implementation.

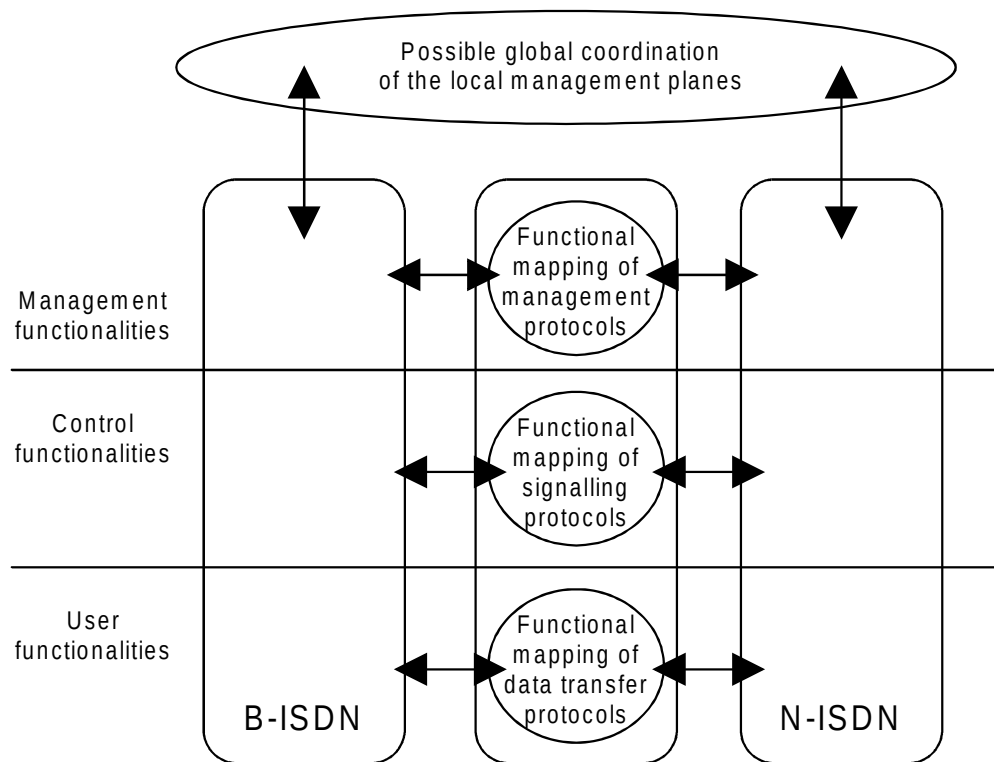


Figure 11: IWU general functional description

In the following, the functions implemented by the IWU between N-ISDN and B-ISDN for FR service are explained, using the functional scheme of figure 11.

5.3.1.4.1 N-ISDN termination functions

Control functions:

- BCF: these provide the signalling functions for the establishment of circuit switched connections (B, H, N*64) between the TE and the IWF. They are based on ITU-T Recommendations Q.931 [25]/Q.921 [22] protocols operating on the D-channel;
- Frame Relay Narrowband Control Functions (FRNCF): these provide the in-band signalling functions for the establishment of frame relay connections between the TE and the IWU. They are based on ITU-T Recommendation Q.933 [26] procedures operating on the logical link identified by the DLCI=0 within the bearer channel between the TE and the IWU.

Management functions:

- Narrowband Management Functions (NMF): these include the PVC handling functions, according to annex A of ITU-T Recommendation Q.933 [26]; they are related to sending and receiving the STATUS ENQUIRY and STATUS messages through the Frame Relay Narrowband Termination Functions (FRNTF). The NMF exchanges information with the PMF for the updating of the status of the end-to-end PVC. Other management functions could be included.

Data termination functions:

- FRNTF: these provide the functions to transmit/receive frame relay data units; they are based on ITU-T Recommendation Q.922 [23] Core protocol.

DLCI different from 0 (user data flow):

B-ISDN → N-ISDN:

they provide the formatting of the ITU-T Recommendation Q.922 [23] Core frame, using the information and parameters determined by the RCF, and forwards it to the BTF for the transmission on the bearer channel.

N-ISDN → B-ISDN:

they receive the ITU-T Recommendation Q.922 [23] Core frame through the BTF, they perform the necessary service specific functions, and sends it to the RCF with the relevant control information.

DLCI =0 (in-band ITU-T Recommendation Q.933 [26] signalling flow):

TE → IWU:

they receive the ITU-T Recommendation Q.922 [23] Core frame through the BTF and pass the information field to the FRNCF or to the NMF on the basis of the type of the ITU-T Recommendation Q.933 [26] message.

IWU → TE:

they receive the ITU-T Recommendation Q.922 [23] Upper frame through the FRNCF or the NMF, construct the ITU-T Recommendation Q.922 [23] Core frame and pass it to the BTF.

- BTF: these provide the functions to terminate the circuit switched bearer channel; they are based on ITU-T Recommendations I.430 [15] and I.431 [16] protocols.

5.3.1.4.2 B-ISDN termination functions

Control functions:

- ATM Control Functions (ACF): these provide the signalling functions for the establishment of ATM VP/VC's between the IWU/FRSF. They are based on ITU-T Recommendation Q.2931 [21]/SAAL protocols operating on the ATM Switched Virtual Channel (SVC);
- Frame Relay Broadband Control Functions (FRBCF): these provide the in-band signalling functions for the establishment of frame relay connections between the IWU and the TE/FRSF. They are based on ITU-T Recommendation Q.933 [26] procedures operating on the logical link identified by the DLCI=0 within the ATM VP/VC between the IWU and the TE/FRSF.

Management functions:

- Broadband Management Functions (BMF): these include the PVC handling functions, according to ETS 300 467 [27]; they are related to sending and receiving the STATUS ENQUIRY and STATUS messages through the Frame Relay Broadband Termination Functions (FRBTF). The BMF exchange information with the PMF for the updating of the status of the end-to-end PVC. Other management functions could be included.

Data termination functions:

- FRBTF: these provide the functions to transmit/receive frame relay data units and service specific frame relay functions such as congestion control. They are based on AAL5 protocol (SAR, Common Part Convergence Sublayer (CPCS), FR-SSCS).

DLCI different from 0 (user data flow):

N-ISDN → B-ISDN:

they provide the formatting of the FR-SSCS Protocol Data Unit (PDU), using the information and parameters determined by the RCF, and forward it to the CPCS sublayer for the transmission over the ATM VC/VP through the ATM Termination Functions (ATF), setting the CPCS primitives parameters according to the options chosen by subscription.

B-ISDN → N-ISDN:

they receive the FR-SSCS PDU through the ATF, they perform the needed service specific functions, and send it to the RCF with the relevant control information.

DLCI =0 (in-band ITU-T Recommendation Q.933 [26] signalling/management flow):

TE/FRSF → IWU:

they receive the FR-SSCS PDU through the ATF and pass the information field to the FRBCF or to the BMF on the basis of the type of the ITU-T Recommendation Q.933 [26] message.

IWU → FRSF/TE:

they receive the ITU-T Recommendation Q.922 [23] Upper frame through the FRBCF or the BMF, construct the FR-SSCS PDU and pass it to the CPCS sublayer for transmission over the ATM VC/VP through the ATF.

- ATF: these provide the functions to terminate ATM VP/VC; they are based on the ATM and physical layer protocols.

5.3.1.4.3 Central IWFs

Control functions:

- Signalling Coordination Functions (SCF):

N-ISDN → B-ISDN:

they receive the request of a FR connection to a broadband TE from the FRNCF. If the VP/VC towards the TE (scenario (a)), or to the FRSF in the path towards the TE (scenario (b)) is not available, they send the request of an ATM connection to the ACF and then, when the ITU-T Recommendation Q.933 [26] entity in the FRBCF has been activated, they send the request of the FR connection to the FRBCF.

B-ISDN → N-ISDN:

they receive the request of a FR connection to a narrowband TE from the FRBCF. If the bearer channel towards the TE is not available, they send the request of a circuit switched connection to the NCF and then, when the ITU-T Recommendation Q.933 [26] entity in the FRNCF has been activated, they send the request of the FR connection to the FRNCF.

In both cases, the SCF request the updating of the RCF with the association between the bearer channel and DLCI values on the N-ISDN side and the physical link, the ATM VP/VC and the DLCI values on the B-ISDN side.

Management functions:

- PVC Mapping Functions (PMF): these provide the proper functions to manage information received from BMF and NMF related to PVC segments of an end-to-end PVC, store it into a database and provide it on demand.

Data termination functions:

- Relaying and Conversion Functions (RCF): they provide the functions for conversion between broadband and narrowband data transfer protocols; in particular, they provide the parameters necessary to create a ITU-T Recommendation Q.922 [23] Core frame from a FR-SSCS PDU and vice versa. They provide the association between the bearer channel and DLCI values on the N-ISDN side and the physical link, the ATM VP/VC and the DLCI values on the B-ISDN side for the relaying of the FR data unit during the data transfer phase.

5.3.2 Interworking for class D services -interworking/interconnection with MAN for CBDS service

The reference configuration, functional architecture, interface requirements and protocol reference model for the interconnection of MAN via an ATM based network and for the interworking between MAN and ATM based network are given in the ETS 300 405 [5] and in the ETR 149 [4] respectively.

Annex A: Access interworking for CBR services

In the access interworking scenario the B-ISDN supports the N-ISDN services. The IWF maps the B-ISDN access protocols and the N-ISDN access protocols.

This annex gives possible transition scenario in the evolution towards the network interworking scenario but it implies different addressing and signalling procedures, connecting the originating user to the IWF in a first step and the destination user in a second step. This is related to the interworking between public and private networks, it can be done in different ways (figure A.1 is an example of these). Interworking between public and private networks is out of the scope of this ETR.

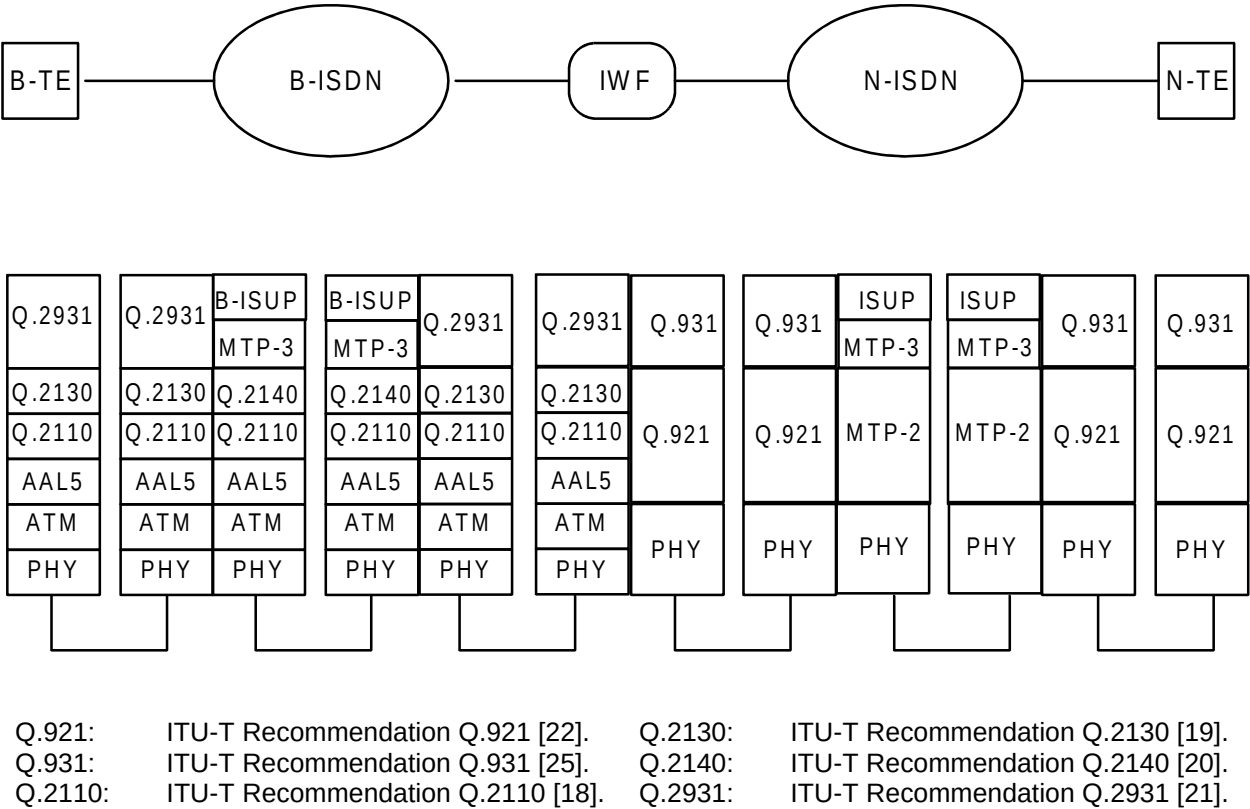


Figure A.1: Control plane protocol stacks: access interworking scenario

History

Document history	
January 1996	First Edition