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Contents

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 ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or an I-ETS.

Introduction

At its meetings during fall 1995, the "European Project for an Information Infrastructure Starter Group (EPIISG)" has defined the terms of reference for project 1.4, "European Backbone Telecommunications Network (EBTN)", based on the report from the ETSI 6th Strategic Review Committee (SRC6), Part A, Recommendations 22-25. TC NA has been proposed as the lead body for this project.

Within TC NA, STC NA5 has been asked to produce a first ETSI Technical Report with a definition of a conceptual model of the EBTN and the specification of background details.

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1 Scope

The ETSI 6th Strategic Review Committee (SRC6) has addressed the **necessity of standards** in order to achieve connectivity and interoperability between the large variety of existing and future telecommunications networks.

The concept of the European Backbone Telecommunications Network (EBTN) has been developed for this purpose and this ETR provides a definition and a first specification. It includes a collection of existing relevant standards and requirements on which additional standards can be based.

2 References

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

[1] SRC6 Report, Part A Recommendations 22, 23, 24, 25.

[2] SRC6 Report, Part B Subclause 5.2.2: European Backbone Telecommunications Network (annex 4); Reference Model for the EBTN (annex 5).

[3] Terms of Reference for project "European Backbone Telecommunications Network" (annex 6).

[4] European directives (published in "European Journal").

[5] ITU Recommendation I.324: "ISDN network architecture".

[6] ITU Recommendation G.804: "ATM cell mapping into plesiochronous digital hierarchy (PDH)".

[7] ITU Recommendation G.832: "Transport of SDH elements on PDH networks - Frame and multiplexing structures".

[8] ITU Recommendation G.707: "Network node interface for the synchronous digital hierarchy".

[9] ITU-T Recommendation I.150: "B-ISDN asynchronous transfer mode functional characteristics".

[10] ITU-T Recommendation I.361: "B-ISDN ATM layer specification".

[11] ITU-T Recommendation I.371: "Traffic control and congestion control in B-ISDN".

[12] ITU-T Recommendation I.610: "B-ISDN operation and maintenance principles and functions".

[13] ITU-T Recommendation I.363.5: "B-ISDN ATM Adaptation Layer specification Type 5 AAL".

[14] ITU-T Recommendation Q.2100: "B-ISDN signalling ATM adaptation layer (SAAL) overview description".

[15] RFC 1483: "Multiprotocol Encapsulation over ATM Adaptation Layer 5".

[16] RFC 1577: "Classical IP and ARP over ATM".

[17] ETR 156: "Asynchronous Transfer Mode (ATM); Multiprotocol interconnect over ATM based subnetworks".

[18] MPOA: "Multiprotocol Over ATM" ATM Forum.

[19] 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".

[20] ETS 300 478: "Network Aspects (NA); Connectionless Broadband Data Service (CBDS) over Asynchronous Transfer Mode (ATM); Framework and protocol specification at the User-Network Interface (UNI); Part 1: Specification".

[21] ETS 300 479: "Network Aspects (NA); Connectionless Broadband Data Service (CBDS) over Asynchronous Transfer Mode (ATM); Network Node Interface (NNI) specification; Part 1: Specification".

[22] ITU-T Recommendation E.800: "Terms and definition related to quality of service and network performance including dependability".

[23] ITU-T Recommendation I.350: "General aspects of quality of service and network performance in digital networks, including ISDNs".

[24] ITU-T Recommendation I.356: "B-ISDN ATM layer cell transfer performance".

[25] ETR 155: "Asynchronous Transfer Mode (ATM); Operation Administration and Maintenance (OAM) functions and parameters for assessing performance parameters".

[26] ITU-T Recommendation M.3010: "Principles for a telecommunications management network".

[27] ETR 325: "Broadband Integrated Services Digital Network (B-ISDN); General principles and functional requirements for interworking B-ISDN and Narrowband-ISDN (N-ISDN)".

[28] ITU-T Recommendation I.580: "General arrangements for interworking between B-ISDN and 64 kbit/s based ISDN".

[29] ITU-T Recommendation I.363: "B-ISDN ATM Adaptation Layer specification".

[30] CCITT Recommendation X.300: "General principles for interworking between public networks and between public networks and other networks for the provision of data transmission services".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETR, the following definitions applies:

connectivity: The capability to establish and maintain connections between networks and parts thereof.

interconnection: The physical and logical linking of telecommunication networks in order to allow users of one organization to communicate with users of another organization or to access services provided by another organization.

interoperability: The capability to provide successful communication between end-users across a mixed environment of different domains, networks, facilities, equipment, etc.

interaction: Mutual or reciprocal action or influence.

interworking: Within this ETR refers to "network interworking": Interactions between networks, or between parts thereof, with the aim of providing communication between entities.

co-operation: The act of working mutually together for a common interest.

3.2 Abbreviations

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

ATM	Asynchronous Transfer Mode
B-ISDN	Broadband ISDN
CATV	Cable TV
CBDS	Connectionless Broadband Data Service
CDV	Cell Delay Variation
EBTN	European Backbone Telecommunications Network
EII	European Information Infrastructure
ETSI	European Telecommunications Standards Institute
GII	Global Information Infrastructure
IEEE	Institute of Electrical and Electronic Engineers
IN	Intelligent Networks
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ITU	International Telecommunications Union
IW	Interworking
LIS	Logical IP Subnetworks
MAN	Metropolitan Area Network
MPOA	Multi Protocol Over ATM
MIB	Management Information Base
NB	Broadband-ISDN reference point, here between operator domains
NHRP	Next Hop Routeing Protocol
NNI	Network Node Interface
NP	Network Performance
PDH	Plesio-synchronous Digital Hierarchy
PSTN	Public Switching Telephone Network
QoS	Quality of Service
SDH	Synchronous Digital Hierarchy
SMDS	Switched Multimegabit Data Service
SRC	Strategic Review Committee
STC	Sub Technical Committee

4 Definition of the EBTN

The EBTN is a concept for a backbone network based on a conglomerate of ATM core networks supporting switched and permanent services, owned and operated by different organizations which may be competing with each other, around which standards should be provided for:

- connectivity between core networks;
- connectivity between other networks connected to the EBTN;
- interworking functions between the core networks and the other networks;
- transparency for of all kinds of end user services with different degrees of Quality of Service;
- network performance;
- interoperability between different implementations of the communications protocols;
- interaction between management systems of core networks and other networks;
- necessary administrative procedures.

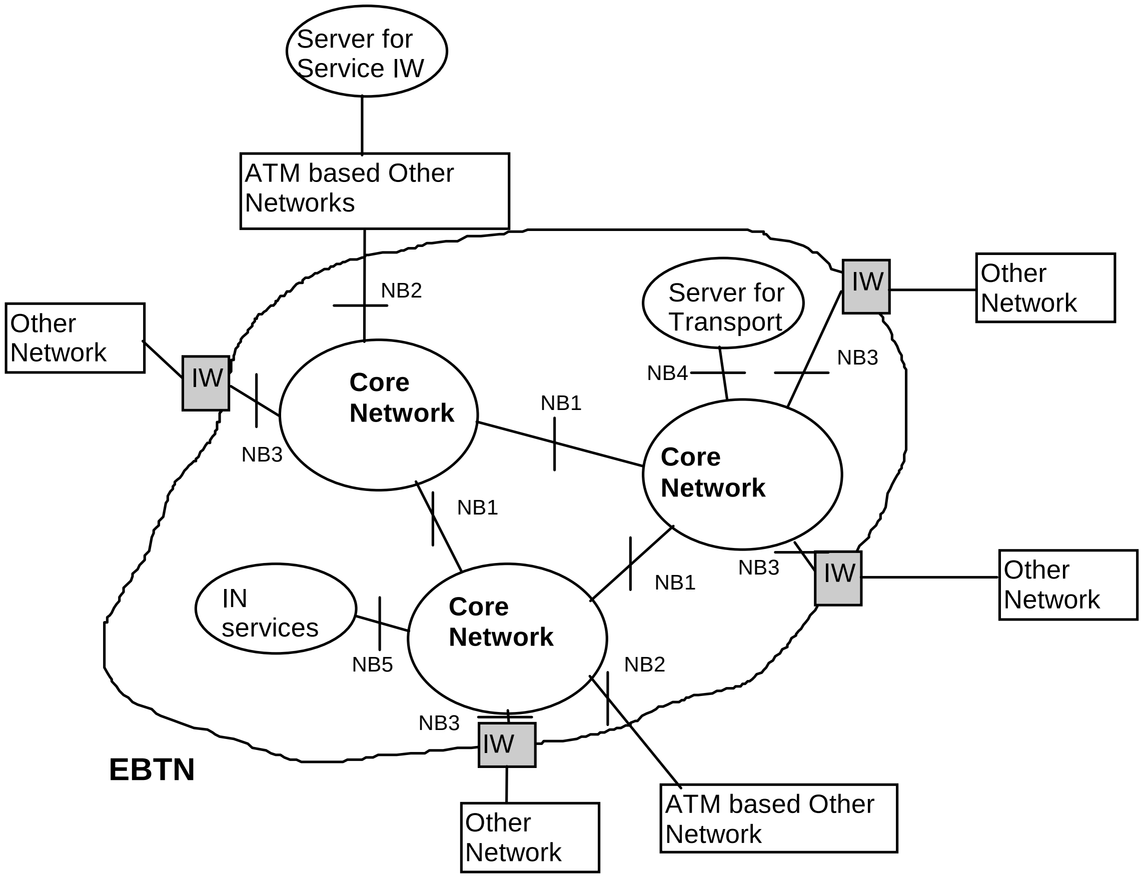
There should be no limitations to the support of higher layer protocols.

The EBTN permits different degrees of co-operation between the ATM core networks. This implies that the EBTN from a management, traffic control and load distribution point of view is not necessarily a single homogeneous network.

5 The role of the EBTN within the EII

The reference model of the EII defined in figure B.4.3 of SRC6, part B [2] has to be expanded in order to show the EBTN in more detail as shown in figure 1. Servers to provide transport services are included in the EBTN. **Servers for service interworking are not included in the EBTN.**

6 ATM as transfer mode for the EBTN



NOTE: "Other Networks" are defined in clause 8, reference points are defined in clause 12. The physical location of the IW function is presently not defined.

Figure 1: Reference configuration of the EBTN

7 The EBTN in a competitive environment

Many backbone-like core networks are presently considered by competing operators in Europe. These networks will go in parallel between some European cities, other cities being touched by one or the other of these networks. In some countries there may also be more than one competing core network which may form part of the EBTN. A number of these networks may be managed together as one homogeneous ATM network. This requires a good co-operation between these network operators, preferably by a co-operation agreement.

Not all European networks may be willing to co-operate: some core networks may provide their core network services in total competition with others. If additional capacity is required it can be bought from a competitor by a "capacity broker".

From an EBTN standardization point of view it may be assumed that additional standards are needed because of the coexistence of competing ATM core networks.

8 Interconnections between "other networks" and the EBTN

8.1 Types of "other networks"

The reference configuration of the EBTN is shown in figure 1. The EBTN is interfaced to "other networks" which, for the understanding in this ETR, are considered to be designated and optimized for the support of a specific end user service. Each end-user service depends on the presence of a suitable network while the EBTN can support any end-user service.

Each "other network" may consist of access or core networks providing telecommunication services to end users. At the boundary of the EBTN a conversion between the interface structure of each network and the ATM interface structure of the EBTN has to be performed. This network InterWorking function (IW) is considered a function of the EBTN. The physical location is not identified at present.

ATM networks may be found among "other networks". In this case the interworking function is not necessary from the interfacing point of view. However, there will still be administrative functions necessary, e.g. for measuring and controlling the amount of information into the EBTN. These functions are expected to be covered by the functions that can be found between the core networks within the EBTN and need no separate consideration.

The following types of networks may be interconnected by the EBTN:

- PSTN;
- N-ISDN;
- B-ISDN;
- Mobile networks;
- IP networks;
- Packet networks;
- Frame Relay networks;
- SMDS/CBDS networks;
- CATV networks;
- Satellite networks (as transmission links).

These networks are shown as "other networks" in figure 1.

8.2 Rules for interconnection

1) Interconnect and interworking provision with "other networks" shall be based on published and internationally recognized standards, if available.

2) There is no obligation for a core network operator of the ETBN to provide all possible interworking functions.

3) A minimum set of interworking functions shall exist. These have to be provided by each core network in the EBTN.

4) "Other networks" may provide their own interworking functions, but these are not part of the EBTN.

5) Operators of the EBTN core networks may provide an interworking function of their own.

9 Operator categories

A wide variety of categories of network operators can be identified within the EBTN context. Many of them provide complete networks, including the core network services, while others are only interested in providing core network functionalities. Often only a part of the necessary core network functionalities is offered, in some cases in conjunction with other non-telecommunication activities (e.g. power companies providing dark fibre at a marginal cost).

The complex management issues of competing/co-operating core networks attract operators offering only network management by accessing core networks through management systems.

The following list identifies a few generic categories of operators:

– operating a core network;

– operating IN services;

– operating switches only;

– operating transmission facilities only;

– operating servers for transport services (e.g. for the IP);

– operating management systems only.

Operators with interest in getting access to the EBTN:

- operating a network which is not part of the EBTN;

- operating servers for service interworking (e.g. for Frame Relay interworking with X.25).

The operators are able to access the EBTN through interworking functions and by interactions between the management systems.

10 EBTN management scenario

Some operators will manage their own resources independently as singular networks and will interconnect to others who may have their own management. Negotiations between operators (e.g. through "capacity brokers") can make additional capacity available for certain periods. In principle, the management of each network is independent from the others (except some minimum information exchange which is always needed). For technical or commercial reasons no network resources are shared with other operators.

Scenario A in figure 2.A shows this situation for two networks, partially interconnected in parallel at two nodes.

The dotted line between the management systems indicates the necessary minimum information exchange between networks in order to share traffic.

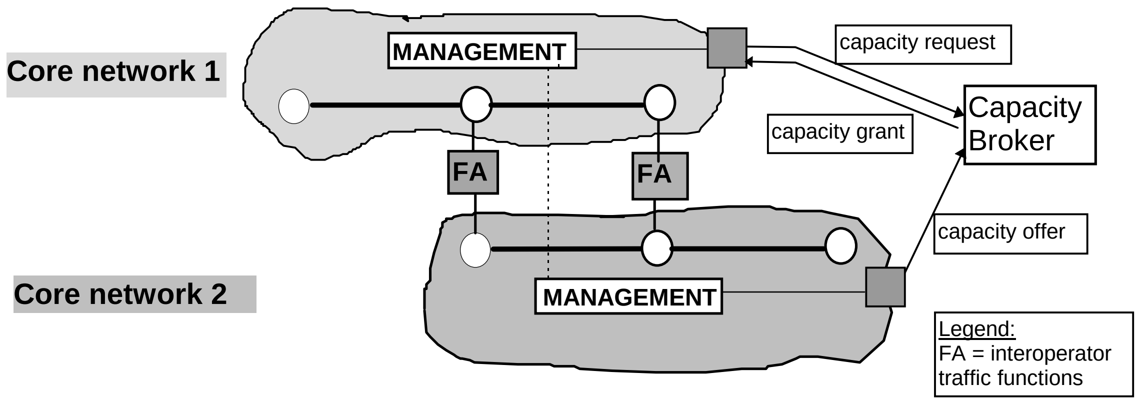


Figure 2.A: Singular networks, interconnected, individual management

A first extension of scenario A is scenario B (see figure 2.B) where the functionality of the management interface between the operators is enhanced to include the capability to make some resources from the network of operator 1 available for operator 2 and vice versa on a case by case basis.

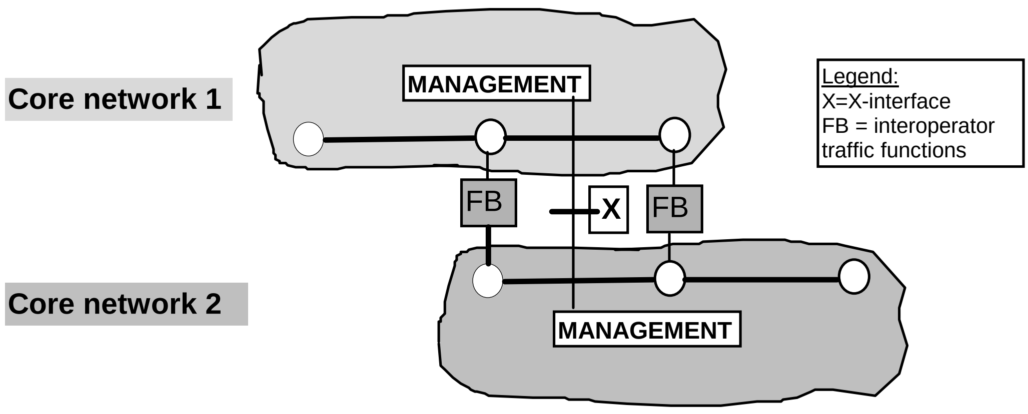


Figure 2.B: Singular networks, interconnected, individual management with some cross allocation of resources between networks

The scenario in figure 2.C describes a co-operative management between operators who are willing to provide their core networks as a common resource. This will optimize traffic control and load distribution for the network by the flexibility of ATM in the interest of higher network performance and a more efficient network use than scenarios A and B. More complex management procedures may have to be accepted.

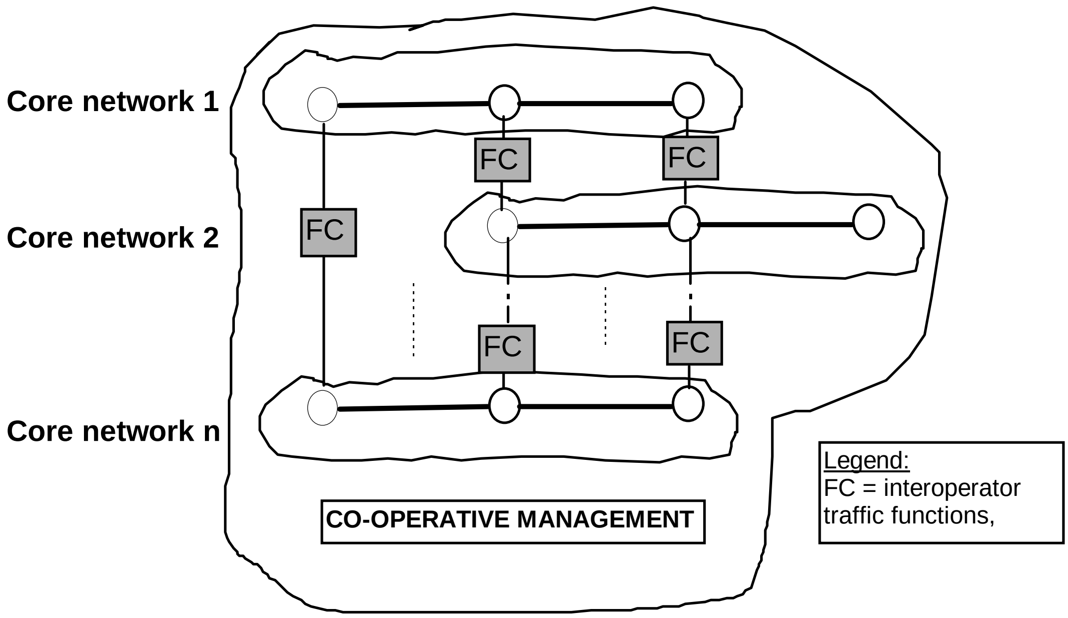


Figure 2.C: Federation of networks, interconnected as a common resource, co-operative management (mutual interest in high performance)

A deeper analysis of management considerations for the different degrees of co-operation is given in annex B.

11 EBTN connectivity

11.1 General

The core networks should be capable of providing digital trails at the physical layer, ATM layer and higher layers and allowing interconnection to one another using a limited set of Network Node Interface (NNI) standards.

This includes ATM cell transport and the OAM functions necessary to maintain the ATM cell transport.

The core network should be able to guarantee the QoS for the specific traffic parameters negotiated by signalling. The presence of satellite links is acceptable in the EBTN if transfer delay sensitive traffic types can be routed through other suitable core networks.

Interworking functions shall provide interconnection between other networks and the core networks for the complete stack of functions being transported end to end between these other networks.

As an example, the interworking functions between an "other network" for N-ISDN and the EBTN is given in annex C.

11.2 Identification of reference points

With reference to figure 1 the following reference points can be identified:

1) NB1 between two core networks within EBTN;

2) NB2 between a core network within EBTN and another ATM based network;

3) NB3 between a core network within EBTN and an interworking function;

4) NB4 between a core network and a transport server;

5) NB5 between a core network and IN service functions.

In ISDN, N is the reference point between two networks (see ITU-T Recommendation I.324 [5]). In the EBTN context it is proposed to use NBx to identify a broadband reference point between operator domains like ATM core networks, switches, servers, IN service functions, etc. Therefore, NB4 which is defined between switching capabilities and server functions is comparable to the P or M reference point in ISDN (see subclause 12.1).

In line with this, the reference point between an ATM network and a IWU is an NBx reference point.

Reference point NB5 between a core network and IN service function is for further study.

11.3 Interfaces

The interfaces at the different reference points are identified by the protocol stacks on user, control and management planes.

The connectivity in the EBTN is addressed by the user and control planes for which the following protocol stacks apply:

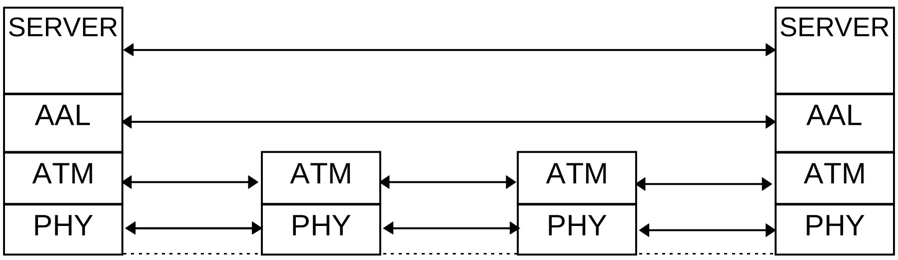


Figure 3: EBTN protocol stacks

The server is a transport server for the user plane and an IN/signalling server for the control plane. The server stack for the control plane has the structure defined in figure 4.

Figure 4: Protocol stacks for control plane server

Refer to subclause 11.4 for the specification of AAL5, ATM and physical layer protocols. The specification of the higher layer protocols is not contained here; some interaction on this subject is needed with the relevant bodies to identify the capabilities to be supported by EBTN as well as the complete set of recommendations that contain the protocol specifications.

11.4 Protocol definitions

Physical Layer

At least two solutions should be considered: 34,368 Mbit/s PDH and 155,520 Mbit/s Synchronous Digital Hierarchy (SDH). The ATM cell mapping specification can be easily derived from ITU-T Recommendations G.804 [6] and G.832 [7] for the Plesiosynchronous Digital Hierarchy (PDH) case and from ITU-T Recommendation G.707 [8] for the SDH case.

ATM Layer

The ATM functional characteristics are specified in ITU-T Recommendation I.150 [9] and the ATM Layer is specified in ITU-T recommendation I.361 [10].

Traffic aspects are covered by ITU-T Recommendation I.371 [11]. A number of points need to be clarified for the EBTN, e.g.:

- which ATM transfer capabilities to be supported by EBTN;
- which actions to be taken if a specific transfer capability is not supported;
- granularity of the traffic parameters and CDV tolerances for the connections in EBTN.

OAM aspects are defined in ITU-T Recommendation I.610 [12]. With reference to ITU-T Recommendation I.610, clarification on the subset of OA&M functions that shall/may be supported by EBTN or shall be transparent to EBTN is needed.

In a first phase it is supposed that EBTN supports point-to-point connections only. The support of multipoint connections should be addressed in a consistent way with reference to all the above areas of connectivity.

ATM Adaptation Layer 5

The protocol definition is contained in ITU-T Recommendation I.363.5 [13]. Clarifications on the support of signalling over ATM connections are contained in ITU-T Recommendation Q.2100 [14].

12 Higher layer functions provided by the EBTN

At present there is a great interest in providing IP, Frame Relay and CBDS services. These require transport functions above the ATM layer, to be provided by the EBTN. Other functions are for further study.

12.1 Reference configuration for server functions

The reference points P and M which are defined in ITU-T Recommendation I.324 [5] corresponds to NB4 in figure 1.

The P reference point is applicable when the owner and operator of the core network is the same organization who owns the server and operates the server for transport.

The M reference point is applicable when the owner and operator of the core network is a different organization to the one who owns the server and operates the server for transport.

Depending on the transport functions, several types of interfaces can be implemented at P or M reference Points.

It should be clarified whether, in the context of EBTN, only M is of interest or whether also P is relevant: this implies both technical and regulatory aspects.

12.2 Internet Protocol (IP) based networks

The support of IP over ATM is specified in the following documents:

- RFC 1483 [15] from the IETF, which describes the encapsulation method of IP on AAL5;
- RFC 1577 [16] from the IETF, which describes the address resolution, the IP network structure and operation on an ATM network(a new version is currently under work);
- ETR 156 [17] Multiprotocol interconnect over ATM based subnetworks;
- MPOA [18] from ATM Forum.

The EBTN will provide IP routeing functions.

The different alternatives for the protocol structure for the EBTN are depicted in the figure 5:

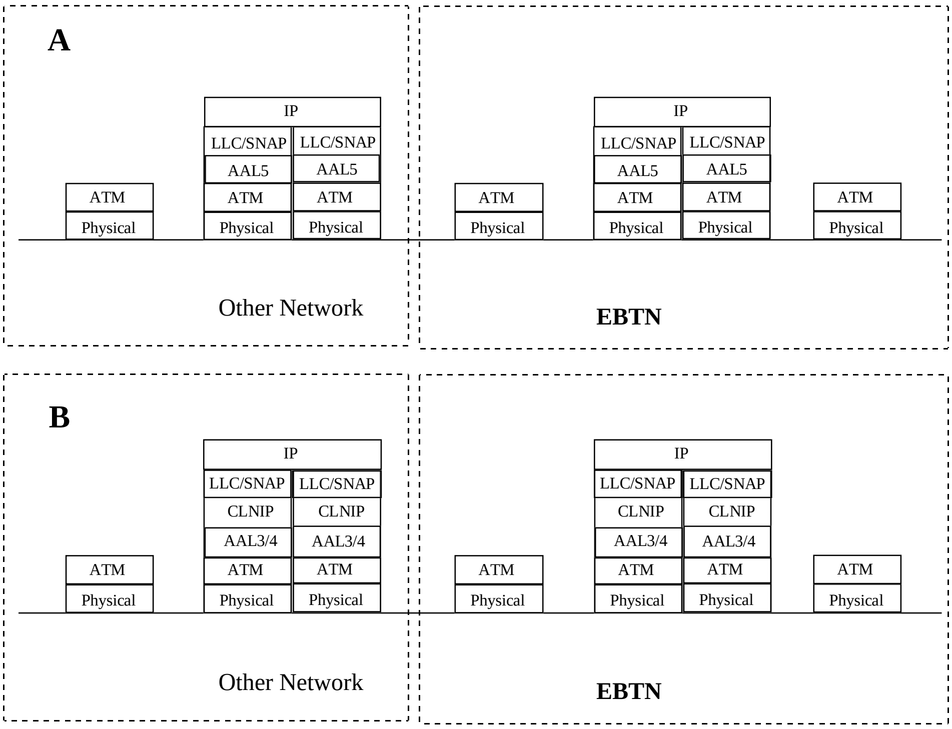


Figure 5: Protocol Structure for the provision of IP in the EBTN

- Solution A is based on the provision of IP over AAL5 according to RFC 1577 [16]. The EBTN will provide IP routeing functions to interconnect Logical IP Subnetworks (LIS), with the necessary mapping between IP addresses and ATM addresses.

Other solutions using direct ATM connections over several LIS are possible (e.g. Next Hop Routeing Protocol (NHRP)).

- Solution B is based on the provision of IP over Connectionless Broadband Data Service (CBDS). In this case the EBTN will provide IP routeing functions over a CBDS overlay network, built on the top of the ATM network.

Solution A is the preferred one.

12.3 Frame Relay networks

The support of the Frame Relaying Bearer Service (FRBS) on B-ISDN is specified in the ETS 300 467 [19]. Two ways for supporting FRBS are considered in this ETR:

- FRBS provided by Frame Relay Service Function (FRSF) using the P/M reference point;

- Frame Relay protocol support via ATM transfer capability. This does not involve the use of a server in the EBTN.

In what concerns the interoperability aspects within the EBTN, only the first option is relevant.

Taking into account the reference configuration for the EBTN as specified in figure 1 the following protocol stacks apply (figure 6):

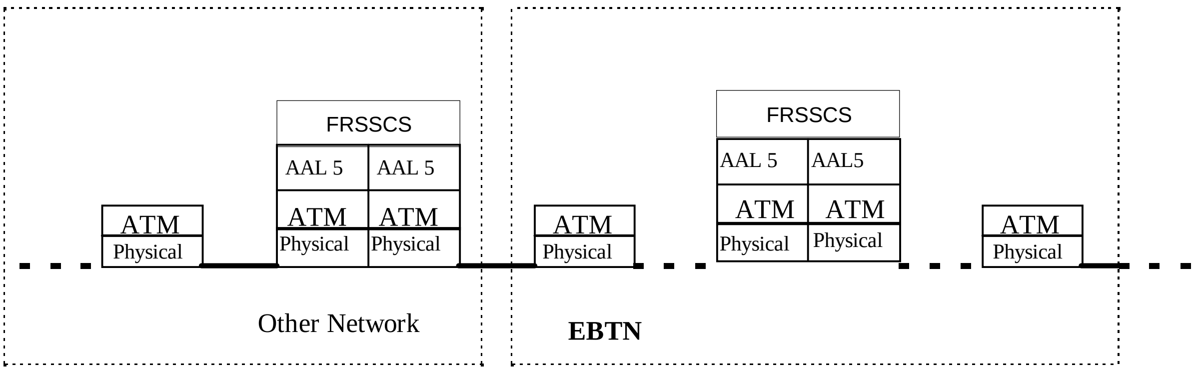


Figure 6: Protocol stacks for Frame Relay

The Frame Relay Server handles Frame Relay protocols and routes the data information.

The FR-SSCS (Frame Relaying Service Specific Convergence Sublayer), located on the top of the CPCS (Common Part Convergence Sublayer) of AAL 5, is used to emulate the FRBS: It is specified in ETS 300 467 [19].

12.4 CBDS networks

The framework and the protocol specification at the UNI and the NNI for CBDS over ATM are covered in ETS 300 478 [20] and ETS 300 479 [21].

Taking into account the reference configuration for the EBTN specified in figure 1 the following protocol stacks apply (figure 7):

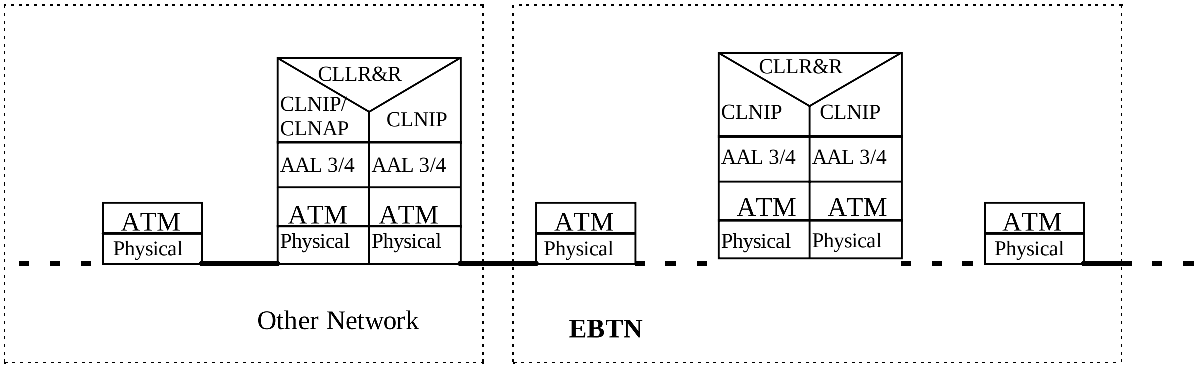


Figure 7: CBDS protocol stacks

The functions in the server include the termination of the CLNIP (Connectionless Network Access Protocol), CLNIP (Connectionless Network Interface Protocol) and Routeing and Relaying (CLLR&R) functions.

13 End-user service transparency and network performance

13.1 General

One of the main goals of EBTN is the substitution of today's different service dependent core or trunk networks by one ATM network - the EBTN.

Figure 8 shows the today's situation where different services are handled by different networks. (Except the transmission network which might be shared among different service networks. This is not shown).

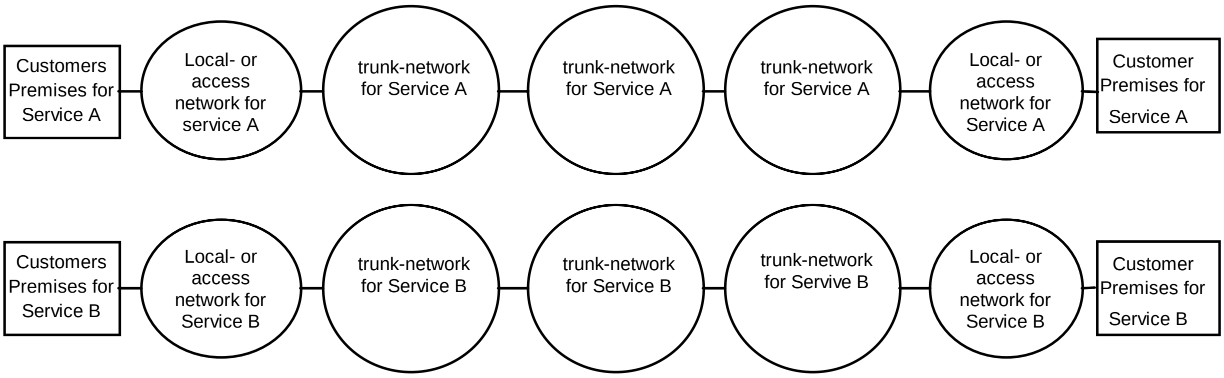


Figure 8: Telecommunication networks - present situation

The local or access networks are represented by the "other networks" in figure 1. All the trunk networks will be substituted by the EBTN, which in reality needs not be the case. Service dependent trunk networks may also be part of "other networks".

13.2 Service aspect

What does this concept of an EBTN mean for the services? A customer should be enabled to convey any service over the network depending on the capability of the local- or access network but regardless whether there is a service specific trunk network or an EBTN with ATM-based core networks.

To fulfil this requirement two options exist:

- the EBTN provides the ATM Layer transfer capability only; or

- the EBTN emulates the today's service dependent trunk networks.

In any case the interworking function has the most important task to convert or adapt the traffic from the local- or access network to ATM.

The first option seems to be very attractive because of its simplicity. Just an ATM-bearer service like the „"Virtual Path Service for Reserved and Semi-permanent Communications" and the "Broadband Connection Oriented Bearer Service" are necessary. For the interworking, different AALs are defined as well as some encapsulation techniques.

On the other hand, today's trunk networks perform more than just transport but can handle exceptions and provide some higher layer functions. (One example is that in the telephone network a trunk exchange which detects congestion puts the appropriate tones and announcements on the voice connection, another example is "call back when free"). The second option seems therefore to be necessary. Whether this applies to all kinds of service dependent networks is for further study.

It is expected that both options will coexist depending on the type of service.

For the implementation of an EBTN according to the second option the necessary functionality can be:

- put into the interworking function;

- put into specialized servers; or

- distributed in the core networks;

as shown in figures 9, 10 and 11 respectively.

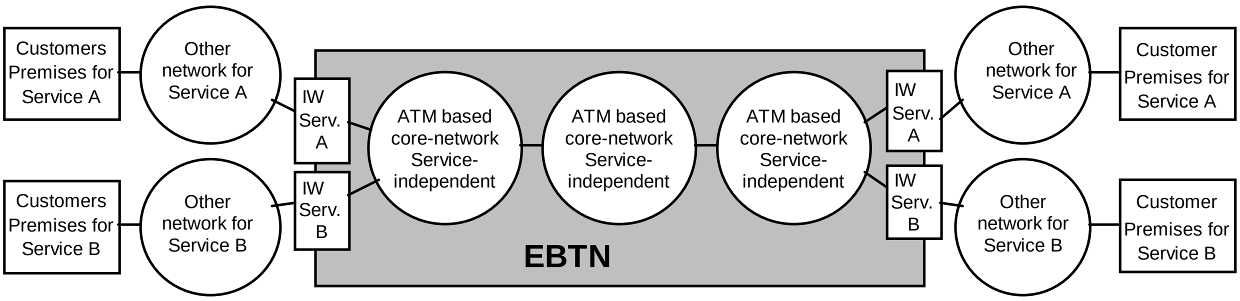


Figure 9: Service dependent part in the Interworking Function

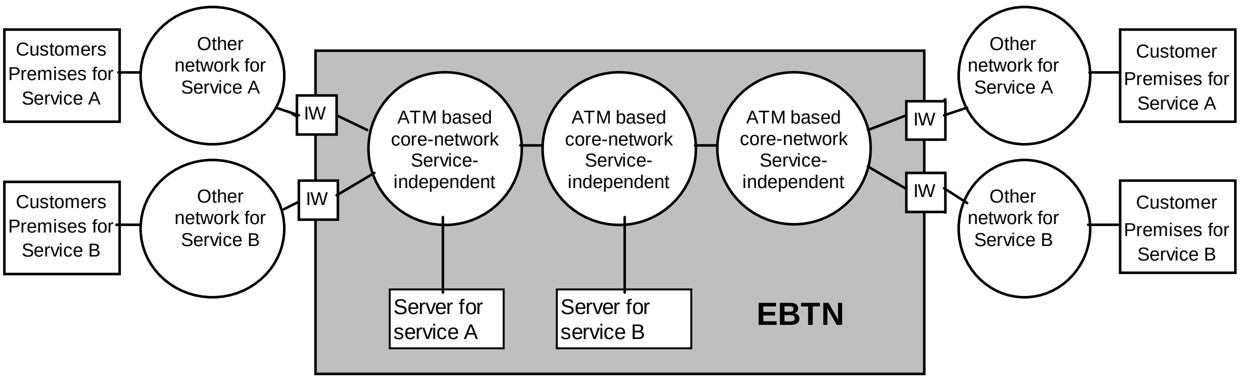


Figure 10: Service dependent part in specialized servers

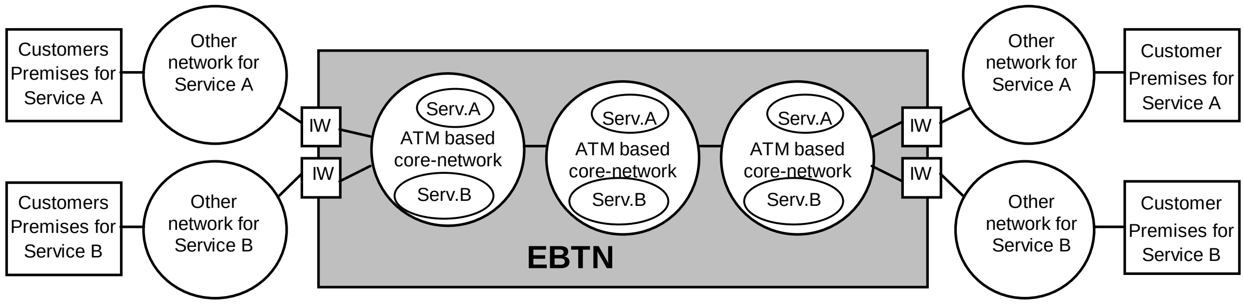


Figure 11: Service dependent part in the core networks

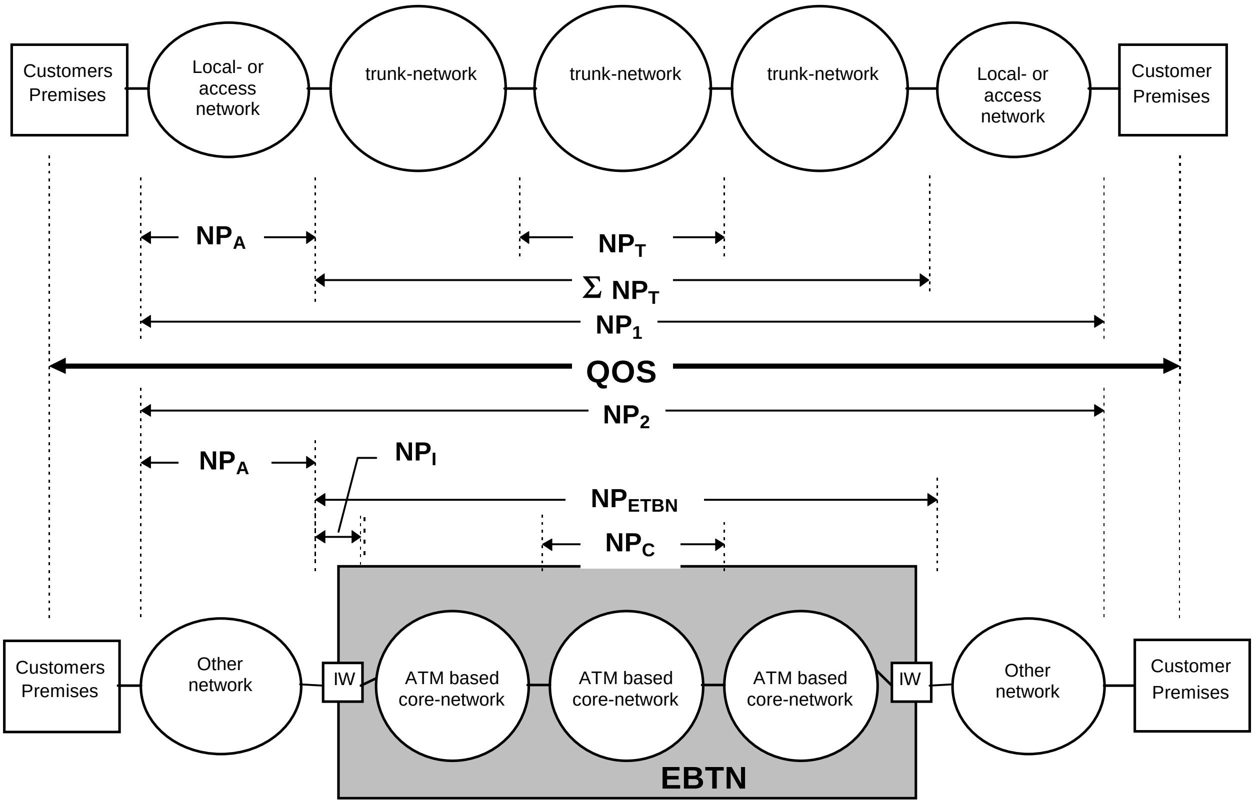
Due to the fact that different services from different service dependent other networks should be handled it seems advisable not to burden the core networks, especially keeping in mind that at the start of an EBTN not all services are known. By putting the service dependent part to the Interworking Function (IW) or a server a later extension can be performed easily by adding another interworking function or a server. In the other case each core network has to be adapted.

Therefore the general rule should be to implement service dependent functions either in the interworking function or the servers.

13.3 Quality of Service and network performance aspects

ITU-T Recommendation E.800 [22] lists a number of Quality of Service (QoS) factors which together compose the global QoS experienced by the user. Further, QoS and Network Performance (NP) and their relationship with each other are described in ITU-T Recommendation I.350 [23]. QoS is either fixed (given by the network) or negotiated during call setup. The EBTN has to provide the necessary NP for the QoS requested by an end user or another network.

The introduction of the EBTN should not adversely affect any services from the customers perspective. Figure 12 shows the comparison between today's network arrangement and the scenario with EBTN in terms of QoS and NP.



NOTE: P_I is included in NP_A for the case that the interworking function (IW) is part of the "other network".

Figure 12: QoS and NP

From a customers point of view the target is that the QoS perceived shall be equal regardless whether the traffic is routed through today's service dependent trunk networks or through EBTN. To guarantee a given QoS the whole network has to guarantee a NP. From this it follows that:

$$\mathbf{NP_1 = NP_2}$$

The overall NP consists of different parts contributed by different networks. In today's networks the:

- local - or access networks; and the
- trunk networks,

contribute with NP_A and NP_T. In the EBTN case the:

- other networks; and the
- EBTN,

contribute with NP_A and NP_{EBTN} where as EBTN itself contains the NP of the:

- Interworking Functions; and
- core networks,

which contribute with NP_I and NP_C.

As the local- or access networks (equals "other networks") are untouched a comparison can be made as follows:

$$\mathbf{\Sigma\ NP_T = NP_{EBTN}}$$

It is expected that not all the core networks will meet the required level of network performance. Therefore, the EBTN has to route the traffic within itself in such a way that only core networks offering the requested NP are considered in the routeing process.

If no route can be found which satisfies the necessary network performance requested of the EBTN the EBTN is considered "not complete" and the traffic has to be handled outside the EBTN. This may happen in the interim period until a fully featured EBTN is established.

13.4 Network performance parameters

ITU-T Recommendation I.356 [24] contains a series of network performance parameters. Unfortunately, not all mechanisms are described on how to measure these parameters. An out of service measurement is possible but not sufficient.

Performance objectives, measurement points and measurement methods for an EBTN have to be defined according to ITU-T Recommendation I.356 [24].

ETR 155 [25] explains how to assess the performance parameters by using normal OA&M procedures like the "performance monitoring".

14 Technically administrative procedures between interconnected core network operators of the EBTN

The following procedures are required between interconnected core networks when an EBTN is in place:

- Traffic shaping.

- Network Parameter Control (Policing).

- Traffic volume measurement at:
  - cell level;
  - call/connection level.

- Network performance assessment.

- Agreement for the support of a minimum subset of a given set of services offered to customers (e.g. a service/supplementary service is offered with full capabilities in one network and with partial/reduced capabilities in another core network.

- Agreement on a set of traffic engineering rules.

- Adding/removing interconnections between core networks:

  - procedures for allocating/de-allocating common resources;
  - procedures for testing new ATM links;
  - procedures for setting up operational new ATM links.

- Charging:

  - accounting;
  - charging parameters to reflect the use of network resources other charging parameters for the use of the network such as by service providers.

- Security and protection of network integrity for the different degrees of cooperation within the EBTN.

- Ensure privacy for messages throughout different networks (e.g. calling line identification (CLI).

15 Requirements

A number of basic requirements have to be fulfilled by the EBTN:

- capability to support switched services as well as permanent services;
- capability to support all types of traffic, including IP traffic;
- capability to interwork with other networks e.g. N-ISDN, IP based networks;
- very good performance, e.g. extremely low cell loss, control of cell delay variation;
- guarantee of allocated resources;
- shaping of the traffic for EBTN access and for the core networks included into the EBTN;
- policing and traffic load measurements within the EBTN;
- allocation of cost for the network use between operators;
- security and protection of network integrity.

Other requirements may be identified later when studying the EBTN in more detail.

16 Available European standards and technical reports or other relevant documents

A great number of European Telecommunications Standards and European Technical Reports which have a bearing on core networks have been produced or are still in preparation. With the exception for Metropolitan Area Networks (MAN) standards, these standards build on ITU-T Recommendations to which ETSI has contributed and which have been adapted for European conditions or have been endorsed as European standards after ITU approval. MAN standards build on a similar co-operation with IEEE 802.

A list of these documents is reproduced in annex A. It does not contain any standards regarding access networks. A status indication is made for available material which is either published or has passed the Public Enquiry and for material in preparation, which may or may not have been approved by the responsible Technical Committee.

The listing of these standards does not preclude the necessity to minimize options before these standards can be used for the EBTN.

17 Regulatory considerations on EBTN

17.1 General

This subclause outlines some general guidelines and principles which would need to be considered by those organizations who are likely to play a key role in the future implementation of a EBTN as described in this ETR. The statements are intended as a guide to both ETSI and implementors of the EBTN.

17.2 Regulatory interconnection principles

In general the regulatory principles contained within the European interconnect directive which sets out the rights and obligations of specific categories of organizations in interconnecting their networks would apply in the case of an EBTN if those interconnecting organizations fall under categories stipulated in the directive.

17.3 Establishment of the EBTN

The decision by organizations will co-operate in the setting up of an EBTN would be based on general commercial agreements between the network operators and may involve the establishment of a

Memorandum of Understanding (MoU). The commercial agreement between constituent members of the EBTN should in general be open to organizations in member states who wish to become part of the EBTN and who would be able to offer the relevant network facilities as identified in clause 9 of this ETR. These organizations may typically be already operating in member states under some kind of national authorization (e.g. licence).

17.4 Co-operation between network operators

The degree to which organizations participating in the EBTN should co-operate in the sharing of each others network resources would be based on commercial and technical criteria identified and agreed by themselves respecting the legal framework. These degrees of co-operation should not in any way distort the development of network and service competition nor lead to any undue preference or discrimination.

Within the EBTN:

The EBTN shall provide information transfer capabilities between any appropriate and matched entity providing the same services or capabilities. The standards which govern the interworking requirements between constituent parts of the EBTN should support interworking of services in an open, transparent and non discriminatory way There should be no technical barriers to organizations who wish to provide and operate facilities of the EBTN and who are able to fulfil the essential technical and commercial criterion which govern participation respecting the essential requirements as given in the respective European directives.

Between the EBTN and all other networks supporting the same service:

The EBTN shall provide information transfer capabilities between any appropriate and matched entity providing the same services or capabilities. There should be appropriate interworking facilities between the EBTN and networks which are not part of the EBTN. The technical interconnect requirements between the EBTN and all other networks should be based on the minimum standardization which supports transparency of service interworking, and should not present technical or economic obstacles to all operators requesting interconnection.

17.5 Access for service providers

Access should be made available for service providers to interconnect their facilities to the EBTN.

The level of access to the EBTN may depend on the functionality that is to be provided to the interconnecting service provider and the standards required would depend on the extent of the functionality asked for by the interconnecting service providers. Access to the EBTN should be provided in a non-discriminatory way to those organizations who wish to access functionality of the EBTN for the provision of services - whether they are independent service providers or the service provider arm of an EBTN operator.

17.6 Access for users

Users should be able to access on a fair and non discriminatory basis a service provider of their choice, or a service broker if such a facility exists, irrespective to which network these service provider organizations are connected. The standards for the access links to EBTN and all other networks should support this level of choice. Users should also be able to change service providers without changing their numbers (number portability) but this is a requirement which is more general and not specific to EBTN. The issue is identified in other clauses of this ETR.

18 Subsequent activities

The standards necessary for traffic functions and management of the EBTN should be developed in a European Project as proposed by the ETSI High Level Task Force and its Implementation Group. Because of the expertise residing in TC NA, the activities for the EBTN project could favourably be co-ordinated by NA.

Subsequent work may have to be subcontracted to other TCs, e.g., SPS and TM.

The next step is to identify which further standards are required.

Annex A: List of relevant European standards and technical reports

The deliverables mentioned for completeness in the table below may not be eventually published or made publicly available. The table A.1 is given in order provide the greatest number of documents which are relevant to EBTN at the publishing date of this ETR.

Table A.1

Type	Number	Title	Relevant documents	STC
ETS	300 742	Physical layer user network interface for 2 Mbit/s ATM signals	I.432.1, G.804	TM
I-ETS	300 811	Transmission and Multiplexing (TM); Broadband Integrated Services Digital Network (B-ISDN); Transmission Convergence (TC) and Physical Media Dependent(PMD) sublayers for the SB reference point at a bit-rate of 25,6 Mbit/s over twisted pair cable		TM
TCTR	001	Operation and maintenance functions and principles for MANs	Q.961, Q.962	NA5
TCTR	002	MAN charging functions and capabilities	IEEE 802.6, D–Recs.	NA5
TCTR	003	B-ISDN User-Network Interface (UNI) and Network-Network (NNI) signalling protocol concepts and examples for Release 2 and beyond		SPS
TCTR	019	Numbering, addressing and routeing aspects in B-ISDN	I.335, E.164	NA5
TCRTR	044	Vocabulary for B-ISDN	I.113	NA5
ETR	072	B-ISDN connection types and their reference configurations	I.327, I.140	NA5
ETR	073	Evolution towards B-ISDN	I.121, I.150, I.311, I.321	NA5
ETR	082	CBDS - Complementary information to ETS 300 217		NA5
ETR	089	Principles and requirements for signalling and management information transfer in the B-ISDN	I.311, I.327 I.374	NA5
ETR	112	B-ISDN Principles	I.121, I.150, I.211	NA5
ETR	117	B-ISDN Signalling ATM Adaptation Layer requirements		SPS
ETR	118	B-ISDN Switching Exchange and Cross Connect Functions and Performance Requirements	I.356, I.371, I.413, I.432, Q.511, Q.512	SPS
ETR	122	CBDS over ATM		NA5
ETR	123 Ed.2	Parameters and mechanisms provided by the network relevant for charging in B-ISDN	I.356, I.371	NA5
ETR	157-2	Part 2: Capability Set 3 (CS2)		SPS
ETR	155	OAM functions and parameters for assessing performance parameters	I.356, I.371	NA5
ETR	157-1	B-ISDN Signalling Requirements for B-ISDN Services Part 1: Capability Set 2 (CS2)		SPS
ETR	156	Multiprotocol Interconnect over ATM based subnetworks		NA5

(continued)

Table A.1 (continued)

Type	Number	Title	Relevant documents	STC
ETR	161	Functional description of B-ISDN VP cross connect network elements	I.413	NA5
ETR	168	Guidelines for the interpretation of ETS 300 443-1	Q.2931	SPS
ETR	180	Optionality aspects of ATM Adaptation Layer type 1	I.362, I.363	NA5
ETR	197	Base Document on Multimedia Services		NA1
ETR	092	Broadband Integrated Services Digital Network (B-ISDN); Framework for conformance testing of lower layers in B-ISDN	I.413, I.321, X.290	MTS
EN	DE/TM-01016-1	Transmission and Multiplexing (TM); Specifications for Asynchronous Transfer Mode (ATM) equipment; Part 1: Functional characteristics and equipment performance		TM
EN	301 004-1	Broadband Integrated Services Digital Network (B-ISDN); Signalling System No.7 Message Transfer Part (MTP) level 3 specification		SPS
ETS	300 647	Broadband Integrated Services Digital Network (B-ISDN); Signalling ATM Adaptation Layer (SAAL); Layer Management for the SAAL at the Network Node Interface (NNI) [ITU-T Recommendation Q.2144 (1995), modified]	Q.2144	SPS
ETR	326	Transmission and Multiplexing (TM); Broadband Integrated Services Digital Network (B-ISDN) access	G.96x	TM
TCRTR	014	Transmission and Multiplexing (TM); Harmonization of transport network architecture and protocol reference model for the transport of Asynchronous Transfer Mode (ATM) cells	I.311, I.321, G.803	TM
EN	DEN/SPS-03019-1	Broadband Integrated Services Digital Network (B-ISDN); Q3 interface for the management and control of the ATM switching network element	I.751, Q.821 NA-52210	SPS
ETR	257	V interfaces at the digital Service Node (SN); Identification of the applicability of existing protocol specifications for a VB5 reference point in an access arrangement with Access Networks (ANs)		SPS
ETR	282	Broadband Integrated Services Digital Network (B-ISDN); Signalling requirements for Video On Demand (VOD) and multimedia interactive services		SPS
EN	DEN/SPS-03045-1	V interfaces at the digital Service Node (SN); Management interfaces associated with the VB5.2 reference point; Part 1: Interface specification	I.751	SPS
EN	301 005-1	V interfaces at the digital Service Node (SN); Interfaces at the VB5.1 reference point for the support of broadband or combined narrowband and broadband Access Networks Part 1: Interface specification		SPS
EN	DEN/SPS-03047-1	V interfaces at the digital Service Node (SN); Interfaces at VB5.2 reference point for the support of broadband or combined narrowband and broadband Access Networks; Part 1: Interface specification		SPS

(continued)

Table A.1 (continued)

Type	Number	Title	Relevant documents	STC
EN	DEN/SPS-03049-1	V interfaces at the digital Service Node (SN); Management interfaces associated with the VB5.1 reference point; Part 1: Interface specification	I.751	SPS
ETR	249	Transmission and Multiplexing (TM); Harmonization of transport network architecture and protocol reference model for the transport of Asynchronous Transfer Mode (ATM) cells	I.311, I.321, G.803	TM
ETS	300 780	Network Aspects (NA); Broadband Connection Oriented Bearer Service [ITU-T Recommendation F.811 (1996)]	F.811	NA1
ETR	316	Broadband Integrated Services Digital Network (B-ISDN); Numbering and addressing in B-ISDN		NA2
ETR	260	Network Aspects (NA); Addressing principles and related aspects for the Connectionless Broadband Data Service (CBDS)	IEEE 802.6, X.720 - X.722, M.3100, M.3010	NA2
EN	DE/NA-021114	Addressing and routeing principles in ATM networks	I.335, I.311	NA2
ETR	325	Broadband Integrated Services Digital Network (B-ISDN); General principles and functional requirements for interworking B-ISDN and Narrowband-ISDN (N-ISDN)	I.580	NA2
ETR	145	Network Aspects (NA); European frame relay services General information and standardization overview	I.233, Q.922, Q.933	NA2
EN	DE/NA-042120	Connection processing performance for B-ISDN connection types		NA4
ES	DI/NA-042122	Accessibility performance for B-ISDN connection types	I.350	NA4
ETS	300 818	Broadband Integrated Services Digital Network (B-ISDN); Asynchronous Transfer Mode (ATM); Retainability performance for B-ISDN switched connections	I.350, I.356	NA4
I-ETS	300 653	Telecommunications Management Network (TMN); Generic managed object class library for the network level view		NA4
ETR	271	Special Mobile Group (SMG); Universal Mobile Telecommunications System (UMTS); Objectives and overview (UMTS 01.01)		
ETR	263	Broadband Integrated Services Digital Network (B-ISDN); Specific interworking functionalities with B-ISDN	I.580, I.581, I.555	NA5
ETR	262	Broadband Integrated Services Digital Network (B-ISDN); Asynchronous Transfer Mode (ATM); Video On Demand (VOD) network aspects	I.375	NA5
ETR	337	Broadband Integrated Services Digital Network (B-ISDN); Mobile network requirements on B-ISDN		NA5
ETR	360	Asynchronous Transfer Mode (ATM); Support of multipoint communication in ATM networks		NA5

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Table A.1 (continued)

Type	Number	Title	Relevant documents	STC
TR	DTR/NA-052112	ATM for the transport of 64 kb/s narrowband channels		NA5
ETS	300 820-3	Broadband Integrated Services Digital Network (B-ISDN); Configuration management information model for the X-type interface between operation systems of a VP/VC cross-connected network ; Part 3: Performance management aspects	-	NA5
ETS	300 820-2	Broadband Integrated Services Digital Network (B-ISDN); Configuration management information model for the X-type interface between operation systems of a VP/VC cross-connected network ; Part 2: Fault management aspects	-	NA5
ETS	300 820-1	Asynchronous Transfer Mode (ATM); Configuration management information model for the X-type interface between Operation Systems (OSs) of a Virtual Path (VP)/Virtual Channel (VC) cross connected network; Part 1: Configuration management aspects	-	NA5
TR	DTR/NA-052218	Mechanisms for providing performance management and fault management	I.610, I.356	NA5
ETS	300 643	Integrated Services Digital Network (ISDN); Overall network aspects and functions; Frame Relaying Service Specific Convergence Sublayer (FR-SSCS) [ITU-T Recommendation I.365.1 (1993)]	I.365.3	NA5
ETS	DE/NA-052624	B-ISDN AAL specification Service Specific Co-ordination Function (SSCF) Connection Oriented Network Service (CONS)	I.365.2	NA5
ETS	300 821	Broadband Integrated Services Digital Network (B-ISDN); Asynchronous Transfer Mode (ATM); Support of the High Level Data Link Control (HDLC) core service by ATM Adaptation Layer 5 (AAL5)	I.FRAME	NA5
ETR	DTR/NA-052809	Resource management procedures and cases of their possible usage	I.371	NA5
ETR	DTR/NA-053001	Broadband Integrated Services Digital Network (B-ISDN); B-ISDN requirements for the support of broadband Virtual Private Networks (VPNs)		NA5
EG	DTR/NA-060108	Framework Document on IN/B-ISDN Integration		NA6
ETS	300 211	Metropolitan Area Networks (MAN) principles and architecture	IEEE 802	NA5
ETS	300 212	MAN Media Access Control layer and Physical Layer specification	IEEE 802.6	NA5
ETS	300 213	MAN Physical layer convergence procedure (PLCP) for 2,048 Mbit/s	G.703 - G.704, G.707 - G.707, IEEE 802.6	NA5
ETS	300 217-4	Connectionless Broadband Data Service (CBDS) Part 4: Address screening supplementary service		NA5

(continued)

Table A.1 (continued)

Type	Number	Title	Relevant documents	STC
ETS	300 214	MAN Physical layer convergence procedure (PLCP) for 34,368 Mbit/s	G.703 - G.751, G.707 - G.707, IEEE 802.6	NA5
ETS	300 217-3	Connectionless Broadband Data Service (CBDS) Part 3: Definition of supplementary services		NA5
ETS	300 215	MAN Physical layer convergence procedure (PLCP) for 139,246 Mbit/s	G.703 - G.751, G.707 - G.707, IEEE 802.6	NA5
ETS	300 217-2	Connectionless Broadband Data Service (CBDS) Part 2: Basic bearer service definition		NA5
ETS	300 216	MAN Physical layer convergence procedure (PLCP) for 155,520 Mbit/s	G.707 - G.707, IEEE 802.6	NA5
ETS	300 217-1	Connectionless Broadband Data Service (CBDS) Part 1: Overview	I.413, I.327, 164 IEEE 802.6	NA5
ETS	300 268	MAN PICS		NA5
ETS	300 269	PICS for PLCP 2,048 Mbit/s		NA5
ETS	300 270	PICS for PLCP 34,368 Mbit/s		NA5
ETS	300 271	PICS for PLCP 139,264 Mbit/s		NA5
ETS	300 272	PICS for PLCP 155,520 Mbit/s		NA5
ETS	300 273	MAN - MAC layer management	IEEE 802.6, X.720 - X.722, M.3100, M.3010	NA5
ETS	300 274	MAN - Conformance specification for the MAC layer management		NA5
ETS	300 275	Interconnection of MANs	M.3010, E.164	NA5
ETS	300 276	MAN Physical layer convergence procedure (PLCP) for 622,080 Mbit/s, SDH based systems	G.707 - G.707, G.783, I.432, IEEE 802.6	NA5
ETS	300 277	PICS for PLCP 622,080 Mbit/s		NA5
ETS	300 278	Support of existing services with guaranteed constant bit rate and specified transfer delay on MAN	G.101, G.114, G.131, G.823, IEEE 802.6	NA5
ETS	300 298-2 Ed.2	Basic characteristics and functional specifications of ATM Part 2: B-ISDN ATM layer specification	I.361	NA5
ETS	300 298-2	Part 2: ATM Layer specification	I.361	NA5
ETS	300 298-1 Ed.2	Basic characteristics and functional specifications of ATM Part 1: B-ISDN functional specification	I.150, I.311, I.361	NA5

(continued)

Table A.1 (continued)

Type	Number	Title	Relevant documents	STC
ETS	300 298-1	B-ISDN - Basic characteristics and functional specification of ATM Part 1: B–ISDN / ATM functional specification	I.150, I.311	NA5
ETS	300 299	Cell based user network access - Physical layer interfaces for B-ISDN applications	I.413, I.432	NA5
ETS	300 299 Ed.2	Cell based User Network Access - Physical layer interfaces for B-ISDN applications Ed.2	I.413, I.432	TM
ETS	300 300	SDH based user network access Physical layer interfaces for B-ISDN applications	I.413, I.432	NA5
ETS	300 300 Ed.2	SDH based User Network Access Physical layer interfaces for B-ISDN applications Ed.2	I.413, I.432	TM
ETS	300 301	Traffic control and congestion control in B-ISDN	I.371	NA5
ETS	300 337	Generic frame structures for the transport of various signals (including ATM) at the CCITT Recommendation G.702 hierarchical rates of 2 Mbps, 34 Mbps and 139 Mbps	G.832, G.804	TM
ETS	300 349	B-ISDN ATM Adaptation Layer (AAL) specification, type 3/4 + PICS	I.362, I.363.3	NA5
I-ETS	300 353	B-ISDN ATM Adaptation Layer (AAL) specification, type 1 + PICS (RI/NA-52626 = new Version)	I.362, I.363.1	NA5
ETS	300 354	B-ISDN Protocol Reference Model and its application	I.321	NA5
ETS	300 399-1	Frame Relay Services Part 1: General description	I.233, Q.922, Q.933	NA2
ETS	300 399-2	Part 2: Service definition		NA2
ETS	300 399-3	Part 3: Frame Relay Data Transmission Service - service definition		NA2
ETS	300 399-4	B -ISDN - Frame Relay Bearer Service - service definition	I.233.1, I.370, I.372	NA5
I-ETS	300 404 Ed.2	B-ISDN Operations and maintenance principles and functions - Version 2	I.610	NA5
ETS	300 405	MAN: Interconnection of MSSs based on an ATM interface	I.364	NA5
ETS	300 428	B-ISDN ATM Adaptation Layer (AAL) specification, type 5 + PICS	I.362, I.363.5	NA5
ETS	300 436-1	B-ISDN Signalling ATM Adaptation Layer (SAAL) Service Specific Connection Oriented Protocol (SSCOP) Part 1: Protocol specification	Q.2110	SPS
ETS	300 436-2	Part 2: PICS proforma specification		SPS
ETS	300 437-1	B-ISDN Signalling AAL Service Specific Co-ordination Function (SSCF) for support of signalling at the User Network Interface (UNI) Part 1: Specification of SSCF at UNI	Q.2130	SPS
ETS	300 437-2	Part 2 PICS proforma specification		SPS
ETS	300 438-1	B-ISDN Signalling ATM Adaptation Layer (SAAL) - Service Specific Co-ordination Function (SSCF) for support of signalling at the Network Node Interface (NNI) Part 1: Specification of SSCF at NNI	Q.2140	SPS
ETS	300 438-2	Part 2: PICS proforma specification		SPS

(continued)

Table A.1 (concluded)

Type	Number	Title	Relevant documents	STC
ETS	300 443-1	B-ISDN Digital Subscriber Signalling System No. 2 (DSS-2) - B-ISDN User Network Interface Layer 3 specification for basic call/bearer control Part 1: Protocol specification	Q.2931	SPS
ETS	300 443-2	Part 2: PICS proforma specification		SPS
ETS	300 443-3	Part 3: TSS&TP		SPS
ETS	300 443-4	Part 4: Abstract Test Suite (ATS) and PIXIT proforma specification		SPS
ETS	300 455-1	Virtual Path service for reserved and permanent Communications Part 1: BVPS for permanent communication	F.813	NA1
ETS	300 455-2	Part 2: BVPS for reserved communication		NA1
I-ETS	300 464	ATM cell transfer performance for B-ISDN connection types	I.356	NA4
I-ETS	300 465	Availability and retainability performance for B-ISDN semi-permanent connections	I.350, I.356	NA4
ETS	300 467	Support of Frame Relaying Bearer Service in B-ISDN and Frame Relay interworking between B-ISDN and other networks	I.233.1, I.370, I.372, I.555	NA5
ETS	300 469	B-ISDN management architecture and management information model for the VP-VC-crossconnect	I.751	NA5
ETS	300 478-1	CBDS over ATM: Framework and protocol specification at the UNI Part 1: Specification	I.364, F.812	NA5
ETS	300 478-2	CBDS over ATM: Framework and protocol specification at the UNI Part 2: CLNAP Protocol Implementation Conformance Statement (PICS) proforma specification		NA5
ETS	300 479-1	CBDS over ATM: Framework and protocol specification at the NNI Part 1: Specification	I.364, F.812	NA5
ETS	300 479-2	CBDS over ATM: Framework and Protocol Specification at the NNI Part 2: CLNIP Protocol Implementation Conformance Statement (PICS) proforma specification		NA5
ETS	300 486-1	B-ISDN Meta Signalling Protocol - Part 1: Protocol specification	Q.2120	SPS
ETS	300 495	B-ISDN Signalling System No.7 - Interworking between B-ISDN User Part (B-ISUP) and Digital Subscriber Signalling System No. 2 (DSS-2)	Q.2650	SPS
ETS	300 496	B-ISDN Signalling System No.7 - Interworking between B-ISDN User Part (B-ISUP) and N-ISUP - Version 2	Q.2660	SPS
ETS	300 656	B-ISDN Signalling System No.7 - B-ISDN User Part (B-ISUP)	Q.2761, Q.2764	SPS
ETS	300 657	B-ISDN Signalling System No.7 - B-ISDN User Part (B-ISUP) -	Q.2730	SPS
	DE/SMG-510301-04	Universal Mobile Telecommunication System (UMTS) network aspects - Part 04: IN and -ISDN concepts in an UMTS environment		

Annex B: Management aspects of the EBTN

This annex describes some likely network scenarios and proposes some approaches to the management of an EBTN. The annex suggests that management will be based on peer-to-peer communication between participating Public Network Operators (PNOs). In order to provide coherent end-to-end service, each PNO should provide some basic (or sets of) management capability.

This annex is laid out as a set of short propositions. Each proposition can be considered independently. Taken together, these propositions form the framework and basic requirements for the management of EBTN.

B.1 EBTN management architecture

1.1 The management architecture of the EBTN will be based on a co-operative approach. The management systems from different PNOs will interact in a peer-to-peer fashion, to achieve management of the larger combined domain. This is illustrated in figure B.1.

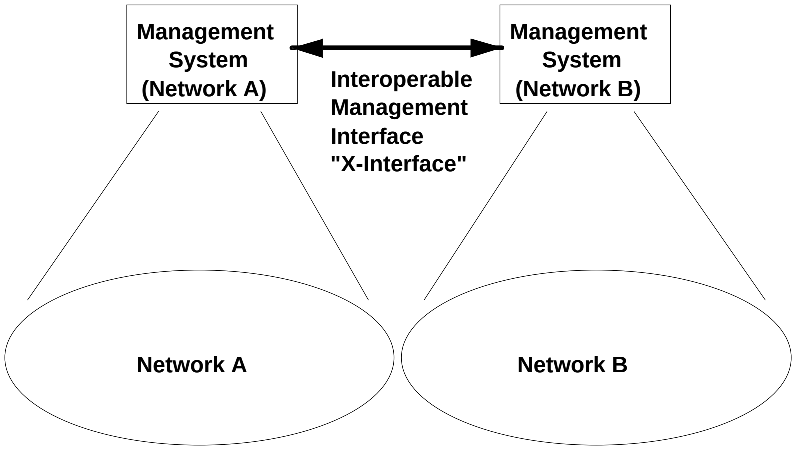


Figure B.1

1.2 There will exist an interoperable management interface between the two management systems. This interface is normally designated as the "X-Interface", as referenced in ITU-T Recommendation M.3010 [26].

NOTE: The ATM Forum uses the term "M5 Interface" and Eurescom prefers "Xcoop Interface". These terms are thought to be synonymous.

1.3 The X-Interface will normally operate at the "Service Level" in the functional hierarchy, identified in ITU Recommendation M.3100 [26]. It is a service-level interaction because there is always a mutually agreed Quality of Service associated with the circuits, which span the domains of the co-operating PNOs.

1.4 The physical realization of the co-operating management systems is not relevant within this architectural view.

1.5 The physical realization of the X-Interface is relevant for actual implementations. This implementation may be considered as having two independent levels:

- Communications stack level (including physical through presentation layer of the OSI model, and including syntactic aspects such as CMIP);

- Semantic level (which defines the functionality offered across the interface, often expressed as an "object model", using formalisms such as GDMO).

B.2 EBTN network arrangements

The EBTN network can be considered as a number of distinct arrangements. This has implications for the routeing and protection aspects of Operations Systems (OSs).

2.1 Normally two co-operating networks will be arranged as in figure B.2. In this case, each network spans a distinct, discrete and separate geographical region. A clearly understood geographic boundary (e.g. a country border) separates the networks and their respective management domains.

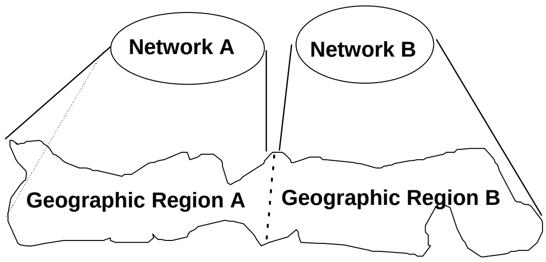


Figure B.2

2.2 Europe's liberalised telecommunications environment will give birth to another arrangement of networks and management domains, where more than one PNO has a network spanning the same geographical region. This is illustrated in figure B.3, where for simplicity Network C is shown to encompass completely the regions covered by Networks A and B.

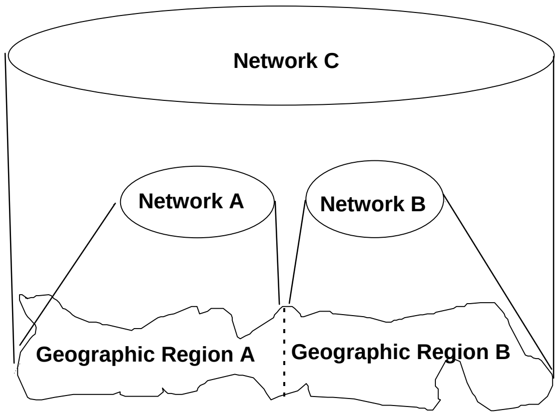


Figure B.3

2.3 In practice domain boundaries may not be aligned simply as in the case of figure B.3. Two management domains may overlap. A management domain may be a strict geographic subset of another domain.

B.3 PNO network views

3.1 When two PNOs have an X-Interface between their networks, only a partial view of the network resources is presented over the interface. This is illustrated in figure B.4, where the management system of Network A has visibility of all the network elements and/or element management systems within Network A, but has no visibility of the network elements or element management systems within Network B.

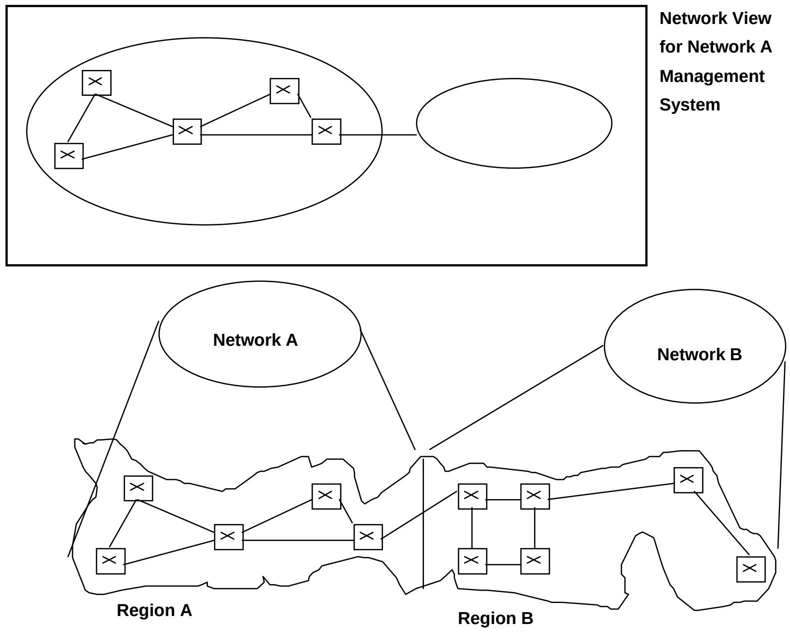


Figure B.4

3.2 Within this partial view of network resources, presented across the interface, there will exist a minimal set of supported functionality, which shall be supported by any PNO involved in the EBTN. This minimal set of functionality may be further profiled into capability sets, which correspond to classes of higher level services (one example of such a capability set could be the set of management functions required to support a pan-European freephone service).

B.4 EBTN organisational model

There are two organisational models for management of the EBTN. These can be termed the "star" and "cascaded" organizations and are described in the following paragraphs:

4.1 Star organisational model.

This approach is illustrated in figure B.5. The management system for Network A, wishes to configure a path from Endpoint 1 in its own Network to Endpoint 2 in Network C, which is separated by an intervening Network B.

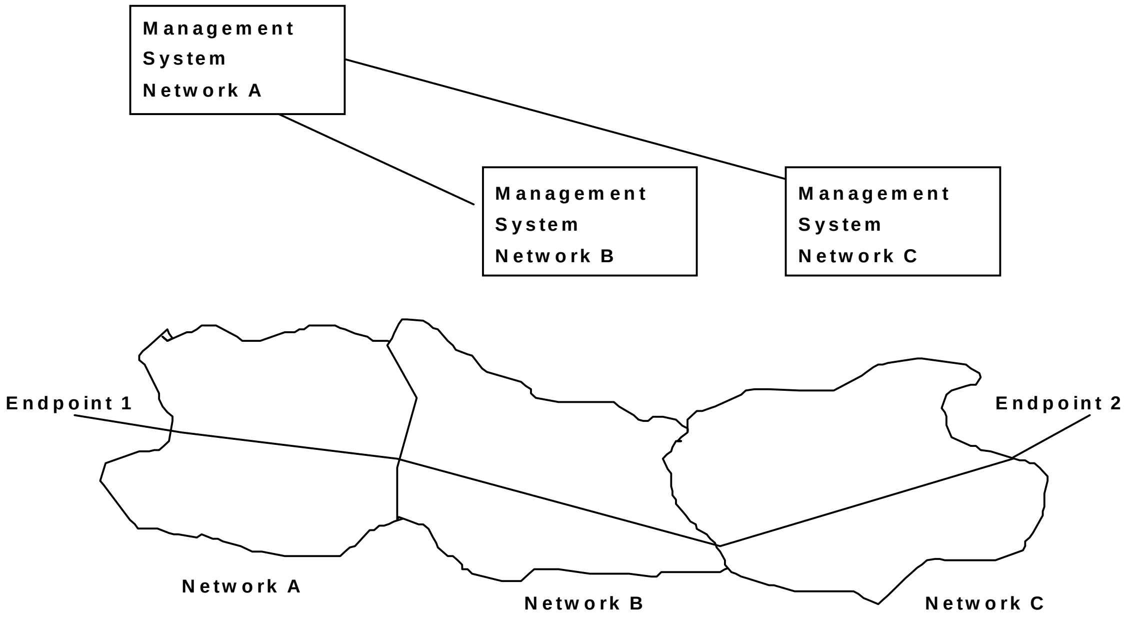


Figure B.5

In order to do this, Management System A shall maintain an X Interface with both management system B and management system C. Secondly, management system A shall have the built-in knowledge to derive the top level routeing from A through B to C. Thirdly, management system A issues and monitors the appropriate requests to the B and C management systems.

In this approach, each management system is responsible for the detailed routeing within its own network.

This approach is viable, when the number of co-operating PNOs is relatively small.

4.2 Cascaded organisational model.

The Star approach, discussed above, becomes less attractive as the number of co-operating PNOs increases. In the Star approach, each participating PNO shall maintain an X Interface with every other PNO. This proliferates the number of X Interfaces in the system and also increases the necessary complexity of each management system, since each system has to service many different independent streams of incoming requests.

The cascaded approach is illustrated in figure B.6. For this example, the path setup requirement is the same. However each participating PNO now maintains only a restricted number of X Interfaces, typically with each contiguous PNO. In order to set up the circuit, management system A passes a single request to management system B.

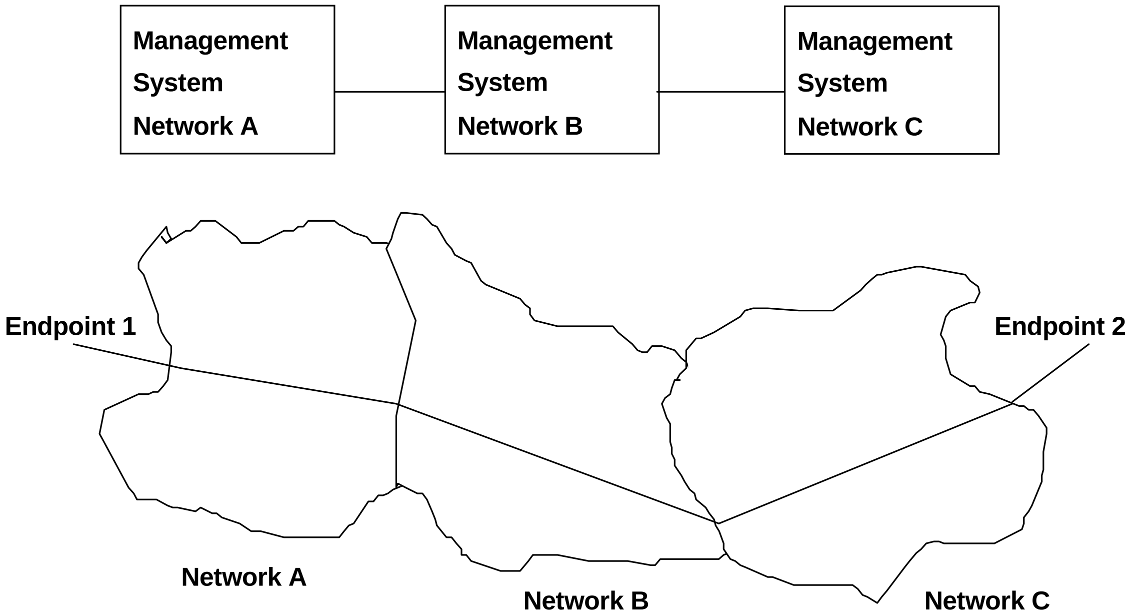


Figure B.6

Management system B has the necessary intelligence to understand that Endpoint 2 is in Network C, and thus passes the request onwards to management system C. The cascaded approach also implies some complexity for the participating management systems, which have to perform the correct routeing and control of the management messages.

This approach becomes more attractive, when the number of participating PNOs increases.

As in the case of the star approach, each management system is responsible for the detailed routeing within its own network.

B.5 Shared network information (semi-permanent data)

The Management Information Base (MIB) of a set of co-operating networks is distributed in nature. Each management system maintains a detailed knowledge of the resources within its domain. However, each management system should share some degree of knowledge of the complete system, in order to serve connection requests correctly.

In the "Star Organisational Model", at a minimum, each management system shall maintain (or have access to) the following data:

- An overall network map of each participating PNO;
- The connectivity between each PNO;
- The list of "contained" endpoints in each PNO.

In the "Cascaded Organisational Model", at a minimum, each management system shall maintain (or have access to) the following data:

- A restricted network map of each contiguous PNO;
- The list of endpoints, which are "accessible from" each contiguous PNO.

To enable the consistent and correct functioning of the EBTN, there shall exist a set of supported mechanisms, which will ensure the integrity of this "Distributed Management Information Base". This might be accomplished in a proprietary way, for example by bi-lateral agreements between adjacent PNOs. However, it is difficult to see how this approach can be sustained when the number of participants becomes large. Each new participant would have to agree, define and implement (potentially different) information-sharing arrangements with each co-operating PNO. This seems especially problematic, when combined with the star approach.

Some form of central directory system, might be a valid approach to this problem, although this is by no means the only solution.

B.6 Shared network information (dynamic data)

There is also a large amount of network data, which shall be routed and delivered round the network on a dynamic basis. For example, data concerning circuit faults may arise in a transit network, but this information is of interest to the endpoints of the circuit. Performance data also falls into this category. Again for example, periodically a given PNO may wish to interrogate other transit or destination PNOs for information, relating to circuits which originate from its own domain.

There shall exist mechanisms to allow these valid scenarios, as exemplified above. At the same time, there shall exist complementary mechanisms to prevent a PNO accessing information, to which it is not entitled.

B.7 Additional routing requirements

In the cascaded approach, described above, a PNO may wish to indicate a preferred transit-PNO routeing, or forbid another potential transit routeing. Typically this could be for political or economic reasons. There shall exist a mechanism, whereby such preferences can be accommodated.

At a smaller level of detail, a PNO may wish to have a degree of control over the detailed routeing within a given PNO's domain. For example, it may be necessary to route a second (back-up) circuit over equipment, nodes, and ducting, all of which are completely disjoint from the resources used by the primary circuit.

B.8 Security requirements

There exist many requirements to ensure the security and integrity of the EBTN, and to protect its data from accidental and wilful attack. This topic is included in this annex for completeness. It is however envisaged that this area should be treated in a separate document, as security threat analysis and the associated defensive techniques require further work.

B.9 Summary

There are a number of areas, where a minimal level of standardization of management functionality is required, in order to achieve consistent service across an EBTN.

Annex C: EBTN interworking with narrowband ISDNs

C.1 Introduction

This annex describes interworking between the ATM based EBTN and narrowband ISDN networks. It is based on ETR 325 [27].

The latter report covers three types of bearer services: circuit, packet and frame mode. This annex focuses on the circuit mode bearer service.

C.2 Interworking scenarios

Figure C.1 is derived from ETR 325 [27]. It shows possible B-ISDN/N-ISDN interworking scenarios in case of the EBTN backbone network. From the interworking scenario point of view both the EBTN and the "Other ATM-based networks" are a sub-domain of the B-ISDN.

EBTN being a backbone, we assume that no customer premises equipment and/or terminals are connected directly to it.

Only scenarios I and II discussed in ETR 325 [27] are applicable. They are:

- Scenario I, representing an **interconnection** scenario between B-ISDN and N-ISDN. In this case the service capabilities provided through the user access points are limited to the narrowband services. The user interfaces are those currently provided by B-ISDN and N-ISDN;

- Scenario II, representing a **concatenation** of N-ISDNs via B-ISDN. In this case the interfaces and the service capabilities provided through the user access points are the same that are currently provided by N-ISDN.

  Two sub-scenarios are possible in this case, depending on the fact whether the second N-ISDN is connected directly to the EBTN (case IIa) or via an other ATM-based network (case IIb).

From the point of view of capabilities provided by the EBTN, two provision scenarios for the N-ISDN bearer services are possible:

- in the **indirect provision scenario** the capabilities necessary to handle the N-ISDN bearer services are located outside the B-ISDN. The EBTN only provides a transparent ATM connection either permanent, semi-permanent or on demand between network elements outside the EBTN able to support the narrowband capabilities. This scenario is characterized by the absence of signalling broadband capabilities or by the presence of signalling broadband capabilities which do not integrate all the narrowband ISDN services;

- in the **direct provision scenario** the capabilities necessary to handle the N-ISDN bearer services are located inside the EBTN. The latter shall support not only broadband capabilities but also narrowband capabilities allowing the establishment of ATM connections able to support the N-ISDN bearer services This scenario is characterized by the availability of broadband signalling capabilities supporting narrowband ISDN services.

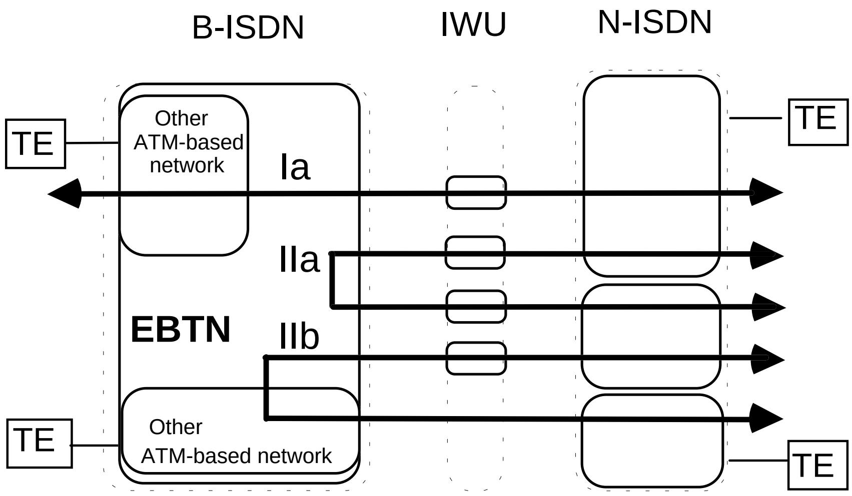


Figure C.1: Interworking scenarios between EBTN and N-ISDN

In the following clause the term "B-ISDN" is used to indicate "EBTN" in order to keep as close as possible to the original text. In fact no confusion is possible because only interworking between the EBTN part of the B-ISDN and the narrowband ISDN is addressed (Interworking Units indicated in figure 1).

C.3 B-ISDN to N-ISDN interconnection (scenario I)

The interworking configuration of B-ISDN to N-ISDN interconnection is shown in figure C.2. B-ISDN and N-ISDN users can communicate each others limiting their communications to those supported by the narrowband ISDN bearer services. The interworking functions to be performed at the boundary between B-ISDN and N-ISDN are provided by the IWU located at the edge between the EBTN and the N-ISDN.

The functions performed by the IWU depend on the capacity of B-ISDN to provide indirectly or directly the N-ISDN bearer services. As indicated above the circuit mode bearer service only is discussed here. Figure C.2 illustrates the interworking functions with details.

The N-ISDN circuit mode bearer service interworks to the Broadband Connection-Oriented Bearer Service Class A (BCOBS-A) supported by AAL type 1 as described in ITU-T Recommendation I.363 [29].

The circuit mode bearer service interworking for the user plane is depicted in figure C.2. In this specific case the terminal connected to B-ISDN is a broadband terminal.

The IWU supports the adaptation functions between the N-ISDN and B-ISDN interfaces and packetizes/depacketizes the user information flow in/from an ATM cell flow. To emulate the N-ISDN circuit mode bearer service within B-ISDN the ATM Adaptation Layer (AAL) 1 is used.

For the control plane two different interworking situations take place according to the indirect and direct provision scenarios of N-ISDN bearer services.

The IWU terminates the N-ISDN and B-ISDN signalling messages and performs the appropriate translation among the narrowband and broadband signalling flows. The functions performed by the IWU are different for the "indirect provision scenario" and the "direct provision scenario".

C.3.1 Indirect provision scenario

In the case of indirect provision the IWU allows terminals connected to B-ISDN to access network elements in N-ISDN. Transparent ATM connections are used to transparently transport user and control information between the terminals connected to B-ISDN and the IWU. In CCITT Recommendation X.300 [30] this category of interworking is defined as "interworking by port access".

Figure C.5 shows the circuit mode bearer service interworking for the control plane in the case of the indirect provision scenario. In this scenario B-ISDN is transparent to the N-ISDN call control. In particular figure C.46 depicts the case of a N-ISDN terminal connected to B-ISDN through the B-NT2. The N-ISDN signalling messages generated by the N-ISDN terminal connected to B-ISDN are transparently transported by an ATM connection.

The IWU packetizes/depacketizes the N-ISDN signalling messages in/from ATM cell flows and terminates the N-ISDN signalling messages.

C.3.2 Direct provision scenario

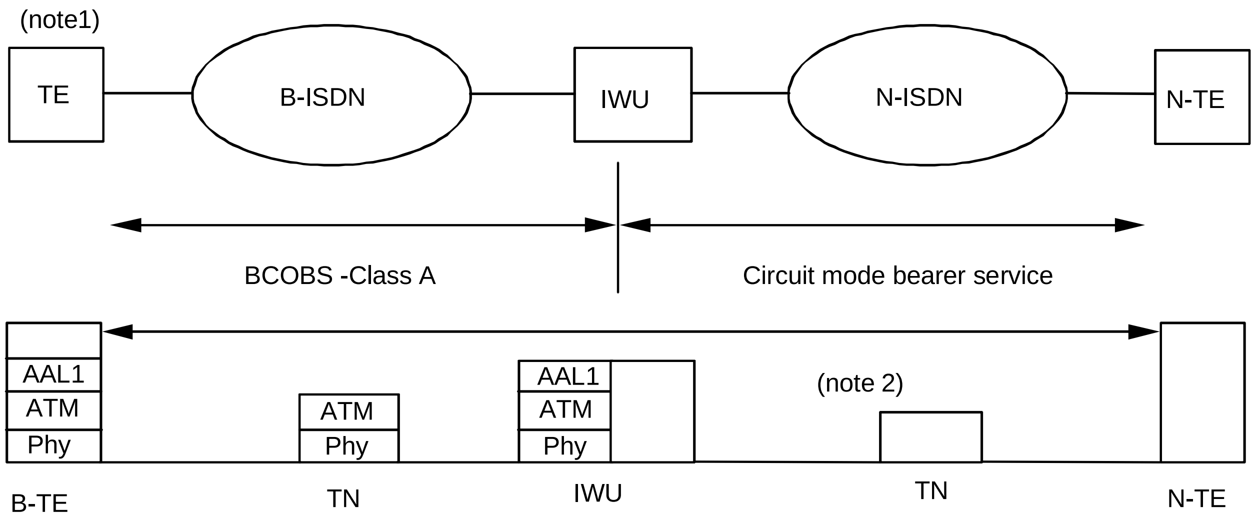
The case of direct provision implies the establishment of ISDN connections based on ATM in the B-ISDN portion of the network and the IWU performing adaptation and interworking functions at the level of user and control plane. In particular the IWU translates the B-ISDN and N-ISDN signalling flows performing termination, generation and protocol conversion of the N-ISDN and B-ISDN signalling messages. In CCITT Recommendation X.300 [30] this category of interworking is defined as "by call control mapping".

Figure C.7 shows the circuit mode bearer service interworking for the control plane in the case of the direct provision scenario. In this scenario B-ISDN supports ISDN connections based on ATM. The SAAL UNI is an ATM Adaptation Layer that has SSCOF-UNI located on the top SSCOP. The SAAL NNI is an ATM Adaptation Layer that has SSCOF-NNI located on the top of SSCOP. The SCCOP resides on the top of CPCS AAL5. The structure and the components of the SAAL are specified in ITU-T Recommendations Q.2100, Q.2110, Q.2130 and Q.2140.

C.4 Concatenation of N-ISDNs via B-ISDN (Scenarios II)

The interworking configuration of a concatenation of N-ISDNs via B-ISDN is shown in figure C.5. In this case the service provided by end-to-end communications are those currently supported by N-ISDN. The interworking functions to be performed at the boundary between B-ISDN and N-ISDN are provided by the IWU.

If B-ISDN supports indirectly the N-ISDN bearer services the IWU shall perform the necessary adaptation functions and establish a transparent ATM connection to transparently transport through B-ISDN signalling and user information. The transparent ATM connection is established between the IWU and the first network element capable to support the ISDN bearer services. In this specific case the first network element is the other IWU.



NOTE 1: TE represents a generic N-ISDN or B-ISDN terminal.

NOTE 2: N-ISDN provides a circuit mode connection over which any user protocol may be transferred.

Figure C.2: Circuit mode interworking - user plane

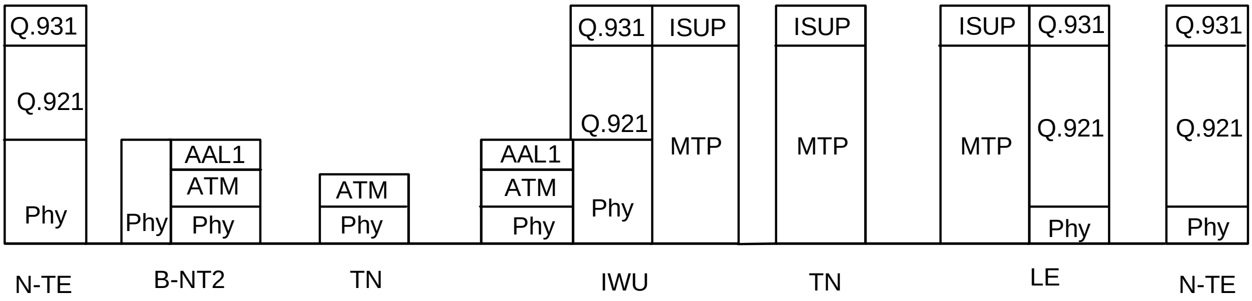


Figure C.3: Circuit mode interworking. Indirect provision scenario - control plane

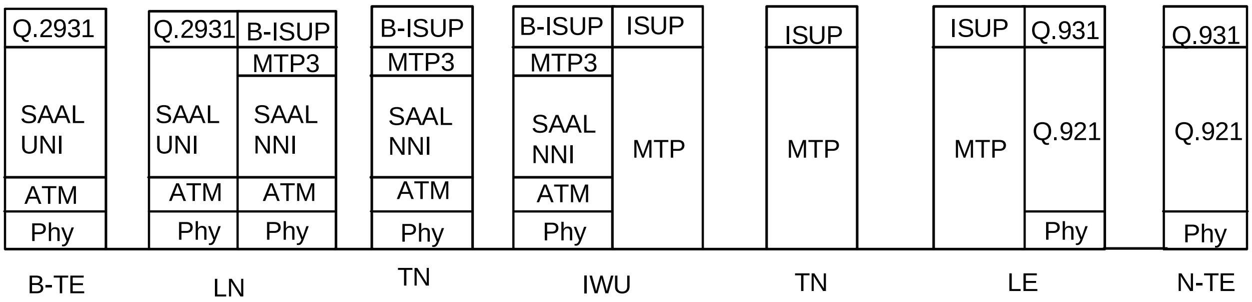
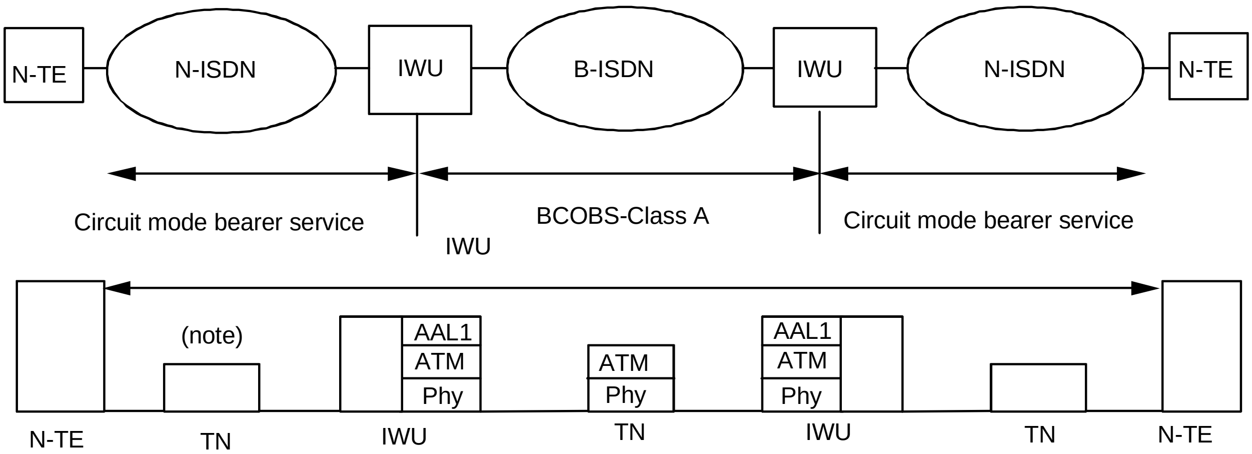


Figure C.4: Circuit mode interworking. Direct provision scenario - control plane



NOTE: N-ISDN provides a circuit mode connection over which any user protocol may be transferred.

Figure C.5: Circuit mode interworking - user plane

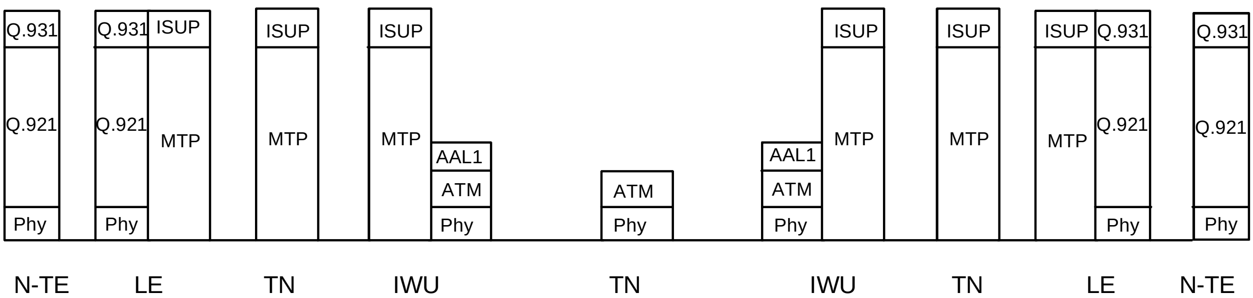


Figure C.6: Circuit mode interworking. Indirect provision scenario - control plane

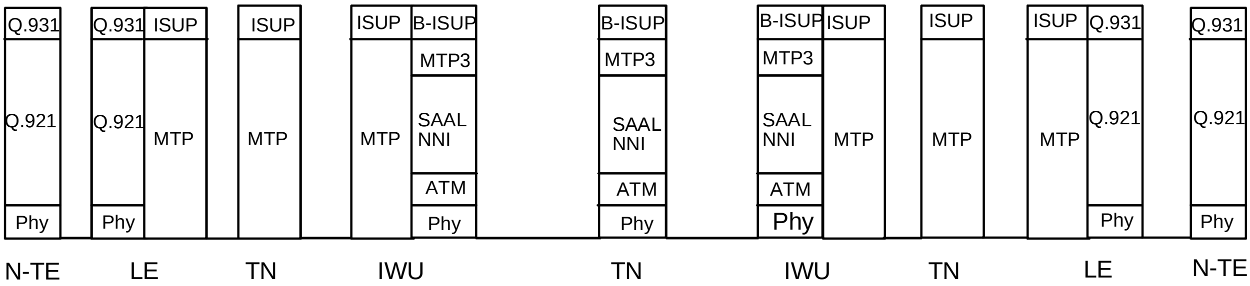


Figure C.7: Circuit mode interworking. Direct provision scenario - control plane

If B-ISDN supports directly the N-ISDN services the IWU shall perform the necessary interworking functions and set an appropriate ISDN connection based on ATM between itself and a network element inside B-ISDN able to handle the N-ISDN capabilities. Interworking functions at the level of user and control plane take place in the IWU.

C.4.1 Association between N-ISDN connections and broadband connections

In the case of interworking between B-ISDN and N-ISDN, the N-ISDN connections shall be related to the broadband connections with the appropriate AAL types and the N-ISDN bearer services shall be related to the B-ISDN bearer services with the appropriate AAL service classes.

The association between N-ISDN and B-ISDN connection types can be performed in two ways:

a) One-to-one correspondence

In the one-to-one correspondence each N-ISDN connection corresponds to a broadband connection characterized by the appropriate AAL type.

The network performance attributes of the N-ISDN and B-ISDN connections shall match as well as the Quality of Service (QoS) classes of the N-ISDN and B-ISDN bearer services supported by the given connections.

In N-ISDN and B-ISDN the modes to establish and release a given connection are: switched, semi-permanent and permanent. In the first case the interworking functions for the establishment of the connection take place at the level of control plane. In the other two cases the interworking functions affect the management plane.

b) K-to-one correspondence

In the K-to-one correspondence multiple N-ISDN connections are bundled without distinguishing between the constituent connections. The bundle corresponds to one broadband connection with an appropriate AAL type.

As indicated for the one-to-one correspondence the N-ISDN network performance attributes and the QoS classes shall properly be related to the B-ISDN ones.

The K-to-one correspondence requires the presence of remote peer-to-peer N-ISDN systems able to distinguish and handle the multiple N-ISDN connections that are bundled and transported in an aggregated way through B-ISDN. Remote peer-to-peer N-ISDN systems may be two ISDN terminals, an ISDN terminal and an ISDN Network Element or two ISDN Network Elements.

C.4.2 Interworking configuration

Figure C.5 shows the interworking configuration in case of concatenation of N-ISDNs via B-ISDN for a circuit mode bearer service.

The service perceived by the end user is the circuit mode bearer service offered by N-ISDN. The N-ISDN circuit mode bearer service interworks to the Broadband Connection-Oriented Bearer Service Class A (BCOBS-A) supported by AAL type 1 as described in ITU-T Recommendation I.363 [29].

The IWU supports the adaptation functions between the N-ISDN and B-ISDN interfaces and packetizes/depacketizes the user information flow in/from an ATM cell flow. To emulate the N-ISDN circuit mode bearer service within B-ISDN the AAL 1 is used.

For the control plane two different interworking situations occur according to the indirect and direct provision scenarios of N-ISDN bearer services.

C.4.3 Indirect provision scenario

For the indirect provision scenario figure C.3 describes the circuit mode bearer service interworking relating to the control plane. In this scenario B-ISDN is transparent to the N-ISDN call control. The N-ISDN signalling messages are transparently transported by B-ISDN.

The IWU packetizes/depacketizes the N-ISDN signalling messages in/from ATM cell flows and, if necessary, terminates the N-ISDN signalling messages. It should be noted that the termination of the N-ISDN signalling messages at the boundaries of B-ISDN may be performed, instead of the IWUs, by ISDN nodes belonging to the remote ISDNs. In this case the IWU shall only provide the adaptation functions to transport by a flow of ATM cells the N-ISDN signalling messages.

C.4.4 Direct provision scenario

Figure C.4 shows the circuit mode bearer service interworking for the control plane in the case of the direct provision scenario. In this scenario B-ISDN supports ISDN connection based on ATM. The IWU terminates the N-ISDN and B-ISDN signalling messages and performs the appropriate translation between the narrowband and broadband signalling flows.

Annex D: Extract from SRC6 report, Part B, Subclause 5.2.2

SOURCE: **Part B, Subclause 5.2.2 of the SRC6 report**

TITLE: **European Backbone Telecommunications Network**

Interoperability of existing and future networks is needed to allow the graceful migration of the EII towards higher bandwidth. A European Backbone Telecommunications Network (EBTN) based on broadband switching technology would be able to support all the services of the EII and would be the first step towards the building of a European B-ISDN. This EBTN would:

- be characterized by the interconnection of ATM core networks in different network operator domains into a single homogeneous ATM network;
- typically use SDH transmission networks following the MoU for a Managed European Transmission Network (METRAN);
- be based on the emerging standards for B-ISDN;
- concentrate on basic connectivity services in order to support simple interoperability between existing networks (i.e. bearer services);
- give consideration to both E.164 and Internet addressing.

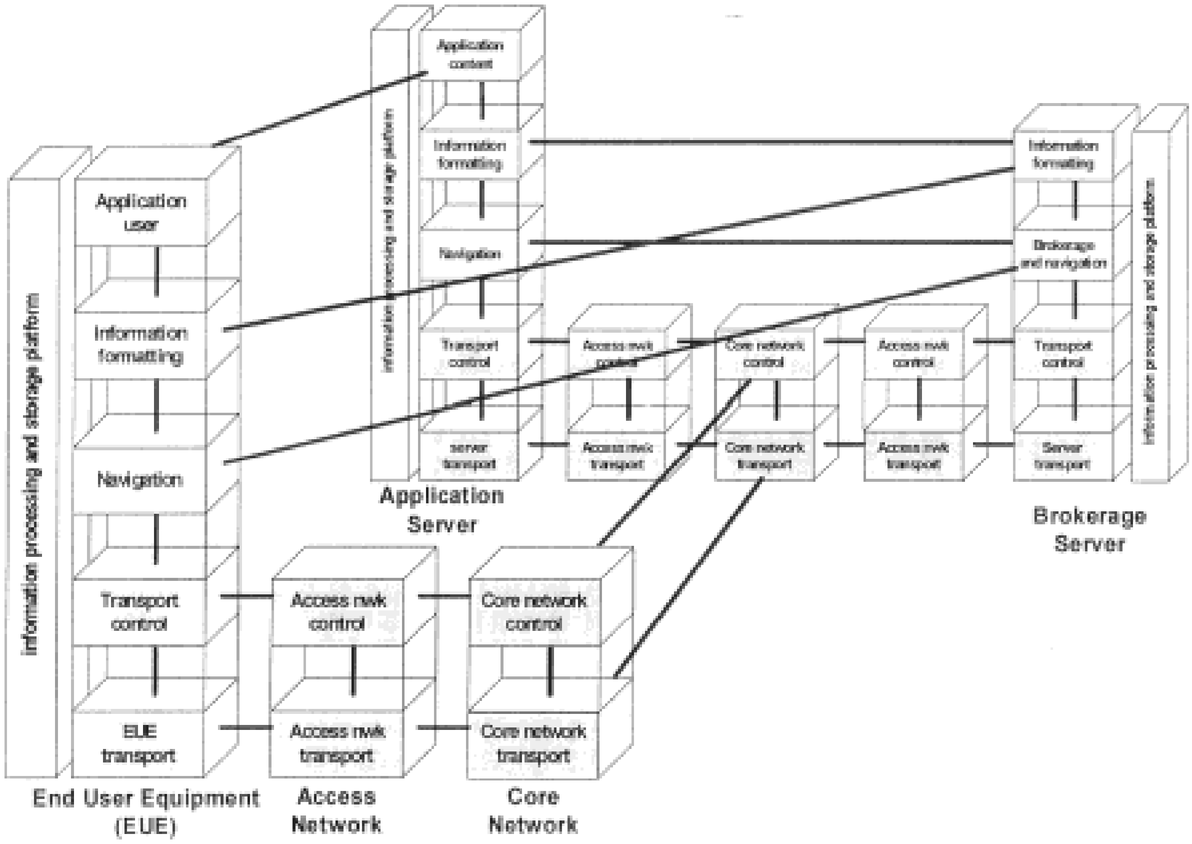
While the Internet backbone in North America could be a model for this network, there are several reasons for not using this directly:

- the Internet backbone still requires broadband telecommunications network services (in North America these are in general T3 private circuits);
- the current Internet Protocol (IP) does not efficiently support continuous bit rate services required for voice and full motion video, and there is still some level of uncertainty in the development of the next generation of the Internet Protocol (IP version 6) which will be better able to support continuous bit rate services;
- there is a growing global consensus that ATM should be the basic transport mechanism for the GII (even recognizing that there is some level of uncertainty that an ATM-based core network will be able to support the interworking of real-time services (e.g. voice telephony) with other networks and with sufficient QoS and become cost-efficient);
- Internet protocols can easily make use of a backbone based on ATM, but not vice versa.

For these reasons, the EBTN should be based on ATM and make use of the emerging B-ISDN standards form the ETSI, ITU, and the ATM Forum.

The European ATM Pilot Network which is being established by many of the European telecommunications network operators as an initial development of such a EBTN and already has some of the essential properties of the EBTN.

Annex E: SRC6 report, Figure B.4.3, Reference Model of the EII



Shaded boxes indicated transport capabilities

Figure 4.3 Reference model of the EII

Annex F: Terms of Reference of the EBTN Project

Source: 5th EPIISG Meeting Sophia Antipolis 20-21 December 1995.

1. Project Number:

1.4

2. Title:

European Backbone Telecommunications Network (EBTN)

3. Objectives

3.1 Considerations

Considering the large number of telecommunications networks that will be involved in the EII, interoperability between these networks will be essential to the success of the EII.

In order to reduce the number of possible requirements for interoperability, SRC6 has defined the concept of European Backbone Telecommunications Network (EBTN), which includes the interoperability of existing networks.

ATM-based B-ISDN is seen as the most appropriate cost effective technology to match the requirements of the information market and as a means of providing interoperability between these diverse existing telecommunications networks. This network technology should be the prerequisite to be considered when defining new applications and services.

As the implementation of the EBTN based on B-ISDN was proposed, the ATM trial network was considered to be an initial development.

The utilization of the ATM technology requires the definition of specific IWUs by making use of existing networks.

SRC6 notes that the Internet based on the Internet Protocol and the Transmission Control Protocol (TCP/IP) also forms a higher layer transport network for applications and that the use of this technology will form a major part of the EII for non-real-time traffic.

The meeting of G7 in February 1995 identified as one of its pilot projects the Global Interoperability of Broadband Networks. Within Europe, the EBTN concept will be the primary element in such interoperability.

3.2 Objectives

The project shall develop the necessary standards to provide a minimum set of capabilities to interconnect networks in order to obtain one seamless federation of networks.

In order to cater for all services of the EII the EBTN shall be based on ATM technology.

Switched VCs (Virtual Channels) shall be available in Europe as soon as possible.

There shall not be any limitations to the support of higher level protocols.

4. Project description:

Though emphasis shall be given on the definition of standards for the interconnection of EURO-ISDN, CATV networks, X.25 networks and GSM networks (Standardization Programme 1) all future interworking cases and the use of the EBTN as a backbone for Internet type of higher layer transport capabilities should be considered (Standardization Programme 2).

The following tasks have to be carried out:

- definition of the concept of EBTN;
- determination of the desired kind of network to network communication (reference configuration model), i.e. what kind of connections between the dedicated networks are desired;
- definition of information flows across relevant interfaces;
  determination and specification of necessary Node Network Interfaces (NNIs) and identification of impacts on them;
- selection and specification of the IWUs that are part of the EEI, e.g. the:
  - IWU between PSTN/ISDN and ATM;
  - IWU between CATV and ATM;
  - IWU between GSM and ATM etc.;
  - LAN/MAN interconnection;
- analysis of the current standardization situation: to what extend are the existing IWU interfaces defined;
- mapping of specifications with existing standards;
- identification of gaps in the stock of standards;
- consideration of different alternatives for implementation;
- verification of new standards requirements under economic aspects;
- proposal of subsequent activities in relation to the decision to be taken.

5. Lead body:

ETSI/NA

6. Collaborating bodies:

EURESCOM

7. Relevant existing international standards/specifications and other documents:

ETSI TA 22 has adopted the following SRC6 Recommendations which have been endorsed at the Joint CEN/CENELEC/ETSI/EWOS Workshop on EPII, 23-24 October in Brussels:

Recommendation 22

SRC6 recommends that ETSI develops and uses the concept of a European Backbone Telecommunications Network (EBTN) in order to facilitate the creation of the standards required to achieve interoperability between the large variety of existing and future telecommunications networks (see: B.5).

Recommendation 23

SRC6 recommends that ETSI uses ATM-based broadband technology as the reference technology for the evolution of the EII and the services which use the EII (see: B.5.2).

Recommendation 24

SRC6 recommends that ETSI specifies the EBTN concept to be capable of efficiently supporting the Internet protocol suite, including TCP/IP.

Additional reference is given in:

- SRC6 Report Chapter B5;
- SRC6 Recommendation 25;
- G7 Project on Global Interoperability for Broadband Networks;
- Open Workshop, Working Session 1.

8. Current work activities:

Specification of X Interfaces.

9. Relationship with other European Projects on Information Infrastructure:

RACE/ACTS/IBTN, TEN, G7 Project on Global Interoperability for Broadband Networks, EPIISG project on Inter-Networking.

10. Deliverables and timescale:

First results should be delivered in form of ETRs defining and proposing the conceptional model and containing the pertinent specifications.

Elaboration of proposal, allocation of tasks	December 95
Evaluation of existing standards, first draft	
definition	February 96
ETR	May 96
Decision on standardization projects to be taken	May 96

History

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