INTERNATIONAL TELECOMMUNICATION UNION

CCITT I.327

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

OVERALL NETWORK ASPECTS AND FUNCTIONS, ISDN USER-NETWORK INTERFACES

B-ISDN FUNCTIONAL ARCHITECTURE

Recommendation I.327

Geneva, 1991

FOREWORD

The CCITT (the International Telegraph and Telephone Consultative Committee) is the permanent organ of the International Telecommunication Union (ITU). CCITT is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The Plenary Assembly of CCITT which meets every four years, establishes the topics for study and approves Recommendations prepared by its Study Groups. The approval of Recommendations by the members of CCITT between Plenary Assemblies is covered by the procedure laid down in CCITT Resolution No. 2 (Melbourne, 1988).

Recommendation I.327 was prepared by Study Group XVIII and was approved under the Resolution No. 2 procedure on the 5th of April 1991.

CCITT NOTES

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

2) A list of abbreviations used in this Recommendation can be found in Annex B.

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Preamble to B-ISDN Recommendations

In 1990, CCITT SG XVIII approved a first set of Recommendations on B-ISDN. These are:

I.113 – Vocabulary of terms for broadband aspects of ISDN

I.121 – Broadband aspects of ISDN

I.150 – B-ISDN asynchronous transfer mode functional characteristics

I.211 – B-ISDN service aspects

I.311 – B-ISDN general network aspects

I.321 – B-ISDN Protocol Reference Model and its application

I.327 – B-ISDN functional architecture

I.361 – B-ISDN ATM Layer specification

I.362 – B-ISDN ATM Adaptation Layer (AAL) functional description

I.363 – B-ISDN ATM Adaptation Layer (AAL) specification

I.413 – B-ISDN user-network interface

I.432 – B-ISDN user-network interface – Physical Layer specification

I.610 – Operation and maintenance principles of B-ISDN access

These Recommendations address general B-ISDN aspects as well as specific service- and network-oriented issues, the fundamental characteristics of the asynchronous transfer mode (ATM), a first set of relevant ATM oriented parameters and their application at the user-network interface as well as impact on operation and maintenance of the B-ISDN access. They are an integral part of the well established I-Series Recommendations. The set of Recommendations are intended to serve as a consolidated basis for ongoing work relative to B-ISDN both within CCITT and in other organizations. They may also be used as a first basis towards the development of network elements.

CCITT will continue to further develop and complete these Recommendations in areas where there are unresolved issues and develop additional Recommendations on B-ISDN in the I-Series and other series in the future.

Recommendation I.327

B-ISDN FUNCTIONAL ARCHITECTURE

1 Introduction

The general functional architecture model for the ISDN is described in Recommendation I.324. The concepts and associated definitions adopted in Recommendation I.324 also apply to the B-ISDN, i.e. reference configurations, functional group, reference points.

The objective of this Recommendation is to provide a basic functional architecture of the B-ISDN to complement Recommendation I.324. The model is not intended to require or exclude any specific implementation of the B-ISDN but to provide a guide for the specification of B-ISDN capabilities.

Recommendation I.310 describes the functions of an ISDN. These functions are by their nature static (i.e. time-independent). The relative distribution and allocation of these functions is the subject of the architecture of the ISDN and is described in this Recommendation. The dynamic aspects of these functions are modelled in Recommendation I.310 as executive processes.

Therefore, the key components in this architecture model are: the functions which are contained in the B-ISDN, where they are located and the relative topology for their distribution in the B-ISDN.

2 General architecture of the B-ISDN

In B-ISDN implementations some of the B-ISDN functions will be implemented within the same network elements, whereas other specific B-ISDN functions will be dedicated to specialized network elements. Various different B-ISDN implementations are likely to be realized depending on national conditions.

A basic component of the B-ISDN is a network for asynchronous transfer mode (ATM) switching of both constant bit rate (CBR) and variable bit rate (VBR) end-to-end connections. These connections will support 64 kbit/s based ISDN services.

3 Architectural aspects of the B-ISDN

The basic architectural model defined in Recommendation I.324 is complemented as shown in Figure 1/I.327. This shows the main information transfer and signalling capabilities of the B-ISDN.

The architecture of the B-ISDN includes low Layer capabilities and high Layer capabilities. These capabilities support services within the B-ISDN and within other networks by means of interworking B-ISDN with those other networks.

3.1 *Low Layer capabilities*

From the functional capabilities of the B-ISDN, as shown in Figure 1/I.327, the information transfer capabilities require further description.

Broadband information transfer is provided by ATM at the B-ISDN user-network interface (UNI) and at switching entities inside the network.

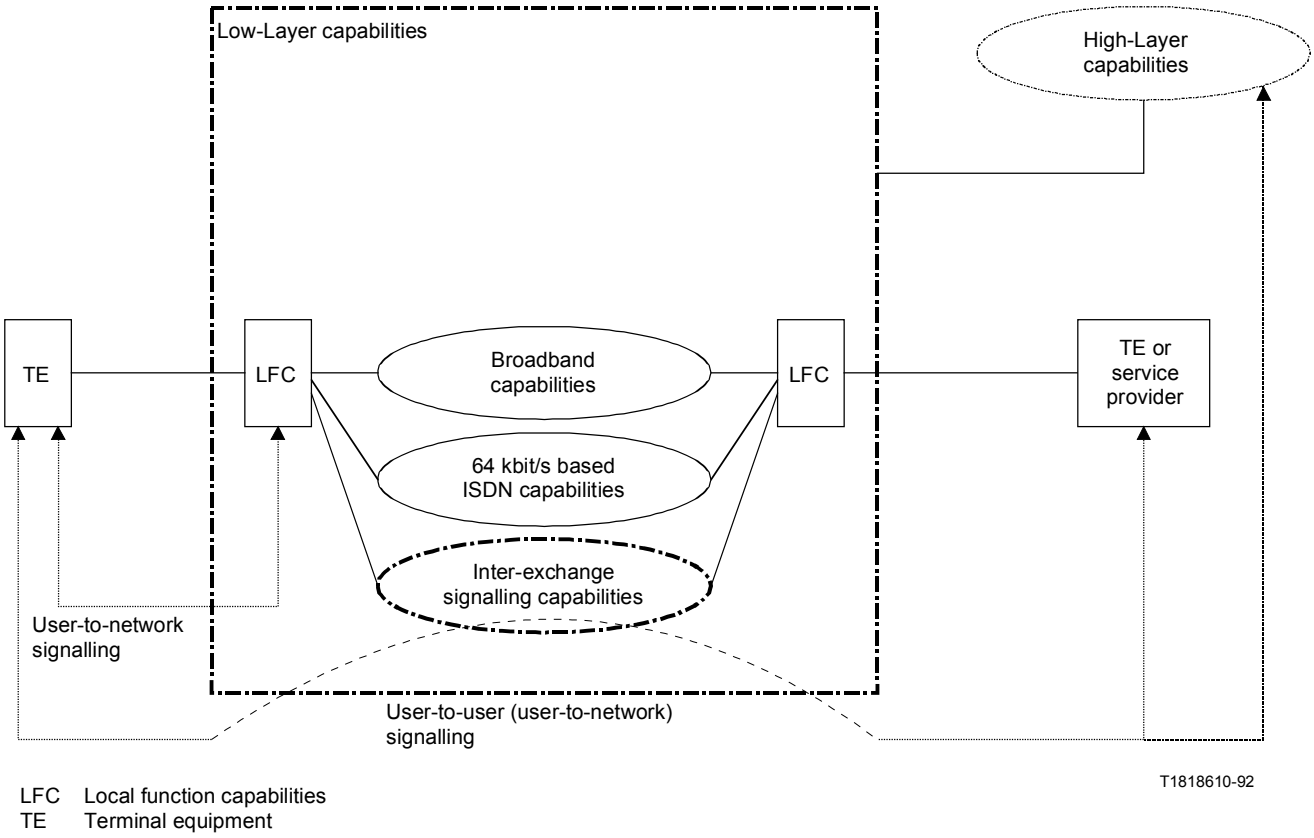


FIGURE 1/I.327

Basic architecture model of the B-ISDN

ATM is a specific packet oriented transfer mode using an asynchronous time division multiplexing technique. The multiplexed information flow is organized in fixed size blocks, called cells. A cell consists of an information field and a header: the primary role of the header is to identify cells belonging to the same virtual channel connection. Cells are assigned on demand, depending on the source activity and the available resources. Cell sequence integrity on a virtual channel connection is preserved by the ATM Layer.

ATM is a connection oriented technique. A connection within the ATM Layer consists of one or more links, each of which is assigned an identifier. These identifiers remain unchanged for the duration of the connection. It should be noted that signalling information for a given connection is conveyed using a separate identifier.

Although ATM is a connection oriented technique, it does offer a flexible transfer capability common to all services, including connectionless services. Examples of mechanisms supporting connectionless data services are illustrated in Annex A.

The switching and transmission capabilities, as described in Recommendation I.324, are also applicable in B-ISDN. The support of 64 kbit/s based ISDN services by a network based on ATM needs further study.

3.2 *High Layer capabilities*

Normally, the high Layer functional capabilities are involved only in the terminal equipment. However, for the support of some services, provision of high layer functions could be made via special nodes in the B-ISDN belonging to the public network or to centres operated by other organizations and accessed via B-ISDN user-network or network-node interfaces (NNIs).

4 Location of functions in the B-ISDN

4.1 *Overall*

In considering a B-ISDN call (i.e. an instance of a telecommunication service) two major functional areas are involved:

i) the customer equipment (TE and optional customer network),

ii) the public B-ISDN.

In the case where the customer network is a B-ISPBX based network providing the same B-ISDN connection type as the public B-ISDN, then the overall B-ISDN connection ends at the S_B reference point as shown in Figure 2/I.327.

Note 1 – In the case where the customer network is null then the B-ISDN connection type can be considered to end at the coincident S_B, T_B reference point.

Note 2 – Other configurations are possible where the call is asymmetrical, or terminates in or involves HLFs.

Note 3 – The terms "B-ISPBX/private B-ISDN" and "public B-ISDN" do not presuppose a particular regulatory situation in any country and are used purely for technical reasons.

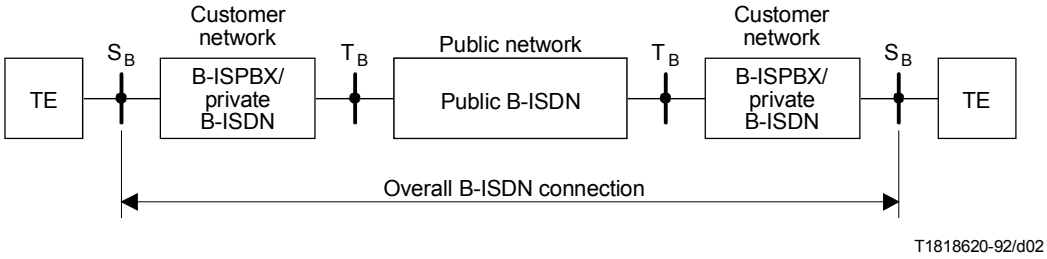


FIGURE 2/I.327

Overall B-ISDN reference configuration for a mixed B-ISPBX/public B-ISDN scenario

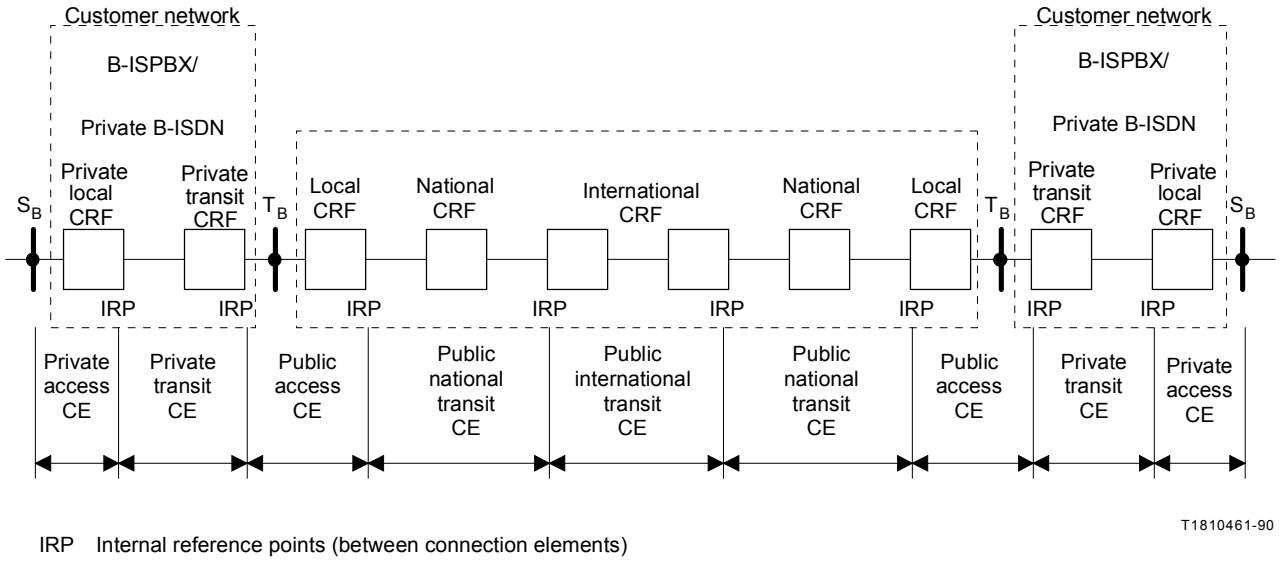
4.2 *Partitioning of the overall B-ISDN connection*

The partitioning of functions within the B-ISDN connection type is done by using connection elements, basic connection components and reference points as defined in Recommendation I.324.

4.2.1 *Connection elements*

The first level of partitioning of the overall B-ISDN connection type is the connection element (CE). The partitioning is based on the identification of reference points between connection elements.

Figure 3/I.327 identifies five CEs for a mixed private/public B-ISDN overall connection type: the private access CE, the private transit CE, the public access CE, the public national transit CE and the public international transit CE.



IRP Internal reference points (between connection elements)
CRF Connection related functions

FIGURE 3/I.327

Connection elements within an overall B-ISDN connection

4.2.2 *Functional groups in the B-ISDN connection elements*

In B-ISDN, the virtual path connection is introduced for routing groups of virtual channels in the network. Therefore two levels of connection handling will exist in the B-ISDN. These levels must be represented by two different switching blocks in the connection elements, one switching according to the virtual path identifier (VPI) and another switching according to the virtual channel identifier (VCI). Each of these switching blocks is under the control of its respective control block.

A general connection element model in B-ISDN is thus described using five functional blocks: a switching block for VPI, the S_{VPI}; a control block for VPI, the C_{VPI}; a switching block for VCI, the S_{VCI}, a control block for VCI, the C_{VCI}, and an interconnection link (see Figure 4/I.327). The link block incorporates all the functions implementing the physical layer. Different links may be identified, e.g. access links and transit links.

In a particular reference configuration for connection types, the connection elements can be realized using a subset of the five functional blocks, for example to represent a connection in the network where only VPI handling is implemented.

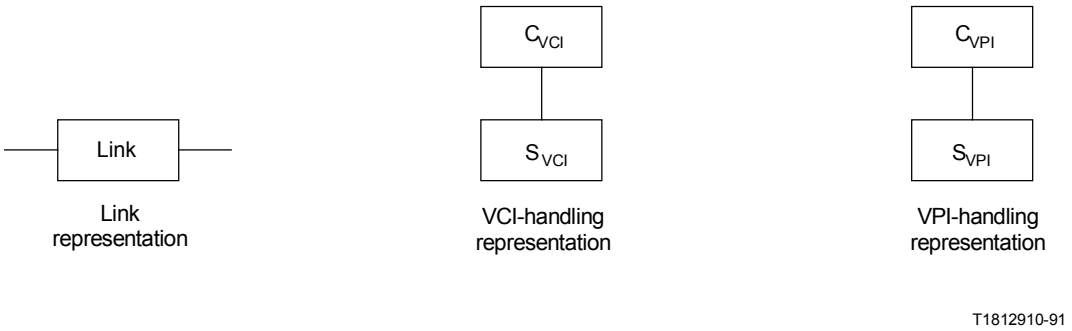
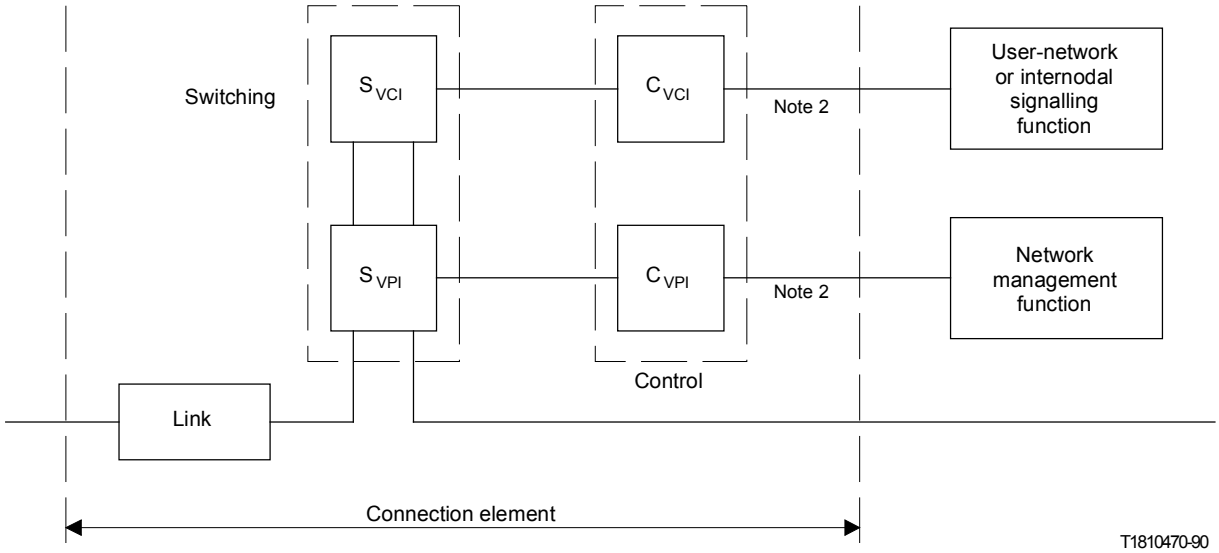


FIGURE 4/I.327

Functional groups in a B-ISDN connection element

4.2.3 *B-ISDN connection element generic description*

The generic B-ISDN connection element is shown in Figure 5/I.327. It represents the logical interrelationship between the functional blocks supporting the B-ISDN connections and the means to control the connections. The B-ISDN connection is supported by the links and the switching blocks S_{VPI} and S_{VCI}. The connections are controlled by the control blocks C_{VPI} and C_{VCI}. These control blocks logically interface to the user-network signalling system on the user side of an access connection element and with the internodal signalling network. For the control of semi-permanent connections, the control blocks also interface to the network management function. These management interface definitions will be the subject of further studies.



Note 1 – Figure 5/I.327 represents a generic connection element. The functional blocks may be combined into a single entity (e.g. S_{VPI} and S_{VCI} could be combined into a single ATM switching entity).

Note 2 – How the control block for VPI handling relates to signalling and network management functions is for further study.

FIGURE 5/I.327

A generic B-ISDN connection element

4.3 *Functional architecture models for the B-ISDN*

Appendix I gives examples of functional architecture models using the principles established in Recommendation I.324. These principles are basically those of Reference Points and Functional Groups identified in Figure 8/I.324.

ANNEX A

(to Recommendation I.327)

Support of connectionless data services in a B-ISDN

Recommendation I.211 identifies the connectionless data service aspects of B-ISDN. Connectionless data services are supported in the B-ISDN using ATM connections between functional groups able to handle connectionless messages. These functional groups may be outside the B-ISDN or may provide a B-ISDN service.

Two mechanisms for supporting connectionless data services are described in Recommendation I.211, § 2.7:

1) indirectly via a B-ISDN Connection Oriented service (Case A),

2) directly via a B-ISDN Connectionless Data service (Case B).

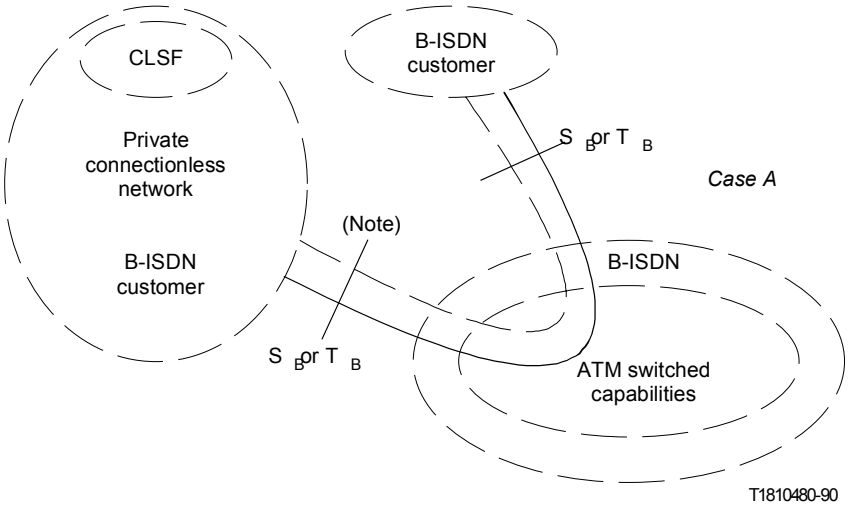
The respective functional architecture model for those two methods are represented in Figures A-1/I.327 and A-2/I.327. The direct provision of a B-ISDN Connectionless Data service and the protocol specification are for further study.

In order to access a Connectionless Data service, a connection has to be established between the user and the Connectionless service function (CLSF). This connection can be:

– a semi-permanent Virtual Path Connection. All the VC connections in this VP connection are dedicated to the Connectionless Data service;

– a switched or semi-permanent VC connection.

CLSF terminates connectionless protocol and routes cells to a destination user according to routing information included in user cells.



Semi-permanent connection

Call-by-call connection

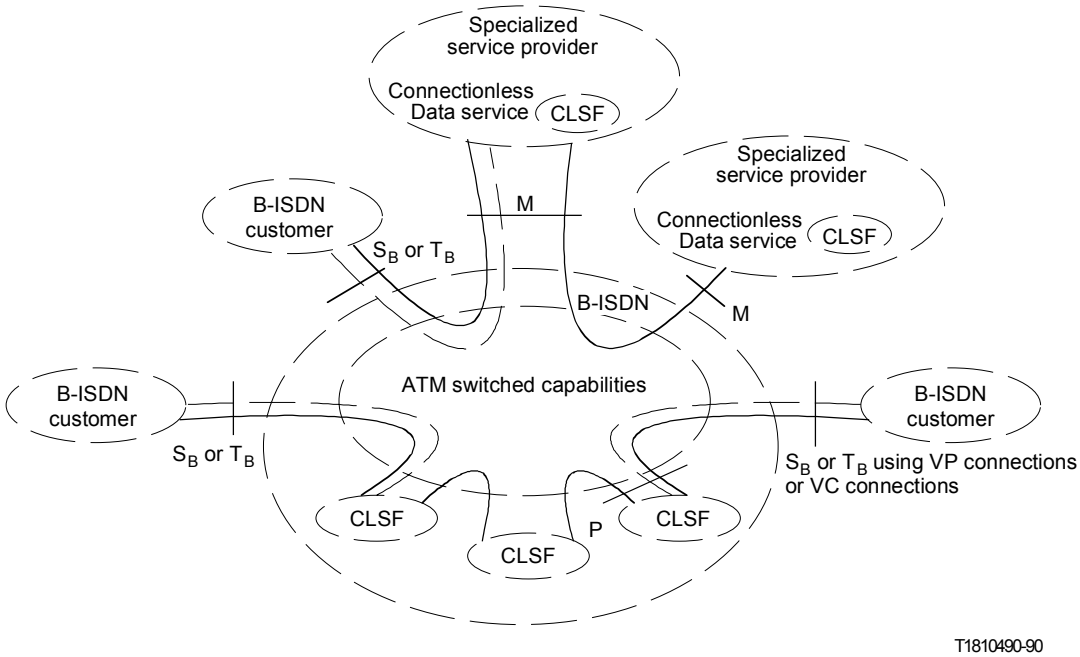
CLSF Connectionless service functions

S_B, T_B Reference points

Note – Connectionless protocols are invisible to, and independent of, the B-ISDN.

FIGURE A-1/I.327

Indirect provision of connectionless data service (Case A)



Semi-permanent connection (VP/VC)

Call-by-call connection

CLSF Connectionless service functions

P, M, S_B, T_B Reference points

VP Virtual path

VC Virtual channel

FIGURE A-2/I.327

Direct provision of Connectionless Data service

APPENDIX 1

(to Recommendation I.327)

Examples for functional architecture models for B-ISDN

Functional architecture models aim to identify various possible physical arrangements for the realization of the network when interconnecting equipments. Depending on the national situations and on the type of access, a number of different functional architecture models exist for accessing the B-ISDN:

- a star structure where customers have direct individual links to the local exchange (LE) (see Figure I-1/I.327);

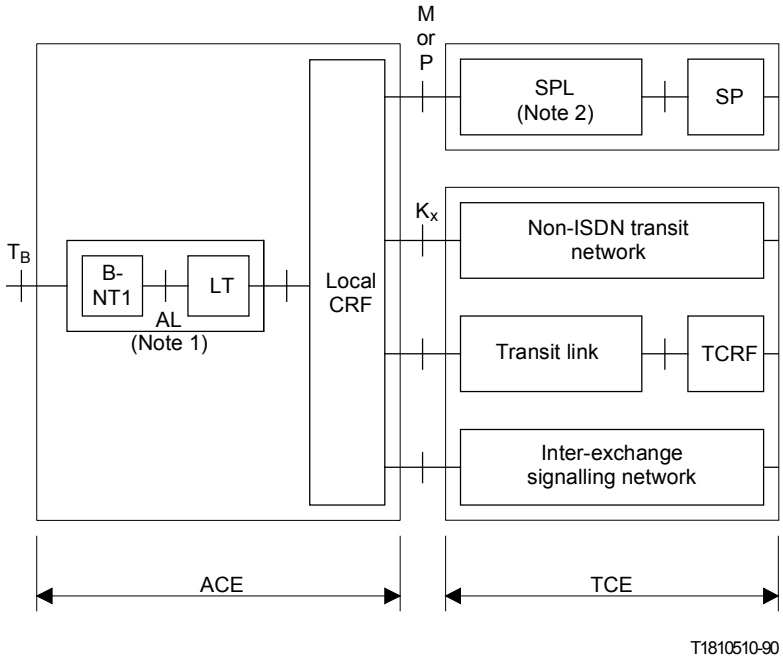
- a multistar structure with a remote unit (RU) between the customer and the main exchange. This is a two stage local network, each stage being star structured (see Figure I-2/I.327);

- a multistar structure, tree-shaped for distributive communication between the local exchange and the remote unit (see Figure I-3/I.327).

Other functional architecture models, such as Metropolitan Area Networks, and access technologies such as Passive Optical Network, are for further study.

Note – The passive optical network concept consists of a shared medium based on a tree topology that allows the connection of several customers to the local exchange using the same medium.

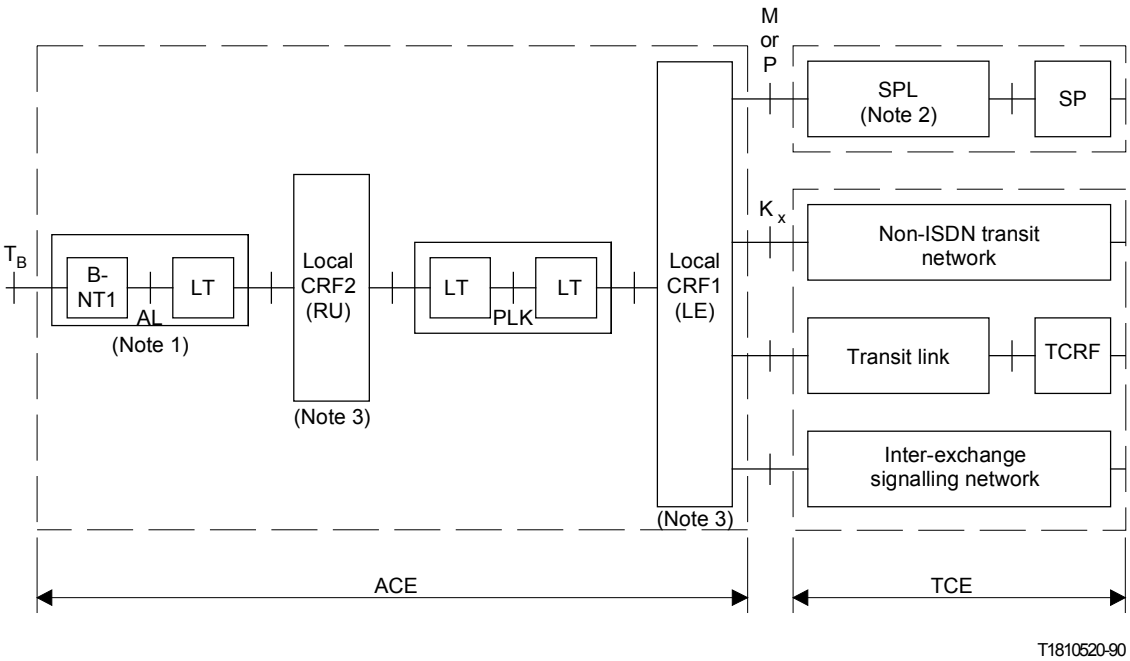
The Metropolitan Area Network logical concept is based on a distributed (not centralized) local CRF. Customers have access to the network using a shared medium based on different topologies.



Note – Explanation of Notes and abbreviations is given in Figure I-3/I.327.

FIGURE I-1/I.327

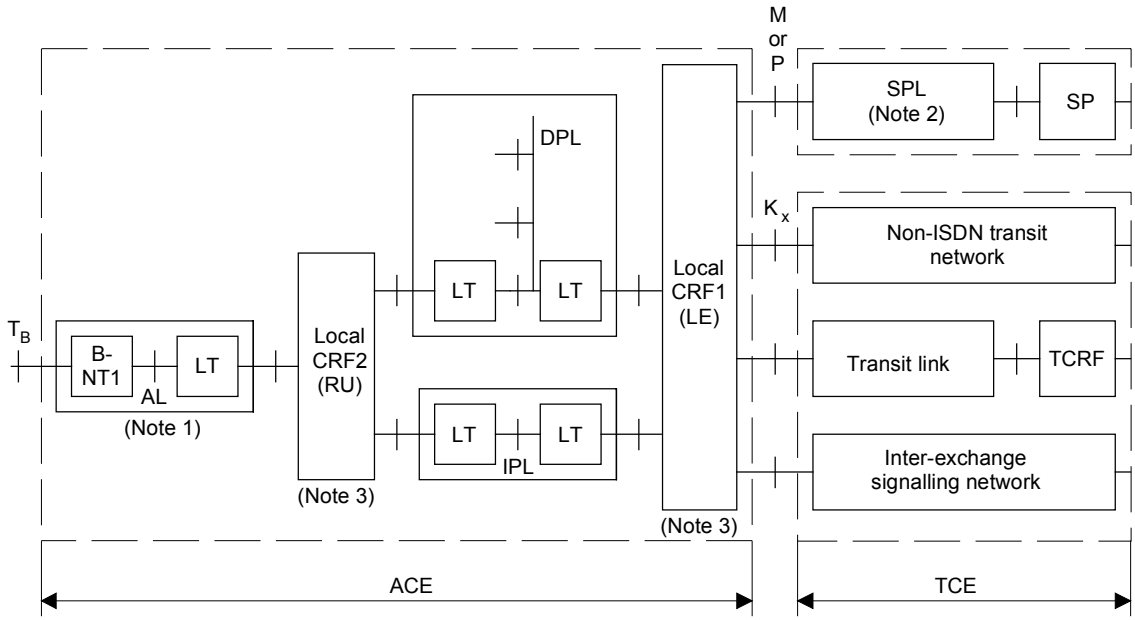
Architecture model using a star structured ACE



Note – Explanation of Notes and abbreviations is given in Figure I-3/I.327.

FIGURE I-2/I.327

Architecture model using a multistar structured ACE



ACE	Access connection element
AL	Access link
CRF	Connection related functions
DPL	Primary link for distribution services
IPL	Primary link for interactive services
LT	Line termination
RU	Remote unit
B-NT1	Network termination 1 for B-ISDN
PLK	Primary link
SP	Service provider
SPL	Service provider link
TCE	Transit connection element
K /M/P	Inter/Intra-network reference points
T_xCRF	Transit connection related function
LE	Local exchange

Note 1 – AL: Access link. Multiplexers may exist on this link. In those cases, specific reference points have to be defined, not represented in these figures.

Note 2 – SPL: Service provider link. This link may be regarded as a transit link or as part of a special connection element.

Note 3 – CRF1 + CRF2 and CRF1' + CRF2' perform the same global functions as if only one CRF block existed.

FIGURE I-3/I.327

Architecture model using a multistar tree structured ACE

ANNEX B

(to Recommendation I.327)

Alphabetical list of abbreviations used in this Recommendation

ACE	Access connection element
AL	Access link
B-NT1	Network termination 1 for B-ISDN
B-ISPBX	Private branch exchange for B-ISDN
CBR	Constant bit rate
CE	Connection element
CLSF	Connectionless service function
CRF	Connection related function
DPL	Primary link for distribution services
IPL	Primary link for interactive services
IRP	Internal reference point
LE	Local exchange
LFC	Local function capabilities
LT	Line termination
NNI	Network-node interface
PLK	Primary link
RU	Remote unit
SP	Service provider
SPL	Service provider link
TCE	Transit connection element
TCRF	Transit connection related function
TE	Terminal equipment
VBR	Variable bit rate
VCI	Virtual channel identifier
VPI	Virtual path identifier

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