§

INTERNATIONAL TELECOMMUNICATION UNION

CCITT **I.211**

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

INTEGRATED SERVICES DIGITAL NETWORK (ISDN)
GENERAL STRUCTURE AND SERVICE CAPABILITIES

B-ISDN SERVICE ASPECTS

Recommendation I.211

§

Geneva, 1991

Printed in Switzerland

FOREWORD

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

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

Recommendation I.211 was prepared by Study Group XVIII and was approved under the Resolution No. 2 procedure on the 5 of April 1991.

CCITT NOTES

1)

indicate both a telecommunication Administration and a recognized private operating agency.

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

Preamble to B-ISDN Recommendations

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

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

I.121 — Broadband aspects of ISDN

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

I.211 — B-ISDN service aspects

I.311 — B-ISDN general network aspects

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

I.327 — B-ISDN functional architecture

I.361 — B-ISDN ATM Layer specification

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

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

I.413 — B-ISDN user-network interface

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

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

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

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

PAGE BLANCHE

Recommendation I.211
Recommendation I.211

B-ISDN SERVICE ASPECTS

Foreword

detailed Recommendations on specific standardized services to be supported by a B-ISDN. The purpose is:

i) to provide a classification of such services;

ii) to provide some considerations on the means to describe services based on the description method as defined in Recommendation I.130;

iii) to give a basis for the definition of the network capabilities required by B-ISDN.

The service concepts considered in this Recommendation are in accordance with § 2 of Recommendation I.210.

The Recommendation takes into account some of the known and relevant aspects of the B-ISDN including:

— capabilities to increase flexibility to both user and network operator including independent call and connection control;

— the quality of service implications of information being structured and transported in cells;

— capabilities for flexible bandwidth allocation;

— capabilities for the provision of service timing information;

— the overall interface capabilities.

The Recommendation also gives guidance on video coding aspects taking into account the characteristics of the ATM based network and recommends a common approach to video coding for all visual services including both interactive and distribution type services.

1 Classification of broadband ISDN services

1.1 *General*

This section describes the classification of broadband services, the definition of those service classes, and gives examples of services in each service class proposed to be supported by the B-ISDN.

This classification does not take into account the location or the implementation of the functions either in the network or in the terminals. This classification is primarily from the point of view of the network and not from the user point of view.

Depending on their communication functions and applications, the services to be supported by the B-ISDN may be internationally standardized and offered by the Administration/RPOA as bearer services or teleservices.

1.2 *Service classes*

Depending on the different forms of the future broadband communication and their applications, two main service categories have been identified: interactive services and distribution services. The interactive services are subdivided into three classes of services, viz., the conversational services, the messaging services, and the retrieval services. The distribution services are represented by the class of distribution services without user individual presentation control and the class of distribution services with user individual presentation control.
Figure 1/I.211 = 7.5 cm

1.3 *Definition of service classes*

1.3.1 **conversational services**

Conversational services in general provide the means for bidirectional communication with real-time (no store-and-forward) end-to-end information transfer from user to user or between user and host (e.g. for data processing). The flow of the user information may be bidirectional symmetric, bidirectional asymmetric and in some specific cases (e.g. such as video surveillance), the flow of information may be unidirectional. The information is generated by the sending user or users, and is dedicated to one or more of the communication partners at the receiving site.

Examples of broadband conversational services are videotelephony, video conference and high speed data transmission.

1.3.2 **messaging services**

Messaging services offer user-to-user communication between individual users via storage units with store-and-forward, mailbox and/or message handling (e.g. information editing, processing and conversion) functions.

Examples of broadband messaging services are message handling services and mail services for moving pictures (films), high resolution images and audio information.

1.3.3 **retrieval services**

The user of retrieval services can retrieve information stored in information centres provided for public use. This information will be sent to the user on his demand only. The information can be retrieved on an individual basis. Moreover, the time at which an information sequence is to start is under the control of the user.

Examples are broadband retrieval services for film, high resolution image, audio information, and archival information.

1.3.4 **distribution services without user individual presentation control**

These services include broadcast services. They provide a continuous flow of information which is distributed from a central source to an unlimited number of authorized receivers connected to the network. The user can access this flow of information without the ability to determine at which instant the distribution of a string of information will be started. The user cannot control the start and order of the presentation of the broadcasted information. Depending on the point of time of the user's access, the information will not be presented from the beginning.

Examples are broadcast services for television and audio programmes.

1.3.5 **distribution services with user individual presentation control**

Services of this class also distribute information from a central source to a large number of users. However, the information is provided as a sequence of information entities (e.g. frames) with cyclical repetition. So, the user has the ability of individual access to the cyclical distributed information and can control start and order of presentation. Due to the cyclical repetition, the information entities selected by the user will always be presented from the beginning.

One example of such a service is full channel broadcast videography.

1.4 *Identification of possible broadband services*

Table 1/I.211 contains examples of possible services, their applications and some possible attribute values describing the main characteristics of the services.

The identification and full specification of specific services for standardization can only be completed after a thorough examination of the needs of users by e.g. market research. The full specification of such services should be based on the application of appropriate description methodology.

µTABLE 1/I.211

Possible broadband services in ISDN a)

Service classes

Type of information

Examples of broadband services

Applications

Some possible attribute values g)

Conversational services

Moving pictures (video) and sound

Broadband b), c) video-telephony

Communication for the transfer of voice (sound), moving pictures, and video scanned still images and documents between two locations (person-to-person) c)
— Tele-education
— tele-shopping
— tele-advertising

— Demand/reserved/permanent
— Point-to-point/multipoint
— Bidirectional symmetric/ bidirectional asymmetric
— (Value for information transfer rate is under study)

Broadband b), c) videoconference

Multipoint communication for the transfer of voice (sound), moving pictures, and video scanned still images and documents between two or more locations (person-to-group, group-to-group)c)
— Tele-education
— Tele-shopping
— Tele-advertising

— Demand/reserved/permanent
— Point-to-point/multipoint
— Bidirectional symmetric/ bidirectional asymmetric

Video-surveillance

— Building security

2 General network aspects of broadband services

2.1 *General*

The purpose of this section is to give guidance concerning some of the important aspects which need to be taken into account when supporting and developing services for the B-ISDN.

In addition, Recommendations I.362 and I.363 describe ATM Adaptation Layer functions for B-ISDN services identified on the basis of timing relation (between source and destination), bit rate (constant or variable) and connection mode (connection oriented or connectionless).

2.2 *Multimedia aspects*

Most broadband services inherently involve more than one information type. These services are termed multimedia services. For example, videotelephony will include audio, video and possibly some form of data. Other information types may be text and graphics for example. A structured approach to the development of multimedia services is recommended to ensure:

— flexibility for the user;

— simplicity for the network operator;

— control of interworking situations;

— commonality of terminal and network components.

The B-ISDN provides independent call and connection control facilities which should be exploited to help achieve the above objectives. The B-ISDN will make it possible, within a single call associated with a specific service, to establish a number of connections which may each be associated with a specific information type. The B-ISDN will enable the addition and/or deletion of optional information types during a call.

It is recommended therefore that the development of multimedia services proceed on the basis of the following principles:

— that a limited set of standardized information types be developed;

— that the association of services and standardized information types be controlled, but in a flexible manner.

2.3 *Quality of service aspects*

2.3.1 *General*

Principles of quality of service (QOS) and network performance (NP) and their relationship with each other are described in Recommendation I.350. A method of identifying QOS and NP parameters is given in Annex A of Recommendation I.350. Further enhancement of the methodology and the definition of individual parameters for B-ISDN are for further study.

2.3.2 *QOS indication and negotiation*

QOS is negotiated during the call set up phase and possibly during a call. It is for further study whether specific QOS parameter values will be explicitly indicated (e.g. by a specific cell loss ratio value) or implicitly associated with specific service requests (e.g. a standardized service will by definition include the specification of all relevant QOS parameters).

Additionally, for some services there is a need for an explicit cell loss priority (CLP) indication on a cell by cell basis as a means of managing cell loss during periods of network congestion. However, if this indicator is used it will be necessary during the call set up phase to indicate the intended incidence of use of this indicator. This is necessary to facilitate appropriate network resource allocation and usage parameter control.

2.4 *Service bit rate aspects*

2.4.1 *General*

The issue of service bit rates and associated user assurances is very much related to suitable allocation of network resources. The objectives should include:

- support of service bit rate requirements;
- simplicity of service bit rate expressions;
- efficient utilization of network resources;
- exploitation of the inherent variable bit rate capability of ATM;
- increased use of network resources during lightly loaded periods.

2.4.2 *Constant bit rate (CBR) services*

Constant service bit rates are negotiated at call set up time for on demand services and the necessary network resources are fully allocated at this stage for the duration of the call. Changes to bit rates during a call may be negotiated via signalling and details are for further study. Service bit rates for permanent and semi-permanent services are agreed with the Administration. This approach is consistent with that adopted for STM networks. For several reasons, including network operation, interworking and service development, a number of specific bit rates will be standardized. The specific bit rates to be standardized are for further study.

2.4.3 *Variable bit rate (VBR) services*

Variable bit rates may be expressed by a number of parameters, related to the traffic characteristics described in Recommendation I.311.

These parameters for on demand services should be negotiated at call set up time, and if agreed, supported for the duration of the call. Service bit rates for permanent and semi-permanent services are agreed with the Administration. Changes to these parameters may be negotiated within the call period and details are for further study. A set of discrete bit rates will be chosen. Further study of the specific bit rates is required.

The support of additional traffic exceeding the negotiated traffic parameter values is for further study.

2.4.4 *Maximum service bit rate supported by the 155.52 Mbit/s interface*

The transfer capability at the user network interface is 155.52 Mbit/s with a payload capacity of 149.76 Mbit/s. With the ATM cell format of a 5 octet header and 48 octet information field, the maximum rate available from the interface from all cell information fields is 135.631 Mbit/s.

The maximum service bit rate which can be supported on this interface may be equal to or less than 135.631 Mbit/s. The actual maximum service bit rate is for further study. The following factors, if applicable, will affect the available maximum service bit rate:

— the time period(s) associated with the "structure" attribute for CBR services such that the service delay and buffering requirements are met;

— the transfer capacity for signalling and OAM cells, considering their burstiness nature;

— the ATM adaptation layer overheads.

Note — The transfer over the B-ISDN of signals at service bit rates above 135.631 Mbit/s (e.g. TV signals near 140 Mbit/s, specified in CCIR Recommendation 721/CMTT) requires further study. In the interim such TV signals could be carried for example, via direct access to VC-4 containers in synchronous digital hierarchy (SDH)-based transport networks, or via plesiochronous digital hierarchy (PDH)-based networks, without the use of ATM. The 622.08 Mbit/s interface may need to support services at bit rates above 135.631 Mbit/s.

2.4.5 *Maximum service bit rate supported by the 622.08 Mbit/s interface*

For further study.

2.4.6 *Bit rate assurances*

Constant bit rates negotiated at call set up time and agreed by the Administration should be assured to the user for the duration of the call. Similarly the parameters relating to VBR services should be assured for the call duration. No assurances can be given concerning additional traffic above that negotiated.

2.5 *Service timing/synchronization aspects*

2.5.1 *General*

Service requirements for timing functions vary widely and may be supported in a number of ways based both on end-to-end service information and on facilities available from the network. Some existing services with 8 kHz integrity will require network provided facilities. New services may need to use end-to-end techniques to meet performance requirements. In addition, combinations of end-to-end and network methods may be used.

2.5.2 *End-to-end methods*

Some services (e.g. asynchronous CBR services) will require end-to-end service timing methods. For these services the following are examples of end-to-end methods available and they may be included in the service specification as appropriate to meet the performance requirements of the service:

i) *Use of an adaptive clock:* The receiver writes the received information field into a buffer and then reads it with a local clock. The filling level of the buffer is used to control the frequency of the local clock.

ii) *Use of a synchronization pattern:* The transmitter writes an explicit synchronization pattern in the information field which is then used by the receiver to synchronize the local clock. The synchronous frequency encoding technique (SFET) may be used for the clock recovery of asynchronous CBR services. SFET uses network provided timing.

iii) *Time stamping:* The transmitter writes an explicit time indication into the information field. It is then used by the receiver to synchronize the local clock.

2.5.3 *Network methods*

Mechanisms should be provided to enable the full requirements regarding network provided timing and synchronization to enable services with 8 kHz integrity to be supported. The requirements of Recommendations G.810 and G.822 will be met but the precise details of the timing mechanism(s) to be made available in the B-ISDN are for further study.

Two examples of network provided timing are:

— driving a local clock with timing information available from the T interface;

— the provision of network sourced time stamped cells.

2.6 *Simultaneous service capabilities*

The B-ISDN will bring flexibility. The B-ISDN interfaces will be able to simultaneously support many combinations of services requiring different bit rates (both CBR and VBR) including broadband and existing ISDN services.

The payload capacity available with the 155.52 Mbit/s interface is 149.76 Mbit/s.

The cell format imposes an upper limit for the cell information transfer rate of 135.631 Mbit/s. The simultaneous service capabilities of the 622.08 Mbit/s interface are for further study.

The payload capacity for both these interfaces will need to accommodate the following:

— cell header overheads (i.e. 5 octets per cell);

— cell information (i.e. 48 octets per cell);

— ATM adaptation layer overheads where applicable (to be carried in the cell information field);

— signalling cell overheads;

— OAM cell overheads;

— an overhead due to the practical situation where, due to the asynchronous nature of services being carried in the interface, it will not always be possible to utilize all cells;

— other factors for further study, e.g. time stamped cells.

2.7 *Connectionless data service aspects*

A connectionless data service supports data transfer between users based on connectionless data transfer techniques. It need not directly imply connectionless methods implemented within B-ISDN.

In the B-ISDN, virtual channels are established at the ATM layer only by means of the connection oriented technique. Therefore, connectionless data service can be supported using the B-ISDN in two ways as follows:

i) *Indirectly via a B-ISDN connection oriented service:* In this case a transparent connection of the ATM layer, either permanent, reserved or on demand, is used between B-ISDN interfaces. Connectionless protocols operating on and above the adaptation layer are transparent to the B-ISDN. The connectionless service and adaptation layer functions are implemented outside the B-ISDN. The B-ISDN thus imposes no constraints on the connectionless protocols to be adopted.

ii) *Directly via a B-ISDN connectionless service:* In this case the connectionless service function would be provided within the B-ISDN. The connectionless service function terminates connectionless protocols and routes cells to a destination user according to routing information included in user cells. Thus a connectionless service above the adaptation layer is provided in this case.

Service i) above, may lead to an inefficient use of virtual connections of user-network interface and network-node interface, if permanent or reserved connections are configured among users. With the availability of signalling capabilities, an end-to-end connection may be established on demand at the commencement of connectionless data service. This on demand operation of service i) above may cause call set up delay, and may introduce a load on call control functions within the network.

For service ii) above, there are also two options depending on the availability of B-ISDN signalling capabilities. Option one is to use preconfigured or semi-permanent virtual connections between users and connectionless service functions to route and switch connectionless data across the network. Option two is to establish virtual connections at the commencement of the connectionless service session.

Support of service i) above will always be possible. The support of a direct B-ISDN connectionless service (Service ii) above) and the detailed service aspects are for further study.

2.8 *Interworking aspects*

The ISDN will have broadband (see Recommendation I.413) and narrow-band (see Recommendation I.412) interfaces connected logically to the same network. Services normally available from narrow-band interfaces will also be available from broadband interfaces. Such services will fully interwork without limitations.

2.9 *Signalling aspects*

The following are signalling requirements from the service perspective. Other aspects are for further study.

2.9.1 *Interactive services*

— Generic signalling mechanisms should be capable of simultaneously supporting many combinations of services as described in § 2.6.

— Specific signalling mechanisms are needed to achieve the capabilities required for B-ISDN signalling as described in Recommendation I.311.

— Several attribute values of the service need to be signalled and possibly negotiated during call establishment and possibly during a call such as:

— quality of service parameters;

— service bit rates for CBR and VBR services (see § 2.4);

— ATM layer parameters (e.g. VCIs and VPIs).

Moreover, negotiated parameters need to be assured. The parameters that can be negotiated are for further study.

— Signalling mechanisms should exist for the transport of parameters associated with layers above ATM (e.g. ATM Adaptation Layer) up to and including the network layer.

— Signalling mechanisms must support the interworking requirements in § 2.8.

2.9.2 *Distribution services*

The signalling requirements for distribution services are characterized by frequent and simultaneous request by several users (e.g. video broadcast programme changes). Other aspects are for further study.

3 Video coding aspects

3.1 *General*

Coordination of video coding studies is required to ensure that maximum integration of video services is achieved through commonality of coding schemes and integration of the control and signalling system. Conformity of video coding studies with B-ISDN studies will allow the advantages available through an ISDN to be extended to the user by minimizing the number of video terminals needed to access a range of interactive and distribution video and still image based services. The objective is to achieve the highest level of service integration through minimizing the number of coding techniques used across a wide range of video services and maximizing commonality of display devices.

The use of a common display device facilitates rationalization of a user's terminal needs for access to multiple video services. However, when this is combined with a single common decoder capable of handling different coding techniques and integration of the control and signalling system, the objective of maximizing commonality between interactive and distribution services can best be realized.

Full integration of the coding schemes to be adopted for all video services, including the following, should be pursued:

— distribution services including video entertainment and information;
— conversational services including videotelephony and video conferencing;
— messaging services including moving picture mail;
— retrieval services including film libraries and high resolution images.

The development of common coding schemes will help to fulfill the following objectives:

- economic provision of multi-service terminals and customer equipment;
- ease of adaptation of terminal equipment for different services;
- minimization of interworking requirements;
- minimization of trans-coding requirements in the network.

The following paragraphs identify the relevant service, network and video coding issues.

3.2 *ATM network impacts on video coding*

The ATM aspects, important from a video coding perspective, which need to be considered include:

- Information will be transported in cells.
- The QOS parameters (cell loss, absolute and relative network delays) will occur within specified limits (the parameters and the limits are for further study and are dependent on connection type).
- Network based timing information will be available with performance meeting the requirements of Recommendations G.813 and G.822 (the relationship between network timing and service timing as described in § 2.5 of this Recommendation, may be independent and requires further study).
- The network will support both variable and constant bit rate services.
- The network will offer independent call and connection control facilities.

The implications of the above network aspects include:

- Coding studies and service developments must be consistent with the inherent capabilities provided by the ATM based B-ISDN.
- Codecs must be tolerant of cell loss which will also affect codec design in terms of the amount of error control and rate of forced image refresh.
- Call establishment and termination, which may require multiple connections, and other network related operation during a call, must be common across the multiple interworking video services.
- Control of the audio and video components of the connection must also be considered with the differential delay within specific bounds to allow independent support.
- End-to-end delay limits must be taken into account in both network and codec design for interactive services.

3.3 *Layered video coding for service integration*

The interworking of video services requires that a video receiver of the related terminal is able to present video information from a service other than that of its primary application. For example, a relatively low resolution video telephony terminal should be able to display, within the limits of its resolution, a video signal of the quality level comparable to say a high quality TV service. Conversely, a relatively high quality receiver should be able to display a video telephony image either as a small image on the screen or perhaps expanded to fill the screen. Terminals intended to receive moving images (i.e. video) should also be capable of accessing still image services.

This interworking should be achieved by either of two alternative methods. First, it could be achieved by designing the video receiver to extract and reconstruct only that part of the incoming video signal that it is capable of displaying. Alternatively, this interworking can be achieved by designing the sending terminal to be able to extract and transmit only that part of the video signal that the receiver is capable of displaying thereby minimizing network load. In either case, this means that the internal processing and storage requirements remain matched to the display device. The data must therefore be arranged in such a way that different levels of image resolution can easily be extracted. That is, a layered or hierarchical structure is required as an essential function for interworking of video services in B-ISDN. Further study is required.

This layered structure means that information describing the different levels of image resolution are separately transmitted in a way that permits their selective reception and reconstruction at a decoder. In layered coding, several layers could be generated so that the layers will correspond to, e.g. the quality parameters of spatial (horizontal and vertical pixels) and temporal (frame rate) resolution of video-phone, video-conference, television and high definition television (HDTV) services.

The structure would be open-ended to allow future higher performance services to be added, using the same structure in the lower layers. All services would build upon the base information in the lowest layer, and all other layers provide incremental information to establish that quality level by building on the layers beneath. While the flexibility could be envisaged to use different coding techniques for each layer, there may be excessive penalties of cost and complexity for high resolution services if this approach is taken, and common techniques should be considered first.

The different layers would be transmitted in different cells, to permit easy extraction of that information which a particular decoder could use. This necessitates layer identification on a cell-by-cell basis, and techniques to do this need to be studied.

Layered coding also offers improved cell loss protection. By decomposing the coded video information into separate layers, it is also possible to localize the most important and least important information into separate cells rather than combining all the information for one part of the picture within one cell. Since the most important information will occupy only a small proportion of the total number of transmitted cells, this means that the probability of a significant error (one that is highly visible) is reduced, i.e. it provides statistical error protection. This advantage is significantly enhanced if cell losses are controlled by the network by selectively discarding cells when necessary by use of the cell loss priority (CLP) indicator.

3.4 *Constant bit rate video coding*

Traditional video source codings producing a constant bit rate will continue to be supported on the B-ISDN. The network will support specific rates up to the maximum service bit rate (see § 2.4.4) which will be assured by the network for the duration of the call. The assurance will refer to a specific maximum rate of cell loss, insertion and delay associated with the specific service negotiated during call set up and possibly during the call.

Bit rates for coding schemes should be chosen such that they can be conveniently carried with the required simultaneity within the user network interface. Paragraph 2.6 indicates some of the necessary considerations. For example, if only one of a certain video service is required then this may use a bit rate up to the maximum service bit rate. The guidelines in § 2.6 should be used for assessing other capabilities.

3.5 *Variable bit rate video coding*

Variable bit rate source coding is a coding method which produces a stream of bits whose rate is time varying according to the variation of amount of information in the original signal. A variable bit rate video coder may produce only coded data of the video signal necessary to maintain a given image quality at each point in time. ATM based B-ISDNs can support variable bit rate coding. The stream of coded data with variable rate must be segmented into cells in order to be transported through the B-ISDN. This leads to bursty arrivals of cells to the network. The cells are transferred between terminals via virtual channel connections. The cell sequence integrity is maintained on each virtual channel connection. Redundant data which may need to be sent in a constant bit rate coding is not sent in variable bit rate coding. Therefore, the network resources needed to support a variable bit rate video coding may be less than those necessary for constant bit rate coding.

Savings of network resources from variable bit rate coding increase as the inherent burstiness of the information rate increases. Retrieval services, for example, could lead to large bursts of data separated by long idle delays while a user is reading or considering the information. It also should be noted that the use of variable bit rate coding on these very bursty services may facilitate relatively easy service interworking. A still image, for example, could be transmitted as a video signal. The interframe differences would rapidly decrease to zero. Variable bit rate coding can easily accommodate this variation.

The network resources of B-ISDNs are, however, finite. Furthermore, both deterministic and statistical ATM supported services may be multiplexed in the networks. Therefore, cell transfer for a call may be influenced by the burstiness of other calls multiplexed simultaneously. Cell loss may occur in such circumstances. In order to maintain the QOS values within a certain range, certain bounded network resources are allocated to each call at the call set up time depending on the rate variation characteristics of the call indicated by the user. During the call, a usage parameter control function may be used to ensure that actual traffic accepted by the network from a user remains within the bounds negotiated (as described in Recommendation I.311). Furthermore, in order to discriminate services with respect to cell loss ratio and sensitivity to delay, priority control may be used in the networks. Because of cell loss/insertion and bounded resource allocation, a given perceptual quality which may be maintained at the source coding stage may not be delivered at the receiving end.

3.6 *Consideration of video coding methods*

Video signals of the layered structure may be coded either at variable bit rate or at constant bit rate. Although both systems could be supported in the B-ISDN, variable bit rate coding is particularly attractive for an ATM based network as described in § 3.5.

There is the possibility of developing non-layered and variable bit rate codecs for the ATM based network. This may be achieved by modifying traditional coding systems, non-layered and constant bit rate coding, so that video signals from the source coder will be transmitted without buffering of signals.

However, as is described in this Recommendation, layered coding combined with variable bit rate coding has advantages concerning the integration of video services and the utilization of ATM network capabilities. Therefore, studies should be concentrated on these methods.

ANNEX A

(to Recommendation I.211)

Alphabetical list of abbreviations used in this Recommendation

CBR **Constant bit rate**

CLP Cell loss priority

HDTV High definition television

NP Network performance

PDH Plesiochronous digital hierarchy

SDH Synchronous digital hierarchy

SFET Synchronous frequency encoding technique