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Foreword

This ETSI Technical Report (ETR) has been produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI).

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Introduction

ETSI Sub-Technical Committee (STC) NA5 has worked with the technical aspects of Broadband Integrated Digital Network (B-ISDN) in the past and some ideas on charging have been elaborated. This ETR does not attempt to create new principles for charging, but indicates the parameters and mechanisms which can be applied to charging in a B-ISDN.

Network capabilities for charging are strongly influenced by the charging principles used to charge future B-ISDN services. On the other hand, charging may influence the behaviour of the users and the balance of the total traffic load of the network. Finally, network capabilities for charging have also a relationship to signalling, traffic control and resource management.

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1 Scope

In Broadband Integrated Digital Network (B-ISDN), because of its innovative transfer mode, the information given in present recommendations on charging are not sufficient to cover all the capabilities that such a network is able to provide.

Therefore, this ETR describes the parameters relevant for charging and the mechanisms needed for charging of communication in the B-ISDN. The general principles for charging are listed which apply to B-ISDN.

Charging will be done both by network operators and service operators for the usage of resources. This ETR describes parameters and mechanisms from a technical point of view. Therefore, the term "operator" is used throughout this ETR where it is applicable to service operators, to network operators, or to both service and network operators.

Tariffing and billing of B-ISDN services are outside the scope of this ETR.

2 References

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

[1] CCITT Recommendation D.210: "General charging and accounting principles for international telecommunication services provided over the Integrated Services Digital Network (ISDN)".

[2] CCITT Recommendation D.211: "International accounting for the use of the Signal Transfer Point (STP) in CCITT Signalling System No. 7".

[3] CCITT Recommendation D.220: "Charging and accounting principles to be applied to international circuit mode bearer services provided over the integrated services digital network (ISDN)".

[4] CCITT Recommendation D.230: "General charging and accounting principles for supplementary services associated with international telecommunication services provided over the Integrated Services Digital Network (ISDN)".

[5] CCITT Recommendation D.231: "Charging and accounting principles relating to the User-to-user Information (UUI) supplementary service".

[6] CCITT Recommendation D.250: "General charging and accounting principles for non-voice services provided by interworking between the ISDN and existing public data networks".

[7] CCITT Recommendation D.251: "General charging and accounting principles for the basic telephone service provided over the ISDN or by interconnection between the ISDN and the public switched telephone network".

NOTE 1: In the above mentioned D-series Recommendations, the attention is focused on the collection of charges and accounting, no information is given on the network capabilities for charging.

[8] CCITT Recommendation I.141: "ISDN network charging capabilities attributes".

NOTE 2: In CCITT Recommendation I.141, only a table is provided on candidate network charging capability attributes (parameters).

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

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

3 Definitions, symbols and abbreviations

3.1 Definitions

Network Charging Capabilities: a set of actions and procedures performed by the network in order to determine all the network parameters of a communication, which are required for account management, and to determine the values of these parameters.

3.2 Symbols and abbreviations

AAL	ATM Adaptation Layer
ATM	Asynchronous Transfer Mode
B-ISDN	Broadband Integrated Services Digital Network
CAC	Connection Admission Control
CBR	Constant Bit Rate
CL	Connectionless
CLP	Cell Loss Priority
DCF	Data Communications Facility
MAN	Metropolitan Area Network
N-ISDN	Narrowband Integrated Services Digital Network
NPC	Negotiated Parameter Control
OAM	Operation And Maintenance
OS	Operations System
QoS	Quality of Service
UPC	Usage Parameter Control
VCC	Virtual Channel Connection
VPC	Virtual Path Connection

4 Charging principles applied to the B-ISDN

In order to better understand which network capabilities are necessary, the following principles for charging are assumed to be correct:

- it is possible to charge the originating user, the destination user or split the charging;
- they do not prevent the presentation of the charging information to the user in due time;
- it is possible that services offered by both Narrowband Integrated Services Digital Network (N-ISDN) and B-ISDN have the same charges independently on the charging method;
- it is possible to reflect a relationship between cost and service with its parameters (e.g. quality);
- it is possible to use non-linear relations between charging and parameters;
- it is possible to charge for the actual usage of a non-Constant Bit Rate (CBR) connection;
- they are simple and transparent to the user.

5 Parameters relevant for charging in B-ISDN

5.1 List of parameters

Charging can be based on parameters and factors seized by the network in real time. Weighting factors may influence the conversion of parameters into charges to the user. Which parameters are used and how they are weighted is a matter of tariffing and out of the scope of this ETR.

Collection charges of the B-ISDN may be divided into two fundamental components:

- the access component; and
- the utilization component (see CCITT Recommendation D.210 [1]).

The following is a list of parameters for both components, which might be relevant for charging in a B-ISDN.

A) parameters related to the subscription (access component).

These parameters allow to compensate administrations for the facilities required for a user to access a service or services (e.g. those facilities specifically provided to that user), and are independent of the utilization:

A1) type of access;

A2) set of services;

A3) customer category;

B) parameters related to the connection (utilization component).

Utilization charges should be in accordance with the service requested by the user and the basis of provision. These charges should in principle be determined on the basis of the network resources and any additional functions required to provide the service to the user. These should be possible by considering a set out of the following parameters.

It should be noted that the following parameters are separated for each unidirectional connection within a B-ISDN call (connections can be asymmetric and a call can be composed of several connections):

B1) related to fixed cost.

This component reflects the cost of the utilization of the control resources:

B1.1) in case of connection oriented services:

B1.1.1) call set up;
B1.1.2) call attempt;

B1.2) in case of Connectionless (CL) services,

for the capability of the network to offer such a service:

B1.3) type of service;

B2) related to the call characteristics.

This component reflects the cost for the utilization of switching and transmission resources:

B2.1) distance;
B2.2) duration;
B2.3) time of day - day of week - day of the year;
B2.4) priority;
B2.5) provided Quality of Service (QoS);
B2.6) negotiated parameters;
B2.7) common resources (e.g. servers) used;
B2.8) violation of negotiated parameters;
B2.9) reserved resources (guaranteed throughput);
B2.10) volume actually used;
B2.11) burstiness of the source (e.g. mean-peak-bit rate and/or its distribution);
B2.12) Total traffic load of a network;
B2.13) Multipoint aspects, if applicable.

Additional charges may be raised for some supplementary services (see CCITT Recommendations D.210 [1] and D.250 [6]).

No specific charging should be done for signalling according to CCITT Recommendation D.211 [2]. In general, this is satisfied by B1) above.

The above list covers all aspects charging in B-ISDN at this point in time. Nevertheless, it might be possible that the parameters listed above will not be sufficient in the future and that evolving new services will lead to additional parameters that do need to be measured inside the network.

5.2 Description of the parameters

This subclause describes the parameters listed in subclause 5.1 in detail.

A1) Type of access

The user has to pay for the capacity provided by the network operator, the maintenance, the redundancy, etc. (e.g. number of links installed, bit rate of the links 155 Mbit/s vs. 622 Mbit/s), independently of the actual use.

A2) Set of services

The user has to pay for the capability provided by the network operator to access particular services, (that influence the dimensioning of common resources) independently from the actual use.

A3) Customer category

This parameter, which has mainly marketing reasons, considers also the overall average characteristics of the traffic generated by the customer which influence the dimensioning of the network. It may be taken into account at system management level.

B1.1.1) Call set up

This parameter corresponds to the cost for the usage of the common and distributed resources (processing, signalling, etc.) for the set-up of each connection.

B1.1.2) Call attempt

This parameter is based on the capability of detecting and communicating the reason of the unsuccessful attempt to the charging entity of the management and may be to calling party (e.g. called party busy, lack of network resources, etc.) It corresponds to the resources used by the network to offer the call to the called party. The possibility and the way of using such a parameter is for further study.

B1.2) Connectionless services

The user has to pay for the capability of the network to offer such a service. See subclause 6.2 for details of CL-service.

B1.3) Type of service

The various parameters may be weighted differently for different services.

B2.1) Distance

In a two party call, this parameter indicates the geographical distance between both parties (usually in fix steps). Between two given points the considered distance should be unique and independent from the actual physical path of the connections.

In a multiparty call (in particular if separate charging is foreseen) the definition of the distances depend on how the call itself is modelled and requires further study.

B2.2) Duration

Two cases can be distinguished:

- the pure time interval between the start and the end of a call; and
- a set of time stamps associated to the relevant variations of the considered parameters for charging a call.

In the second case, it may be considered also in semipermanent connections.

If, during a call, one or more of the connections which support it become unavailable, the charging mechanism has to be stopped. Depending on the disposable protection means, the connection can be re-routed or the call released. In the first case the charging mechanism needs to be re-activated.

B2.3) Time of day - day of week - day of the year

These parameters allow to encourage a better distribution of the user traffic over the time and may be applied in different ways to different services.

B2.4) Priority

Two types of priorities are supposed which are:

- implicit priority;
- explicit priority.

The first type is connected to the possibility of using Virtual Path Connection/Virtual Channel Connection (VPC/VCC) having implicit high priority in the network.

For the second type, the Cell Loss Priority (CLP) mechanism manipulated by the user at cell level may be considered but requires some clarification.

B2.5) Provided QoS

This complex parameter should be considered split into its component parameters, such as described in ITU-T Recommendation I.356 [9]. In fact, different services are sensitive to different parameters.

Some classes of quality may be defined, in a way understandable to the customer who can choose the class which is appropriate to his needs.

B2.6) Negotiated parameters

A charging strategy can be based on traffic volume, allocated resources or other parameters described in ITU-T Recommendation I.371 [10].

The strategy, in the case of a charging strategy based on traffic volume, may be described by sustainable cell rate and peak cell rate.

In case the strategy is based on the allocated resources these parameters are already included in the amount of the resources themselves.

B2.7) Common resources (e.g. servers) used

For further study.

B2.8) Violation of negotiated parameters

The violation of negotiated parameters may cause some sanctions by the network, either by discarding the extra traffic or by introducing an extra charge. This is for further study.

B2.9) Reserved resources

This parameter deals mainly with the allocated resources and is the simplest way to charge a call, but it requires a fixed correspondence between the user requests and the allocated resources. More precisely, for each type of user request a reference value of allocated resources should be provided. The resources actually allocated may also depend on other factors like the QoS required.

B2.10) Volume actually used

The method requires a traffic measurement during the connection, and may be used as a supplementary criterion also on semipermanent connections (in Asynchronous Transfer Mode (ATM) environments the cost of a semipermanent connection depends also on its usage).

B2.11) Traffic characteristic of the source

Relevant factors are sustainable cell rate, peak cell rate, duration of peak and burstiness. (Other factors are for further study.) The meaning of these factors are discussed actually in connection with the functions Connection Admission Control (CAC) and Usage Parameter Control (UPC).

The parameters "traffic characteristic of the source" and "negotiated parameters" as well as "reserved resources" and "volume actually used" are closely related to each other. It is for further study which of them is best suited to be taken into account for charging.

B2.12) Total traffic load of a network

This parameter allows to encourage a better distribution of the user traffic over the time and may be applied in different ways to different services, but it requires a communication between the customer and the network. This is the "dynamic" version of the parameter "time of day".

B2.13) Multipoint aspects

"Multipoint aspects" is not a parameter itself but may influence some of the other parameters. This point is for further study.

6 Charging mechanisms required in B-ISDN

The following functions and capabilities are part of the charging entity in the network (see ITU-T Recommendation I.356 [9]):

- functions for the measuring of the parameters;

- an activity generating charging records from the measured data and reports for the Operations System (OS);

- a storage function, necessary for storage of charging records over a limited period of time;

- the capability to detect whether there is still sufficient storage capacity for new records;

- a timer function to be able to send reports to the OS at regular intervals;

- a Data Communications Facility (DCF) for communication with the OS;

- availability control and performance monitoring. Recording and communication of relevant events. This has not necessarily to be done in real-time. Such parameters may be detected at the endpoint of a connection.

Only the first point will be dealt with in subclause 6.1. The other points are more or less related to accounting functions and have no direct impact on the network.

6.1 Measuring of the charging parameters

Clause 5 list a variety of parameters which can be used to charge for a B-ISDN connection. But first the parameters have to be measured. This subclause describes how the parameters can be measured.

The parameters can be divided into three categories:

- parameters which are relevant for administration without impacting the network. This category covers all parameters related to the subscription (point A) in Clause 5);

- parameters which impact the network and are well known from today's networks. This category covers the parameters related to fixed cost (point B1)) and the parameters distance, duration, time of day - day of week - day of the year, common resources used - points B1), B2.2), B2.3) and B2.7);

- parameters which impact the network and are related to the ATM technique.

Only the third category which is specific to the ATM technique will be dealt with in the following paragraphs. All these measurements are mainly made at the ATM layer; no higher layers of the user plane (especially ATM Adaptation Layer (AAL)) are engaged.

Measuring of priority:

- implicit priority.

  Information on implicit priority can be obtained from signalling. Verification of the degree of priority is obtained considering the cell loss rate with respect to the total load of the network. This may be done by the system management;

- explicit priority.

  If CLP is used different measurements for both classes may be needed.

Measuring of provided QoS:

- the only method to measure the quality is the activation of performance monitoring for a given VPC/VCC (Operation And Maintenance (OAM) flow F4/F5). So if QoS is charged performance monitoring has to be activated and the result of performance monitoring has to be forwarded to the charging entity. This parameter can only be applied to the limited number of VPCs/VCCs for which performance monitoring is activated.

Measuring of negotiated parameters:

- this information can be obtained from the entity for connection admission control.

Measuring of violation of negotiated parameters:

- measurement of the number of cells violating parameters is done at the entrance of the network. It should be performed both at UPC and Negotiated Parameter Control (NPC). It may be useful information related to the performance degradation, even in the case in which the violated cells are discarded.

Measuring of reserved resources:

- this information can be obtained from the entity for connection admission control.

Measuring of the volume actually used:

- the only possibility is the counting of all cells of a connection. The location of the counting of cells is for further study.

Measuring of the traffic characteristic of the source:

- this information can be obtained from the entity for usage parameter control. Whether this information is sufficient for charging is for further study.

Measuring of the total traffic load of the network:

- for further study.

Measuring of multipoint aspects:

- for further study.

6.2 Special applications

6.2.1 Connectionless service

The ATM-based B-ISDN is in its nature connection oriented. The provision of CL-service will be done by CL-servers. So from the B-ISDN network a connection oriented bearer service from the user to the CL-server will be charged. It will be a subject of negotiation between the B-ISDN network provider and the provider of the CL-server to elaborate a charging scheme satisfactory for the user. (The CL-service may in some cases be fully integrated in the B-ISDN administration, in case there will be no administratively separate charging. In other cases the CL-service will be administrated separately, in which case separate charges for the ATM transport and higher layer service will exist).

The charging procedures mentioned in subclause 6.1 for the volume actually used is in principle also applicable to CL applications supported by ATM.

Charging will include supplementary services such as group address usage.

For Metropolitan Area Networks (MANs) a detailed description of the charging for CL-service is available (see ITU-T Recommendation I.356 [9]). Whether charging of CL-service in B-ISDN should be identical to that in MAN is for further study.

6.2.2 Semipermanent connections

In a first phase the charging of semipermanent connections could be made on a subscription basis. Whether other parameters should be taken into account later is for further study.

6.2.3 Multiparty calls and broadcast

The mechanism for charging multiparty calls depend on how such kind of calls is modelled, and on what is the actual utilization of network resources. If a point to multipoint connection is present, it is necessary to define how the charging parameters can be applied to this kind of connection, in particular if the charging is split among the parties.

6.2.4 Frame relay in B-ISDN

For further study.

History

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