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DIGITAL EXCHANGES

DIGITAL EXCHANGE FUNCTIONS

ITU-T Recommendation Q.521

(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 Q.521 was revised by the ITU-T Study Group XI (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 Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.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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DIGITAL EXCHANGE FUNCTIONS

(Melbourne 1988, modified at Helsinki, 1993)

1 General

This Recommendation applies to digital local, combined, transit and international exchanges for telephony in Integrated Digital Networks (IDN) and mixed (analogue/digital) networks and also to local, combined, transit and international exchanges in an Integrated Services Digital Network (ISDN).

The field of application of this Recommendation is more fully defined in Recommendation Q.500.

Some text may only apply to a certain type (types) of exchange, e.g. digital transit, local or combined. Where this occurs, the application is defined in the text. Not all the recommended functions will necessarily be provided in every exchange.

2 Exchange functions – Introduction and framework

2.1 General

The purpose of this Recommendation is to specifically address those functions required to support basic and supplementary services in performing this test, this Recommendation takes account of the principles set down in Recommendation I.310 and draws a clear distinction between services and the exchange capabilities required to support them.

It should be noted that the list of functions identified in this Recommendation is not necessarily extensive.

2.2 Exchange model

The functions described in this and associated Recommendations can be considered within the framework of an exchange functional model. Such a model is shown in Figure 1. This divides the exchange into three functional areas as follows:

a) *control functions* – Those functions required to control services and connections, e.g. signalling, routing and connection/resources handling functions;

b) *connection functions* – Those functions directly related to the connection path through an exchange, i.e. switching and transmission mechanism (including ET);

c) *operation and maintenance functions* – Those functions of an operational, management and maintenance nature which are not employed for call establishment and supervisory purposes, e.g. test functions.

The exchange functional model shown in Figure 1 is appropriate to exchanges operating in an IDN and also those operating in an IDN which is evolving towards an ISDN. In terms of this Recommendation, most of the functions fall within the control functions area.

Connection functions are primarily covered in Recommendation Q.522. These address the basic switch characteristics of different connection types. OA&M functions are primarily covered in Recommendation Q.542.

2.3 Utilization of exchange functions for services

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

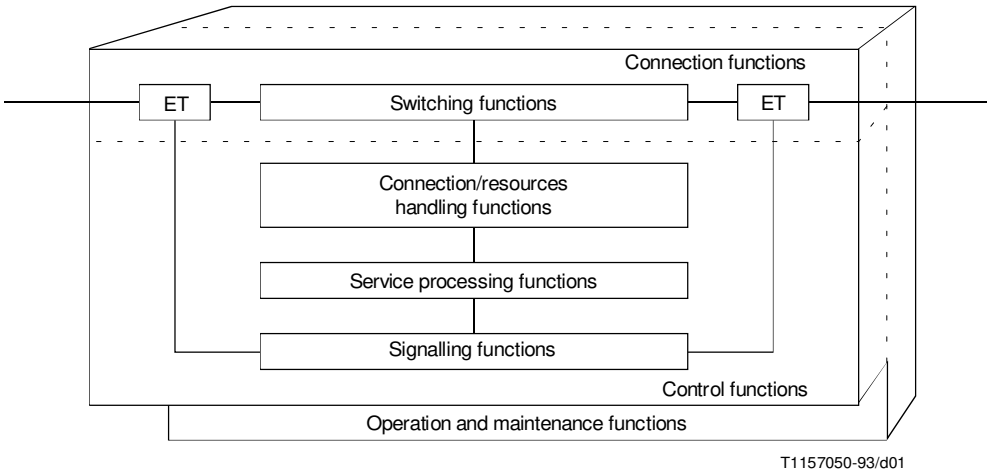

FIGURE 1/Q.521

Exchange functional model

Within the framework of the model shown in Figure 1, the utilization of functions arising from a service request can be considered in the following way:

a) on receipt of a service request (via the Signalling Functions) the Service Processing Functions are used to identify the appropriate connection type(s);

b) the appropriate type of connection is established by use of the Connection/Resources Handling Functions;

c) Supplementary Services which involve additional functions and information flows beyond those required for bearer services, are provided under the control of logic residing in the Service Processing Function. This logic is designed to provide specific services. Corresponding service/feature capabilities must also reside in the Signalling and Connection/Resources Handling Functions.

In addition to services provided by use of logic/data residing in the exchange, some services may be provided under the control of logic located at separate specialized nodes (Service Control Points). Also, data required or process certain service requests may be kept in a remote data base accessed by use of the Signalling Function.

3 General functions required in an exchange for operation in the IDN, ISDN or mixed analogue/digital environment

3.l Timing and synchronization

3.1.1 Exchange timing

Distribute timing within the exchange so that it will maintain synchronism on 64 kbit/s channel timeslots in a connection through the exchange.

3.1.2 Synchronization

Operate in the IDN or ISDN in synchronism with other digital entities and provide timing signals to other network entities as required.

3.1.3 Interval timing

Measure time between events as required for call processing and/or signalling.

3.1.4 Time of day clock

Determine and indicate as required, time of day.

NOTE – The level of accuracy of the time of day clock is for further study.

3.2 Signalling

3.2.1 User access signalling functions

3.2.1.1 In-band signalling

Receive/transmit and interpret decadic or Dual Tone Multi-Frequency (DTMF) signalling from/to users.

3.2.1.2 Digital subscriber signalling

- Support user access signalling layers 1 and 2 in accordance with Recommendations I.430, I.431 and Q.921.
- Communicate with user terminals using layer 3 signalling in accordance with Recommendation Q.931.

3.2.2 Network signalling functions

3.2.2.1 CCITT Signalling systems

- Support and use CCITT signalling systems included in Recommendation Q.7 as required, particularly CCITT Signalling System No. 7.
- Communicate with other network entities using the CCITT Signalling System No. 7, Q.700-Series of Recommendations User Parts.

3.3 Data Packet Handling

3.3.1 Handle Packets

Transmit and receive data messages to/from users and data networks in accordance with Recommendation X.31.

3.3.2 Interwork with data network(s)

Interface and interact with data networks in accordance with Recommendations X.31.

3.4 Information retrieval and analysis

3.4.1 Access data bases

Gain access to data bases internal or external to the exchange.

3.4.2 Retrieve information from:

3.4.2.1 User/line data bases

Retrieve information about access lines and/or users such as “class of service”, priority level, parameters of basic bearer and teleservices subscribed to, etc.

3.4.2.2 Interexchange circuit data bases

Retrieve information about interexchange circuit groups, such as the identity of the entity to which it connects, the size of the circuit group and the location of its terminations, the type of circuits (incoming, outgoing or both ways), type of transmission system (analogue, digital), signalling required, etc.

3.4.2.3 Data base relating to “other terminations”

Retrieve information about other terminations on the exchange (tone circuits, announcements, bridge terminations, etc.).

3.4.2.4 Data base related to routing information

Retrieve information needed to determine how to route a call attempt based on the called number, call history and/or other pertinent information (e.g. network management information).

3.4.2.5 Data base of charging information

Retrieve information needed to determine the charging functions and rates needed for a particular call attempt or service usage.

3.4.3 Analyze information

Relate information pertaining to a call attempt or service request to information obtained from data base(s) to determine the appropriate course of action.

3.5 Resource management

3.5.1 Monitor the status of resources

Detect changes in status (busy, idle, out of service, etc.) of resources (lines, interexchange circuits, other terminations, exchange components, etc.).

3.5.2 Maintain status information

Determine in real time the availability of all resources for use in call attempt or service request processing and for other functions (e.g. network management).

3.5.3 Establish and maintain information relating to call attempts

Establish and maintain in registers for as long as necessary, information (service used, calling and called numbers, resources used, etc.) and events (connect time, disconnect time, etc.) related to individual calls, attempts or services used.

3.5.4 Check continuity

Verify that proper transmission capability is available on a connection or resource when such a check is required and take appropriate action when the check fails.

3.5.5 Check proper operation of resources

Verify the proper operation of user access and exchange or transit resources, as required, and to take appropriate action when verification fails.

3.5.6 Handle queues

Establish and manage queues, as required, when the number of bids exceeds the available resources required to handle them.

3.6 Ongoing operations

3.6.1 Make measurements

Make and record counts of attempts and events, measurements of usage and occupancy of resources, as required.

3.6.2 Calculate percentages

Calculate in real time the ratio or percent of total volumes attempts, events, etc., as required.

3.6.3 Detect and react to congestion

Detect when specified congestion thresholds are reached and to take appropriate action.

3.6.4 Generate/respond to network management controls

Generate and respond as required to network management controls, signals and/or messages.

3.6.5 Interact with TMN operations systems/centres

Communicate and interact with Operations Systems (Network Management, Accounting, Maintenance, etc.) via the Telecommunications Management Network (TMN).

3.6.6 Report faults/failure events

Detect and report faults and their cause, if known, to the appropriate system(s) or centre(s).

3.6.7 Perform charging functions:

3.6.7.1 Accumulate and store charging data

Accumulate and store call or service information required for proper billing.

3.6.7.2 Format charging data

Assemble call or service charging details into the proper format for transfer as required for billing computation.

3.6.7.3 Transfer charging data

Send charging details as required (batch or per call), to accounting centre or billing system or function.

3.6.7.4 Send charging information to user

Indicate to the user, as required, the amount of charging involved in the use of the service.

NOTE– This function may be a service feature provided on a national basis.

4 Functions used in processing bearer service call attempts

4.1 Process Service Request

Recognize and respond to service request.

Recognize and interpret signals or messages from users that indicate the initiation of a call (or a request for service), acknowledge the receipt of the signal or message as required and take action to process the call or initiate the service.

4.2 Connect (through connect)/Disconnect

Establish, as required, a path or virtual path through exchange (one-way or two-way)/ take down connection through exchange and make resources available for other call attempts.

4.3 Perform originating screening (in originating exchange)

4.3.1 Identify the calling user

Determine the ISDN number of the user based on line or channel class and information sent by the user.

4.3.2 Determine the user terminal characteristics

Determine the characteristics of the user terminal based on its ISDN number.

4.3.3 Examine service request

Determine the required service charcteristics by examining information sent by the calling terminal.

4.3.4 Examine user's service authorization

Determine whether or not the user is authorized to use the requested service.

4.3.5 Determine priority

Determine the priority level assigned to a user line or terminal and/or priority level of a particular call/message based on priority information associated with the call/message.

4.3.6 Establish call reference

Assign and retain for the duration of a call (or service usage), internal reference(s) for associating the resources used with the call (or service usage) and for keeping status information.

4.4 Perform terminating screening (in terminating exchange)

4.4.1 Identify called user (in exchange serving the called user)

Identify the called user line(s)/channel(s) and their characteristics based on the called subscriber number.

4.4.2 Determine the user terminal characteristics based on its ISDN number.

4.4.3 Verify that the called user is authorized and/or capable of receiving the call/service request.

4.4.4 Establish call reference

Assign and retain for the duration of the call (or service usage), internal reference(s) for associating the resources used with the call (or service usage) and for keeping status information.

4.5 Process Attempt

4.5.1 Analyze called number

Examine the called number and determine routing and other required treatment (e.g. special handling and/or treatment).

4.5.2 Analyze routing information

Analyze routing information, service requirements, any network management controls in effect and routing information sent by the user (e.g. restriction on using satellite links).

4.5.3 Determine connection elements type

Determine the connection types and elements (resources) required to provide the requested service.

4.5.4 Determine outgoing route/circuit group

Determine the appropriate sequence of routing choices (e.g. circuit groups) based on address and routing information analysis.

4.5.5 Select resources

Select specific available resources (access channel, outgoing circuit, other resources, etc.) for use in setting up the call or service. In a terminating exchange, if called user channels are busy or unable to complete the call or establish service, return appropriate signal or message toward originating user.

4.5.6 Select path through exchange

Select an available path through the exchange for use on the call to provide a connection between incoming and outgoing terminations or a means of passing data messages through the exchange.

4.5.7 Reserve resources:

4.5.7.1 User-network access

Hold the selected channel(s)/virtual channel available for use in supporting the requested service or call attempt.

4.5.7.2 Interexchange circuits

Hold the selected circuit(s)/virtual channel available for use on a call attempt or service.

4.5.7.3 Other resources

Hold echo suppression, pads and other equipment or functions available for use on the call or call attempt, if required.

4.5.8 Forward SETUP information as required and/or send alerting signal/indication or message(s) toward called user/calling user, as required.

5 Additional functions required to provide ISDN Supplementary Services

(For further study.)