ETSI TECHNICAL REPORT

ETR 118

December 1993

Source: ETSI TC-SPS

Reference: DTR/SPS-03009

ICS: 33.080

Key words: B-ISDN, switching, cross-connect, performance

Broadband Integrated Services Digital Network (B-ISDN); Switching, exchange and cross-connect functions and performance requirements

ETSI

European Telecommunications Standards Institute

ETSI Secretariat

Postal address: F-06921 Sophia Antipolis CEDEX - FRANCE
Office address: 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE
X.400: c=fr, a=atlas, p=etsi, s=secretariat - **Internet:** secretariat@etsi.fr

Tel.: +33 92 94 42 00 - Fax: +33 93 65 47 16

Contents

Foreword

This ETSI Technical Report (ETR) has been produced by the Signalling Protocols and Switching (SPS) 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.

Blank page

1 Scope

This ETSI Technical Report (ETR) describes Broadband Integrated Services Digital Network (B-ISDN) switching, exchange and cross-connect functions and performance requirements and applies to public network nodes of a B-ISDN.

This ETR is not intended to define any systems or equipment in, or connected to, B-ISDN network nodes.

Some text may only apply to a certain type (or types) of B-ISDN network node. Where this occurs, the application is defined in the text. Not all the recommended functions will necessarily be provided in every B-ISDN network node.

2 References

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

[1] DE/SPS-03007: "Broadband Integrated Services Digital Network (B-ISDN); Metasignalling protocol".

[2] DE/SPS-03019: "Broadband Integrated Services Digital Network (B-ISDN); Information models and protocols for the management/control of the ATM switching network element".

[3] CCITT Recommendation I.113: "Vocabulary of terms for broadband aspects of ISDN".

[4] ITU-T Recommendation I.211: "General service aspects of B-ISDN".

[5] ITU-T Recommendation I.311: "B-ISDN general network aspects".

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

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

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

[9] ITU-T Recommendation I.432: "B-ISDN user-network interface - Physical layer specification".

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

[11] ITU-T Recommendation I.610: "Organisation and maintenance principles of the B-ISDN access".

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

[13] CCITT Recommendation Q.9: "Vocabulary of switching and signalling terms".

[14] CCITT Recommendation Q.511: "Exchange interfaces towards other exchanges".

[15] CCITT Recommendation Q.512: "Exchange interfaces for subscriber access".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Asynchronous Transfer Mode (ATM)

ATM is used in this ETR as addressing a specific packet oriented transfer mode using Asynchronous Time Division (ATD) multiplexing technique: the multiplexed information flow is organised in fixed size blocks, called cells. A cell consists of an user information field and a header field; the primary role of the header is to identify cells belonging to the same virtual channel on the ATD multiplex. Cells are assigned on demand, depending on the source activity and the resources available. Cell sequence integrity on a virtual channel is guaranteed by the B-ISDN.

ATM is a connection-oriented technique: header values are assigned to each section of a connection at call set-up and released at the end of the call. Signalling and user information are carried on separate virtual channels.

ATM is designed to offer a flexible transfer capability common to all services.

ATM Cross-Connect (AXC)

The ATM cross-connect is directed by management plane functions only. According to the functionalities provided by the user plane ATM cross-connects are classified into:

- ATM Multiplexers (MUX) (bandwidth management, Usage Parameter Control (UPC), header translation functions can be limited);

- ATM cross-connect.

ATM switch

The ATM switch is directed by control plane functions. According to the functionalities provided by the control plane ATM switches are classified into local exchanges, transit exchanges and concentrators.

B-ISDN network node

A B-ISDN network node is a cell handling node of the public ATM-based network including Virtual Path (VP)/Virtual Channel (VC) cross-connect (ATM cross-connect) and VP/VC switches (ATM switch).

3.2 Symbols and abbreviations

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

AAL	ATM Adaptation Layer
ATD	Asynchronous Time Division
ATM	Asynchronous Transfer Mode
AXC	ATM Cross-Connect
B-ISDN	Broadband ISDN
CBR	Constant Bit Rate
CON	ATM Concentrator
CPN	Customer Premises Network
ET	Exchange Termination
GMDP	Generalised Markovian Deterministic Process
HEC	Header Error Control
HED	Head-End for Distribution services
ISDN	Integrated Services Digital Network
LEX	Local EXchange
MUX	ATM Multiplexer
NNI	Network Node Interface
NPC	Network Parameter Control

OAM	Operations, Administration and Maintenance
SDH	Synchronous Digital Hierarchy
STM	Synchronous Transfer Mode
TEX	Transit EXchange
TMN	Telecommunications Management Network
UNI	User-Network Interface
UPC	Usage Parameter Control
VBR	Variable Bit Rate
VC	Virtual Channel
VCI	Virtual Channel Identification
VP	Virtual Path
VPI	Virtual Path Identification

4 Overview

4.1 Principles of B-ISDN

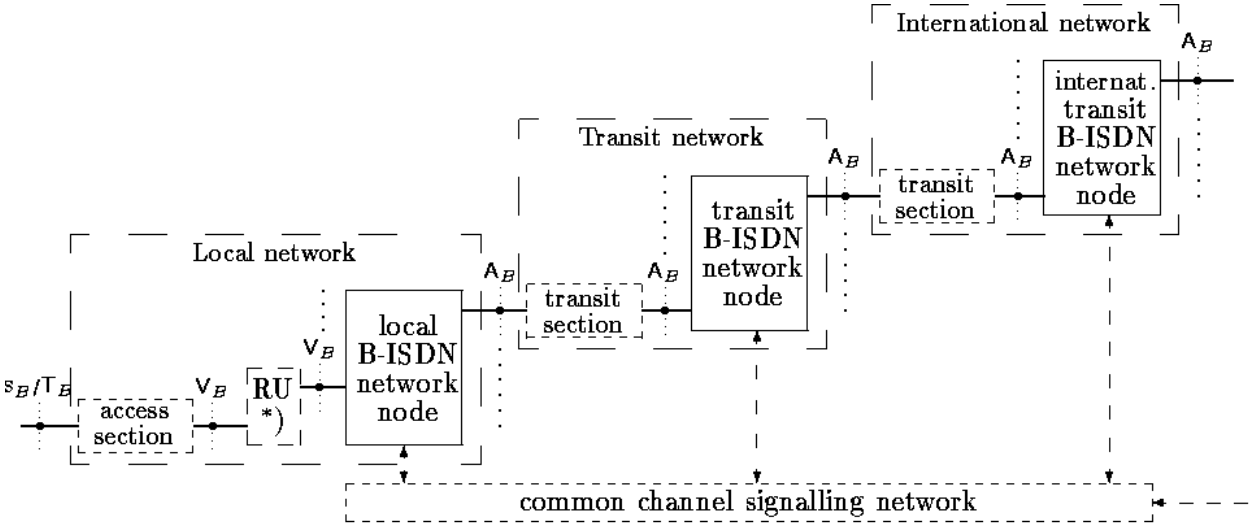
The main feature of the B-ISDN concept is the support of a wide range of audio, video and data applications in the same network. A key element of service integration for B-ISDN is the provision of a range of services using a limited set of connection types and multi-purpose user-network interfaces. B-ISDNs support both switched and non-switched connections.

A B-ISDN will contain intelligence for the purpose of providing service features, maintenance and network management functions. This intelligence may not be sufficient for some new services and may have to be supplemented by either additional intelligence within the network, or possibly compatible intelligence in the user terminals.

A layered structure should be used for the specification of the access protocol to a B-ISDN.

4.2 Field of application

This ETR is intended to be applied to public ATM-based network nodes in a B-ISDN. The general reference configuration of the B-ISDN is illustrated in figure 1.



*) May or may not exist.

NOTE: The relationship between B-ISDN and Telecommunications Management Network (TMN) is for further study.

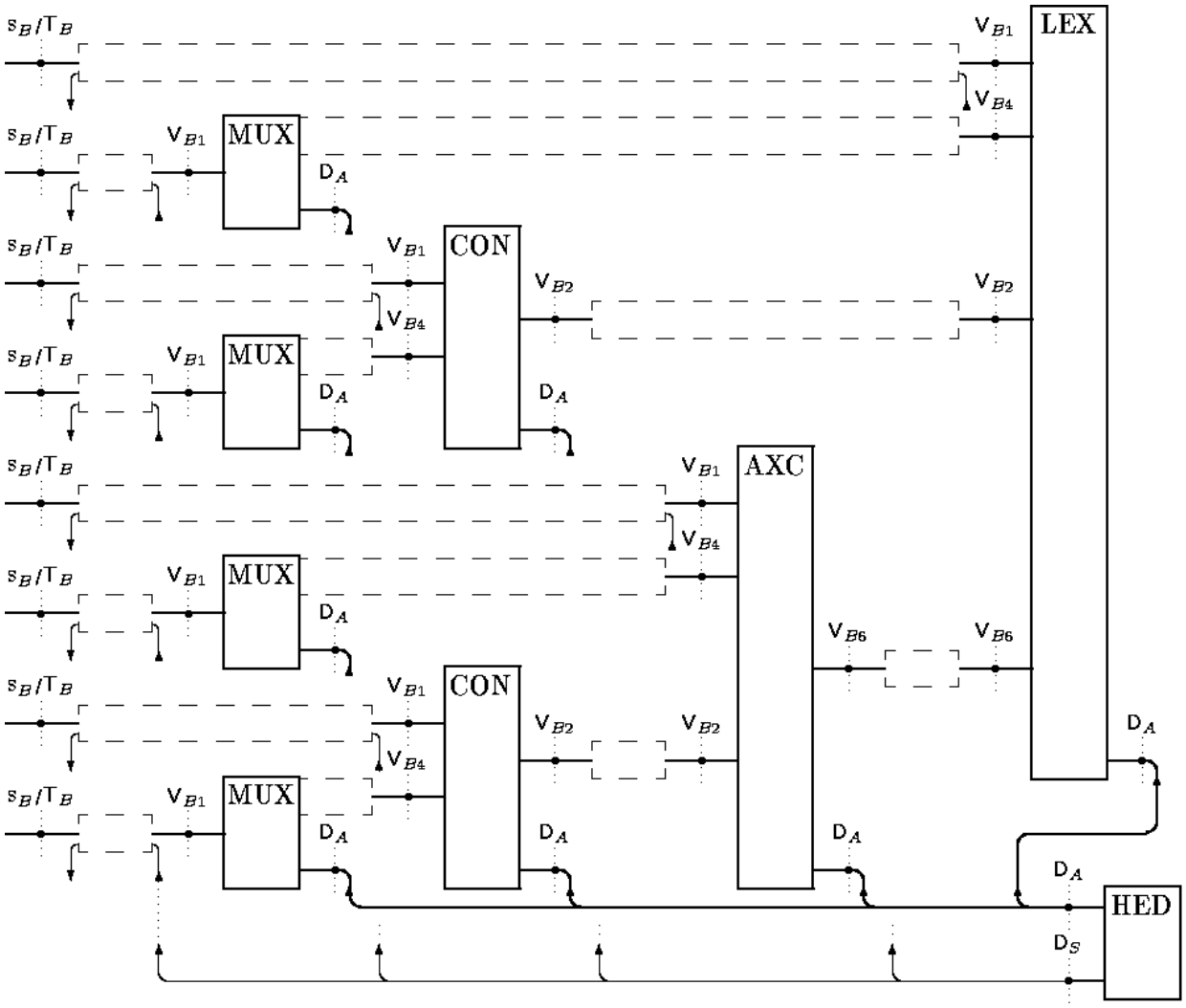
Figure 1: General reference configuration of public B-ISDN

It is recognized that B-ISDN may be implemented in a variety of ways according to specific national situations, e.g. this may be the use of the existing telecommunication infrastructure and technology. For the selection of features, functions and interfaces to be provided in a B-ISDN, the different releases (i.e. release 1, 2 and 3) as defined by ITU-T Study Group 13 (formerly CCITT Study Group XVIII) should be taken into account.

In figure 2, the configuration for B-ISDN customer access is detailed. A number of ATM Concentrators (CONs) and ATM Cross-Connects (AXCs) are shown.

In addition, a so-called "Head-End for Distribution services" (HED) is identified which may provide the distribution channels towards the Customer Premises Network (CPN). The interfaces and possible distribution services are for further study.

Two different solutions for provisioning of such distribution channels towards the customer are illustrated which are either based on ATM techniques (interface at reference point D_A) or other techniques but integrated in the B-ISDN customer access on the transmission level (interface at reference point D_S).



NOTE: The arrows indicate the direction of the distribution channels. Additional backward channels may be required for signalling and Operations, Administration and Maintenance (OAM) flows.

Figure 2: Possible configurations for subscriber access including distribution services

In figure 3, the configuration for B-ISDN interexchange trunks of the public B-ISDN is detailed. Beside direct interconnections of B-ISDN exchanges (either a Local EXchange (LEX) or a Transit EXchange (TEX)), connections via ATM cross-connect equipment are illustrated.

In addition, there are pure VP switching based connections shown which may be used to realize so-called "leased lines" between CPNs.

It should be mentioned that cross-connect equipment based on Synchronous Transfer Mode (STM) or Synchronous Digital Hierarchy (SDH) techniques are considered as part of the transmission systems and not as B-ISDN network nodes.

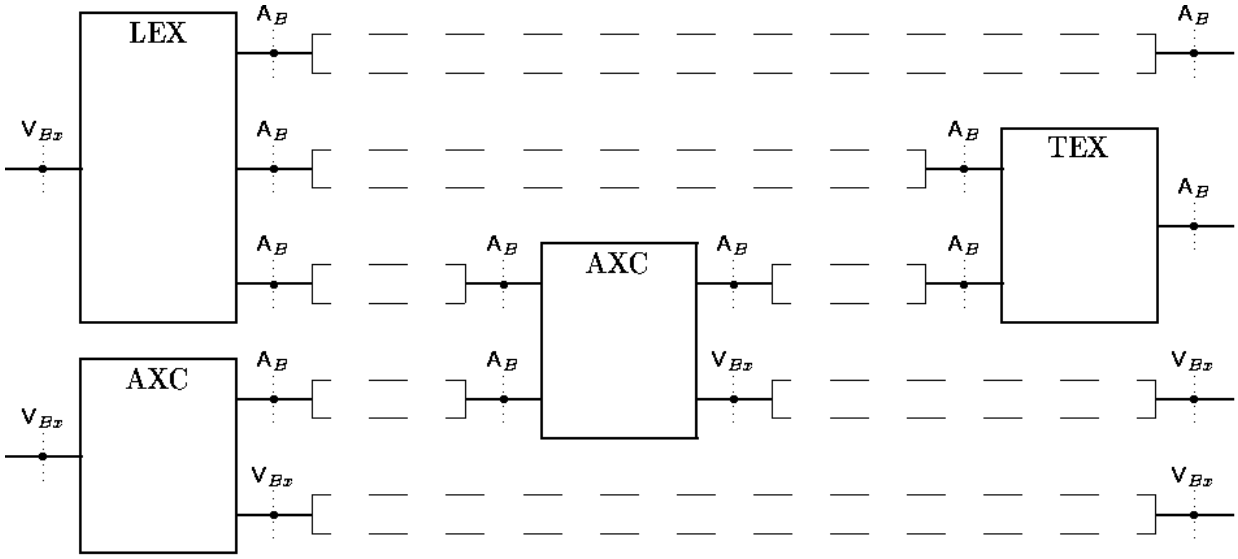


Figure 3: Configurations for interexchange trunks

5 General characteristics of B-ISDN network nodes

5.1 General

5.1.1 Cell structure and encoding of the header elements

The cell structure and encoding of the header elements is specified in ITU-T Recommendation I.361 [7].

The following exceptions are identified for this ETR:

- cell loss priority indication (see ITU-T Recommendation I.371 [8]);
- the usage of the cell loss priority requires further study.

6 Interfaces on B-ISDN network nodes

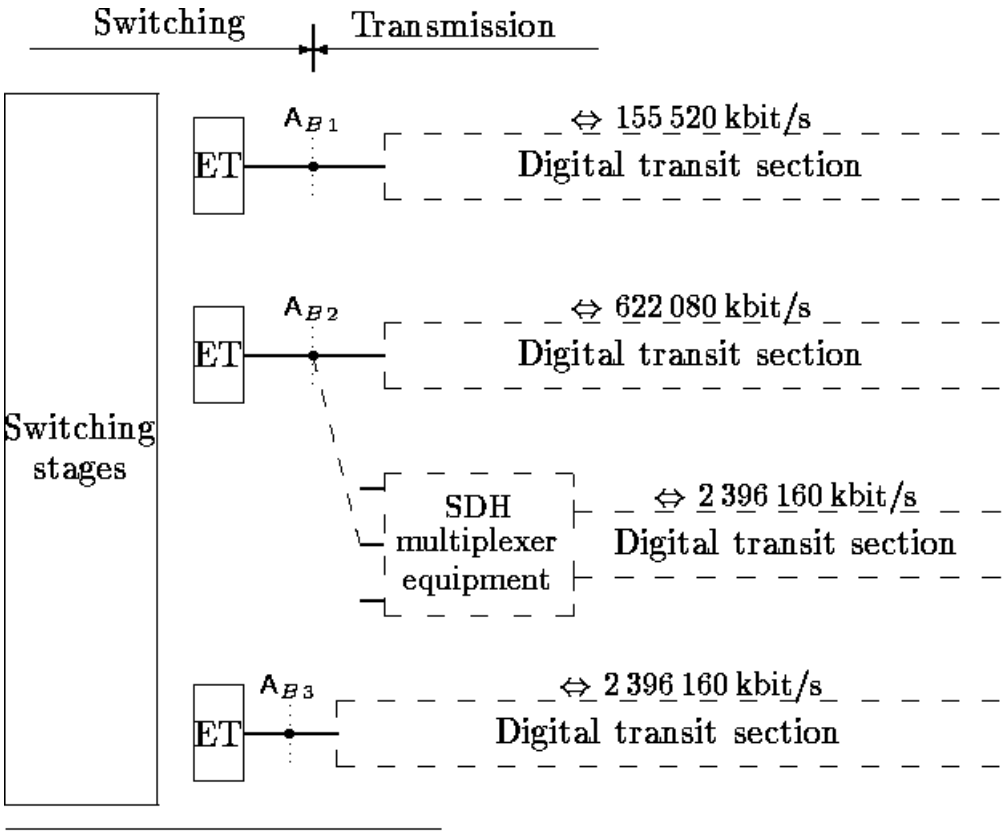
6.1 General

This Clause is not intended to define any transmission system, network or customer premises equipment in or connected to a CPN or B-ISDN network node via these interfaces. Therefore only the characteristics of the interfaces are described.

Within this ETR, a digital section is defined as the whole of the means of digital transmission between two consecutive reference points.

6.2 Interfaces towards other B-ISDN network nodes

Interfaces towards other B-ISDN network nodes that have been considered are described and illustrated in figure 4, but it is not intended to specify every possible interface. Other interfaces are for further study.



⇔: The bit rate is symmetric, i.e. has the same bit rate in both transmission directions.

Figure 4: Interfaces towards other B-ISDN network nodes

6.2.1 Characteristics of interfaces towards other B-ISDN network nodes

6.2.1.1 General

The interfaces towards other B-ISDN network nodes are identified by the reference point A_B.

6.2.1.2 Functional characteristics

The functional description of interfaces at A_{B1} and A_{B2} reference points is illustrated in figure 5 and the following general functional requirements are defined:

a) Interface structure and transfer capability

The interface structure consists of a continuous stream of cells.

The user information together with the information for connection related functions (e.g. signalling) are carried in ATM cells belonging either to a VC link or a VP link.

The transfer capability is defined for interfaces at A_{B1} and A_{B2} reference points.

b) Cell header format and encoding

The cell header format and encoding is defined for interfaces at A_{B1} and A_{B2} reference points.

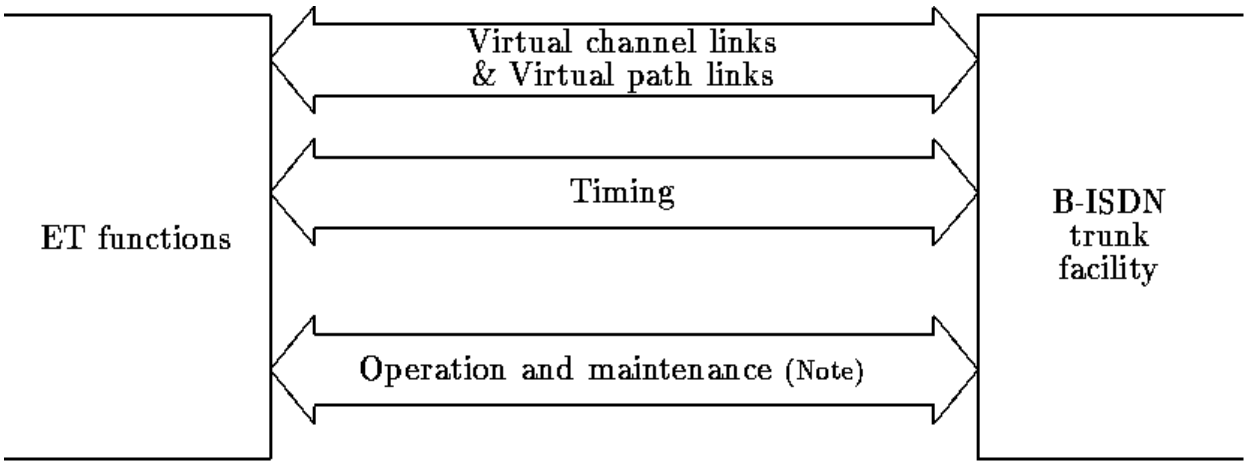
c) Timing

Timing functions provide the necessary information for bit (signal element) transmission, octet and cell boundaries (i.e. cell delineation).

Other timing functions are for further study.

d) Operation and maintenance

For further study.



NOTE: Provision of these functions are covered by the OAM channel(s).

Figure 5: Functional description of interfaces at A_{B1} and A_{B2} reference points

6.2.1.3 Interface A_{B1}

6.2.1.3.1 General

Interface A_{B1} is an interface to allow interconnection towards other B-ISDN network nodes.

6.2.1.3.2 Functional characteristics

The functional description of interface A_{B1} is illustrated in figure 5 and the following functional requirements are defined.

a) Interface structure and transfer capability

The transfer capability of the interface is 149 760 kbit/s. The interface is symmetric, i.e. it has the same bit rate in both transmission directions.

b) Cell header format and encoding

For this interface the coding scheme at the Network Node Interface (NNI) as described in ITU-T Recommendation I.361 [7] is used.

c) Operation and maintenance

For further study.

6.2.1.3.3 Physical medium characteristics

For interface A_{B1} maximum commonality between the functions of the physical layer described in ITU-T Recommendation I.432 [9] is aimed at:

a) Electrical interface

For further study.

b) Optical interface

For further study.

6.2.1.3.4 Virtual channel and virtual path allocation

At interface A_{B1} the Virtual Channel Identification (VCI) and Virtual Path Identification (VPI) values may be established in one of three ways:

- via pre-assignment by standardization;
- via management plane functions;
- via on-demand signalling procedures.

6.2.1.3.5 Signalling

The on-demand signalling procedures for VC connections are defined by ETSs and ITU-T Recommendations.

6.2.1.4 Interface A_{B2}

6.2.1.4.1 General

Interface A_{B2} is an interface to allow interconnection towards other B-ISDN network nodes.

6.2.1.4.2 Functional characteristics

The functional description of interface A_{B2} is illustrated in figure 5 and the following functional requirements are defined.

a) Interface structure and transfer capability

The transfer capability of the interface is 599 040 kbit/s. The interface is symmetric, i.e. it has the same bit rate in both transmission directions.

b) Cell header format and encoding

For this interface the coding scheme at the NNI as described in ITU-T Recommendation I.361 [7] is used.

c) Operation and maintenance

For further study.

6.2.1.4.3 Physical medium characteristics

For interface A_{B2} maximum commonality between the functions of the physical layer described in ITU-T Recommendation I.432 [9] is aimed at:

a) Electrical interface

For further study.

b) Optical interface

For further study.

6.2.1.4.4 Virtual channel and virtual path allocation

At interface A_{B2} the VCI values and VPI values may be established in one of three ways:

- via pre-assignment by standardization;
- via management plane functions;
- via on-demand signalling procedures.

6.2.1.4.5 Signalling

The on-demand signalling procedures for VC connections are defined by ETSs and ITU-T Recommendations.

6.2.1.5 Interface A_{B3}

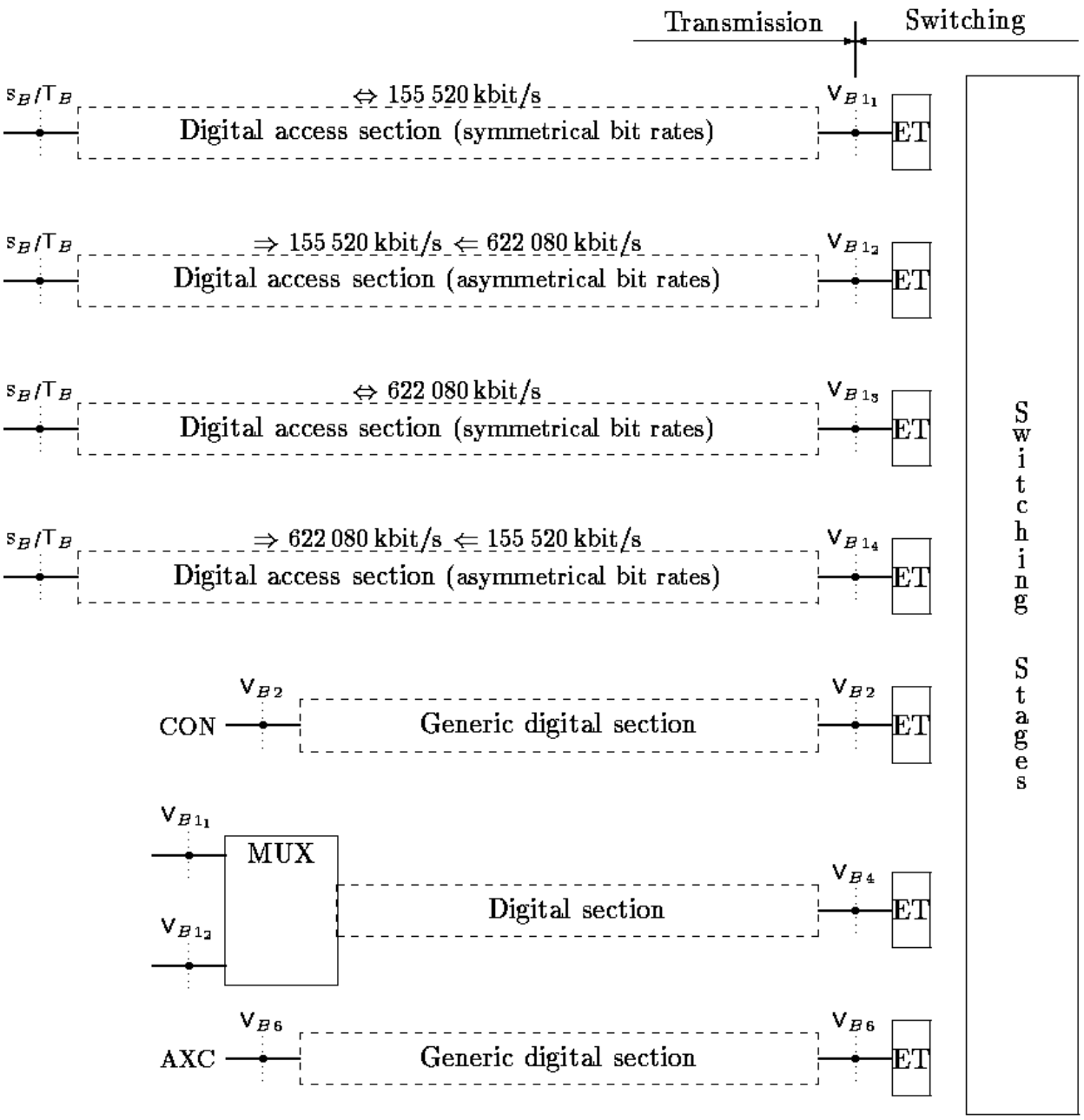
As B-ISDN is still in its beginning phase, it is recognized that other interfaces towards B-ISDN network nodes can be realised in the further which combines the Exchange Termination (ET) function and the SDH multiplexer equipment (as illustrated in figure 4).

The bit rate of the interface is 2 396 160 kbit/s.

For further study.

6.3 Interfaces for B-ISDN customer access

Interfaces for B-ISDN customer access that have been considered are described, and illustrated in figure 6, but it is not intended to specify every interface. Other interfaces are for further study.



NOTE: Not all interfaces will necessarily exist in every implementation.

⇔: The bit rate is symmetric, i.e. has the same bit rate in both transmission directions.
⇒: The bit rate in upstream direction.
⇐: The bit rate in downstream direction.

Figure 6: Interfaces for B-ISDN customer accesses

6.3.1 Characteristics of interfaces for B-ISDN customer access

6.3.1.1 General

As an objective, the characteristics of B-ISDN interfaces at reference points towards the CPN of B-ISDN network nodes should be aligned with the characteristics of B-ISDN user/network access structure.

The interfaces for customer access of B-ISDN network nodes are identified at the reference point V_B.

6.3.1.2 Functional characteristics

The functional description of interfaces at V_B reference points is illustrated in figure 7 and the following general functional requirements are defined:

a) Interface structure and transfer capability

The interface structure consists of a continuous stream of cells.

The user information together with the information for connection related functions (e.g. signalling) are carried in ATM cells belonging either to a VC link or a VP link.

The transfer capability is defined for each individual interface at V_B reference points.

b) Cell header format and encoding

The cell header format and encoding is defined for each individual interface at V_B reference points.

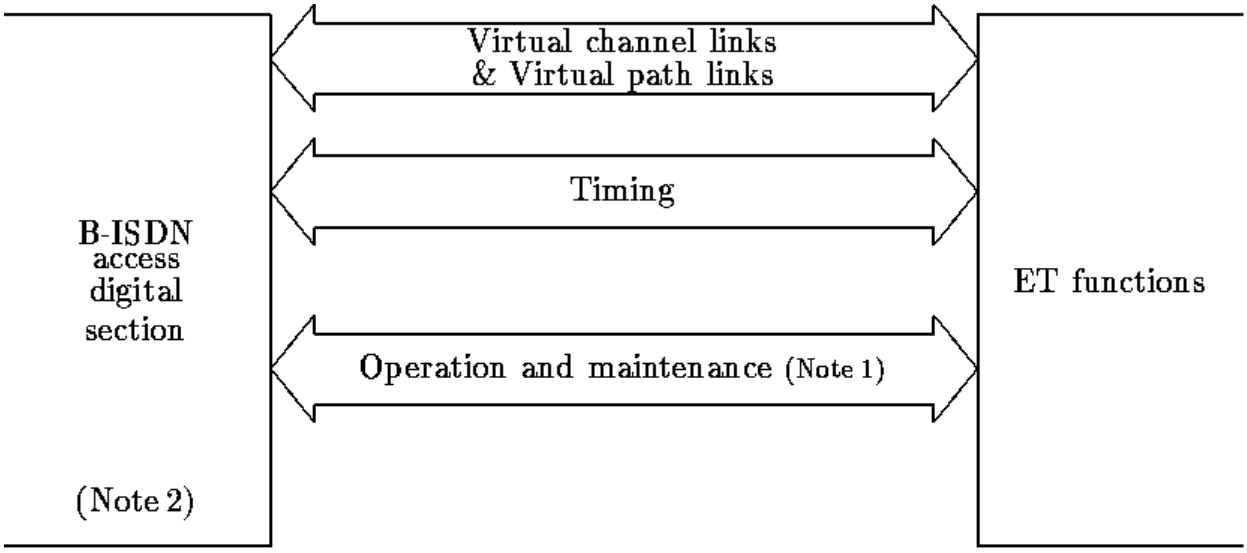
c) Timing

Timing functions provide the necessary information for bit (signal element) transmission, octet and cell boundaries (i.e. cell delineation).

Other timing functions are for further study.

d) Operation and maintenance

For further study.



NOTE 1: Provision of these functions are covered by the OAM channel(s).
NOTE 2: The provision of power feed is for further study.

Figure 7: Functions at interfaces V_B

6.3.1.3 Interface V_{B1_1}

6.3.1.3.1 General

Interface V_{B1_1} may be used at the V_B reference point to connect to a B-ISDN access digital section for the provision of a single broadband customer access.

6.3.1.3.2 Functional characteristics

The functional description of interface V_{B1_1} is illustrated in figure 7 and the following functional requirements are defined:

a) Interface structure and transfer capability

The transfer capability of the interface is 149 760 kbit/s. The interface is symmetric, i.e. it has the same bit rate in both transmission directions.

b) Cell header format and encoding

For this interface the coding scheme at the UNI as described in ITU-T Recommendation I.361 [7] is used.

c) Operation and maintenance

For further study.

6.3.1.3.3 Physical medium characteristics

The electrical and/or optical characteristics of interface V_{B1_1} are outside the scope of this ETR.

6.3.1.3.4 Virtual channel and virtual path allocation

At interface V_{B1_1} the VCI values and VPI values may be established in one of four ways:

- via pre-assignment by standardization;
- via provisioning (e.g. directed by management plane functions);
- via metasignalling procedures (to establish signalling VCs);
- via on-demand signalling procedures.

6.3.1.3.5 Signalling

The metasignalling procedures are defined by DE/SPS-03007 [1] and ITU-T Recommendations.

The on-demand signalling procedures are defined by ETSs and ITU-T Recommendations.

6.3.1.4 Interface V_{B1_2}

6.3.1.4.1 General

Interface V_{B1_2} may be used at the V_B reference point to connect to a B-ISDN access digital section for the provision of a single broadband customer access with asymmetrical bit rates (e.g. for provision of ATM distribution signals in the down stream direction).

6.3.1.4.2 Functional characteristics

The functional description of interface V_{B1_2} is illustrated in figure 7 and the following functional requirements are defined:

a) Interface structure and transfer capability

The interface V_{B1_2} is asymmetrical, where the transfer capability of the interface is 599 040 kbit/s in the downstream direction and 149 760 kbit/s in the upstream direction.

Other transfer rates, multiplexing schemes and use of e.g. optical wavelength division multiplexing are for further study.

b) Cell header format and encoding

For this interface the coding scheme at the UNI as described in ITU-T Recommendation I.361 [7] is used.

c) Operation and maintenance

For further study.

6.3.1.4.3 Physical medium characteristics

The electrical and/or optical characteristics of interface V_{B1_2} are outside the scope of this ETR.

6.3.1.4.4 Virtual channel and virtual path allocation

At interface V_{B1_2} the VCI values and VPI values may be established in one of four ways:

- via pre-assignment by standardization;
- via provisioning (e.g. directed by management plane functions);
- via metasignalling procedures (to establish signalling VCs);
- via on-demand signalling procedures.

6.3.1.4.5 Signalling

The metasignalling procedures are defined by DE/SPS-03007 [1] and ITU-T Recommendations.

The on-demand signalling procedures are defined by ETSs and ITU-T Recommendations.

In addition, the signalling aspects for distribution services as specified in ITU-T Recommendation I.211 [4] shall be taken into account.

6.3.1.5 Interface V_{B1_3}

6.3.1.5.1 General

Interface V_{B1_3} may be used at the V_B reference point to connect to a B-ISDN access digital section for the provision of a single broadband customer access.

6.3.1.5.2 Functional characteristics

The functional description of interface V_{B1_3} is illustrated in figure 7 and the following functional requirements are defined:

a) Interface structure and transfer capability

The transfer capability of the interface is 599 040 kbit/s. The interface is symmetric, i.e. it has the same bit rate in both transmission directions.

b) Cell header format and encoding

For this interface the coding scheme at the UNI as described in ITU-T Recommendation I.361 [7] is used.

c) Operation and maintenance

For further study.

6.3.1.5.3 Physical medium characteristics

The electrical and/or optical characteristics of interface V_{B1_3} are outside the scope of this ETR.

6.3.1.5.4 Virtual channel and virtual path allocation

At interface V_{B1_3} the VCI values and VPI values may be established in one of four ways:

- via pre-assignment by standardization;
- via provisioning (e.g. directed by management plane functions);
- via metasignalling procedures (to establish signalling VCs);
- via on-demand signalling procedures.

6.3.1.5.5 Signalling

The metasignalling procedures are defined by DE/SPS-03007 [1] and ITU-T Recommendations.

The on-demand signalling procedures are defined by ETSs and ITU-T Recommendations.

6.3.1.6 Interface V_{B1_4}

6.3.1.6.1 General

Interface V_{B1_4} may be used at the V_B reference point to connect to a B-ISDN access digital section for the provision of a single broadband customer access with asymmetrical bit rates (e.g. for provision of ATM distribution signals in the upstream direction).

6.3.1.6.2 Functional characteristics

The functional description of interface V_{B1_4} is illustrated in figure 7 and the following functional requirements are defined.

a) Interface structure and transfer capability

The interface V_{B1_4} is asymmetrical, where the transfer capability of the interface is 149 760 kbit/s in the downstream direction and 599 040 kbit/s in the upstream direction.

Other transfer rates, multiplexing schemes and use of e.g. optical wavelength division multiplexing are for further study.

b) Cell header format and encoding

For this interface the coding scheme at the UNI as described in ITU-T Recommendation I.361 [7] is used.

c) Operation and maintenance

For further study.

6.3.1.6.3 Physical medium characteristics

The electrical and/or optical characteristics of interface V_{B1_4} are outside the scope of this ETR.

6.3.1.6.4 Virtual channel and virtual path allocation

At interface V_{B1_4} the VCI values and VPI values may be established in one of four ways:

- via pre-assignment by standardization;
- via provisioning (e.g. directed by management plane functions);
- via metasignalling procedures (to establish signalling VCs);
- via on-demand signalling procedures.

6.3.1.6.5 Signalling

The metasignalling procedures are defined by DE/SPS-03007 [1] and ITU-T Recommendations.

The on-demand signalling procedures are defined by ETSs and ITU-T Recommendations.

6.3.1.7 Interface V_{B2}

6.3.1.7.1 General

Interface V_{B2} is a generic digital interface used to connect remote or local B-ISDN concentrator equipment via a digital section. The local B-ISDN concentrator application is considered as a subset of the remote B-ISDN concentrator application. This B-ISDN concentrator equipment may support combinations of broadband customer access (V_{B1_1}, V_{B1_2}, V_{B1_3} and V_{B1_4}) and B-ISDN multiplexers (V_{B4}).

6.3.1.7.2 Functional characteristics

The functional characteristics depend on the specific application of the V_{B2} interface. However, for this interface the cell header format and encoding for the NNI as described in ITU-T Recommendation I.361 [7] are used.

The transfer capability of the interface depends on the specific application for the B-ISDN concentrator.

6.3.1.7.3 Physical medium characteristics

For interface V_{B2} maximum commonality between the functions of the physical layer described in ITU-T Recommendation I.432 [9] is aimed at:

a) Electrical interface

For further study.

b) Optical interface

For further study.

6.3.1.7.4 Virtual channel and virtual path allocation

The allocation of VCs and VPs depends on the specific application of the V_{B2} interface.

6.3.1.7.5 Signalling

The signalling procedures (i.e. metasignalling, on-demand signalling, signalling for distribution services) depends on the specific application of the V_{B2} interface.

6.3.1.8 Interface V_{B4}

6.3.1.8.1 General

Interface V_{B4} is a digital interface used to connect a digital access link which includes an ATM multiplexer equipment supporting several B-ISDN access digital sections. The local ATM multiplexer application is considered to be a subset of the remote ATM multiplexer application.

6.3.1.8.2 Functional characteristics

For this interface, the cell header format and encoding for the NNI as described in ITU-T Recommendation I.361 [7] are used. The other functional characteristics are for further study.

The transfer capability of the interface depends on the specific application for the ATM multiplexer.

6.3.1.8.3 Physical medium characteristics

For interface V_{B4} maximum commonality between the functions of the physical layer described in ITU-T Recommendation I.432 [9] is aimed at:

a) Electrical interface

For further study.

b) Optical interface

For further study.

6.3.1.8.4 Virtual channel and virtual path allocation

The allocation of VCs and VPs depends on the specific application of the V_{B4} interface.

6.3.1.9 Interface V_{B6}

6.3.1.9.1 General

Interface V_{B6} is a generic digital interface used to connect remote or local ATM based cross-connect equipment via a digital section. The local cross-connect application is considered as a subset of the remote cross-connect application. This ATM cross-connect equipment may support combinations of broadband customer access (V_{B1_1}, V_{B1_2}, V_{B1_3} and V_{B1_4}), B-ISDN concentrators (V_{B2}) and B-ISDN multiplexers (V_{B4}).

6.3.1.9.2 Functional characteristics

For interface V_{B6} the cell header format and encoding for the NNI as described in ITU-T Recommendation I.361 [7] are used. Other functional characteristics are for further study.

The transfer capability of the interface depends on the specific application for the ATM based cross-connect.

6.3.1.9.3 Physical medium characteristics

For interface V_{B6} maximum commonality between the functions of the physical layer described in ITU-T Recommendation I.432 [9] is aimed at:

a) Electrical interface

For further study.

b) Optical interface

For further study.

6.3.1.9.4 Virtual channel and virtual path allocation

The allocation of VPs (and VCs) is directed by management plane functions only.

6.4 Interfaces for provision of distribution services

6.4.1 Interface D_A

Interface D_A provides distribution services which are switched by a B-ISDN network node.

For further study.

6.4.2 Interface D_S

If the distribution services are not switched by a B-ISDN network node but integrated on the customer access on the transmission level, another interface might be necessary. This interface is called D_S.

The specification of this interface is outside the scope of this ETR.

6.5 Interfaces for operations, administration and maintenance

These interfaces should be based on the Q_3 interface described in ITU-T Recommendation M.3010 [12] and the description provided in DE/SPS-03019 [2].

6.6 Support of existing interfaces

The deployment of B-ISDN may require a period of time as operators seek to find the most economical means of evolving to the B-ISDN. These evolutionary phases will need to be harmonized with the overall B-ISDN concepts ensuring the continued support of existing interfaces specified in CCITT Recommendations Q.511 [14] and Q.512 [15].

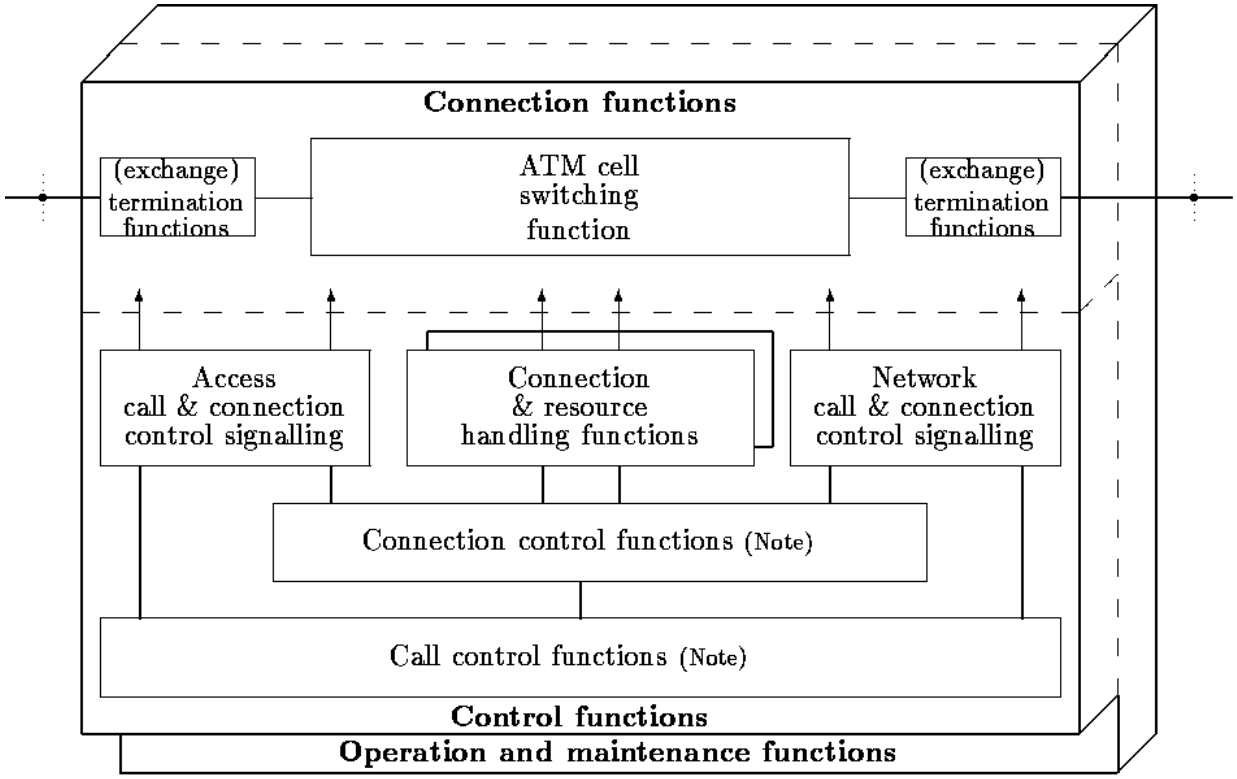
7 Functions of B-ISDN network nodes

7.1 General

This Clause covers the definition of the principal functions to support services and includes a description of a functional model for B-ISDN network nodes.

7.1.1 Functional model

The functions described in this subclause can be considered within the framework of a functional model. Such a model is shown in figure 8.



NOTE: Even though depicted here as logically separate functional entities, the control functions can equally be represented as a single logically integrated functional entity.

Figure 8: B-ISDN exchange functional model

This divides the B-ISDN network nodes into three functional areas as follows:

a) **connection functions:** those functions directly related to the VP and VC connection through a B-ISDN network node, i.e. switching and transport mechanism (including ET);

b) **control functions:** those functions required to control services and virtual connections, e.g. signalling, routeing and connection/resource handling functions;

c) **operations, administration and maintenance functions:** those functions of an operational, management and maintenance nature which are not employed for connection establishment and supervisory purpose, e.g. test functions.

The functional model shown in figure 8 is appropriate to B-ISDN exchanges. A subset (excluding signalling and call control functions) is appropriate for B-ISDN cross-connect. In terms of this ETR, most of the functions fall within the control function area.

7.2 Connection functions

The connection functions are mainly related to the lower layers of the B-ISDN protocol reference model (i.e. physical layer, ATM layer and ATM Adaptation Layer(s) (AAL(s))).

In addition the connection functions can be subdivided into (exchange) termination functions and switching functions.

Only as an example, within the functional model all port (ET) related functionalities are grouped into the termination functions. The switching functions are considered as more centralized, i.e. these functions are independent of the external port.

7.3 Control functions

The control functions are mainly related to the higher layers of the B-ISDN protocol reference model.

In addition from the view point of hardware realization the control functions are subdivided into signalling, service processing and connection/resource handling functions.

Within the functional model the control functions are considered as more centralized.

7.3.1 Operations, administration and maintenance functions

These functions will be based on TMN principles (see ITU-T Recommendation M.3010 [12]) and the functions provided in ITU-T Recommendation I.610 [11].

7.4 Utilization of functions for services

Functions are used and reused in various stages of connection handling. Some may be combined with others to create features used in providing supplementary services. The specific functions used in a given context will be determined by the requesting service.

Within the framework of the functional model shown in figure 8 the utilization of functions arising from a service request, can be considered in the following way:

a) on receipt of a service request (via the signalling functions) the service processing functions are used to identify the appropriate connection type(s);

b) the appropriate type of connection is established by use of the connection/resource handling functions;

c) supplementary services which involve additional functions and information flows beyond those required for bearer services, are provided under the control of logic residing in the service processing functions. This logic is designed to provide specific services. Corresponding service/feature capabilities shall also reside in the signalling and connection/resource handling functions.

In addition to services provided by use of logic/data residing in the B-ISDN network nodes, some services may be provided under the control of logic located at separate specialized nodes (service control points). Also, data required for processing certain service requests may be kept in a remote data base accessed by use of the signalling function.

7.5 Termination functions

7.5.1 General

Ability to provide the physical layer functions:

- interface with the external port specific physical medium;
- bit timing;
- cell delineation;
- Header Error Control (HEC) generation/verification;
- cell rate decoupling;
- maintenance,

the ATM layer functions:

- cell header extraction and generation;
- cell header translation;
- usage monitoring (e.g. Usage Parameter Control (UPC)/Network Parameter Control (NPC));
- cell multiplexing and demultiplexing;
- maintenance,

and the AAL functions:

- signalling AAL;
- AAL for interworking with 64 kbit/s based ISDN.

7.5.2 Functions of the physical layer

7.5.2.1 General description of physical layer functions

Within this subclause a summary of functions identified for the physical layer related to B-ISDN network nodes is given. For certain functions, a more detailed description will be given in subsequent subclauses.

7.5.2.2 Physical medium sublayer functions

The physical medium sublayer provides bit transmission capability including bit transfer and bit alignment. It may include line coding and electrical/optical transformation.

7.5.2.2.1 Physical medium

For further study.

7.5.2.2.2 Bit timing

This function provides bit (signal element) timing to enable the link terminations to recover information from the aggregate bit stream.

7.5.2.3 Transmission convergence sublayer functions

7.5.2.3.1 Cell delineation

This function provides cell timing for the purpose of supporting the cell structure. Cell delineation prepares the cell flow in order to enable the receiving side to recover cell boundaries according to the self-delineating mechanism defined in ITU-T Recommendation I.432 [9]; the cell stream is scrambled in the transmit direction; cell boundaries are identified and confirmed (using the HEC mechanism) and the cell flow is descrambled in the receive direction.

7.5.2.3.2 Header error control generation/verification

In the receive direction, cell header verification checks or modifies the HEC of each cell received. In detection mode, all cells with errored headers are discarded. In correction mode, the errored headers are modified, correcting only single bit errors.

In the transmit direction, it calculates the HEC and inserts it in the cell header.

Counting of discarded cells may be required for measurements.

7.5.2.3.3 Cell rate decoupling

Cell rate decoupling includes insertion and suppression of idle cells, in order to adapt the rate of valid ATM cells to the payload capacity of the transmission system.

7.5.2.4 Maintenance

This function provides information concerning operational or failure conditions of the interface.

For further study.

7.5.3 Functions of the ATM layer

7.5.3.1 General description of ATM layer functions

Within this subclause a summary of functions identified for the ATM layer related to B-ISDN network nodes is given. In addition to the functions listed below, further ones may occur which are dependent on the implementation of individual B-ISDN network nodes.

7.5.3.2 Cell header extraction

The cell header extraction function extracts the header field from the received ATM cell.

Checking the validity of the individual elements contained in the received header field of the ATM cell is performed. All cells that are found to carry invalid cell header elements/values are discarded.

7.5.3.3 Cell header translation

For further study.

7.5.3.4 Usage parameter control/network parameter control

The description of UPC and NPC is given in ITU-T Recommendation I.371 [8].

The usage of the cell tagging option requires further study.

7.5.3.5 Cell multiplexing and demultiplexing

In the receive direction, the cell demultiplexing function directs individual cells from an incoming cell flow to the appropriate VPs and/or VCs. In the transmit direction, the cell multiplexing function combines cell from individual VPs and/or VCs into an outgoing cell flow.

7.5.3.6 Cell header generation

In the transmit direction, the cell header is updated with new values of VPI in case of VPC or with new values for VPI and VCI in case of VCC. The HEC has to be generated accordingly.

7.5.3.7 Maintenance

For further study.

7.5.4 Functions of the ATM adaptation layer

For further study.

7.6 ATM cell switching functions

The B-ISDN network node has to preserve the cell sequence integrity on the VCs.

Other functions are for further study.

7.7 Signalling functions

7.7.1 User access signalling functions

The user access signalling functions are defined by ETSs and ITU-T Recommendations.

7.7.2 Network signalling functions

The network signalling functions are defined by ETSs and ITU-T Recommendations.

7.8 Service processing functions

For further study.

7.9 Interworking functions

7.9.1 Interworking functions between B-ISDN and 64 kbit/s based ISDN

Interworking functions between B-ISDN and 64 kbit/s based ISDN (if realized inside the B-ISDN network node) are for the time being considered as separate functions of the B-ISDN network node. This function is described in ITU-T Recommendation I.580 [10] as "network adapter".

7.10 Connection/resource handling functions

7.10.1 Resource management functions

For further study.

7.10.2 Overload handling

In existing circuit switched networks the function called "overload handling/control" is mainly concerned with supervision and limitation of the number of calls handled simultaneously within a system. Additionally in the circuit mode world the bandwidth (i.e. "information transfer rate") is clearly specified and reserved for the complete lifetime of a call, e.g. 64 kbit/s.

Because in a B-ISDN the cells ("bandwidth") are assigned on demand depending on the source activity, there is an additional possibility of overload at cell level.

Figure 9 shows an example of the structure for the "connection acceptance and rejection".

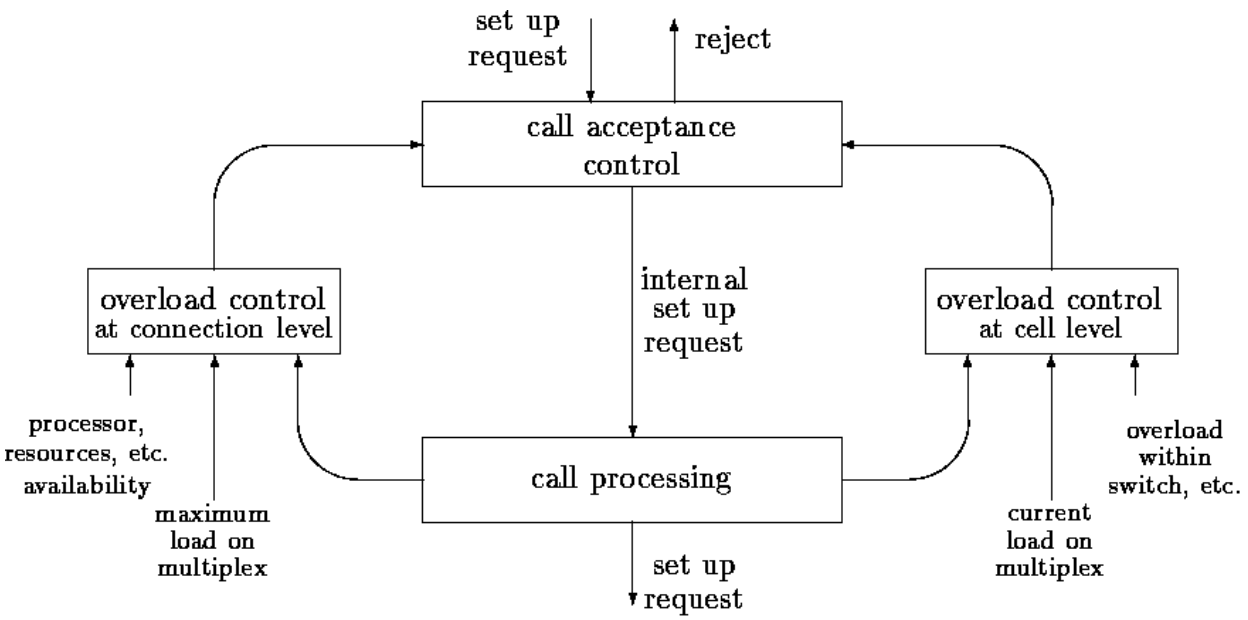


Figure 9: Connection/call acceptance

The call acceptance control receives the external set up request and has to decide if this request for call establishment can be accepted.

7.10.2.1 Overload handling at connection level

The overload control at connection level is responsible to supervise and limit the number of calls handled simultaneous within the system (this is also present in circuit switched systems). This function works on mainly (statical) low dynamic information from the system.

EXAMPLE: Examples for this function are:

a) Overload control of processors or other resources within the system

Input for this part of the function can be:
- number of resources which are serviceable.

b) Overload for multiplex

Input for this part of the function can be:
- maximum bandwidth allowed on a specific multiplex;
- maximum number of VPIs/VCIs allowed on a specific multiplex.

c) Overload for call processing

Input for this part of the function can be:
- number of calls in build-up phase;
- number of calls in conversation phase.

Possible actions in case of connection level overload are well-known from existing switching systems such as "reject call attempt".

7.10.2.2 Overload handling at cell level

The overload control at cell level is responsible to supervise the quality of service of the system. This function works on mainly (high) dynamic information from the system.

EXAMPLE: Examples for this function are:

a) Overload of the switching network

Input for this part of the function can be:
- overflow indication from buffers;
- current traffic (load) on system internal multiplex.

b) Overload of the multiplex

Input for this part of the function can be:
- current traffic (load) on the multiplex.

For calls which are accepted by the system the reaction in case of cell level overload is simply "discard cell(s)". Normally this is still done by the hardware equipment within the system due to the fact that a real action will not be possible at this speed.

Traffic overload within a system may occur due to certain reasons such as:

- incorrect projecting of the system (i.e. maximum load on multiplex not correct defined);
- variations in traffic source statistics;
- malfunctioning of the usage monitoring function.

Possible additional actions of a B-ISDN network node in case of cell level overload may be:

- status report to network management and/or network provider;
- reducing the accepted call attempts for a defined time interval by a certain percentage. The values to be used for time intervals and for the percentage should be dependent on the individual service.

7.11 Operations, administration and maintenance functions

OAM functions should be based on the TMN principles (ITU-T M series of Recommendations).

7.11.1 General functions required for operation

For further study.

7.11.2 Operations functions

For further study.

7.11.3 Administration functions

For further study.

7.11.4 Maintenance functions

For further study.

8 Connection types

8.1 General

The characteristics of the connection types[1)] detailed in this subclause refer to an established connection when it is made available to the users.

A B-ISDN network node shall be able to provide the following types of connections:

transit connection

A connection between an incoming and outgoing interexchange circuit or ATM link at interfaces to other network nodes.

originating connection

A connection between an access channel or ATM link of a calling customer at an interface for customer access and an outgoing interexchange circuit at an interface to other network nodes.

terminating connection

A connection between an incoming interexchange circuit or ATM link at an interface to other network nodes and an access channel or ATM link of a called customer access at an interface for customer access.

internal connection

A connection between access channels or ATM links of two customer at interfaces for customer access.

NOTE: The definition of these types of connections is based on CCITT Recommendation Q.9 [13] and for the ATM link on CCITT Recommendation I.113 [3].

A B-ISDN network node shall be able to provide both unidirectional and bi-directional connections between input and output interfaces for services to be supported by B-ISDN (see ITU-T Recommendation I.211 [4]). Both symmetrical and asymmetrical modes of operation shall be supported on a bi-directional connection. In addition a B-ISDN network node shall be able to provide unidirectional point-to-multipoint connections.

8.2 Explanatory information on the connection diagrams

The functions associated with the groupings shown in connection diagrams are detailed in Clause 7. The generic definitions of "connection end-point functions" and "connecting point functions" are given in ITU-T Recommendation I.311 [5].

Key to the connection diagrams in figures 10 to 14:

——————— information other than separate signalling. The information is assumed to be bi-directional unless explicitly indicated.

———————➤ undirectional information other than separate signalling.

..... separate signalling.

---

1) The connection types contained in this section should be considered as not exhaustive. Other types of connections and variants of these basic connection types may be feasible in a B-ISDN and are for further study.
However, it should be noted that other connection types will only be included if a clear usage with respect to the provided service can be identified.

Information flows:

s: signalling information associated with customer terminals.

s_1: signalling information different from the signalling associated with customer terminals.

8.3 Basic connection types

These connection types show the basic forms of connection and their associated information flows which are required for B-ISDN network nodes in a B-ISDN.

These diagrams are functional and not intended to represent any particular implementation. They illustrate the options which may be available for handling a given information type or service within a B-ISDN network node. Although this approach leads to some duplication between the individual diagrams when considered from the connection point of view, the approach is a logical basis for the further consideration of the more detailed issues arising from the impact of the B-ISDN on the B-ISDN network node functionalities.

It is not intended to imply that every B-ISDN network node should necessarily have the capability to handle these types of connection.

8.3.1 B-ISDN to B-ISDN connection types

8.3.1.1 Type A_1 connection

This point-to-point connection type provides the capability to transport the information field of ATM cells transparently through the B-ISDN network node. It applies to internal, originating, terminating and transit connections at the B-ISDN network node. It supports the application of:

- VP connections where the B-ISDN network node provides VP connection point functions (i.e. translation of VPI value);

- VC connections where the B-ISDN network node provides VP/VC connection point functions (i.e. translation of VCI values and reassignment of VPI values),

as defined in ITU-T Recommendation I.311 [5].

Establishment and control of the connection is directed by control plane functions (i.e. signalling).

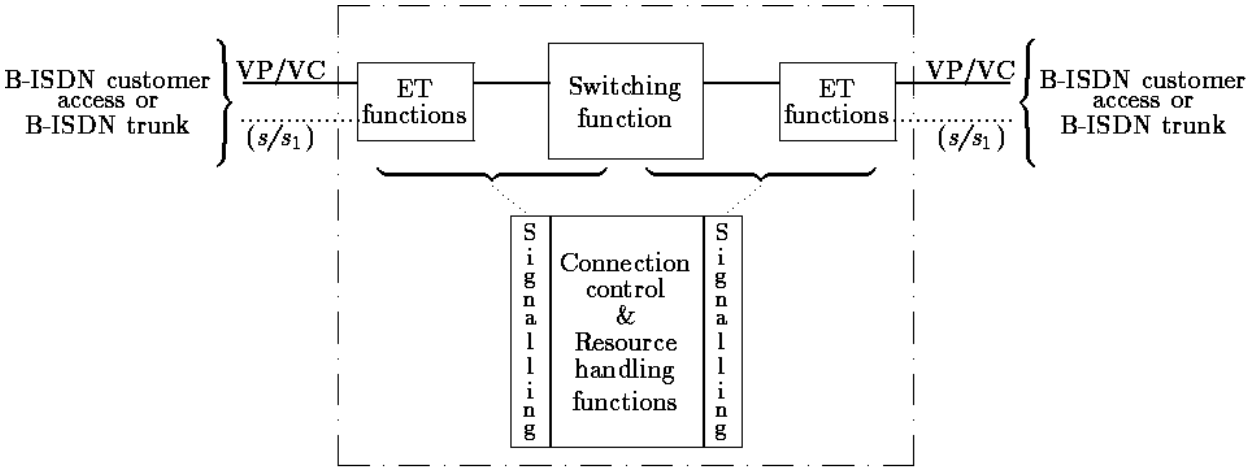


Figure 10: Type A_1 connection

For this connection type, most of the information transfer attributes are defined via the signalling information during call/connection establishment.

The following information transfer attributes are fixed:

class and rate

Shall be the same at both interfaces for correct operation.

establishment

Switched - semi-permanent.

configuration

Point-to-point.

8.3.1.2 Type A_2 connection

This point-to-point connection type provides the capability to transport the information field of ATM cells transparently through the B-ISDN network node. It applies to internal, originating, terminating and transit connections at the B-ISDN network node. It supports the application of:

- VP connections where the B-ISDN network node provides VP connection point functions (i.e. translation of VPI value);

- VC connections where the B-ISDN network node provides VP/VC connection point functions (i.e. translation of VCI values and reassignment of VPI values),

as defined in ITU-T Recommendation I.311 [5].

Establishment and control of the connection is directed by management plane functions.

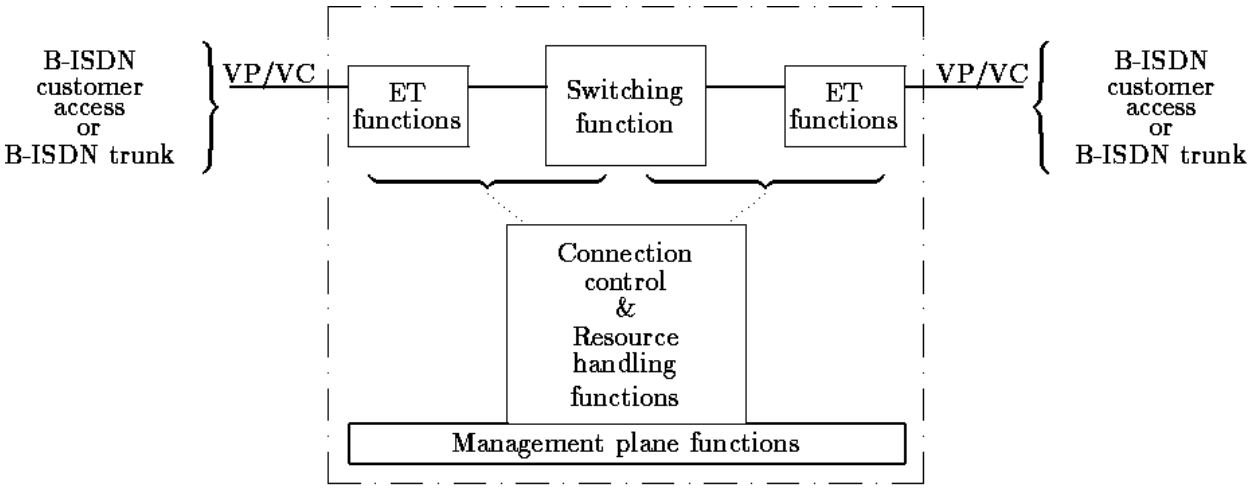


Figure 11: Type A_2 connection

For this connection type, most of the information transfer attributes are defined by management plane communication.

The following information transfer attributes are fixed:

class and rate

Shall be the same at both interfaces for correct operation.

establishment

Reserved - permanent.

configuration

Point-to-point.

8.3.1.3 Type B_1 connection

This point-to-multipoint connection type provides the capability for unidirectional transport of the ATM cell information field transparently through the B-ISDN network node. It supports the application of:

- VP connections where the B-ISDN network node provides VP connection point functions (i.e. translation of VPI value);

- VC connections where the B-ISDN network node provides VP/VC connection point functions (i.e. translation of VCI values and reassignment of VPI values),

as defined in ITU-T Recommendation I.311 [5].

Establishment and control of the connection is directed by control plane functions (i.e. signalling).

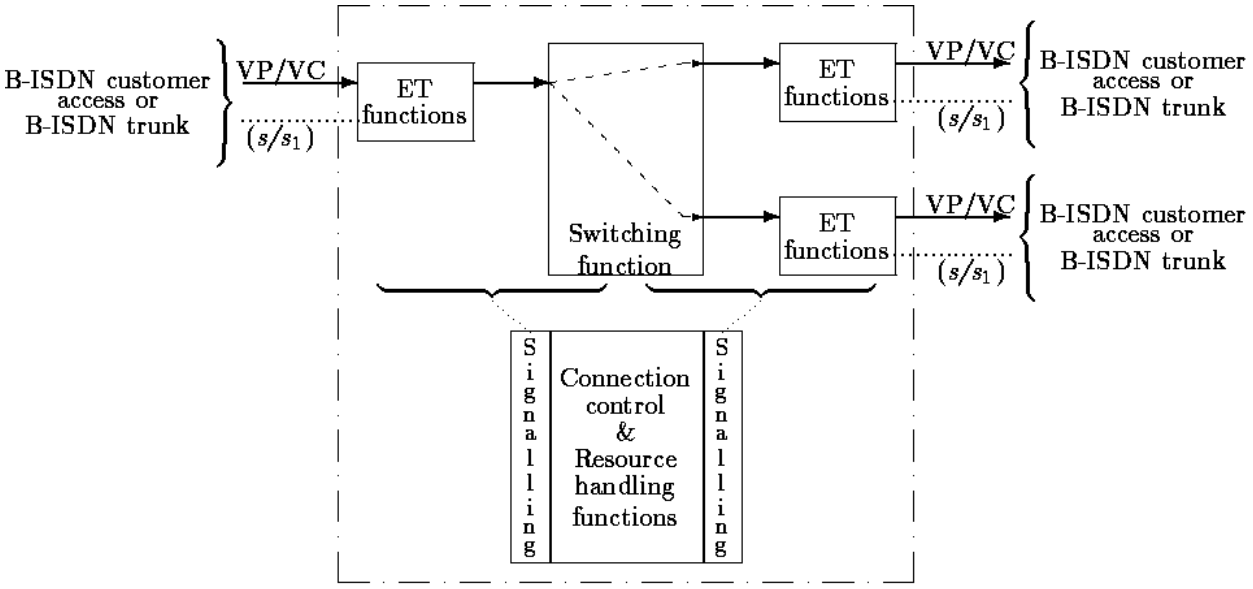


Figure 12: Type B_1 connection

For this connection type most of the information transfer attributes are defined via the signalling information during call/connection establishment. The following information transfer attributes are fixed:

class and rate

Shall be the same at all interfaces for correct operation.

establishment

Switched - semi-permanent.

symmetry

Unidirectional.

configuration

Point-to-multipoint.

8.3.1.4 Type B_2 connection

This point-to-multipoint connection type provides the capability for unidirectional transport of the ATM cell information field transparently through the B-ISDN network node. It supports the application of:

- VP connections where the B-ISDN network node provides VP connection point functions (i.e. translation of VPI value);

- VC connections where the B-ISDN network node provides VP/VC connection point functions (i.e. translation of VCI and reassignment of VPI values),

as defined in ITU-T Recommendation I.311 [5].

Establishment and control of the connection is directed by management plane functions.

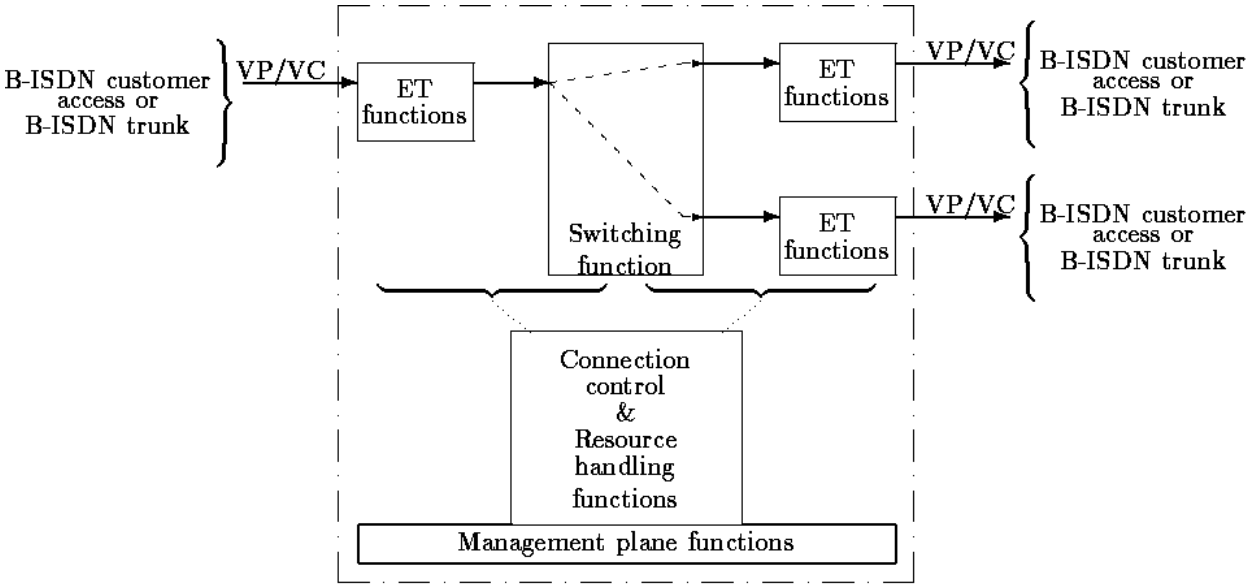


Figure 13: Type B_2 connection

For this connection type most of the information transfer attributes are defined by management plane communication. The following information transfer attributes are fixed:

class and rate

Shall be the same at all interfaces for correct operation.

establishment

Reserved - permanent.

symmetry

Unidirectional.

configuration

Point-to-multipoint.

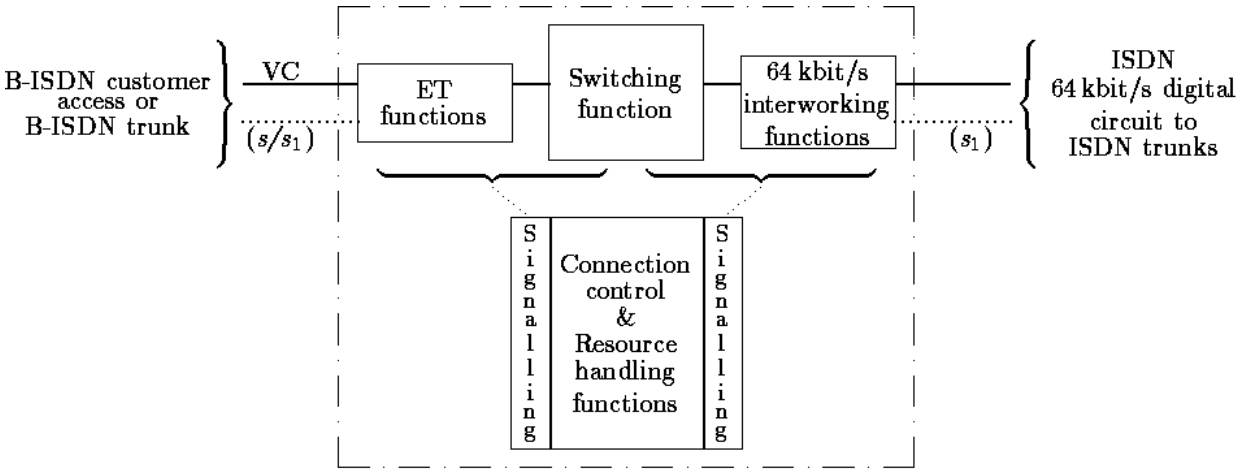
8.3.2 B-ISDN to 64 kbit/s based ISDN connection types

8.3.2.1 Type C connection

This point-to-point connection type provides the capability to transfer speech, 3,1 kHz audio, 7,1 kHz audio, and 64 kbit/s unrestricted bearer information between a B-ISDN customer access or trunk on one side of a node and a 64 kbit/s based ISDN trunk on the other one. This connection type applies to originating, transit and terminating connections across an B-ISDN network node. It supports the application of:

- VC connections where the B-ISDN network node provides VP and VC connection end-point functions (i.e. termination of VPCs and VCCs), as defined in ITU-T Recommendation I.311 [5].

Establishment and control of the connection is directed by control plane functions (i.e. signalling).



NOTE 1: Even though depicted here as a function inside the B-ISDN network node, the 64 kbit/s interworking unit can be realized outside the B-ISDN network node (see ITU-T Recommendation I.580 [10] for network adapter).

NOTE 2: The description of the A interface can be found in CCITT Recommendation Q.511 [14].

Figure 14: Type C connection

The connection type is characterized by the following attributes:

capability

Speech, 3,1 kHz audio, 7,1 kHz audio and 64 kbit/s unrestricted bearer information.

class and rate

Class A, 64 kbit/s.

establishment

Switched and semi-permanent.

symmetry

Bi-directional symmetric.

configuration

Point-to-point.

9 Design objectives - general, operations and maintenance

9.1 Charging principles

This is likely to be influenced by the functions of policing.

9.2 Maintenance

For further study.

9.3 Routeing

For further study.

9.4 Flow control

"Flow control" is a control mechanism between network nodes for X.25 services. By definition, there is no flow control between nodes in an ATM network. Necessary control mechanism are done end-to-end.

9.5 Cell sequence integrity

A B-ISDN network node shall be capable of guaranteeing cell sequence integrity.

9.6 B-ISDN availability performance objectives

9.6.1 Load control

For further study.

9.6.2 Accessibility

NOTE: Term to be checked according to ITU-T Study Group 2 terminology.

Accessibility influences blocking. A switch should have full accessibility to fulfil the blocking requirements.

10 Performance design objectives

The performance objectives are design objectives which should not be construed to be quality of service or operating (network performance) requirements. In actual operation, B-ISDN network nodes will be engineered to provide adequate grade of service as economically as possible and the performance requirements of the B-ISDN network node in operation will differ from the stated values for these performance design objectives.

These performance design objectives are applicable to all B-ISDN network node implementations (e.g. exchanges, multiplexers, concentrators/remote switch nodes, cross-connect, etc.) at all points in the growth cycle up to the maximum size. They may be used by manufacturers in designing B-ISDN network nodes and by administrations in evaluating a specific B-ISDN network node design or for comparing B-ISDN network node designs.

10.1 Performance design objectives

10.1.1 Traffic model

In order to facilitate the testing and definition of quality requirements of a B-ISDN network node a number of traffic models are necessary to describe the traffic working conditions.

Parameters that may be used are:

- average number of cell peaks, which occur in a time interval;
- peak cell rate;
- call duration;
- service distribution.

The traffic working conditions are defined as "reference traffic loads". The given reference traffic loads are the conditions under which the performance design objectives stated in subclauses 10.1.2 to 10.1.5 are to be met. Reference traffic load 1 is intended to represent the normal upper mean traffic load level of which Administrations would wish to provide for. Reference traffic load 2 is intended to represent an increased traffic load level.

10.1.1.1 Reference traffic load 1

For further study.

10.1.1.2 Reference traffic load 2

For further study.

10.1.2 Blocking

Blocking: A switching network is in a blocking state if it is not possible to connect an allocatable VC/VP on the incoming link with an equivalent allocatable VC/VP on the outgoing link.

The load control can not accept a new connection, although the outgoing link has enough capacity available. Blocking may occur due to:

- lack of capacity;
- lack of internal VCI/VPI;
- switch design.

Blocking aspects are for further study.

10.1.3 Cell transfer performance objectives

10.1.3.1 General

The general directions for cell transfer performance are contained in ITU-T Recommendation I.356 [6]. These parameters are defined on the basis of "cell transfer reference events" which may be observed at physical interfaces of B-ISDN network nodes.

Whether these parameters apply as defined in ITU-T Recommendation I.356 [6] and their application to network nodes is for further study.

10.1.3.2 Cell error parameters

10.1.3.2.1 Cell error ratio

For the definition of this parameter, refer to ITU-T Recommendation I.356 [6].

Whether this parameter applies as defined in ITU-T Recommendation I.356 [6] and the application to network nodes is for further study.

10.1.3.2.2 Severely errored cell block ratio

For the definition of this parameter, refer to ITU-T Recommendation I.356 [6].

Whether this parameter applies as defined in ITU-T Recommendation I.356 [6] and the application to network nodes is for further study.

10.1.3.3 Cell loss ratio

For the definition of this parameter, refer to ITU-T Recommendation I.356 [6].

It can be caused by:

a) buffer overflow;

b) header corruption which can be caused by:

- header translation errors;
- header errors caused by the switch.

Cell loss is said to occur if a valid cell is not delivered to the outgoing interface within the maximum cell transfer delay.

Whether this parameter applies as defined in ITU-T Recommendation I.356 [6] and the application to network nodes is for further study.

Cell loss ratio values depend on service requirements.

10.1.3.4 Cell misinsertion rate

For the definition of this parameter, refer to ITU-T Recommendation I.356 [6].

Whether this parameter applies as defined in ITU-T Recommendation I.356 [6] and the application to network nodes is for further study.

10.1.3.5 Cell transfer delay

For the definition of this parameter, refer to ITU-T Recommendation I.356 [6].

10.1.3.5.1 Maximum cell transfer delay

The maximum B-ISDN network node transfer delay shall be given for each service class, e.g.:

- delay sensitive services;
- delay non-sensitive services.

Whether this parameter applies as defined in ITU-T Recommendation I.356 [6], and the application to network nodes is for further study.

10.1.3.5.2 Mean cell transfer delay

For the definition of this parameter, refer to ITU-T Recommendation I.356 [6].

Whether this parameter applies as defined in ITU-T Recommendation I.356 [6] and the application to network nodes is for further study.

10.1.3.5.3 Cell delay variation

For the definition of this parameter, refer to ITU-T Recommendation I.356 [6]. This parameter is relevant only for services with timing requirements (class A and B according to the ITU-T service classification for the AAL). It is caused by contention for cell slots inside multiplexers and switches.

Cell delay variation aspects are for further study.

10.1.4 Connection processing performance objectives

10.1.4.1 Connection set up delay

For further study.

10.1.4.2 Connection release delay

For further study.

10.1.4.3 Connection processing error parameters

Currently, four connection processing error parameters have been identified. Additional parameters could be foreseen.

10.1.4.3.1 Connection set-up error probability

For further study.

10.1.4.3.2 Connection set-up failure probability

For further study.

10.1.4.3.3 Premature release probability

The probability that a B-ISDN network node malfunction will result in the premature release of an established connection in any one minute interval is for further study.

10.1.4.3.4 Release failure probability

The probability that a B-ISDN network node malfunction will prevent the required release of a connection is for further study.

10.1.5 Exchange call processing performance objectives

10.1.5.1 Exchange call establish delay

For further study.

10.1.5.2 Exchange call release delay

For further study.

10.2 B-ISDN network node performance during overload

10.2.1 Overload condition at cell level

Overload conditions at cell level occurs if cell loss or QoS requirements are not met by the B-ISDN network node.

NOTE: Overload handling is dealt with in draft ITU-T Recommendation Q.52A.

Conditions are for further study.

Annex A: Traffic characterisation

A.1 Introduction

Based on the Generalized Markovian Deterministic Process (GMDP) input process model, several artificial traffic sources are defined. Traffic source models, an important part of overall traffic models, are required as a basis for off-line studies with the aim to better understand the traffic behaviour of real networks and thereby to improve on-line traffic handling in those networks. Furthermore, traffic mixes are proposed for the description of heterogeneous traffic. The identification of traffic mixes allows the definition of reference loads under which traffic performance values have to be specified.

A.2 Reference single source traffic model

A.2.1 Levels of resolution in time

The traffic destined for the transport on a cell basis in a B-ISDN can be looked at four levels of behaviour corresponding to a certain resolution in time:

- connection level;
- dialogue level;
- burst level;
- cell level,

regardless of the service, see figure A.1.

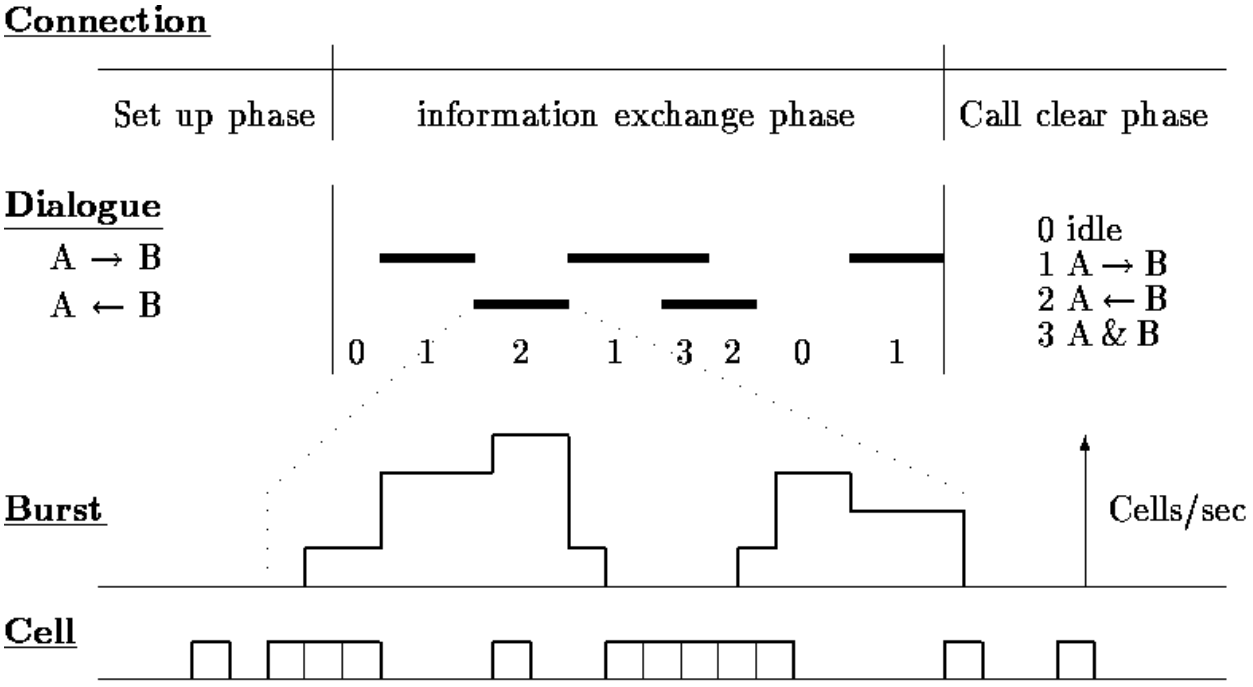


Figure A.1: Behaviour of a traffic source: Levels of resolution in time

The connection level describes the behaviour of a traffic source on the virtual connection basis. The call set-up and call clear events, which delimit a call duration, are the most macroscopic behaviour of a stationary traffic source. The duration of a call is typically in the time range of 100 to 1 000 seconds, depending on the service.

The dialogue level describes the interaction between the agents at both ends of the connection.

In principle four situations are possible:

- silence;
- A-subscriber transmitting;
- B-subscriber transmitting;
- both subscribers transmitting,

so that the interaction can be modelled by a four state finite state model. Typical duration of a transmission period in the case of telephony is in the order of some 10 seconds.

The burst level describes the behaviour of an active (sending) partner that is its statistical behaviour including the auto correlation. For telephony the on-off characteristics of the cell generation process is modelled in this level. Durations of the on-time and the off-time are in the range of 0,1 s to a few seconds. For a voice transmission, the statistics and the parameters are well known.

The cell level describes the behaviour of cell generation at the lowest level. From the (maximum) bit rate of the service and the length of the information field of a cell the (minimum) distance between cells can be derived.

A.2.2 State model

The model shown in figure A.2 describes the behaviour of a traffic source at the cell and burst level. It is based on the GMDP input process model.

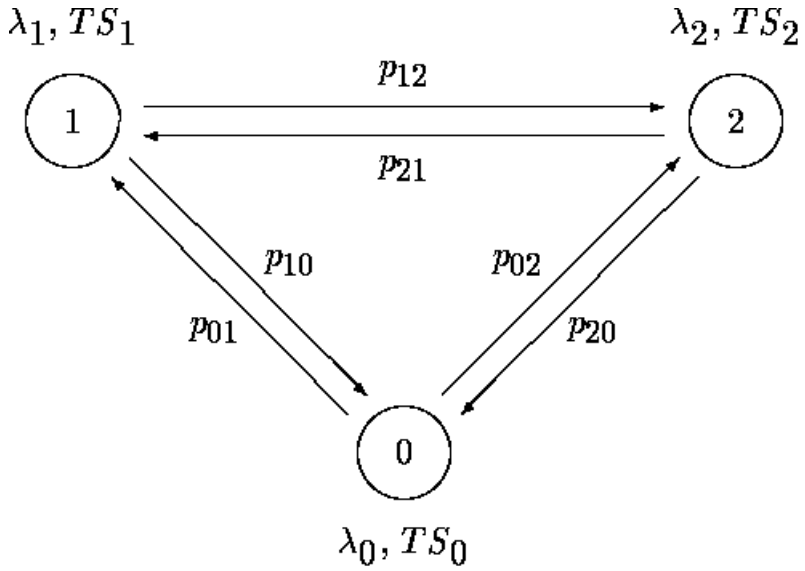


Figure A.2: State model of a single traffic source

To reduce complexity, the model has three states numbered 0, 1 and 2. In each state i, cells are sent with a constant rate i during a geometrically distributed sojourn time TS_i. After the sojourn time is over, the process leaves state i and enters state j(i) with a transition probability P_{ij} (P_{ii} - 0).

The model comprises the well-known talkspurt model for voice sources at the burst level and a video source with slow and fast moving images. It can be used for single sources as well as for the superposed traffic stream. The moments of the GMDP model can be calculated. For most traffic types the number of states is sufficient, although for certain video sources, 4 to 8 states might improve the quality of modelling.

A.2.3 Parameter values

Still to be defined.

A.3 Traffic mixes on an ATM link

The traffic at an UNI or NNI is typically the superposition of many traffic sources having different characteristics. This traffic will be described by a number of mixes of several traffic types.

A.3.1 Definition of service classes

As new services may evolve rapidly, all the future services supported by a B-ISDN cannot be foreseen. Therefore, services which are expected in the near future are taken into account to define different service classes. We define service classes for conventional, messaging and retrieval telecommunication services as Constant Bit Rate (CBR) and Variable Bit Rate (VBR) sources.

Table A.1: CBR (class A) service

No.	CBR (class A) services	Bit rate
1	telephony, fax, data retrieval	64 kbit/s
2	video telephony	128 kbit/s
3	file transfer, colour fax, HQ sound, video conferencing	2 Mbit/s
4	TV distribution	10 Mbit/s
5	HDTV distribution, TV contribution	34 Mbit/s
6	HDTV contribution	140 Mbit/s

Table A.2: Real time VBR (class B) service

No.	Real time VBR (class C) service	peak Bit rate
7	video telephony (high quality)	2 Mbit/s
8	video conferencing, video (high quality)	10 Mbit/s
9	TV	30 Mbit/s
10	HDTV	140 Mbit/s

Table A.3: Non-real time VBR (class C) service

No.	Non-real time (class C) services	Bit rate
11	interactive data (low speed)	64 kbit/s
12	interactive data (medium speed), retrieval of (still) pictures	2 Mbit/s
13	interactive data (high speed), LAN interconnection	10 Mbit/s
14	LAN interconnection, CAD	30 Mbit/s

A.3.2 Definition of traffic mixes

For further study.

A.3.3 Traffic mixes

The behaviour of the B-ISDN network node is specified under certain traffic conditions, which are specified on all inlets. It is not sufficient to specify just one mix, several mixes are needed which are:

- matching realistic sources;
- reproducible;
- artificially generated.

The following mixes have these properties assuming that all connections are stationary at the connection level.

The following scenarios are proposed:

a) homogeneous traffic, i.e. mixes of identical sources;

b) mixes of sources with identical burstiness but different peak bit rates;

c) mixes of sources with identical peak bit rates but different burstiness;

d) mixes of 2 to 3 VBR sources with different burstiness and peak bit rates. In any of the scenarios 1 to 4 the portion of each traffic type is varied between 0 and 1;

e) mixes of many CBR sources and a few VBR sources;

f) mixes derived from the forecasts.

History

Document history	
December 1993	First Edition
February 1996	Converted into Adobe Acrobat Portable Document Format (PDF)