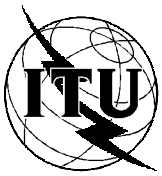

INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

I.310

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

(03/93)

INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

OVERALL NETWORK ASPECTS AND FUNCTIONS

ISDN – NETWORK FUNCTIONAL PRINCIPLES

ITU-T Recommendation I.310

(Previously “CCITT Recommendation”)

FOREWORD

The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the International Telecommunication Union. The ITU-T 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 World Telecommunication Standardization Conference (WTSC), which meets every four years, established the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

ITU-T Recommendation I.310 was revised by the ITU-T Study Group XVIII (1988-1993) and was approved by the WTSC (Helsinki, March 1-12, 1993).

NOTES

1 As a consequence of a reform process within the International Telecommunication Union (ITU), the CCITT ceased to exist as of 28 February 1993. In its place, the ITU Telecommunication Standardization Sector (ITU-T) was created as of 1 March 1993. Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.

In order not to delay publication of this Recommendation, no change has been made in the text to references containing the acronyms "CCITT, CCIR or IFRB" or their associated entities such as Plenary Assembly, Secretariat, etc. Future editions of this Recommendation will contain the proper terminology related to the new ITU structure.

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

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Recommendation I.310

ISDN – NETWORK FUNCTIONAL PRINCIPLES

(Malaga-Torremolinos, 1984; amended at Melbourne, 1988 and at Helsinki, 1993)

1 General

1.1 Basic philosophy of the functional description

The objective of this Recommendation is to provide a common understanding of the ISDN capabilities, including terminal, network and specialized service centre aspects.

A functional description of ISDN capabilities must allow a clear distinction between definition/specification aspects of services provided by the ISDN and the actual specification of the equipment utilized to support those services. Therefore, an implementation-independent approach should be adopted.

Moreover in the context of this Recommendation the adjective "functional" is used in the sense of an implementation-independent approach. The noun "function" itself has a specific meaning which is explained below.

The description of network capabilities is consistent with the protocol reference model, e.g.:

- the layering structure of all systems involved in a communication process, i.e. partitioning the required functions between different layers;
- the clear discrimination between layer service concept, layer function concept and layer protocol concept.

Furthermore, the three following distinctions apply:

- distinction between basic services and supplementary services;
- distinction between ISDN capabilities and services offered to the customer;
- distinction between static and dynamic aspects of the description.

NOTE – The inclusion in this Recommendation of aspects of intelligent network architecture, as described in Recommendations I.312/Q.1201, I.328/Q.1202, I.329/Q.1203, and further Recommendations of the Q.1200-Series is subject to further study.

1.2 Services supported by an ISDN

The concepts and the principles of an ISDN are described in Recommendation I.120. The services supported by an ISDN are given in the I.200-Series Recommendations. A classification and the tools for the description of telecommunication services are specified in Recommendation I.210 according to the description method as given in Recommendation I.130. The network capabilities to support these services are defined in the I.300-Series Recommendations. The relationship between these Recommendations and some other relevant I-Series Recommendations is shown in Figure 1.

It should be noted that the service concept defined in Recommendation I.210 is different from the layer service concept of the OSI model. The telecommunication service concept in Recommendation I.210 corresponds to the services offered to users by the network. Besides operational and commercial aspects, the provision of these telecommunication services (bearer and teleservices) and associated supplementary services requires the availability of appropriate capabilities:

- network capabilities, in various network equipments (exchanges etc.);
- terminal capabilities;
- specialized service centre capabilities, when required.

1.3 Generic description of required capabilities

ISDN capabilities are the total sum of the functions required to support all basic and supplementary services offered by the ISDN.

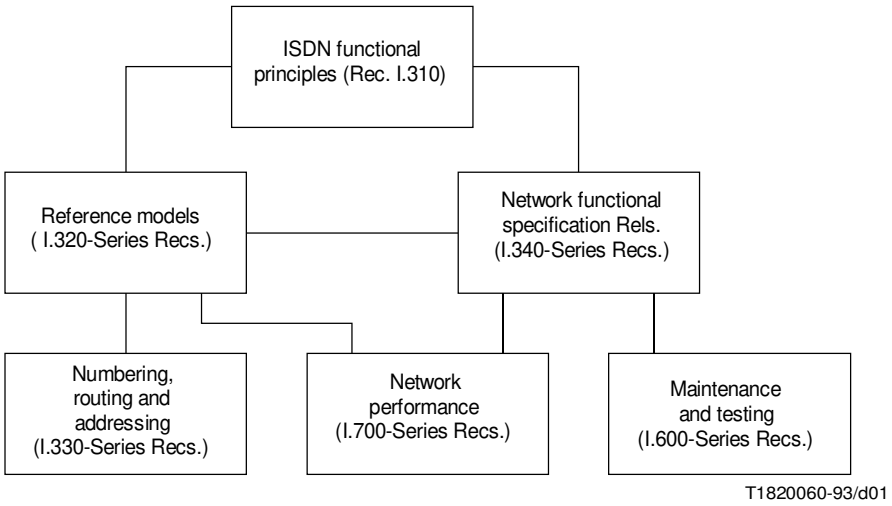


FIGURE 1/I.310

ISDN network series of Recommendations

1.3.1 Static description

The identification and characterization of these functions, which are related to the specification and analysis of these basic and supplementary services, form the first step of the generic description. This part of the generic description is intrinsically static.

1.3.2 Dynamic description

The use of a basic or supplementary service generally requires cooperation between functions located in different equipment.

The static description of the ISDN capabilities, which will be a list of functions, is not sufficient. It is necessary, in addition, to depict the sequence of events and the activation of functions coordinated by suitable inter-equipment signals. This second step is the dynamic aspect of the description. This involves firstly an identification and characterization of the functions and then a method of showing the dynamic interaction between functions.

2 Objectives of the functional description of the ISDN

As described in Recommendation I.120, an integrated services digital network (ISDN) is a network providing end-to-end digital connectivity to support a wide range of telecommunication services.

The characterization of ISDN is centered on three main areas:

a) the standardization of services offered to users, so as to enable services to be internationally compatible;

b) the standardization of user-network interfaces, so as to enable terminal equipment to be portable [and to assist in a)];

c) the standardization of ISDN capabilities to the degree necesary to allow user-network and network-network interworking, and thus achieve a) and b) above.

The I.200-Series Recommendations identifies the range of telecommunication services to be offered in an ISDN, namely bearer services, teleservices, and associated supplementary services and the attributes characterizing those services. The I.400-Series Recommendations describes both the functional and technical aspects of user-network interfaces. This Recommendation defines the ISDN capabilities to support services via interfaces in terms of functions. A functional description enables a decoupling of services and ISDN capabilities, and therefore allows an implementation-independent approach.

The principal objectives of the ISDN functional method are

1) to define the ISDN capabilities, by building up a harmonized set of functions that are necessary and sufficient to support telecommunication services by their static and dynamic description;

2) to aid the evolution of ISDN capabilities (modifications, addition of capabilities to support new basic or supplementary services), by organizing this set of functions in an open-ended and modular structure;

3) to aid the standardization of system-independent switching functions between exchanges of differing designs and manufacture;

4) to aid the standardization of interworking standards between switching systems located in different countries;

5) to provide information for the preparation of functional specifications for new telecommunication services;

6) to maximize the exploitation of functions provided and available in switching systems.

The transition from an existing network to a comprehensive ISDN may require a period of time extending over one or more decades. Therefore the design of an ISDN will be revolutionary, adding capabilities in a flexible and modular manner. An ISDN may therefore be expected to provide an open-ended set of functional capabilities able to accommodate new needs as they arise at acceptable cost.

During a long intermediate period, some functions may not be implemented within a given ISDN. Also, specific arrangements should be used to ensure compatibility with existing networks and services. An ISDN should also give access to existing services and interwork with existing networks and terminals.

3 Generic description model

3.1 General concepts

The ISDN functional description defines a set of capabilities which enable bearer and teleservices to be offered to users (see Recommendation I.210). The services require two different levels of ISDN capabilities viz.:

– the low-layer functions (LLF) relate to the bearer services;

– the high-layer functions (HLF) together with the lower layer functions relate to the teleservices.

In addition, operation and maintenance capabilities are required to support both bearer and teleservices (see Figure 2).

The capabilities of the ISDN need a detailed and rigorous characterization because there is a wide range of standardization issues involved.

To achieve the functional objectives described in 2, the ISDN functional description has been designed to

– define the overall functional characteristics of the ISDN;

– be implementation-independent and place no constraints on national network architectures beyond the network and interface standards given in the I-Series Recommendations;

– take full account of the constraints of existing dedicated networks;

– support the layering protocol concepts defined in Recommendation I.320.

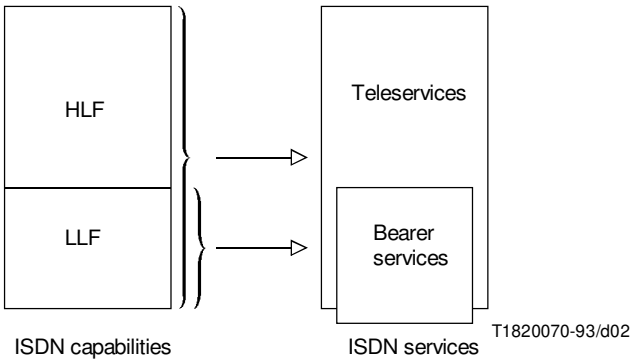


FIGURE 2/I.310

Relationship between telecommunication services and network capabilities

For this purpose the concept of an ISDN function is used, which is defined as

"A distiguishing characteristic which describes functional capabilities of a given equipment, or system, or network, as seen from the designer point of view."

As far as possible, the number of functions should be limited.

3.2 Static description model

3.2.1 Global functions (GF)

The description of ISDN capabilities concerns the low layers (1 to 3) in a global context (see Note), i.e. taking into account all the equipment involved in the communication, according to the protocol reference model (see Figure 3). In this context, a global function is defined as:

– referring to the ISDN capabilities;

– having a global significance in the lower layers.

The set of all GFs leads to the description of the total ISDN low layer capabilities.

NOTE – This concept of global function may be extended to describe the higher layer capabilities of ISDN terminals (and network capabilities, where these exist). In this case the GF has a global significance inside the higher layers.

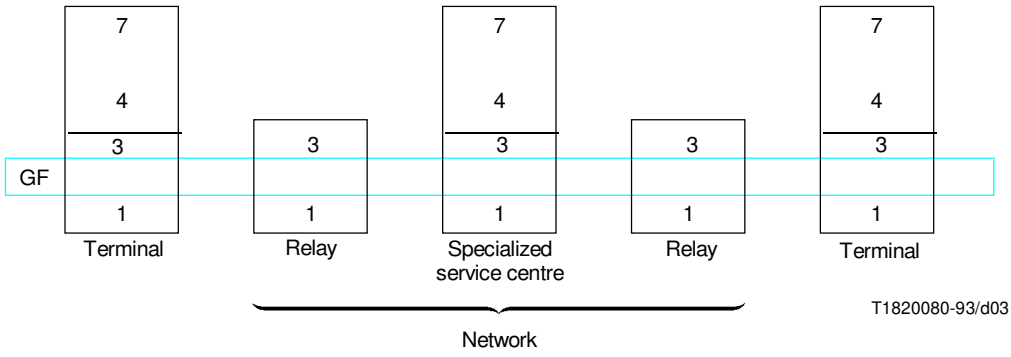


FIGURE 3/I.310

Global function concept

There are two kinds of GFs:

– the basic global functions (BGF), are those global functions needed to support ISDN basic services. The BGFs are related to ISDN connection types, as indicated in Table 1;

– the additional global functions (AGF), are related to the ISDN capability to support supplementary services. Details of the relationship between AGFs and the ISDN capability to support supplementary services are given in 4.1.2.

3.2.2 Elementary functions (EF)

The introduction of the GF concept allows a general description of low layer capabilities.

The following is a more detailed description: for each GF, a set of elementary functions is identified as the set of basic elements which are then *allocated* to different functional entities involved in the communication.

$$GF = (EF1, EF2, EF3, \ldots EFn)$$

An EF within this Recommendation is the lowest level of functionality. It is allocated to a functional entity involved in supporting a telecommunication service. An EF is an intrinsically static description of the capability of performing an action on a resource when defined conditions are met.

For building up a GF, each associated EF must be present in one or more functional entities of the ISDN. (In this context the ISDN may include the terminals, the network or specialized service centres.) But in a specific functional entity the complete set of associated EFs need not be present (see for example Figure 4).

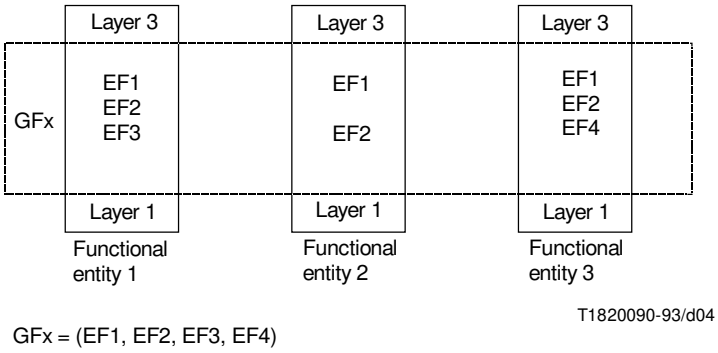


FIGURE 4/I.310

EFs associated with a GFx

3.2.3 Allocation of EFs

This flexibility in construction of EFs allows a specialization of the functions to be allocated to particular functional entities. Because the Recommendations on the architecture of the ISDN (see Recommendation I.324) will only specify a functional approach to standardization, the relationship between functional entities and specific equipment is, in general, a national matter. However, an important first step in allocation of functions will be the distinction between terminal equipment and the network equipment involved.

Recommendation I.324 introduces the functional grouping CRF (connection related functions). The CRF can be local, national transit or international transit. EFs can be associated with each of these.

3.3 Dynamic description model

The complete description of ISDN capabilities must include dynamic aspects involved in the process of a call.

This association of functional and protocol aspects leads to the use of the following dynamic description method:

3.3.1 Information flow diagrams

The operation of basic and supplementary services are described and characterized, as seen from a network point of view, by using information flow diagrams which show the sequence of events occurring in the course of the call.

3.3.2 Executive processes

An executive process (EP) corresponds to the particular use of one or more elementary functions within a particular functional entity which always yields specific results. In the intelligent network architecture, those results are called "functional entity actions" (FEAs) (see also 3.2/I.130). Therefore, an EP is characterized by input information it needs for execution and by output information of functional entity actions from execution of the EP.

Executive processes involve (see Figure 5)

a) sequences that link together events producing the activation of an EP, by means of signalling information passed between the function entities;

b) the information (or data) actually used:

- protocol information (signalling information sent or received by the component);
- component information ("network information");
- static information (description of available resources, environment, services, etc.);
- dynamic information (elaborated and used during the call handling).

The dynamic description of each basic or supplementary service as required in stage 2 of the description method given in Recommendation I.130, based on the above elements, results in a chart showing functional entities involved (e.g. associated with originating and destination exchanges, specialized service centres when required), the signalling information flow passed between them, and the executive processes used inside them.

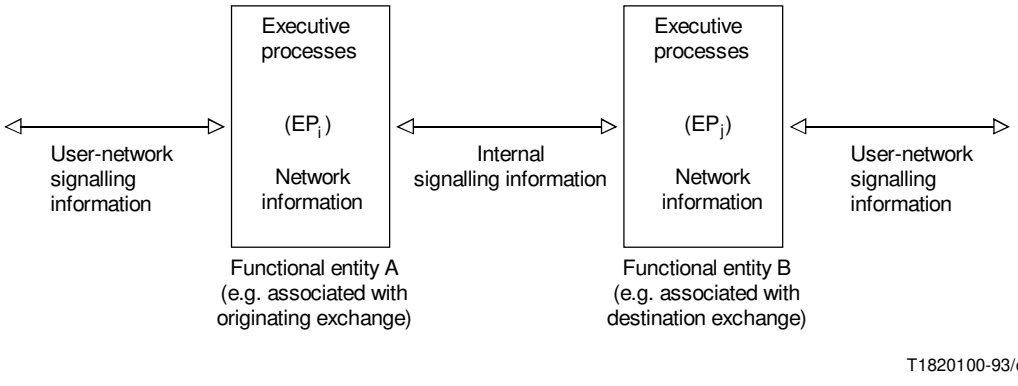


FIGURE 5/I.310

Basic functional allocation and executive processes

4 Use of generic description model

The analysis of telecommunication services and technological development leads to the identification of the range of required functions.

The analysis of all the basic and supplementary services provided by the ISDN will lead to the establishment of a set of elementary functions which can be allocated to different functional entities.

The design of a new basic or supplementary service should maximize the use of the set of existing EFs available to existing systems. This will minimize changes to the systems necessary for introducing these new services. The specifications for new equipment designed for providing particular services will have to comply with the set of EFs required for these services.

4.1 Identification of ISDN global functions

4.1.1 Basic global functions (BGF)

The basic global functions correspond to the ISDN capability to provide the various connection types that support telecommunication services.

The functions implemented to support telecommunication services can be classified into the following categories:

- *Connection handling:* Functions which enable the establishment (set-up), holding and release of connections (e.g. user-to-network signalling).
- *Routing:* Functions that determine a suitable connection for a particular service (call) request, i.e. suitable paths between the various equipments and inside the switching systems to establish end-to-end connections (e.g. called number analysis).
- *Resources handling:* Functions that enable the control of the resources necesary for the use of connections (e.g. transmission equipment, switching resources, data storage equipment).
- *Supervision:* Functions that check the resources used to support the connections, to detect and signal possible problems and to solve them if possible (e.g. transmission error detection and correction).
- *Operation and maintenance:* Functions providing the capability to control the correct working of the services/network as well for the subscribers as for the Administration.
- *Charging:* Functions providing the capability to the Administration to charge the subscribers.
- *Interworking:* Functions providing the capability for both service and network interworking.
- *Layer 2 and 3 data unit handling:* Functions providing handling of layers 2 and 3 data units during the information transfer phase for the case of packet mode connections.

According to this classification, a basic global function is defined as

- referring to an ISDN connection type;
- belonging to one of the above categories.

Table 1 shows the total set of BGFs.

4.1.2 Additional global functions (AGF)

The additional global functions corresponds to the ISDN capability to support supplementary services.

The classification of AGFs is based on the principle that the support of a supplementary service is considered as being realized by a number of functions distributed throughout the ISDN. The definition of AGFs needs further study.

TABLE 1/I.310

ISDN basic global functions

Category	Connection type			
	CT_1	CT_2	. . .	CT_n
Connection handling	1 BGF_1	2 BGF_1		n BGF_1
Routing	1 BGF_2	2 BGF_2		n BGF_2
Ressources handling	1 BGF_3	2 BGF_3		n BGF_3
Supervision	1 BGF_4	2 BGF_4		n BGF_4
Operation and maintenance	1 BGF_5	2 BGF_5		n BGF_5
Charging	1 BGF_6	2 BGF_6		n BGF_6
Interworking	1 BGF_7	2 BGF_7		n BGF_7
Layer 2 and 3 data unit handling	1 BGF_8	2 BGF_8		n BGF_8

4.2 Identification of ISDN elementary functions

Like GFs, there are two kinds of elementary functions: the basic EFs (i.e. components of BGFs, and possibly AGFs) and the additional EFs (i.e. components of AGFs). Therefore, identification of basic EFs requires a detailed analysis of connection types. Implementation and identification of additional EFs requires a detailed analysis of supplementary services implementation.

- *Basic EFs:* For each connection type, there are up to 8 BGFs to implement (see Table 1). Therefore each BGF is composed of basic EFs related to this connection type. However, some basic EFs may be common to several connection types (e.g. "called number analysis" belonging to the BGF "routing").
- *Additional EFs:* Additional EFs form a common set of functional elements available to build up the various AGFs, and thus to implement supplementary services.

This grouping of EFs into sets of BGFs and AGFs is illustrated in Figure 6.

The list of EFs so far identified is contained in Annex A, together with a preliminary set of definitions.

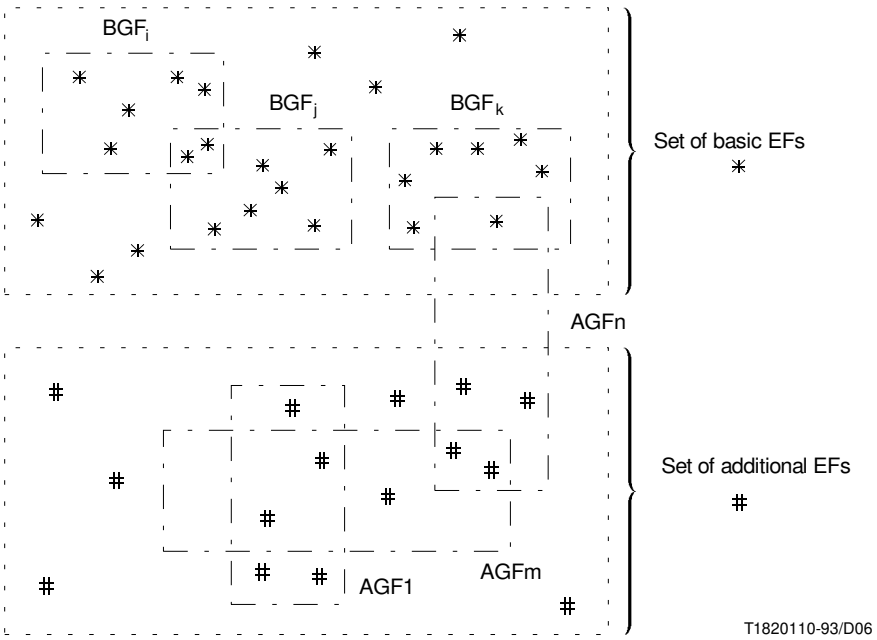
5 Functional realization of basic service requests

From the functional point of view, the process involved in satisfying a basic service request in the ISDN can be described as follows:

a) A basic service request contains a set of attribute values. The appropriate connection type(s) to support the service must be identified.

Service request examination:

- input: service request containing a set of attribute values;
- process: examine service request and determine appropriate connection type(s);
- output: connection type(s).



BGF$_i$ Basic global function related to connection type CT$_i$
AGF1 (see Table Additional global function related to supplementary service 1

FIGURE 6/I.310

EFs association principles for building up GFs

b) Once selected, the connection type (which has end-to-end significance) can be further broken down into one or more smaller functional components called "connection elements" (see Recommendation I.324).

Connection element selection:

– input: connection type;

– process: determine connection element(s) to form the connection type;

– output: connection element(s).

c) Each connection element would require a set of functions in order to be established.

Function set determination:

– input: connection element;

– process: select appropriate functions to establish connection element;

– output: set of functions.

Annex A

(This annex forms an integral part of this Recommendation)

A.1 List of identified basic elementary functions and additional elementary functions (EFs) for the ISDN

A.1.1 BASIC EFs related to connection types

Connection handling

BEF100 Characteristics of service requested examination

BEF101 Connection elements type determination

BEF102 User-network access resources reservation (channels)

BEF103 Transit resources reservation

BEF104 Communication references handling

104 E Establish call reference

104 C Clear call reference

BEF105 Establishment control

105 R Establish connection-return path only

105 F Establish connection-forward path

150 B Establish connection-both directions

BEF106 Release control

BEF107 Service related authorizations examination

BEF108 User-network signalling handling (layer 3)

BEF109 Inter-exchange signalling handling (user part)

BEF110 Supplementary services compatibility checking

BEF111 Building up of and maintaining dynamic information relating to the call/connection

BEF112 Signalling interworking

BEF113 Priority

BEF114 Queue handling

Routing

BEF200 ISDN number identification

BEF201 Called number analysis (address analysis)

BEF202 Routing information examination (if provided)

BEF203 Predetermined specific routing

BEF204 Connection path selection

BEF205 Rerouting

Resources handling

BEF300 Hold and release of user-network access resources (channels)

300 H Hold user-network access resources

300 R Release user-network access resource

BEF301 Hold and release of transit resources (circuits)

301 H Hold transit resources

301 R Release transit resources

BEF302 Insertion and suppression of specific equipment

BEF303 Tones, announcements and display information

BEF304 User-network signalling handling (layer 1 and 2)

BEF305 Inter-exchange signalling handling (message transfer)

BEF306 Path search inside switching unit

BEF307 Synchronization handling

BEF308 Timing handling

BEF309 Line service marking

BEF310 Real time clock

Supervision

BEF400 User-network access resources monitoring

BEF401 Transit resources monitoring

BEF402 Continuity checking

BEF403 Detection of congestion

BEF404 Semi-permanent connection checking

Operation and maintenance

BEF500 Management of subscriber data

BEF501 Fault report

Charging

BEF600 Charging management

600 I Initiate charging

600 C Cease charging

BEF601 Charging registering

BEF602 Charging recording

BEF603 Billing

BEF604 Accounting

BEF605 Charging information

Interworking

BEF700 Rate adaption

BEF701 Protocol conversion

BEF702 Handling of signalling for interworking

BEF703 Numbering interworking

BEF704 Special routing algorithms

BEF705 Negotiation

BEF706 Notification

BEF707 Charging for interworking

BEF708 Mapping of lower layer comparability

A.1.2 AEFs relating to supplementary services

AEF00 Insertion and suppression of additional resources (tones, etc.)

AEF01 Line hunting

AEF02 Direct dialling-in

AEF03 Address determination

AEF04 Subscriber's dedicated storage

AEF05 Bridge

AEF06 User-network access resource hold

AEF07 Hold of communication

AEF08 Additional subscriber signalling

AEF09 Additional inter-exchange signalling

AEF10 Multi-call handling

AEF11 Internal call initialization

AEF12 Access/route restriction

AEF13 Subscriber call data registration

AEF14 Data display option

A.2 Short description of elementary functions

A.2.1 Basic EFs related to connection types

A.2.1.1 Connection handling

100 *Characteristics of service requested examination*

Function of a functional entity to determine the required service characteristics (certain attributes of the bearer service and optional supplementary services) of a call by means of examination of information set by calling terminal.

101 *Connection elements type determination*

Function of a functional entity to determine connection types and connection elements necessary to provide the requested service.

102 *User access resources reservation*

Function of a functional entity to determine the type of user-network access (basic, primary), the state of the resources (channels availability) and to reserve the channel(s) needed for establishing the access connection element.

103 *Transit resources reservation*

Function of a functional entity to reserve the transit connection element, based on the state of resources.

104 *Communication references handling*

Function of a functional entity to assign a local reference (at the access interface) to the call and an internal reference (at the internal interface) to the connection, and to clear these references when the call/connection is cleared/released.

104 E Establish call reference (for further study)

104 C Clear call reference (for further study)

105 *Establishment control*

Function of a functional entity to set up a connection through the functional entity.

105 R Establish connection-return path only (for further study)

105 F Establish connection-forward path (for further study)

105 B Establish connection-both direction (for further study)

106 *Release control*

Function of a functional entity to release a connection through the functional entity.

107 *Service related authorization examination*

Function of a functional entity to determine the authorization (calling or called user) relating to basic and supplementary services that have been subscribed to.

108 *User-network signalling handling (layer 3)*

Function of a functional entity to support the layer 3 protocol of the user-network signalling system.

NOTE – For layers 1 and 2, see A.2.1.3, Resources handling.

109 *Inter-exchange signalling handling (user part)*

Function of a functional entity to support the user part of the inter-exchange signalling system.

110 *Supplementary services compatibility checking*

Function of the network to check the compatibility of requested supplementary services, e.g.:

- with requested bearer service to teleservice;
- with other requested supplementary services;

and to verify coherence between parameters that may be associated.

111 *Building-up of and maintaining dynamic information related to the call/connection*

Function of a functional entity to compile information related to the call/connection, e.g.:

- resources needed (connection type, connection elements, channels, circuits);
- details of call in progress;
- supplementary services effected and associated parameters.

112 *Signalling interworking*

Function of a functional entity to support interworking functions between signalling systems.

113 *Priority*

Function of a functional entity to handle specific calls with priority (e.g. in the case of overload or degraded mode of operation).

114 *Queue handling*

Function of a functional entity to store requests in a queue, in order to handle this information later in a predefined order.

A.2.1.2 Routing

200 *ISDN number identification*

Function of a functional entity to identify the ISDN number of the user-network interface. This information is limited to that included within the ISDN numbering plan.

201 *Called number analysis*

Function of a functional entity to analyse called ISDN number sent by the calling terminal in the call set-up phase.

202 *Routing information examination*

Function of a functional entity to analyse routing information that may be sent by the calling terminal and that has an effect on path selection.

203 *Predetermined specific routing*

Function of an exchange to select a specific routing according to the information received from the calling terminal (for example routing towards operators, access points, an interworking unit, an operational or maintenance unit, etc.).

204 *Connection path selection*

Function of a functional entity to select the transit outgoing part relating to connection types to be used, and the overall path through the network.

205 *Rerouting*

Function of a functional entity to select a new connection path through the network depending on changed conditions during call set-up or information transfer phases.

A.2.1.3 Resources handling

300 *Hold and release of user-network access resources (channels)*

Function of a functional entity to hold the access channel(s) reserved to support the communication, and to release it at the end of this communication.

300 H Hold user-network access resource (for further study)

300 R Release user-network access resource (for further study)

301 *Hold and release of transit resources (circuits)*

Function of a functional entity to hold the circuit(s) reserved to support the communication at the transit connection element and to release it at the end of this communication.

301 H Hold transit resources (for further study)

301 R Release transit resources (for further study)

302 *Insertion and suppresion of specific equipment*

Function of a functional entity to insert or remove specific equipments particularly to satisfy the service request invoked by the user. Examples of such equipment include

- echo suppressers;
- A-μ law conversion units (change of A/D conversion);
- interworking unit;
- storage unit.

303 *Tones, announcements and display information*

Function of a functional entity to provide call progress information in one or more of the following ways:

- a tone is an audible (call progress) indication comprising one or more discrete frequencies but excluding speech;
- a recorded announcement is an audible indication in the form of speech or music;
- display information is (call progress) information set to the user which is displayed visually.

Definitions of the other topics are not yet available.

304 *User-network signalling handling (layers 1 and 2)*

Functions of a functional entity to support layers 1 and 2 of the user-network signalling system.

305 *Inter-exchange signalling handling (message transfer)*

Function of a functional entity to support the messages transfer part of the inter-exchange signalling systems.

306 *Path search inside switching unit*

Function of a functional entity to select an internal connection inside the switching unit.

307 *Synchronization handling*

Function of a functional entity to provide synchronization between different functional entities and

function of a functional entity to provide its own internal synchronization functional entity.

308 *Timing handling*

Function of a functional entity to provide timing between time instances involved in calls.

309 *Line service marking*

Functions of a functional entity to store for each customer the data on the parameters of the bearer and teleservices that are subscribed to. The store also contains the data on the parameters of the basic bearer and teleservices that are subscribed to by the customer. In addition, it contains the binary information (i.e. subscribed to or not) for a range of supplementary services which the subscriber can use. In general this data does *not* contain information on the type of subscriber terminal, but it may contain information on the type of access (basic, primary rate, etc.), the type of NT2 (simple, intelligent, etc.) and the attributes of the services subscribed to.

310 *Real time clock*

Function of a functional entity to provide real time information.

A.2.1.4 Supervision

400 *User-network access resources monitoring*

Function of a functional entity to check the correct operation of subscriber access resources.

401 *Transit resources monitoring*

Function of a functional entity to check the correct operation of the transit resources.

402 *Continuity checking*

Function of a functional entity to control the checking operations relating to the continuity of a connection.

403 *Detection of congestion*

Function of a functional entity to detect congestion during the selection of a connection path.

404 *Semi-permanent connection checking*

Function of a functional entity to check the availability of a given semi-permanent connection (e.g. passive continuity checking).

A.2.1.5 Operation and maintenance

500 *Management of subscriber data*

Function of a functional entity to manage subscriber data related to services. Examples include

- in/out of service;
- number translation;
- changing of subscriber data.

501 *Fault report*

Function of a functional entity to register the cause if an attempt to set up a call fails.

A.2.1.6 Charging (the groupings below require further study)

Function of the network to determine, collect and store the charging information. The following features are involved in this process.

600 *Charging management*

Function of a functional entity to determine by means of certain parameters the charging mode (free of charge, ordinary, peak, reduced rate charge, etc.). These parameters include service type, class of customer, time information, distance, etc.

600 I Initiate charging (for further study)

600 C Cease charging (for further study)

601 *Charging registering*

Function of a functional entity to register the details of the call (both short- and long-term storage).

602 *Charging recording*

Function of a functional entity to format the charging details in a standardized way.

603 *Billing*

Function of functional entity to calculate the variable charges to the customer which depend on the use of a service and on the fixed costs of the subscription. Both of these are accumulated over a fixed period of time. This billing is associated with the subscriber and not with a user-network interface, a terminal, etc.

604 *Accounting*

Function of a functional entity to analyse, store and forward information relating to the use of inter-network resources between the different Administrations involved in a call.

605 *Charging information*

Function of the network to indicate the user the amount of the charge involved in the (current) use of the service.

A.2.1.7 Interworking

Functions that permit the establishment of end-to-end connections when an ISDN and a dedicated network are involved. This requires the provision of the basic elementary features (BEFs) which are described below and others that have been defined already (service request examination, signalling interworking, called number analysis, routing information examination, insertion and suppresion of interworking units, etc.).

700 *Rate adaption*

Function of a functional entity to adapt, according to a certain method, the user/dedicated network bit rates to the ISDN bit rates.

701 *Protocol conversion*

Function of a functional entity to support mapping functions between interfaces.

702 *Handling of signalling for interworking*

Function of a functional entity to handle signalling information for interworking (interpretation, termination, generation).

703 *Numbering interworking*

Function of a functional entity to support interworking functions between numbering plans.

704 *Special routing algorithms* (for further study)

705 *Negotiation* (for further study)

706 *Notification* (for further study)

707 *Charging for interworking* (for further study)

708 *Mapping of lower layer comparability (LLC) lists* (for further study)

A.2.2 Additional EFs relating to supplementary services

AEF00 *Insertion and suppression of additional resources (tone, etc.)*

NOTE – A definition has already been proposed for a basic EF. It needs to be considered if this feature should also be regarded as an additional feature. With respect to supplementary services a proposed description is:

Function of an exchange to manage (reserve, insert, release) additional resources related to the handling of supplementary services.

AEF01 *Line hunting*

Function of a functional entity to select, on receipt of a certain terminal address, one free line in a multi-line group corresponding to that number.

AEF02 *Direction dialling-in*

Function of a functional entity to transfer address and other appropriate call handling information to a PABX for the purpose of setting up a call to its extensions without assistance of the PABX operator.

AEF03 *Address determination*

Function of a functional entity to determine the destination number(s) called by means of short-long number conversion or of association between one code and one list of numbers.

AEF04 *Subscriber's dedicated storage*

Function of a functional entity to store details in addition to the LSM (line service marking) for each customer and which contains the registration data for supplementary services that have been subscribed to (i.e. listed in the LSM as binary 1). For example, it would contain a list of abbreviated numbers.

AEF05 *Bridge*

Functions of a functional entity to allow more than two individual participants on the same call.

AEF06 *User-network access resource hold*

Function of a functional entity to hold the user-network access resources (channel) involved in a communication in a waiting condition and, at the same time, to release the network connection. The call reference information is maintained.

AEF07 *Hold of communication*

Function of a functional entity to initiate the function to hold one, or more, of the other parties engaged in an established call in a waiting condition without the disestablishment of the call, and at the same time to release the initiating user-network access resource.

AEF08 *Additional subcriber signalling*

Functions of an exchange to send or receive specific signalling information to or from the user, related to the handling of supplementary services. (Additional signalling to the subscriber signalling for basic calls.)

AEF09 *Additional inter-exchange signalling*

Function of a functional entity to send or receive specific signalling information to or from another component, related to the handling of supplementary services. (Additional signalling to the inter-exchange signalling for basic calls.)

AEF10 *Multi-call handling*

Function of a functional entity to set up and manage several connections by means of a single procedure. (In response to only one call request.)

AEF11 *Internal call initialization*

Functions of a functional entity to initiate the setting-up of a connection without receiving a call request from the user [e.g. used for Completion of Call to Busy Subscribers (CCBS) supplementary service and alarm call services].

AEF12 *Access/route restriction*

Function of a functional entity to reject incoming or outgoing calls, either:

- totally for all services; or
- for one type of service (e.g. telephony).

AEF13 *Subscriber call data registration*

Function of a functional entity to register and display or print subscriber call data. Subscriber call data is information related to specific calls. This data is collected by the same functional entity as that which contains the EF "subscriber call data registration".

AEF14 *Data display option*

Functions of a terminal to display information to the user.