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**Broadband Integrated Services Digital Network (B-ISDN);  
Connection types and their reference configurations**

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## Contents

|                                                                                           |    |
|-------------------------------------------------------------------------------------------|----|
| Foreword .....                                                                            | 5  |
| Introduction .....                                                                        | 5  |
| 1 Scope .....                                                                             | 7  |
| 2 References .....                                                                        | 7  |
| 3 Abbreviations .....                                                                     | 8  |
| 4 Information transfer in B-ISDN .....                                                    | 8  |
| 5 Relationship between B-ISDN connection types and the protocol reference model .....     | 9  |
| 5.1 Layers .....                                                                          | 9  |
| 5.2 Planes .....                                                                          | 9  |
| 6 Relationship between B-ISDN connection types and services .....                         | 10 |
| 7 Applications of B-ISDN connection types .....                                           | 10 |
| 8 B-ISDN connection types and their attributes .....                                      | 10 |
| 9 B-ISDN connection types .....                                                           | 12 |
| 10 Reference configurations for B-ISDN connection types .....                             | 13 |
| 10.1 Objective .....                                                                      | 13 |
| 10.2 Relationship with other I-series CCITT Recommendations .....                         | 13 |
| 10.2.1 B-ISDN architectural model .....                                                   | 13 |
| 10.2.2 B-ISDN user-network interfaces .....                                               | 13 |
| 11 Development of the concept of reference configurations .....                           | 14 |
| 11.1 Definition .....                                                                     | 14 |
| 11.2 Principles for developing reference configurations for B-ISDN connection types ..... | 14 |
| 11.3 Connection elements .....                                                            | 14 |
| 11.4 Functional groupings .....                                                           | 16 |
| 11.5 Reference points .....                                                               | 16 |
| 12 Specific reference configuration for broadband class .....                             | 16 |
| 12.1 Virtual path connection class .....                                                  | 17 |
| 12.2 Virtual channel connection class .....                                               | 18 |
| History .....                                                                             | 19 |

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## Foreword

ETSI Technical Reports (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 application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or I-ETS.

This ETR has been produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI), and defines the interworking cases for the Memorandum of Understanding (MoU) on ISDN priority 1 and 2 services.

The Integrated Services Digital Network (ISDN) may be described by a limited set of user-network interfaces (refer to CCITT Recommendation I.411 [14]) and a limited set of ISDN connection types to support the telecommunication services described in the I.200 series of CCITT Recommendations. This ETR identifies and defines these connection types which are a description of the basic lower functions (layers 1-3, see CCITT Recommendation I.310 [1]) of the ISDN network needed to support the basic services.

Broadband Integrated Services Digital Network (B-ISDN) connections need to be able to transfer a large variety of information flows, characterised by different bandwidth, burstiness, loss and delay constraints. Each connection may transfer both monomedia and multimedia information flows. Moreover, the request of a given customer may change from time to time. An important problem for the network is how to dynamically allocate the appropriate resources to each connection.

## Introduction

An ISDN provides a set of network capabilities which enable telecommunication services to be offered to a user (refer to the I.200 series of CCITT Recommendations).

ISDN connection types are a description, using the attribute method of CCITT Recommendation I.140 [12], of the Basic Low Layer Functions (BLLFs) of the ISDN. The set of possible values for the attributes is given in Clause 7. In principle, not all of the combinations of attribute values lead to "significant" connection types. A set of (agreed) connection types with the relative combination of attribute values is reported in Clause 8.

An ISDN connection is a connection established between ISDN reference points (see CCITT Recommendations I.340 [4], I.410 [13] and I.411 [14]). All ISDN connections are established to support a request for an ISDN service and are time dependent and of a finite duration. All ISDN connections fall under the category of one or other of the connection types. It follows therefore that an ISDN connection type is a time independent description and an ISDN connection is an instance of a type.

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## 1 Scope

This ETSI Technical Report (ETR) defines the interworking cases for the Memorandum of Understanding (MoU) on ISDN priority 1 and 2 services.

The Integrated Services Digital Network (ISDN) may be described by a limited set of user-network interfaces (see CCITT Recommendation I.411 [14]) and a limited set of ISDN connection types to support the telecommunication services described in the I.200 series of CCITT Recommendations. This ETR identifies and defines these connection types which are a description of the basic lower functions (layers 1-3, see CCITT Recommendation I.310 [1]) of the ISDN network needed to support the basic services.

This ETR describes the connection types and their reference configurations, for the Broadband Integrated Services Digital Network (B-ISDN).

## 2 References

The following references are used in this ETR.

- [1] CCITT Recommendation I.310: "ISDN - Network functional principles".
- [2] CCITT Recommendation I.320: "ISDN protocol reference model".
- [3] CCITT Recommendation I.321: "B-ISDN protocol reference model and its application".
- [4] CCITT Recommendation I.340: "ISDN connection types".
- [5] CCITT Recommendation I.327: "B-ISDN functional architecture".
- [6] CCITT Recommendation I.211: "B-ISDN service aspect".
- [7] CCITT Recommendation I.610: "OAM principles of the B-ISDN access".
- [8] CCITT Recommendation I.325: "Reference configurations for ISDN connection types".
- [9] CCITT Recommendation I.324: "ISDN network architecture".
- [10] CCITT Recommendation I.311: "B-ISDN general network aspects".
- [11] CCITT Recommendation I.413: "B-ISDN user-network interface".
- [12] CCITT Recommendation I.140: "ISDN user-network interfaces - Reference configurations".
- [13] CCITT Recommendation I.410: "ISDN user-network interfaces - Reference configurations".
- [14] CCITT Recommendation I.411: "ISDN user-network interfaces - Reference configurations".
- [15] ISO Standard 7498: "Information processing systems - Open Systems Interconnection - Basic Reference Model".

### 3 Abbreviations

The following symbols and abbreviations are used within this ETR.

|        |                                                |
|--------|------------------------------------------------|
| AAL    | ATM Adaptation Layer                           |
| ATM    | Asynchronous Transfer Mode                     |
| B-ISDN | Broadband Integrated Services Digital Network  |
| CE     | Connection Element                             |
| CRF    | Connection Related Functions                   |
| HRX    | Hypothetical Reference Connection              |
| IRP    | Internal Reference Point                       |
| MoU    | Memorandum of Understanding                    |
| N-ISDN | Narrowband Integrated Services Digital Network |
| SVCI   | Switching function based on VCI                |
| SVPI   | Switching function based on VPI                |
| VC     | Virtual Circuit                                |
| VP     | Virtual Path                                   |

### 4 Information transfer in B-ISDN

The information transfer within B-ISDN is supported by connections. These connections are described by a set of attributes with specific values. In an Asynchronous Transfer Mode (ATM) environment, two new concepts can be introduced with reference to the information transfer:

- 1) information flow between CORE entities;
- 2) information flow between EDGE entities;

where CORE entities terminate ATM layer functions and EDGE entities terminate ATM Adaptation Layer (AAL) functions.

The section between EDGE entities typically corresponds to the extent of the overall ISDN connection type. EDGE-to-EDGE entities may include both monomedia and multimedia information flows.

The section between CORE entities is called a connection section. In some cases a connection section will correspond with a connection element, in others several connection sections are concatenated to form a connection element.



As to the location of the CORE and EDGE entities, it can be considered that the CORE entities are located in the following functional groupings:

- Terminal Equipment 1 (TE1);
- Terminal Adapter (TA);
- Network Termination 2 (NT2);
- Local Connection Related Functions (LCRF);
- Transit Connection Related Functions (TCRF);
- network adapter (IWU);

the EDGE entities are mandatory in the following functional groupings:

- Terminal Equipment 1 (TE1);
- Terminal Adapter (TA);
- network adapters (IWU);

whereas EDGE entities are optional in the following functional groupings:

- Network Termination 2 (NT2);
- Local Connection Related Functions (LCRF);
- Transit Connection Related Functions (TCRF).

The B-ISDN connection sections and connection elements can be described by the attributes used to describe the overall B-ISDN connection. Where appropriate, association laws are to be given for each attribute to show how the value of the attribute of the overall B-ISDN connection types is obtained from the values of the attribute applicable to the connection elements.

## **5 Relationship between B-ISDN connection types and the protocol reference model**

### **5.1 Layers**

Connection types are a description of the basic lower layer functions of a network (see CCITT Recommendation I.310 [1], figure 2).

For the Narrowband Integrated Services Digital Network (N-ISDN), the lower layers are structured into Layer 1 (physical), 2 (data link) and 3 (network) according to the OSI Reference Model (ISO Standard 7498 [15], see also the ISDN protocol reference model, CCITT Recommendation I.320 [2]). Some of the attributes (or sub-attributes) of N-ISDN connection types are directly related to these layers.

In the B-ISDN protocol reference model (see CCITT Recommendation I.321 [3], figure 1, the lower layers of B-ISDN are structured into:

- physical medium dependent layer;
- ATM layer; and
- AAL.

B-ISDN connection types describe the capabilities of these 3 layers and others, up to layer 3; some of the attributes (or sub-attributes) may be directly related to one or more of these layers.

### **5.2 Planes**

The B-ISDN protocol reference model (see CCITT Recommendation I.321 [3], figure 1) includes three planes:

- the user plane;
- the control plane; and
- the network management plane.

In all three planes, communication flows could occur. Future study is needed to identify how the aspects of these planes influence the specification of B-ISDN connection types.

## 6 Relationship between B-ISDN connection types and services

Based on B-ISDN connection types, telecommunication services can be offered to users (cf. CCITT Recommendation I.340 [4], figure 1). User demands for certain types of services play an important role in identifying the relevant connection types.

## 7 Applications of B-ISDN connection types

The 4 applications a), b), c) and d) of ISDN connection types, shown in CCITT Recommendation I.340 [4], figure 2, are also valid for B-ISDN. It should be noted that for applications a), b) and c) the overall B-ISDN connection type ends at the  $S_B$  reference point (as shown in CCITT Recommendation I.327 [5], figure 2). If the terminal equipment is directly connected to the public B-ISDN (i.e. the customer network is null), the  $S_B$  and  $T_B$  reference points coincide.

## 8 B-ISDN connection types and their attributes

The basic concepts stated in the current CCITT Recommendation I.340 [4] also apply to B-ISDN. Therefore, also B-ISDN connection types are characterised by a set of attributes. To each attribute a set of possible values is associated. CCITT Recommendation I.140 [12] describes the attribute technique and gives the definitions of the attributes to be used for the ISDN connection types. The application of the same methodology to the B-ISDN requires modifications which may affect the choice of the attributes and the attribute values.

One of the main characteristics of B-ISDN is the decoupling of service bit-rates from transfer capacity. Therefore, the attribute "Channel Rate" (of CCITT Recommendation I.340 [4]) is not applicable to B-ISDN connections.

The attribute "Information Transfer Rate" is to be modified. Further study is needed to determine how, for example, fixed and variable bit-rate transfer capabilities should be specified.

A new attribute "Transfer Capacity" referring to the maximum bit-rate provided, is proposed for inclusion.

Possible value: <depends on maximum transfer capacities of connection elements involved>

Unlike the ISDN, the information bit-rate of services supported by the B-ISDN very likely differ from the gross transfer rate of access/transit lines and interfaces. Therefore, the ISDN attributes "Information Transfer Rate" and "Channel Rate" will be changed for B-ISDN connections.

The proposed new attribute "Transfer Capacity" takes into account restrictions on the bit-rate deriving from the maximum transfer capacities of access/transit lines and interfaces. The transfer capacity indicates the maximum bit-rate available for a service supported by the considered connection. The transfer capacity of an overall B-ISDN connection is defined as the minimum of the transfer capacities of the connection elements forming the overall connection. Possible values depend on standardised interfaces and other determinations of international standardisation bodies (see, for example, CCITT Recommendation I.211 [6], § 2.4).

The transfer capacity of a connection depends on the layer. As an example, if ATM cells are transferred via an interface with a payload capacity of 149,76 Mbit/s, the maximum information bit-rate (for the information carried by the cells) will be less than 135,631 Mbit/s.

The actual service bit-rate is decoupled from the transfer capacity of a connection; therefore, it is not regarded as an attribute of a B-ISDN connection even if it can have an impact on other connection attributes (e.g. "Network Performance").

The actual service information flow is, of course, not directly referred to as an attribute (e.g. "information transfer rate") of B-ISDN connections, but may have some impact on the attributes "AAL Transfer Type" and "Network Performance".

Some of the attributes of CCITT Recommendation I.340 [4] are not used for B-ISDN connections because they do not provide enough information to describe the characteristics of B-ISDN connections. Contrarily, some other attributes typical for B-ISDN connections have been added, e.g.: "ATM Transfer Type" with the values "Virtual Path Connection" (VPC); and "Virtual Channel Connection" (VCC).

Table 1 provides an overview of attributes and proposed values for an (overall) B-ISDN connection type. For a full description of the connection type, the attribute values should be given also for the connection section and the connection elements.

**Table 1: Attributes and proposed values for a B-ISDN overall connection type**

| Attributes                                                      |                                                                                                            | Values for attributes for a B-ISDN overall connection type                                                                                    |
|-----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 1                                                               | - information transfer mode<br>- basic transfer mode<br>- TM transfer mode<br>- AAL transfer mode (NOTE 2) | ATM<br>Virtual Path Connection (VPC)<br>Virtual Channel Connection (VCC)<br>Type A, type B, type C, type D,<br>multimedia (for further study) |
| 2                                                               | - Transfer capacity                                                                                        | <Values depend on maximum transfer capacities of connection element involved (NOTE 1).<br>These values are layer dependent>                   |
| 3                                                               | - Physical Transport Medium (PTM) (NOTE 2)                                                                 | Optical fibre, coaxial cable, mobile satellite, others (for further study)                                                                    |
| 4                                                               | - Establishment of connection                                                                              | Permanent, semi-permanent, switched                                                                                                           |
| 5                                                               | - Symmetry                                                                                                 | Bi-directional symmetric, bi-directional asymmetric, unidirectional                                                                           |
| 6                                                               | - Connection configuration<br>- topology<br>- geographical extension (NOTE 2)                              | Point-to-point, multipoint, broadcast<br>local, metropolitan, national, international                                                         |
| 7                                                               | - Structure                                                                                                | Data unit integrity (for further study)                                                                                                       |
| 8                                                               | - Priority                                                                                                 | <Priority classes, if depend>                                                                                                                 |
| 9                                                               | - Connection control protocol                                                                              | <Reference to connection control protocols used in B-ISDN>                                                                                    |
| 10                                                              | - Information transfer coding protocol                                                                     | <Reference to information transfer coding protocols used in B-ISDN>                                                                           |
| 11                                                              | - Network Performance (NP)                                                                                 | NP classes; these may be defined using sub-attributes e.g. (bit) error performance, cell loss ratio, cell delay (variation), etc.             |
| 12                                                              | - Network interworking                                                                                     | For further study                                                                                                                             |
| 13                                                              | - Operation and maintenance                                                                                | <Reference to relevant OAM standards of B-ISDN, see e.g. CCITT Recommendation I.610 [7]>                                                      |
| NOTE 1: See e.g. CCITT Recommendation I.211 [6], § 2.4.         |                                                                                                            |                                                                                                                                               |
| NOTE 2: The inclusion of these attributes is for further study. |                                                                                                            |                                                                                                                                               |

## 9 B-ISDN connection types

B-ISDN connection types are derived by selecting sets of attribute values from the attributes given in table 1. The number of possible combinations of attribute values is reduced by considering only some "dominant" attributes (as in CCITT Recommendation I.340 [4]).

Table 2 provides a first draft of a set of B-ISDN connection types as a basis for further study (see also NOTE 2 to table 1):

- 1) fixed permanent connection types;
- 2) fixed semi-permanent connection types;
- 3) fixed switched connection types;
- 4) mobile connection types;
- 5) satellite connection types;
- 6) asymmetric group connection types;
- 7) distributive connection types.

The names of these connection types have been derived by referring to some "dominant attribute values", the full deployment of which for the selected connection types is reported in table 2.

It should be noted that these B-ISDN connection types are at present only intended to represent typical B-ISDN connections. Possible additional B-ISDN connection types are for further study.

**Table 2: B-ISDN connection types**

| N°   | ATM transfer mode | AAL transfer type       | Physical transport medium        | Symmetry                  | Topology                  | Geographical extension | Establishment of connection |
|------|-------------------|-------------------------|----------------------------------|---------------------------|---------------------------|------------------------|-----------------------------|
| 1    | VPC               | ***                     | optical fibre, coaxial cable     | bi-directional symmetric  | point-to-point multipoint | ***                    | permanent                   |
| 2    | VCC               | ***                     | optical fibre, coaxial cable     | bi-directional symmetric  | point-to-point multipoint | ***                    | semi- permanent             |
| 3    | VCC               | ***                     | optical fibre, coaxial cable     | bi-directional symmetric  | point-to-point multipoint | ***                    | switched                    |
| 4    | ***               | ***                     | mobile                           | bi-directional symmetric  | point-to-point multipoint | ***                    | ***                         |
| 5    | ***               | ***                     | satellite                        | bi-directional symmetric  | point-to-point multipoint | international          | ***                         |
| 6    | ***               | multi-media             | optical fibre, coaxial satellite | bi-directional asymmetric | multipoint                | ***                    | ***                         |
| 7    | VPC               | class A, B; multi-media | optical fibre, coaxial satellite | unidirectional            | broadcast                 | ***                    | permanent                   |
| ***: | all values        |                         |                                  |                           |                           |                        |                             |

## 10 Reference configurations for B-ISDN connection types

In order to apply the network performance parameters to B-ISDN, some Hypothetical Reference Connections (HRXs) are necessary. These HRXs should be based on appropriate reference configurations for the connection types to which the network performance parameters refer. CCITT Recommendation I.325 [8] shows how reference configurations can be developed for the B-ISDN connection types and what form such reference configurations should take.

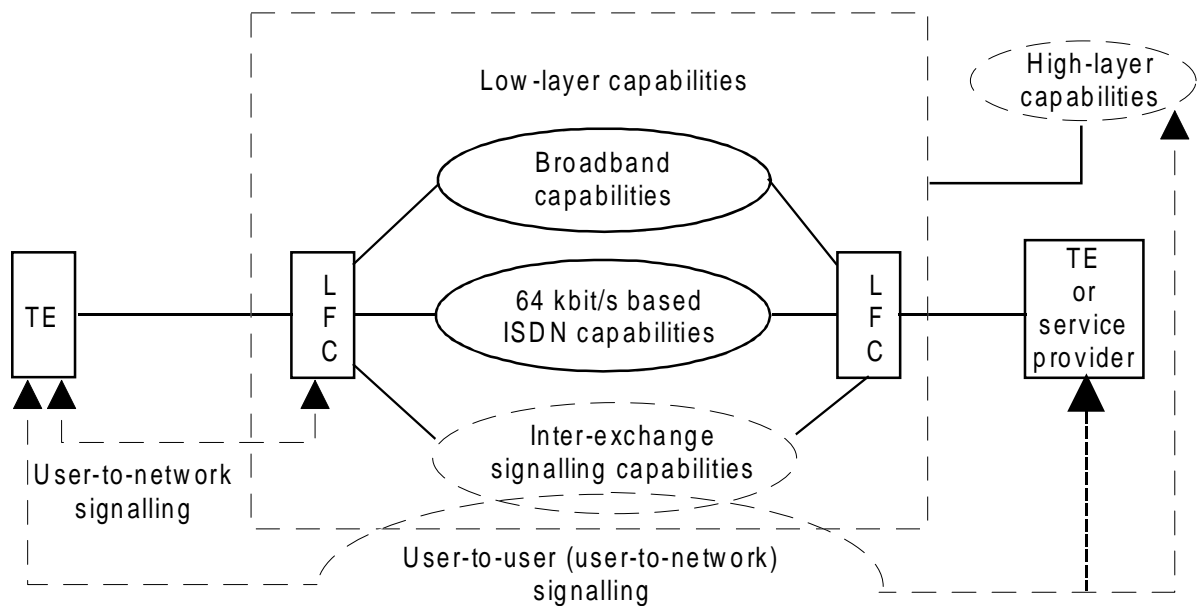
### 10.1 Objective

The general architectural model of ISDN is given in CCITT Recommendation I.324 [9]. The concepts and associated definitions adopted in CCITT Recommendation I.324 [9] also apply to the B-ISDN. The basic functional architecture of the B-ISDN is described in CCITT Recommendation I.327 [5].

### 10.2 Relationship with other I-series CCITT Recommendations

#### 10.2.1 B-ISDN architectural model

It should be noted that defining a set of reference configurations pre-supposes a particular architectural model of a B-ISDN (see figure 1). The architectural model for B-ISDN is contained in CCITT Recommendation I.327 [5]. In addition, CCITT Recommendation I.311 [10] on B-ISDN general network aspects and particularly on networking techniques, when considered together with CCITT Recommendation I.327 [5], gives the general basis of the architecture of the B-ISDN, from which it is possible to develop reference configurations for B-ISDN connection types.



LFC: Local Function Control.  
 TE: Terminal Equipment.

Figure 1: Basic architectural model of a B-ISDN

#### 10.2.2 B-ISDN user-network interfaces

The concept of reference configurations is used to describe the topological association of functional groupings at the user-network interface points. CCITT Recommendation I.413 [11] is the complete description of these particular reference configurations.

## 11 Development of the concept of reference configurations

### 11.1 Definition

A **reference configuration** is defined to be "a conceptual configuration based on association rules of functional groupings and reference points".

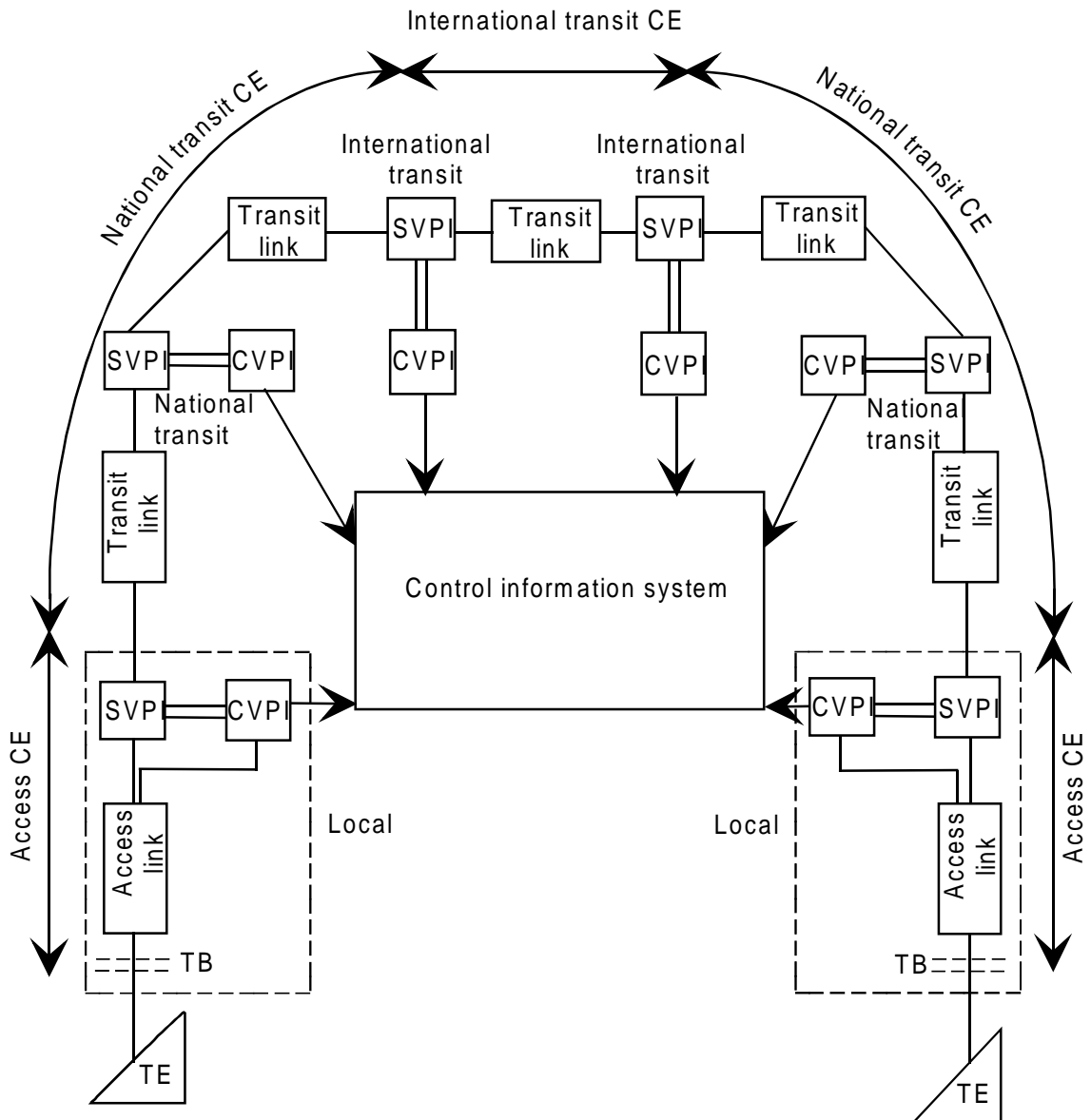
### 11.2 Principles for developing reference configurations for B-ISDN connection types

The concept of B-ISDN connection elements, as introduced in CCITT Recommendation I.324 [9], CCITT Recommendation I.340 [4] and CCITT Recommendation I.327 [5] can be effectively used to demarcate the different sections of the reference configuration. In order to keep the number of reference configurations manageable, only a restricted list of connection types and a limited number of models of frequently realised connection topologies are considered.

### 11.3 Connection elements

CCITT Recommendation I.327 [5] shows that five types of Connection Element (CE) have been defined (so far):

- private access connection element;
- private transit connection element;
- public access connection element;
- public national transit connection element;
- public international connection element.



IRP: Internal Reference Point between connection elements  
 CRF: Connection Related Functions

**Figure 2: Connection elements within an overall B-ISDN connection**

## 11.4 Functional groupings

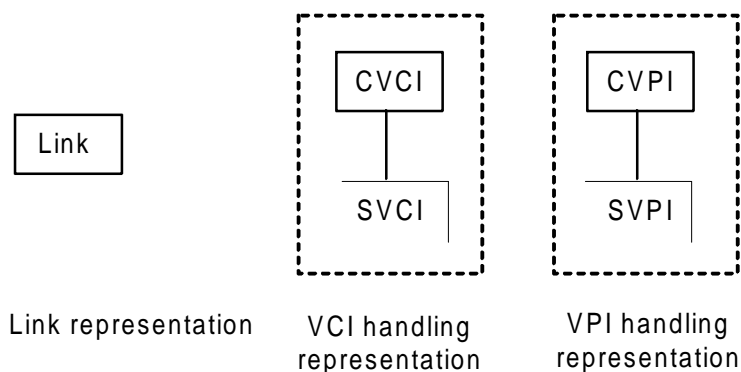
In order to define reference configuration, it is necessary to define certain functional groupings and also reference points, which are the conceptual points dividing these groupings.

The concept of Connection Related Functions (CRFs) include all the functional grouping involved in establishing and controlling the connections within the particular connection element. Two functional groupings are identified in B-ISDN.

- CRF(VP): CRFs related to virtual path;
- CRF(VC): CRFs related to virtual circuit.

Within each CRF above mentioned, two sub-groupings have been identified:

- the switch: virtual circuit switch and virtual path switch;
- the signalling and exchange control functions related to each switch.



SVCI: Switching function based on VCI.  
SVPI: Switching function based on VPI.  
CVCI: Signalling and control function for the VCI.  
CVPI: Signalling and control function for the VPI.

**Figure 3: Functional groupings in B-ISDN**

## 11.5 Reference points

The other element involved in the description of a reference configuration is the reference point concept. The I-series already identifies reference points  $S_B$  and  $T_B$  (in CCITT Recommendation I.413 [11]) and  $K_X$ ,  $M$ ,  $N_X$  and  $P$  (in CCITT Recommendations I.324 [9] and I.327 [5]).

## 12 Specific reference configuration for broadband class

Four dominant attributes are defined in CCITT Recommendation I.340 [4] for ISDN connection type: information transfer mode; information transfer rate; information susceptance; and establishment of connection.

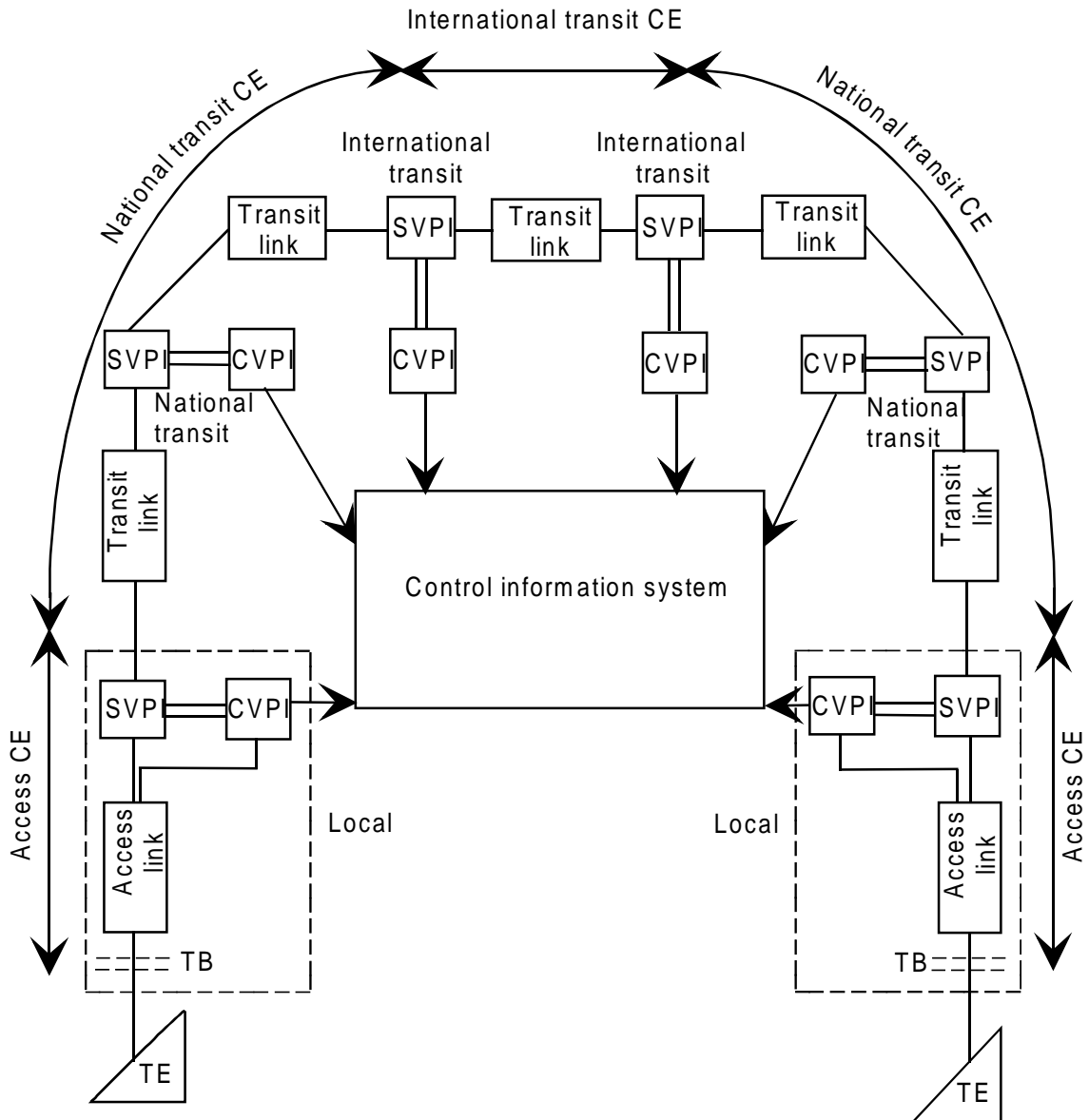
For an initial analysis, only the first two of the four dominant attributes listed in CCITT Recommendation I.340 [4] need to be considered. The other two dominant attributes do not require separate reference configurations but will manifest themselves by different performances values.

The information transfer mode could be divided into two parts, one according to the ATM transfer type (virtual path connection or virtual channel connection) and the other one to the ATM adaptation layer used (type A, type B, type C or type D). The second one, "information transfer rate" will be modified in B-ISDN using ATM transfer mode.



12.1 Virtual path connection class

This class includes connection types for all the AAL types and switched, semi-permanent and permanent establishments.

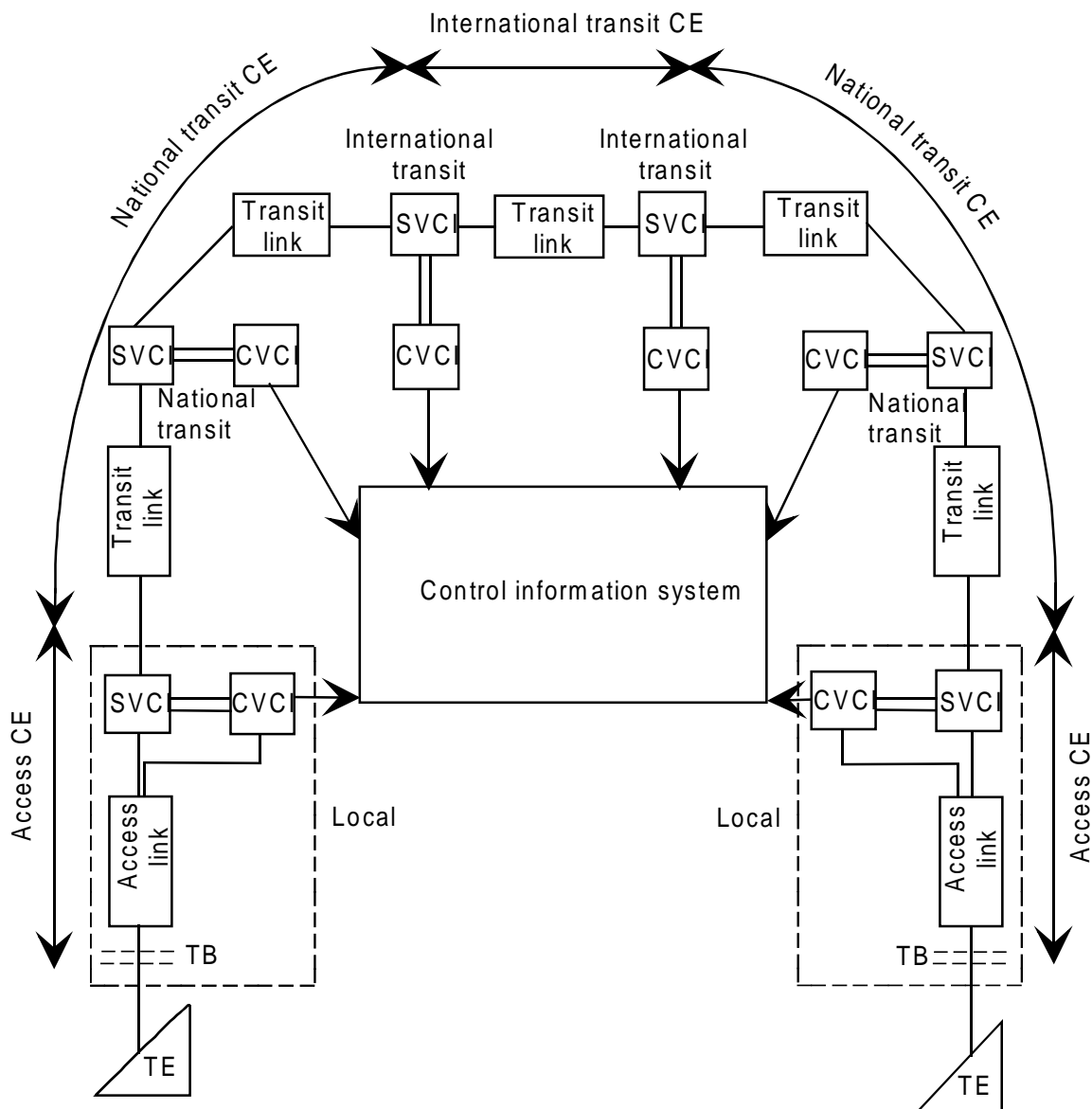


NOTE: Control information system could be either signalling system or management system.

Figure 4: Reference configuration - virtual path group

12.2 Virtual channel connection class

This class includes connection types for all the AAL types and switched, semi-permanent and permanent establishments.



NOTE: Control information system could be either signalling system or management system.

Figure 5: Reference configuration - virtual channel group

## History

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