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Working Party XV/1
Experts Group for ATM Video Coding

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Appendix to Annex of WPXVIII/8 Report

STUDY GROUP XVIII
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SOURCE: SWP XVIII/8-3 (Editor of IVS Baseline)

TITLE: IVS BASELINE DOCUMENT

The IVS Baseline Document has been modified to incorporate new text as proposed by CCIR IWP 11/9, CMTT/3 and CCITT SGXV and to also reflect the enchancements to the document resulting from the ITU Co-ordination meeting on Integrated Video Services (IVS) in Broadband ISDN.

The text has been updated to reflect the results of SWPs of WPXVIII/8 at this December 1991 Melbourne meeting. Further updating may be required to reflect changes arising from the activities of other relevant working parties of SGXVIII.

INTEGRATED VIDEO SERVICES (IVS) BASELINE DOCUMENT
December 1991

(Note : Areas amended since the previous version are identified by a vertical bar.)

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1. General

This document is initiated by CCITT SGXVIII to gather information related to Integrated Video Services (IVS) support on B-ISDN. The document contains aspects related to the work of several other groups to provide a consolidated overview of Integrated Video Service issues and the areas that need to be addressed and specified to become both technically and commercially viable. The prime purpose is to provide a common basis for the ongoing study of Integrated Video Services by SGXVIII and other groups.

It is the intention of SGXVIII to maintain and update this baseline document until such time as the relevant information is transferred to Recommendations for which different groups are responsible. Relevant groups include : Task Group CMTT/2, CCITT SGXV ATM Video Coding Experts Group, ISO/MPEG, CCIR SG11 and CCITT SGI.

To keep this document updated and complete, all groups involved are invited to study it carefully and provide appropriate input. Endorsement of this baseline document has been received from the CCITT SGXV Video Coding Expert's Group, ISO/MPEG and CMTT/3.

Major areas which require further development are contained in separate annexes to this document. The scope of the document should be expanded as necessary to meet the requirements of the different groups involved. For example, it is recognised that video is a common component of audiovisual and multimedia services.

2. Objectives

Video and image services represent an increasingly important form of communications. With the establishment of powerful and extensive broadband network facilities, customer interest in video and image services is expected to lead to growing demands for greater service variety and higher quality.

The B-ISDN will form the foundation of public networks capable of the integrated support of voice, data and video applications. In addition to a consistent broadband transmission and switching fabric, the B-ISDN will provide common interfaces for the support of all customer services and supplementary services (e.g. picture within picture), ensuring connectivity and a competitive multi-vendor equipment environment.

Integrated network support and delivery of the various service classes can provide advantages in terms of efficient handling of service types within the network and a consistent application environment within the customer's premises.g. common display, control, etc.

Service integration can occur at many levels within networks and customer equipment. The emergence of B-ISDN standards and network technology provides an opportunity to rationalise video service support by developing a framework for the integration of interactive and distribution video service delivery. Video service integration will provide a means of maximising the rate and extent of video service development and application within both the residential and business market sectors. The objective is therefore to develop a communications environment which can provide effective and flexible video service support, across all service types, together with positive incentives for new service development and deployment.

From a customer viewpoint, the integrated support of video services would offer lowered costs and enhanced flexibility.

To achieve this flexibility and provide integrated service support requires alignment and consistency between related service standards.

Video service integration benefits will be maximised under conditions offering commonality of User-Network Interface, signalling and control formats, coding techniques and display devices across a range of service types.

Draft Recommendation I.211 "B-ISDN Service Aspects" provides a classification of services to be supported by the B-ISDN, and basic considerations of the network capabilities required by the B-ISDN. For video service applications, it identifies the key objective of maximum integration through common coding and integration of control and signalling systems, and also provides an overview of the related coding and service interworking issues.

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

- economic provision of multiservice terminals and customer equipment;
- ease of adaptation of terminal equipment for different services;
- minimisation of interworking requirements;
- minimisation of transcoding requirements within the network.

To achieve these objectives it will be necessary that there be close cooperation and liaison between all the B-ISDN video services standardisation groups. It is the prime purpose of this baseline document to provide the vehicle for achieving this liaison and the required level of cooperation and commonality of direction. The need is also noted for consideration of audio aspects as associated with video.

3. Responsibilities

CCITT SGXVIII

Responsible for, amongst other tasks:

- Recommendations on all network aspects of the B-ISDN, including the network architecture, transport techniques, User-Network Interface, access and inter-exchange signalling and ATM Adaptation Layer specifications;

- identifying network wide impact on B-ISDN service support, including the coordination across ITU bodies necessary to maximise commonality between communicative and distribution video services;

- establishing the framework for video service support in the B-ISDN;

- general aspects of quality of service and network performance in digital networks including ISDNs;

- providing coordination across different groups on Integrated Video Services in B-ISDN.

The following areas of responsibility are SGXVIII's understanding of the terms of reference for the other groups interested in video services on B-ISDN.

CCITT SGXV

Responsible for, amongst other tasks:

- Recommendations on video coding algorithms necessary to support a range of different quality communicative video services on the B-ISDN;

- Recommendations for transmission systems and equipment utilised in the B-ISDN;

- Recommendations for audiovisual system aspects;

- cooperatively assess compatibility between video coding algorithms used for the support of communicative and distribution video services with CMTT.

CCITT SGXI

Responsible for, amongst other tasks:

- Recommendations on Stage 2 and Stage 3 service descriptions for the Stage 1 service descriptions as provided by SGI.

CCITT SGVIII

Responsible for, amongst other tasks:

- Recommendations on coding for still image communication.

CCITT SGI

Responsible for, amongst other tasks:

- Recommendations on the service attributes including end-to-end service quality of all communicative services supported on the B-ISDN;

- Stage 1 service descriptions:

- cooperatively assess compatibility of end-to-end performance levels of television and communicative services on the B-ISDN with CCIR SG11.

CMTT

Responsible for, amongst other tasks:

- Recommendations on the bit rate reduction coding, packaging and transmission of television and sound programme signals in all portions of the telecommunications network; this includes contribution, primary distribution and secondary distribution signals;

- cooperatively assess compatibility between video coding algorithms used for the support of communicative and distributive video services with CCITT SGXV.

CCIR SG11

Responsible for, amongst other tasks:

- Recommendations defining and assessing the subjective and objective performance of digital television coding schemes proposed by the CMTT and supported on the B-ISDN proposed by CCITT SGXVIII;

- cooperatively assess compatibility of end-to-end performance levels of television and communicative service on the B-ISDN with CCITT SGI.

IEC/ISO

Responsible for, amongst other tasks:

- Through the Moving Picture Experts Group (MPEG), develop standards for storage and retrieval of moving images and sound for Digital Storage Media (DSM);

- development of standards for display devices.

4. Range of Services

CCITT Recommendation I.211, "B-ISDN Service Aspects", identifies two broad service categories; interactive and distribution.

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

- distribution services including entertainment and information;

- conversational services including videotelephony and videoconferencing;

- messaging services including moving picture mail;

- retrieval services including film libraries and high resolution images.

Video service applications in B-ISDN fall across this entire range of broad service types and thus must be considered when developing a framework for B-ISDN video coding studies.

5. Evolution to Integrated Video Services in B-ISDN

It is clear that the development of B-ISDN Recommendations will follow a staged approach. Similarly it can be expected that the achievement of the objectives for IVS as described in Section 2 will also necessitate a staged approach. Assuming that there is agreement on the long term objectives of Section 2, a number of issues on the evolution to IVS emerge. It is the intent of Annex 1, 'Work Plan', to provide the means of identifying the stages in development of Recommendations relevant to achievement of the objectives of IVS.

Integrated Video Services (IVS) Baseline Document

Annex 1. Work Plan

The attached tables represent simplistically the anticipated availability of standards related to video network, service and coding activities. The full details of these tables can be found in the relevant reports of the Study Groups.

STANDARDISATION TIMETABLE 1 - CCITT SGXVIII

The timeframes of this work plan indicate when Recommendations are expected. The contents should reflect the development status of B-ISDN network capability and the stages in development of Recommendations relevant to video coding for the B-ISDN.

1. CCITT SGXVIII Network Capability	1992	1994	1994+
	Basic B-ISDN Capability (Release 1)	Enhanced B-ISDN (~Release 2)	Full B-ISDN Capability (~Release 3)
1.1 STM/ATM	- ATM	- ATM	- ATM
1.2 CBR/VBR	- CBR	- CBR & VBR	- CBR & VBR
1.3 Bit Rate	- 155 Mbit/s UNI User Rate <135.631 Mb/s	- 622 Mbit/s UNI Max Payload 599.040 Mb/s	
1.4 Design Features	- Peak rate only	- Statistical multiplexing	
1.5 Service Types	- point-to-point	- Point-to-Multipoint (multicasting) - Multipoint - Distribution	- Broadcast
1.6 Other Features	- Connection oriented & connectionless services - VCC Switched - VPC Semi-permanent	- Cell Loss Priority - Multi connections per call - Renegotiation within call - VPC Switched	- Multimedia capability
1.7 Interworking	- Connectionless (802.6) - Limited N-ISDN	- Full N-ISDN interworking	
1.7 Dependencies	CCITT SGI - Stage 1 Service Descriptions CCITT SGXI - Stage 2 & 3 Service Descriptions CCITT SGXV - QOS & NP Required	Same as 1992, plus CMTT/2&3 - QOS Requirements	As per 1994

STANDARDISATION TIMETABLE 2 - TG CMTT/2

2. TG CMTT/2 Digital Secondary Distribution	1992	1994	1994+
	Outline specification for TV/HDTV coding methods	Recommendation for TV coding methods*	Recommendation for HDTV coding methods (1996)
2.1 STM/ATM	STM/ATM	STM/ATM	STM/ATM
2.2 CBR/VBR	CBR and/or VBR	CBR and/or VBR	CBR and/or VBR
2.3 Bit Rate	Equivalent to 1~ 0.5 bit/pixel	Equivalent to 1~ 0.5 bit/pixel	Equivalent to 1~ 0.5 bit/pixel
2.4 Design Features	Compatibility between TV and HDTV	Compatibility between TV and HDTV	Compatibility between TV and HDTV
2.5 Service Types	TV/HDTV Secondary Distribution	TV/HDTV Secondary Distribution	HDTV Secondary Distribution
2.6 Other Features	Commonality or compatibility with H.26x, MPEG 2 and Digital Emission Coding	Commonality or compatibility with H.26x, MPEG 2 and Digital Emission Coding	Commonality or compatibility with H.26x, MPEG 2 and Digital Emission Coding
2.7 Interworking 2.8 Dependencies	CCIR SG11 CCITT SGXV, MPEG CCITT SGXVIII	CCIR SG11 CCITT SGXV, MPEG CCITT SGXVIII	CCIR SG11 CCITT SGXV, MPEG CCITT SGXVIII

* By March 1993, a specification of a coding algorithm for TV and HDTV.

STANDARDISATION TIMETABLE 3 - CCITT SGXV

3. CCITT SGXV ATM Video Coding Experts Group	1992	1994	1994+
3.1 STM/ATM	Outline Recommendation	Recommendation completed ATM	
3.2 CBR/VBR	Decision on CBR/VBR	CBR and/or VBR	
3.3 Bit Rate		Range up to several tens of Mbit/s	
3.4 Design Features		- Universal coding (in terms of services, quality resolution, application and bit rate) - extension capability to HDTV quality	
3.5 Service Types		- Conversational - Distribution - Retrieval	
3.6 Other Features		Compatibility with H.261, MPEG 2 and CMTT/2	
3.7 Interworking		Terminal interworking	
3.8 Dependencies		CCITT SGXVIII - AAL Spec CCITT SGXVIII - QOS and network performance CCITT SGI - Stage 1 Service Descp MPEG - Generic Coding CMTT - Secondary Distribn Coding	

STANDARDISATION TIMETABLE 4 - CCIR SG11

4. CCIR SG11 Digital terrestrial and satellite TV broadcast	1992	1994	1994+
4.1 STM/ATM 4.2 CBR/VBR 4.3 Bit Rate 4.4 Design Features 4.5 Service Types 4.6 Other Features 4.7 Interworking 4.8 Dependencies	SEE NOTES BELOW	APPROVAL OF RECOMMENDATIONS	

Notes: 1. ATM not included in current studies

2. Timing for and scope of standards for digital terrestrial and satellite TV distribution to be considered at the November 1991 CCIR SG11 meetings.

STANDARDISATION TIMETABLE 5 - MPEG

5. MPEG Digital Storage Media (DSM)	1992	1994	1994+
		MPEG 2	MPEG 3
5.1 STM/ATM		(not transmission based)	
5.2 CBR/VBR		CBR and/or VBR	CBR and/or VBR
5.3 Bit Rate		up to 10 Mbit/s	Up to 40 Mbit/s
5.4 Design Features		Generic Coding	Generic Coding
5.5 Service Types		Digital VTR Digital Disc Cable TV	High resolution TV Systems (HDTV)
5.6 Other Features			
5.7 Interworking			
5.8 Depedencies		TG CMTT/2 CCITT SGXV	

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STANDARDISATION TIMETABLE 6 - CCITT SGI

6. CCITT SGI Stage 1 Service Descriptions	1992	1994	1994+
Broadband connection oriented bearer service	Recommendation F.811		
Broadband connectionless bearer service	Recommendation F.812		
Broadband video telephony service	Recommendation F.722		
Broadband video conference service	Recommendation F.732		
Broadband TV distribution service	Recommendation F.821		
Broadband HDTV distribution service	Recommendation F.822		
Broadband videotex service	Recommendation F.310		

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Annex 2. Network Aspects

A2.1. Information Flows

The nature of service information flows within a communications network influences the design and dimensioning of switches and transmission links and interfaces. Approaches to network resource management are also influenced by the characteristics of the service information flow. This issue is particularly relevant to the B-ISDN given the diverse range of video service types and qualities to be supported.

Video service information can be characterised in many ways, including:

- The direction of information flow: video services may be bidirectional, e.g.. videotelephony and videoconference, or essentially unidirectional, e.g.. video distribution services for business and entertainment.

- The symmetry of information flow: messaging, retrieval and distribution services are characterised by asymmetrical information flows.

- The origin of the source material: how video signals enter the network (e.g.. direct from camera, from storage media, via satellite or other delivery mechanisms) can also provide a means of characterising service information flows.

Telecommunications Services

The term service is used and understood in many different ways however. A recognised definition is given in CCITT Recommendation I.210. Two families of telecommunication services have been identified :

- Bearer services

- Teleservices

Bearer services provide the network capabilities to transfer information between points of access to the network. The communication between the users will only function if the two parties, by prearrangement, have chosen compatible terminals and communication protocols. In terms of standardisation, bearer services are "interface services", i.e. if the interfaces to the network are functionally identical, the invoked bearer service can be used. Thus compatibility is ensured if the protocols used for layer 1, 2 and 3 comply with CCITT standards.

In contrast, a teleservice provides the full capacity for communication by means of terminal and network functions, and possibly also functions provided by dedicated centres. The teleservices are end-to-end services. In addition to standardised bearer functions, communication requires standardised functions within the terminals involved. In the case of teleservices, all protocols of the 7 layers of the OSI model have to conform to the relevant CCITT standards for communication to take place.

These two types of basic services may be supported by a range of supplementary services e.g. call diversion, call waiting, closed user group etc. Supplementary services are mainly offered by the network and they can only be used in conjunction with the basic services.

A2.2. Switch Functionality

The switching infrastructure of a Broadband ISDN may be required to support a variety of switched services.

For example,

- Point-to-point switching e.g videotelephony
- Point-to-multipoint: bi-directional e.g. videoconferencing, multimedia conferencing
- Point-to-multipoint unidirectional e.g. broadcast distribution services, switched distribution services.
- Multipoint-to-point e.g. televoting services, transfer of charging information to service providers.
- General and selective broadcast switching e.g. switched and unswitched distribution services.

An ATM based B-ISDN will have the ability to support one-to-many call distribution through multicast switching. The basic multicast capability could be used with appropriate connection management to support a wide range of multipoint services e.g. conference calls, message broadcasting, video-on-demand, etc. This may result in significant simplification in multimedia terminal design and could also support the flexible deployment of multimedia and multipoint bridges.

A2.3. Signalling Requirements

The proposed service diversity of Broadband ISDN may require some associated enhancement of signalling protocols to accommodate the expanded service range. Signalling is necessary for the flexible implementation of multiparty and multiconnection calls for customers with multisite, multimedia communication needs over the full range of service bandwidths from low bit rate videotelephones to HDTV.

B-ISDN Signalling Principles

B-ISDN Recommendation I.311 identifies the following signalling capabilities as being needed:

- Capabilities to control ATM virtual channel and virtual path connections
  - Establish, maintain and release ATM Virtual Channel Connections (VCCs)s and Virtual Path Connections (VPCs).
  - Support point-to-point, point-to-multipoint and broadcast communication configurations.
  - Negotiate traffic characteristics of a connection at connection establishment.
  - Renegotiate source traffic characteristics of an established connection.
- Capability to support simple multiparty and multiconnection call
  - Symmetric and asymmetric simple calls
  - Simultaneous establishment and removal of multiple connections within a call

- Add and remove connection from an existing call

- Ability to correlate (when requested) connections composing a multiconnection call.

- Reconfigure a multiparty call including an existing call or splitting the original multiparty call into more calls.

• Processing related functions

- Capability to reconfigure an established connection e.g to pass through an intermediate processing facility such as a conference bridge.

- Support for interworking between different coding schemes.

- Support for service interworking

Signalling for point-to-multipoint video services

• *requires further study*

The full signalling requirements for distribution services are for further study, however likely additional requirements include :

• Selection Switching

Distribution services of all types (eg. data, audio, video, image and multimedia) require a means of selecting items from the range available at the point of service distribution.

These actions correspond to a customer/viewer changing programmes.

• Fast Call Establishment

Switched access to distribution services (such as television) will require significantly shorter call establishment delays than existing networks. While set up delays of 2-3 seconds may be acceptable in a voice network, the tolerable delay for a user changing a TV channel is unlikely to exceed 100 ms.

• *Supplementary service aspects for further study.*

A2.4. Call and Connection Control

The mature B-ISDN will offer independent call and connection control facilities. This concept has two aspects :

• Separate specification of call and connection control within the network;

• Call control information flows may take a different route to the connection control information flows.

The multimedia and multipoint nature of many B-ISDN services will require flexible means of connection control. It should, given that network resources are available, be possible to add or remove parties from a multiparty call and add or remove services from a multimedia call.

Call establishment and termination, which may require multiple connections, and other network related operations during a call, must be common across multiple interworking video services.

A2.5. Storage Requirements

Many video and image services may require the network to store some aspect of the service. For example, video and messaging services will require network resident storage facilities, as will many forms of database. The efficiency and economy of such services is strongly influenced by the ease of coding and decoding images for storage and the characteristics of the storage medium itself e.g. compact disk, videotape, magnetic disk.

Storage related issues :

- Efficient image compression/decompression algorithms to achieve cost efficient use of available storage capacity.

- Image coding times which reflect the nature of the intended service. e.g. for deferred delivery services, such as video mail, acceptable coding solutions may take the form of slow, but efficient coding and fast decoding.

- Others for further study.

A2.6. Service Bit Rates

The B-ISDN will be based on ATM techniques which are well suited to supporting source traffic which is time varying. The establishment of virtual connections which involve the transfer of information only when required will mean that the resources of the network can be closely matched to the needs of the source traffic.

The following areas relating to service bit rates are still under investigation :

Maximum Service Bit Rate Supported by the 155.52 Mbit/s Interface

The transfer capability of the 155.52 Mbit/s interface provides a payload capacity of 149.76 Mbit/s. Allowing for ATM cell overheads, the maximum service bit rate which can be supported is equal to or less than 135.631 Mbit/s. The actual maximum service bit rate is for further study. The actual value depends on the capacity required by signalling, operations and maintenance and ATM adaptation overheads.

The granularity of the actual service bit rates offered by networks is for further study.

Maximum Service Bit Rate Supported by the 622.08 Mbit/s Interface

Agreement has been reached that the B-UNI (I.413, I.432)at 622 Mbit/s should be based on a single ATM stream rather than a multiplexed structure of four 155 Mbit/s streams. The overhead structure of the UNI and the NNI at 622 Mbit/s is common and this results in an ATM cell transfer capacity of 599.040 Mbit/s.

Bit Rate Assurances

Parameters for constant and variable bit rates agreed at call set up time are assured for the duration of the call. No assurance is given concerning additional traffic above the level initially negotiated.

The specification of service bit rate parameters

• specification of the bit rate of CBR services requires only a single parameter

• specification of the service bit rate of VBR services is expected to require multiple parameters, e.g peak and average rates, burst length etc.

• the time period over which the rate is specified is influenced by service timing and buffering constraints and the capabilities of the network interface.

• options for the specification of service bit rate include cells per unit time, bits per unit time or nx64 kbit/s.

• for CBR services there are two options to be addressed in specifying service bit rates;

-the service bit rate is the actual bit rate. i.e. a user must generate traffic at the exact bit rate.

-the service bit rate means a ceiling to be supported by the B-ISDN. A user can generate traffic at any bit rate less than the service bit rate. The use of a CBR service in this manner is for further study.

• multiple parameters may be required if a unique time period cannot be agreed as meeting the requirements of all services.

• the parameters selected must be of a form and nature which allows the network to exercise the option of statistically multiplexing VBR services, where appropriate, in a manner which does not violate the agreed QOS.

Control and monitoring of source traffic behaviour

• required for CBR and VBR services to ensure agreed parameters are not exceeded.

• it may be possible for the network to accept non-negotiated traffic, however it will not be possible to give the same quality of service assurance in such circumstances.

Allocation and control of network resources

• does not present new problems for CBR services

• large savings may be possible from the statistical multiplexing of uncorrelated VBR sources.

Traffic Control and Resource Management

The objectives of ATM layer traffic control have been identified as the following :

- ATM layer traffic controls should support a set of ATM layer Quality of Service classes sufficient for all foreseeable B-ISDN services

- ATM layer traffic controls should not rely on AAL protocols which are B-ISDN service specific, nor on higher layer protocols which are application specific.

- The design of an optimal set of ATM layer traffic controls should trade-off minimising network and end-system complexity for maximising network utilisation.

- ATM layer traffic controls should maintain the ATM layer Quality of Service even under congestion conditions.

Usage Parameter Control and Network Parameter Control

Usage Parameter Control (UPC) and Network Parameter Control (NPC) are similar functions

- UPC is performed within the Connection Related Function (CRF) on Virtual Paths only.

- NPC functions are performed on VC or VP links at the access point where they are terminated in the network.

- the need to standardise the UPC/NPC algorithm is for further study.

- UPC should accommodate any implementation of the customer equipment (CEQ).

- UPC should not assume any specific Generic Flow Control (GFC) mechanism. However any GFC should meet cell delay variation requirements and may introduce traffic shaping procedures for that purpose.

- to ensure, and protect, network performance - both CLP=0 and CLP=1 traffic flows must be allocated resources. Both must be controlled at the UPC/NPC. The impact on cell sequence integrity on a VCC requires further investigation.

- at the cell level, the UPC/NPC acts in response to user violation of the traffic parameters agreed at call establishment. For non-compliant cells, the network need not respect the end-to-end performance contract.

- at the cell level actions of the UPC/NPC include the following :

• cell passing

• cell rescheduling (a combination of traffic shaping and usage parameter control)[1]

• cell tagging[1] When the cell tagging option is exercised, non-compliant CLP=0 cells may be overwritten to CLP=1.

• cell discard

When the cell tagging option is excercised, non-compliant CLP=0 cells may be overwritten to CLP=1. Non-complying cells are merged with the remaining CLP=1 flow before it is subject to control. Non-complying CLP=1 cells are discarded. If no resources have been allocated to CLP=1, non-complying CLP=0 cells are discarded. Appropriate network dimensioning makes it possible to provide a given QOS for low priority cells.

Traffic parameters and descriptors

For a VCC, traffic descriptors are specified at the ATM SAP[2] or at some reference event in the ATM layer (such an event taking place before any ATM multiplexing and before any cell delay variation occurs).

A VPC is specified at some reference event, if possible similarly defined at the ATM layer. This issue is for further study.

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[1] Optional

[2] As agreed by CCITTSGXVIII/8-7, Geneval, 11-28 June 1991

Peak Rate

The following definition applies to both CBR and VBR connections and addresses the intrinsic peak cell rate generated by a given source before being altered by any ATM or Physical Layer mechanism. The basic event used as a reference is the Request to send an ATM_SDU (48 octet information field, note however this field may not be completely filled with user information.

The peak cell rate Rp is the inverse of the minimum inter-arrival time T0 of the basic event described earlier. The unit to assess this inter-arrival time must be much smaller than the cell time and is for further study.

Resource allocation - preventative actions.

Three options are under consideration :

- *resource allocation*, i.e. allocating different resource levels for CLP=0 and CLP=1 traffic

- usage/network parameter control

- *traffic shaping*, i.e. rescheduling cells according to the declared peak cell rate value on individual ATM connections.

Resource allocation - reactive actions to relieve existing congestion conditions

Two options are under consideration :

Normal conditions. i.e. those under which the peak cell rate in the traffic descriptor specifies an upper bound on the traffic that can be submitted on an ATM connection. Enforcement of this bound by a UPC allows the network operator to allocate sufficient resources to ensure that the performance objectives (e.g. for CLR) can be achieved. For low priority traffic, some adaptive rate control facilities at the ATM layer or above may be used. Such cell based reactive techniques are for further study.

Failure conditions - for further study.

Network Traffic Issues

• Traffic characteristics of voice telephony calls are well known and documented. Similar studies should be undertaken to determine the traffic patterns of video users.

Merit of Using CLP bit

Layered coding is a suitable technique to use both priority classes. The adoption of this technique is dependent on its value in terms of network resource savings.

The degree of network resource saving to be obtained from the use of low priority cells requires further study.

A2.7. Quality of Service Aspects

Customer control of video and image service quality is an issue of both technical and economic importance. The flexibility to select the required service quality based on tariff, application, or other considerations requires the availability of suitable mechanisms for characterising different qualities.

It is generally accepted that quality of service is largely a users view of a service as opposed to the network providers view. Definition is difficult because of the nature of the key factors involved :

- different users;
- different services;
- subjective dependence on the users view of the service.

Quality of service is defined in CCITT Recommendation I.350 as "the collective effect of service performances which determine the degree of satisfaction of a user of a specific service". Network Performance is defined as " the ability of the network or network portion to provide the functions related to communications between users. Also, NP is a statement of the performance of a connection element or a concatenation of connection elements employed to provide a service". The relationship between QOS and NP is of vital importance. In CCITT Recommendation I.350 the relationship is described in these terms, "the user oriented QOS values provide a valuable framework for network design but they are not directly usable in specifying performance requirements for particular connections. Similarly, the NP parameters primarily determine the QOS, but they do not necessarily describe the quality in a way that is meaningful to users". Both types of parameter are needed and their values qualitatively related if a network is to be effective in serving its users.

A2.7.2 Quality of Service Indication and Negotiation

Draft Recommendation I.150 describes B-ISDN ATM functional characteristics including Quality of Service. Issues covered include :

- QOS related to Virtual Channel Connections (VCCs)

While the detailed specification of QOS classes is for further study, it has been agreed that the user will be provided with one class per VCC. The agreed QOS cannot be changed during a call. Renegotiation may require the establishment of a new connection.

- QOS related to Virtual Path Connections (VPCs)

Again the detail specification of specific QOS classes is for further study and only one class may be assigned to each VPC. The QOS is agreed at call/connection establishment and does not change for the duration of the VPC. Since an individual VPC may carry VC links of various QOS classes, the VPC QOS must meet the needs of the most demanding VC. This is of particular relevance in the consideration of multiplexing schemes for multimedia service support.

Several Recomendations make reference to QOS negotiation issues.

- Recommendation I.211, indicates QOS is negotiated at call setup or possibly during a call. It is for further study to determine whether specific QOS parameters will be explicitly indicated (.e.g. by a specific cell loss ratio) or implicitly associated with specific service requests. Services making use of the Cell Loss Priority indication on a cell-by-cell basis will need to indicate the intended use of this indicator at call establishment. This indication is needed to allow appropriate network resource allocation and usage parameter control.

- Recommendation I.211 also comments on CBR and VBR service bit rates. For both CBR and VBR services the service bit rate parameters are negotiated at call establishment and supported for the duration of the call. Changes to these parameters may be negotiated within the call period and the details of this negotiation are for further study. In both cases, a set of discrete bit rates will be chosen.

A2.7.3 General Aspects of ISDN Performance

**** NOTE : TEXT CONTAINED IN THIS SECTION MUST BE CHECKED FOR CONSISTENCY WITH THE RESULTS OF THE DECEMBER 1991 MEETING**

Recommendation I.350 defines Quality of Service and Network Performance principles and illustrates how the QOS and NP concepts are applied in digital networks. Draft new Recommendation I.35B defines performance parameters and performance objectives for the ATM layer of a Broadband ISDN.

ATM cell transfer performance parameters are specified on the basis that the sequence of cells on a virtual channel is preserved (reference I.121). In principle, a point-to-multipoint connection might cause out of sequence cells.

ATM performance parameters subject to definition and specification within I.35B are :

• Cell Loss Ratio

Simulation results indicate that cell loss events may occur in clusters rather than independently. One or more parameters describing the distribution or relative frequency of consecutive cell loss events in ATM networks should therefore be considered.

The response to lost cells for CBR and VBR is under study within CCITT WPXVIII/6, however two service independent methods are available :

- replacement of lost cells by a fixed bit pattern;

- correction for lost cells through the use of forward error correcting codes.

The effect of discarding cells will be service dependent. For example video services may require discarded cell ratios of 10-9 to 10-10. This is particularly the case for high bit rate video services.

• Cell Misinsertion Ratio - the number of misinserted cells within a specified time interval. Cell misinsertion may exert a major influence on QOS since it is more difficult to deal with misinserted than lost cells. Inserted cells result in an increased information flow for the VC concerned and the cell misinsertion ratio selected must ensure that no load problems arise. For some services. misinserted cells may result in loss of terminal synchronisation.

• Cell Error Ratio

• Cell Transfer Delay - the end-to-end cell transfer delay consists of :

- inter-ATM node transmission delay;

- queueing, switching and routing processes in ATM nodes. As an objective this delay component should be of the order of 20ms. In practice, the delay of one ATM switching element is likely to be less than 1ms, although it may vary with the traffic load on the switch.

• Mean Cell Transfer Delay

• Cell Delay Variation

• Severely errored cell ratio - severely errored cells arise when a successfully delivered cell has N or more bit errors in its information field. The need for and methods of measuring the severely errored cell ratio are for further study.

• Cell Transfer Capacity - the definition of this parameter is for further study. Some of the issues to be considered are :

- the relationship between this parameter and the user's a priori request for capacity

- the effects of ATM flow control mechanisms, including the requirements on the user to apply and respond to these mechanisms.

- the limits on the cell loss ratio when the connection is operating at its cell transfer capacity.

- the unit of time over which the parameter is measured.

Relationship Between ATM Layer NP and the QOS of the AAL for CBR Services

• Lost and Misinserted Cells

The Sequence number (SN) in the adaptation layer header can be used to detect lost and misinserted cells. Detection mechanisms are for further study.

Inserted cells may be discarded without disrupting the user information flow.

Lost cells may be substituted by dummy cells in order to adjust the number of bits (bit count integrity) however this results in bit errors in the user information. The content of the dummy cells require further study.

• Errored and Severely Errored Cells

Bit errors occurring in the ATM cell information field are transferred to the user as they occur.

• Cell Transfer Delay

To compensate for the variation of cell delay, arriving cells are buffered at the receiving side Adaptation layer. Buffering and cell assembly increase the transfer delay of user information. Lost cell detection mechanisms may also increase the overall transfer delay.

Excessive cell transfer delay may cause substitution by dummy information and result in bit errors in user information.

Variable Bit-Rate Services - Adaptation Layer Performance Specifications

For further study.

A2.8. Timing Issues

The support of real-time services over an ATM network requires mechanisms to achieve timing recovery and compensate for variable, although bounded, network delays.

Cell jitter (the variable delay in cell arrivals) must be buffered within the codec. The size of the required buffers is determined by the cell jitter and the service bit rate.

For multimedia services there is a need to ensure differential delay between the various service components of a multimedia service, particularly the video and audio, is both bounded and acceptable.

Additional information with respect to AAL1 can be found in Annex 3.

A 2.9 Network Parameters Impacting on Video Coding Definition

A number of parameters and operational procedures concerning the B-ISDN network will have significant impact on the definition of appropriate coding schemes for the support of video services.

The areas requiring definition are listed below:

Cell loss ratio

This is an important determinant of the quality of service achievable for a video application. It determines the means, and even necessity, for providing cell loss protection for different services. It is recognised that there is a degree of flexibility in this figure, since the network operators have some flexibility to dimension the network to provide certain cell loss ratios if they are considered essential for some video services, while the codec design can also be changed to accommodate different figures. Progress needs to be made, though, perhaps by considering the impact of a range of cell loss ratios on both network and codec. The cell loss ratios for both priority levels need to be defined. The SGXV Experts Group believes that guaranteed overall cell loss ratios, for both priority levels, will be essential to satisfy video quality of service requirements. Guaranteed performance, at least within certain time intervals, will also be required.

If the cell loss ratio is sufficiently small, no cell loss protection may be necessary. Table 1 provides some network performance requirements obtained from some example service quality figures. The table concentrates on bit error and cell loss error correction techniques. Layered coding concealment techniques are however under consideration and lead to different figures.

Studies are required to determine the quality of service parameters available to the user, and to relate these to cell loss ratio.

Cell loss burst behaviour

It is understood that cell losses may occur in bursts. This impacts on the means of cell loss protection: the use of forward error correction may be too expensive and delay may be excessive for conversational services if multiple consecutive lost cells must be detected and corrected. Cell loss burst behaviour may be modelled by the Gilbert model (a two-state Markov model requiring four transition probabilities, with one state representing no cell loss and the other constant cell loss).

Open questions remaining are:

- How will the cell loss burst behaviour depend upon the service rate?

- Will the burst behaviour of high priority cells differ from that of low priority cells and, if so, how?

- How can we estimate the average interval time, T, in which no cell loss occurs? If T>>1/(bitrate x CLR), the requirement for CLR might be relieved.

Table 1 : SERVICE AND NETWORK REQUIRMENTS

Service	Bit Rate	QOS Requirements (***)	Required BER/CLR without error handling in AAL	AAL Type	Required BER/CLR after single bit error correction on cell basis in AAL (*)	Required BER/CLR after single bit EC on cell basis and addit. cell loss correction in AAL (**)
Communication						
Videophone	64 kbps/2Mbps FBR (H261)	30 min error free	BER <1.e-6 CLR< 1.e-7 (BCH (511.4 93) FEC in user layer)	Type 1	In user layer	BER<... CLR <8.e-5
Videophone	2 Mbps VBR	30 min error free	BER<3e-10 CLR<1e-7	Type 2	BER<1.2e-6 CLR<1e-7	BER<2.3e-5 (CLR=1.e-6) CLR<8e-5
Videoconference	5 Mbps VBR	30 min error free	BER<1e-10 CLR<4e-8	Type 2	BER<8e-7 CLR<4e-8	BER<1.8e-5 (CLR-1.e-6) CLR<5e-5
Videodistribution						
TV Distribution	20-50 Mbps VBR	2 hours error free	BER<3e-12 CLR<1e-9	Type 2	BER<1.2e-7 CLR<1e-9	BER<6e-6 (CLR=1.e-6) CLR<8e-6
MPEG 1 core	1.5 Mbps VBR	30 min error free	BER<4e-10 CLR<1e-7	Type 2	BER<1.4e-6 CLR<1e-7	BER<2.5e-5 (CLR=1.e-6) CLR<9.5e-5
MPEG 2 core	10 Mbps VBR	30 min error free	BER<6e-11 CLR<2e-8	Type 2	BER<5.4e-7 CLR<2e-8	BER<1.5e-5 (CLR=1.e-6) CLR<4.e-5

(*) Payload scrambling polynomial 1+x**43 produces double, correlated bit errors
(**) Based on parity cell built from 31 consecutive data cells. The cell losses are assumed to be isolated. with this simple correction scheme, single cell losses are corrected if combined with cell loss detection by cell numbering. Also non-corrected but detected bit errors in a cell are handled by replacing this faulty cell by a dummy cell followed by correction of this cellby the cell parity mechanism. The BER calculations are done in the assumption that all double ATM link errors (2 times 2 correlated errors due to payload scrambling) can be detected.
(***) QOS requirements, as visualised by viewers; not directly related to channel errors.

Notes
- These values are calculated under the assumption that cell losses are isolated. If cell losses tend to occur successively, another cell loss ration and another cell loss correction technique may be required.
- It was assumed that one cell loss always causes picture degradation. The visual perception of the picture, however, may be acceptaable even if cell loss concealment technique is not used. Therefore there is a possibility that these requirements will be relaxed.

Use of CLP bit

The CLP bit is seen as a useful mechanism to provide protection against cell loss by controlling that information which might be lost. It is crucial that, after a cell is labelled "high priority" by a terminal device, this is not changed by the network.

A related issue is the use of the ATM header codepoints to support video/multimedia services. In this respect, the following is understanding has been reached :

- The CLP bit remains separate from the 3 bit Payload Type field. However the significance of the CLP bit value when some Payload Type codepoints occure (i.e. resource mamangement codepoints for example) remains open at this time.
- In the Payload Type field a capability exists the support of user-user applications.

Open questions:

- Will there be separate negotiations for the two priority levels?

- Will the usage monitoring structure encourage use of both high and low priority cells?

- What options are available in selecting the quality of service?

Usage parameters

The rate statistics required of a video encoder have a significant impact on its performance (in terms of picture quality and delay). For circuit switched networks, the target was straightforward; minimise the rate and keep it constant. For the B-ISDN (with the possible advantages of variable rate over constant rate operation), entirely different rate control strategies may be appropriate, and these could have a significant impact on codec performance. At this stage, the only clear decision is that peak rate will be an important
parameter that is monitored.

In our group the term "*window*" means the policing time for the average bit rate. The following methods are considered for policing in the network:

Jumping window:

There is no time interval between two successive windows.

Moving window (sliding window):

The window is sliding at a time step smaller than the window size.

Stepping window:

There is a time interval between two successive windows, which always start at a valid cell.

Leaky bucket:

Cells are put into a buffer and taken from the buffer at an average bit rate. If the buffer overflows, cells are discarded.

If a codec does not know when the network measuring window starts, it should control the bit rate by sliding window (the most severe method). Is there any way in which the starting time of the network measuring window can be known?

Open questions:

- What parameters will be used for policing and admission control?

- What policing mechanism will be used?

- What averaging intervals can be used to measure mean, peak, etc.? Longer intervals (significantly greater than a video frame period which is typically 33-40 ms) are preferred
for video services.

- When the network capacity is very large, the bit rate requirements of a single user will be relatively small. In this situation it seems there will be very little difference in the required network resources for low and high priority cell loss classes. Will the high priority cell loss class continue to exist in the future?

Multimedia connections

Multiplexing of multiple media has been carried out within the terminal device for circuit switched networks. The B-ISDN offers the flexibility to use virtual channel (i.e. cell) based multiplexing instead. An important factor in the choice between terminal-based or cell-based multiplexing is whether there will be a penalty caused by the use of an ensemble of virtual channels instead of one composite one, although the overall rate characteristic, for example, would be the same. The choice of mulitplexing options must therefore take into consideration a number of variables, including :

- transmission cost
- control cost
- flexibility
- efficiency
- overall service performance

Cell sequence integrity within a Virtual Path Connection will be maintained to enable OAM performance monitoring. A the availablity of sequence integrity at this level will influence options available for the support of video/multimedia services.

Some multimedia connections (most obviously associated audio, stereo in particular, and video channels) require synchronism. A concern arises, therefore, if the differential delay between virtual channels became noticeable in some service applications. This is unlikely to be a problem unless the cumulative differential delay exceeds some tens of milliseconds from end to end.

Open questions:

- How will multimedia services be handled in the B-ISDN?

- What signalling methods are being proposed?

- What kind of multimedia multiplexing method is preferred from the standpoint of network resource management?

- At what stage of B-ISDN development will it be possible for the signalling and control needed to minimise and control cross-media delay be available?

Bit error rates

Cell payloads will be subject to a small probability of transmission error on the B-ISDN. The statistics of such errors will determine the need for, and type of, error correction mechanism and the overhead necessary to achieve this. It could also influence approaches to, and efficiency of, video coding and choice of codeword assignment scheme. Estimates of the likely bit error rates are required by those working on video coding schemes for the B-ISDN.

For interworking between video codecs on 64 kbit/s ISDN and B-ISDN networks, the B-ISDN bit error rate must be no greater than that for the 64 kbit/s ISDN. It should also be noted that the Recommendation H.261 coding scheme for 64 kbit/s ISDN provides bit error correction, so this would not be a necessary function of the AAL in this case.

SGXVIII should work in close collaboration with the video coding experts to define any capability within the AAL concerning bit error detection or correction.

Cell delay and jitter

The fixed component of end-to-end network delay contributes to the total service end-to-end delay and therefore is a determining factor in the overall quality of service. Estimates of the limits of B-ISDN delay are required to quantify such performance and determine its impact on video encoders and decoders.

The variation in delay, or jitter determines the size of receiver buffers necessary for its removal, and therefore again influences total end-to-end delay. The expected statistics of cell delay jitter need to be known to determine the impact on the video coding system and overall quality of service.

Annex 3. ATM Adaptation Layer

Recommendation I.363 -" B-ISDN ATM Adaptation Layer (AAL) Specification", is in the process of being enhanced to reflect recent agreements on AAL Type 1 and AAL Type 2.

Updated versions of the full text of revised Recommendation I.363 has been sent to all relevant groups by liaison statement.

Integrated Video Services (IVS) Baseline Document

Annex 4. Video Service Interworking

The B-ISDN will be capable of delivering a range of service applications (e.g. communicative real-time video, video retrieval or store-and-forward video, distributive services), using signal formats covering a wide range from videophone resolution to HDTV and at a range of qualities for any given signal format.

Integration of video services is recognised as a key objective for ATM Video Coding. It is an agreed target for the video coding systems under study by the CCITT SGXV Experts Group on Video Coding for ATM Networks and by CMTT. Both groups have identified several methods by which interworking between video services can be achieved:

Negotiation, or switchable encoder, approach

At the commencement of a connection, terminals negotiate a set of parameters with which both can cope. A set of standards of increasing quality would be defined and a basic capability assumed for all terminals.

Simulcast

Transmitting terminals contain multiple encoders, operating at a variety of resolutions and quality levels so that broad interconnectivity can be achieved by transmitting multiple parallel encoded signals. Receiving terminals could be simple devices able to receive one of the bit streams, or could contain multiple decoders allowing a selection.

Layered Signal Approach

A hierarchical representation of the video signal is defined. Coders transmit a baseband signal which provides a basic quality service. Incremental signals, which can be used along with the baseband to recover a high quality signal, are also transmitted. Receiving terminals utilise the baseband and an appropriate number of incremental signals to recover the video signal to the quality which they are capable of displaying. Transmitting terminals provide the number of signals commensurate with their input signal quality. Three additional terms relevant to layered coding also require definition:

- Flexible layering. Identified within the SGXV Experts Group, this concept allows for a choice to be made as to how many layers should be used for particular services or in particular applications. Those layers not required can be "switched off" with possible advantages in complexity and transmitted rate while still allowing for broad interworking. Note that full layering and single layer coders are special cases.
- Embedded bit stream. This is an implementation of layered coding, in which the receiving device need only accept the data stream it can usefully process. The layers could, for example, be transmitted in separate VCs in an ATM network.
- Syntactic extension. This is another layered coding implementation, in which the decoder accepts the entire generated bitstream and separates from it that information it can usefully process by means of the common syntax.

A range of issues needs to be considered in comparing these different approaches, including complexity, coding rate penalties and performance. They provide different levels of compatibility, impose different constraints on coding algorithm design and are better matched to different applications. Negotiation would seem inappropriate for multipoint and distribution services, whereas simulcast seems inappropriate for storage applications (e.g store and forward video mail). Layered coding seems suited to the widest application range, with the additional benefit of providing inherent cell loss tolerance. "Flexible layering" appears to provide broad interworking capability with few restrictions, and is currently one of the options under study by the SGXV Experts

Group. Layered coding has been identified by CMTT as suitable for extension to future video systems such as super HDTV.

Studies continue to identify the applicability, advantages and disadvantages of the various techniques.

Constraints imposed by compatibility may be unacceptable in certain specific situations. The main objective for contribution television applications, for example, is to achieve the best picture quality. Due to possible post-processing, it is not desirable to lose any information. Therefore, it may not be appropriate to assign a lower priority to some cells of the bit stream as is possible with e.g. layered coding. Instead (or, perhaps, in addition) Forward Error Correction methods may be required to maintain the very high end-to-end QOS objective.

It is recognised that to provide easy interworking or conversions between services, and to use common display components on a terminal device intended to access multiple video services, the definition of a family of picture formats would be beneficial. Picture formats represent an important area that will influence video coding and it is being studied actively in the SGXV Experts Group. CMTT has, however, recognised that standardisation of a hierarchy of picture formats could impose constraints on the production process.

Integrated Video Services (IVS) Baseline Document

Annex 5. Coding Aspects

A5.1 Constant Bit Rate (CBR) and Variable Bit Rate (VBR) coding

Restrictions of traditional circuit switched networks have meant that all commercial digital video codecs operate at a constant bit rate, despite the inherently varying information content of a motion video sequence (being dependent on changing image complexity, degree of motion, frequency of scene changes, etc.). The internally varying rate in these codecs is smoothed by buffering, and dynamic control of codec parameters (sensitivity, quantiser stepsize, etc.) ensures that the buffer neither empties nor overflows. Such codecs operate in a fixed rate, but variable quality, mode.

ATM Networks will support Variable Bit Rate (VBR) coded video, allowing the transmitted bit rate to reflect the information content of the changing video signal, limited by the maximum channel capacity and parameters agreed with the network resource management system.

A VBR codec can therefore (usually) maintain a fixed quality, variable bit rate mode of operation. The possible advantages of this are:

- Because data is not transmitted when the information content is low, and because high rates are only used when necessary, VBR codecs are expected to deliver a given overall quality at a lower average rate than a CBR codec;
- The reduction in buffer size and easing of constraints on rate control means that there could be savings in codec complexity and cost;
- Reduced buffering may mean that end-to-end delays will be reduced; this is an important consideration for communicative services such as videotelephony and videoconferencing.

There may be substantial savings in average bit rate through the use of VBR coding and statistical multiplexing of multiple sources on the one network. Studies are required to confirm this advantage under realistic network conditions and to determine its sensitivity to the type of application (videoconferencing, television distribution, etc.) and method of coding. Measurements which indicate that under certain conditions the statistical multiplexing gain of some VBR video service applications is only small.

Studies are also required to quantify the reduction in delay resulting from VBR coding and relate this to limits obtained from human factors investigations.

A5.2 Current codecs and ATM networks

Existing CBR codecs have been designed to be used in current plesiochronous networks. Their output bit-rate matches the rates of the plesiochronous hierarchy e.g 34-45 Mbit/s and 140 Mbit/s. As a consequence, their design includes an adaptation to plesiochronous networks in the form of an error detection and correction unit. As existing CBR video codecs have been defined, it is not envisaged to remove this plesiochronous-oriented adaptation.

When a CBR video codec is to be connected to an ATM network, one problem appears because the internal adaptation does not perform extra functions required by ATM networks. Therefore, an additional adaptation is necessary. It is called the AAL (ATM Adaptation Layer), and it has to be added beside the built-in adaptation of the codec. Such a scheme is not an optimum one, because it is not easy to combine functions of both adaptations.

According to the service classification defined in CCITT Rec.I.362, constant bit rate (CBR) video services pertain to Class A. Codecs are currently available performing these

services. For the time being, most of existing codecs, if not all, have been designed to be connected to plesiochronous networks. For the connection of existing plesiochronous-adapted codecs to ATM networks, two methods have been identified: circuit emulation and direct connection, both using a dedicated AAL.

- Circuit emulation - The codec is used as it if were connected to a plesiochronous network. The signal is inserted into the relevant PDH frame structure which is then carried transparently over ATM networks through a specific AAL. As a result, particular requirements of the CBR signal components (video, audio, data) are not taken into account.
- Direct connection - The definition of the AAL takes advantage of error correction which is already performed in the codec itself. In this case the different components of the signal (video, audio, data) may be carried in the ATM network in separate VCs.

A5.3 Compatibility Aspects.

It is important to consider the various applications of coded video signals and to maximise commonality where possible to achieve a truly integrated video services structure. A particularly important area for compatibility is in the coded representation of video for communications and storage.

Stored video has some constraints that are not applicable for communications applications. For example, there may be the requirement for fast forward, and reverse play. The constraints may differ depending on whether tape or disk based storage is used.

Efforts to provide commonality between stored and transmitted video formats have already been initiated by the ISO/IEC MPEG group. If, however, the coding techniques cannot be made identical, care should be taken to ensure that compatibility can be facilitated readily.

Compatibility between an IVS signal format and existing or emerging standard digital video formats for circuit switched networks should be the objective during the interim period before full B-ISDN support.

A5.4 Cell-based (ATM) Transport aspects relating to Video Coding

Transmission of video information in cells requires consideration of several factors:

- Error protection. A layered coding approach (see Annex 4) appears attractive as a means of minimising the effect of cell loss, particularly if it occurs in bursts. This requires separation of the video information into high and low priority components and appropriate setting of the cell loss priority (CLP) bit in the ATM cell header.
- Error propagation. Mechanisms to avoid propagation of errors in the event of a cell loss need to be investigated.

Annex 6. Multimedia Service Support

A6.1 Multimedia Service Categories

Multimedia services may be categorised on the basis of how they appear to the customer e.g.

Multimedia Call and Conference, e.g. multiparty, multimedium calls;

Multimedia Mail, e.g. extending the text based electronic mail model to include other media;

Multimedia Database ,e.g. browsing through catalogues, educational tutorials;

Shared Resource Multimedia Applications e.g. sharing network resources among users as a means of containing costs for expensive or infrequently used facilities.

Guidance on important aspects which need to be taken into account in supporting and developing services for B-ISDN can be found in Recommendation I.211 - B-ISDN Service Aspects.

The methodology for all multimedia services is the responsibility of CCITT SGXVIII/5-2 (Multimedia and B-ISDN). This group is responsible for the investigation of the network capabilities required to ensure the support of multimedia services. Additional Information relating to Network Capabilities for Multimedia Service Support may be found in Draft Recommendation I.37y.

A6.2. Network Issues

A6.2.1 Multimedia Service Attributes

Multimedia services have multivalued service attributes which distinguish them from traditional telecommunications services such as voice or data. Service attribute examples include : information transfer rate, traffic type, structure, symmetry.

A multimedia service may involve multiple parties, multiple connections, the addition/deletion of resources and users within a single communications session.

A6.2.2 Multimedia Call Modelling

For further study.

A6.2.3 Signalling for Multiparty Multimedia Services

Call and connection control for multimedia services is a new consideration for public network standards. Work in this area is at a very early stage of development. CCITT SGXI are currently investigating the functionality required of call and connection control.

B-ISDN Recommendation I.311 identifies the following signalling capabilities as being the basic capabilities required to support simple multiparty and multiconnection calls :

•*Capabilities to control ATM virtual channel and virtual path connections;*

- Establish, maintain and release ATM VCCs and VPCs;

- Support point-to-point, point-to-multipoint and broadcast communication configurations;

- Negotiate traffic characteristics of a connection at connection establishment;

- Renegotiate source traffic characteristics of an established connection.

• *Capability to support simple multiparty and multiconnection call;*

- Symmetric and asymmetric simple calls;

- Simultaneous establishment and removal of multiple connections within a call;

- Add and remove connection from an existing call;

- Ability to correlate (when requested) connections composing a multiconnection call;

- Reconfigure a multiparty call including an existing call or splitting the original multiparty call into more calls.

• *Processing related functions;*

- Capability to reconfigure an established connection e.g to pass through an intermediate processing facility such as a conference bridge;

- Support for interworking between different coding schemes;

- Support interworking with non-B-ISDN services e.g. 64 kbit/s ISDN.

Support of multimedia services on B-ISDN will permit the use of virtual channels for separate service components of the multimedia connections.

Issues that must be studied in this area include:

• Interworking with a terminal multiplexed multimedia connection (e.g. using Recommendation H.221);

• differential delays between virtual channels (particularly important for audio and associated video).

• Network usage parameter control and charging based on ensembles of virtual channels within one or multiple virtual paths.

• Signalling to support multi-connection calls within a single call, or use of multiple calls (each supporting one connection).

A6.2.4 Multimedia Traffic Control and Resource Management

A6.2.4.1 Connection Admission Control

Recommendation I.311 indicates:

• in the case of multimedia and multiparty services, connection admission control procedures are performed for each VC or VP connection;

• Signalling messages sent by a user at call establishment must convey at least the following information :

- source traffic characteristics:

- required QOS class.

These parameters may be difficult to determine in those cases where media is multiplexed on anything other than a virtual channel or virtual path basis.

• Methods for characterising source traffic are for further study. Traffic characteristics may include : average rate, peak rate, burstiness and peak duration. Again it may prove difficult to characterise multimedia services where media is multiplexed on the basis of anything other than a virtual channel or a virtual path.

• Traffic characteristics are negotiated with the network at call establishment and may be renegotiated, by user request, during the call. The network may limit the frequency of these renegotiations Further study is required to determine the impact of such potential restrictions on multimedia calls.

A6.2.4.2 Usage Parameter Control

Recommendation I.311 indicates :

• Usage parameter control is performed on VCs and VPs at the access point where they are terminated within the network. This implies multiple usage parameter control for a multimedia service where individual services are carried on separate VCs or VPs.

• Agreed parameters for usage control are for further study.

• Actions proposed when traffic violates the call establishment agreement include :

- discarding cells which exceed the pre-negotiated traffic levels;

- tagging of violating cells;

- releasing the connection.

A6.2.4.3 Resource Management

Recommendation I.150 specifies

• For VPs are required to carry VCs with a range of QOS values, the VPC QOS corresponds to the most demanding VC link carried.

The impact of this arrangement on options for multimedia service support is for further study.

Draft new Recommendation I.xxx specifies:

• Where the network has no knowledge of the QOS of the VCs within a VP connection, it is the users responsibility to determine, in accordance with the network capabilities, the QOS appropriate to his VP.

A6.2.4.4 Resource Renegotiation

The Experts Group is considering the conversion of 64 kbit/s multiplexing signals to B-ISDN to Virtual Channel multiplexed signals either in Terminal Adaptors (TA) or B-

ISDN/64 kbit/s ISDN Interworking Units (IWU). Current user multiplex structures (e.g. Recommendation H.221) can reconfigure their internal rate allocation in the order of 20msec.

Resource allocation in user-multiplexed structures such as those described in Recommendation H.221 corresponds to a redistribution of a fixed resource allocation.

Resource allocation for Virtual Channel multiplexed structures corresponds to a change in the allocation of resources within a communications network. The performance achievable and required in terms of network resource allocation is for further study.

A6.3. Customer Premises Network Issues

A6.4 Customer Premises Equipment Issues

A6.5 Open Issues

- multimedia service interworking (between services, terminals and networks)

- interworking terminals and the determination of basic levels of compatibility e.g. Recommendation H.221 requires all terminals to include a PCM coder-decoder, hence all compliant terminals are compatible with 3.1 kHz audio and speech terminals.

- media multiplexing options and their impact on required network capabilities e.g. sychronisation to provided bounded cross media delays. The multiplexing needs of low rate, real time services must not be overlooked, particularly the impact of any control costs associated with the multiplexing scheme adopted.

- compatibility checking at call establishment must be extended to include new features associated with multimedia services, e.g. terminal type and facilities, coding for information interchange, representation and presentation and special user-user required protocol compatibility.

- service negotiation issues.

- multimedia service interaction e.g. voice activated video.

- multipoint networking (e.g. multicast, broadcast and conference connections for multimedia)

- charging issues

Annex 7. Service Requirements

A 7 General

A7.1 Requirements Associated with Recommendation H.261

A7.1.1 Status Notation

(A) Agreed
(P) Preferrable
(M) Mandatory
(T) Target
(FFS) Implementation method is for further study

A7.1.2 Bit Rate

Up to several 10s Mbit/s	(A)

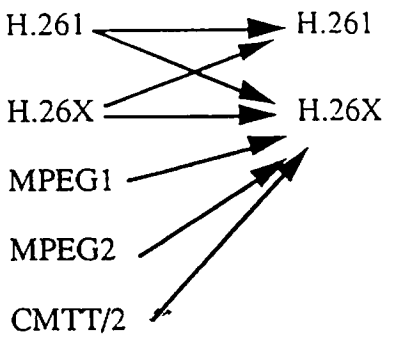
A.7.1.3 Codec Source Format

QCIF/CIF	(A)
"601" Class	(FFS)
EDTV	(?)
HDTV	(?)

A7.1.4 Compatibility

Encoder	Decoder	
Recommendation H320 --->	Recommendation H.32X (terminal)	(A,M)
Recommendation H.32X --->	Recommendation H.320 (terminal)	(A,M)
Recommendation H.321 --->	Recommendation H.26X	(P,FFS)
Recommendation H.26X --->	Recommendation H.261	(P, FFS)
MPEG1---> RecommendationH.26X		(P,FFS)
MPEG2---> Recommedation H.26X		(P,FFS)
"CMTT/2"* --> Recommendation	H.26X	(P,FFS)

* Secondary distribution, which may include classes above "601"



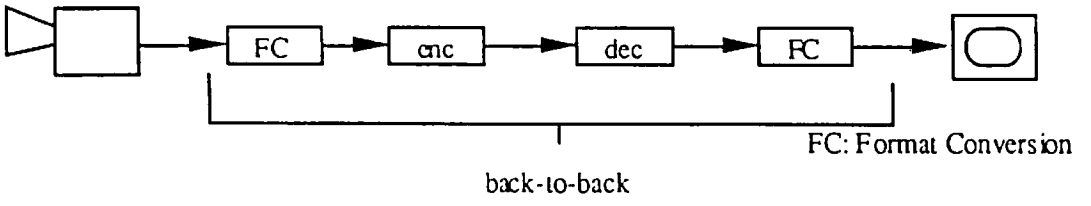
A7.1.5 Applications

"PAL/NTSC" at 3-5 Mbit/s and delay =? (T,FFS)

"CCIR Rec 601" at 8=10 Mbit/s and delay = ? (T,FFS)

A7.1.6 Delay

Less than about 150 ms at bit rate >2 Mbit/s (FFS)



A7.1.7 Codec Complexity

Complex/high performance
vs
simple/low performance
ex. pure intra-codec

A7.1.8 Applications

CTV Cable TV Distribution on optical networks, copper, etc
ENG Electronic News Gathering (including SNG, Satellite News Gathering)
IPC Interpersonal Communications (videoconferencing, videophone, etc)
ISM Interactive Storage Media (optical disks,etc)
NDB Networked Database Services (via ATM, etc)
RVS Remote Video Surveillance
SSM Serial Storage Media (digital VTR, etc)
STV Satellite TV Broadcasting
TTV Terrestrial TV Broadcasting

A7.1.9 ATM

VBR and CBR (A,M)

Cell loss resilience (M.FFS)

Bit error resilience	(M,FFS)
High/low priority cell utilisation	(P,FFS)
High/low priority cell independent rate control	(P,FFS)
Usage Parameter Control	(M,FFS)

A7.1.10 Multipoint

Continuous presence possible (P,FFS)

- Time-sliced decoding
- Editing without decoding-recoding

Mix of Recommendation H.320 and Recommendation H.32X (M,S)

A7.1.11 Recommendation H.32X Terminal

- with :

Recommendation H.320	(A,FFS)
Network database	(P,FFS)
Distributive service	(P,FFS)
Multipoint	(A,FFS)
Stored bit stream	(P,FFS)

• Multimedia multiplexing	(M,FFS)
• Audio quality >?	(FFS)
• Relative audio/video delay<?	(FFS)
• Video clock recovery	(FFS)
• Encryption/scrambling	(FFS)

Annex 8. Related Recommendations

CCITT SGXVIII

Recommendation I.113 - Vocabulary of terms for broadband aspects of ISDN

Recommendation I.140 -

Recommendation I.150 - B-ISDN ATM Functional Characteristics

Recommendation I.210 :

Recommendation I.211 - B-ISDN Service Aspects

Recommendation I.311 - B-ISDN General Network Aspects

Recommendation I.321 - B-ISDN Protocol Reference

Recommendation I.327 - B-ISDN Functional Architecture

Draft Recommendation I.35B -

Recommendation I.361 - B-ISDN ATM Layer Specification

Recommendation I.362 - B-ISDN Adaptation Layer (AAL) Functional Description

Recommendation I.363 - B-ISDN Specification

Draft Recommendation I.371 : Traffic Control and Resource Management

Draft Recommendation I.37y - Network Capabilities for the Support of Multimedia Services

Recommendation I.413 - B-ISDN User-Network Interface

Recommendation I.432 - B-ISDN User-Network Interface Physical Layers Specification

Recommendation I.610 - OAM Principles of B-ISDN Access

Annex 9. Vocabulary and Abbreviations

A9.1 Objective and Rationale

The objective of this annex is to provide a basis for the consistent and unambiguous use of terms and abbreviations between the various groups participating in IVS co-ordination studies and contributing to the IVS Baseline document.

A9.2 Abbreviations Used in the IVS Baseline Document

A : Agreed

AAL : ATM Adaptation Layer

ATM : Asynchronous Transfer Mode

BER : Bit Error Rate

B- ISDN : Broadband Integrated Services Digital Network

B-UNI : Broadband User-Network Interface

CBR : Constant Bit Rate

CCIR : The International Radio Consultative Committee

CCITT : The International Telegraph and Telephone Consultative Committee

CDV : Cell Delay Variation

CEQ : Customer Equipment

CIF : Common Intermediate Format

CLP : Cell Loss Priority

CLR : Cell Loss Ratio

CMTT :

CODEC : Coder/decoder

CRF : Connection Related Function

CTV : Cable TV Distribution

DSM : Digital Storage Media

EDTV : Enhanced Definition Television

ENG : Electronic News Gathering

FC : Format Conversion

FEQ : Forward Error Correction

FFS : For Further Study

GFC : Generic Flow Control

HDTV : High Definition Television

IEC : International Electrotechnical Commission

IPC : Interpersonal Communications (videoconferencing, videophone, etc)

ISDN : Integrated Services Digital Network

ISM : Interactive Storage Media (optical disks, etc)

ISO : International Standards Organisation

ITU : International Telecommunications Union

IVS : Integrated Video Service

IWU : Interworking Unit

M : Mandatory

OAM : Operations and Maintenance

MPEG : Moving Picture Experts Group

NDB : Network Database Services

NNI : Network Node Interface

NP : Network Performance

NPC : Network Parameter Control

UPC : Usage Parameter Control

NTSC :

P : Preferrable

PAL :

PCM : Pulse Code Modulation

PDU : Protocol Data Unit

QCIF :

QOS : Quality of Service

RVS : Remote Video Surveillance

SAP : Service Access Point

SDU : Service Data Unit

SN : Sequence Number

SNG : Satellite News Gathering

SSM : Serial Storage Media (digital VTR etc)

STV : Satellite TV Broadcasting

T : Target

TA : Terminal Adaptor

TTV : Terrestrial TV Broadcasting

TV : Television

UNI : User-Network Interface

VBR : Variable Bit Rate

VC : Virtual Channel

VCC : Virtual Channel Connection

VP : Virtual Path

VPC : Virtual Path Connection

VTR : Video Tape Recorder

A9.3 Vocabulary

A9.3.1 Scope and Intent

This section of the IVS Baseline document contains vocabulary terms and expressions used within the Baseline text. The section has been compiled with the intent of providing guidance to the wide and diverse community of users of the Baseline document.

Contributors are urged to ensure that defined terms are used where-ever possible and that terms with multiple definitions (for example - media) are always clearly identified by context.

Where possible, the source of the definition is provided. For example, Recommendation I.113 provides the primary source and reference for the vocabulary of terms for Broadband aspects of ISDN. Annex B of Rec I.113 (Geneva 1991) provides a list of abbreviations used in B-ISDN Recommendations.

A9.3.2. Vocabulary of Terms Used by Contributors to the IVS Baseline Document

add/remove : when connection elements can be established and released while other connection elements of the same connections still exist, the configuration of this connection is described as add/remove. (Rec I.140)

Asynchronous Transfer Mode (ATM): a transfer mode in which the information is organised into cells, it is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic. (Rec I.113)

bearer service : ref I.210

broadband : a service or system requiring transmission channels capable of supporting greater than the primary rate. (Rec I.113)

broadcast : a value of the service attribute "communications configuration" which denotes unidirectional distribution to all users. (Rec I.113)

broadcast connection : to be defined

broadcast communication : undirectional communication from a single access-point to an unlimited number of unspecified destination access-points. (Rec I.140 - revised)

broadcasting : within this document this term is most commonly used in reference to coding to support a television broadcasting service.

call :

call control :

cell : unit of information of fixed length, and consisting of a header and an information field. It is identified by a label at the asynchronous transfer mode layer of the B-ISDN protocol reference model. (Rec I.113)

cell delay variation :

cell discard :

cell error ratio :

cell loss :

cell loss ratio :

cell misinsertion ratio :

cell tagging :

cell transfer delay :

circuit emulation :

communication configuration : the spatial arrangement for transferring information between two or more access points. It completes the structure associated with a telecommunication service as it associates the relationship between the access points involved and the flow of information between the access points. Possible values include : point-to-point, multipoint and broadcast. (Rec I.140)

connection :

connection configuration : describes the spatial arrangement for transferring information on a given connection. It consists of two sub-attributes, topology and dynamics. (Ref I.140)

connectional establishment :

connection oriented :

constant bit rate :
1. a type of telecommunications service characterised by a service bit rate specified by a constant value (Rec I.113)
2. a constant value bit rate arising from a specific coding algorithm

continous presence :

distributive : see distribution

distribution : service characterised by the unidirectional flow of information from a given point in the network to other (multiple) locations. (Rec I.113)

embedded bitstream :

enhanced-quality television : television of quality superior to existing-quality television, but less than the quality of high-definition television . (Rec I.113)

existing- quality television : television as defined in conventional 625-line and 525-line television standards, such as NTSC, PAL and SECAM. (Rec I.113)

frame : a block of variable length identified by a label at layer 2 of the OSI reference model, e.g. HDLC. (Rec I.113)

header :bits within a cell allocated for functions required to transfer the cell payload within the network. (Rec I.113)

interactive service : a service which provides a means for bidirectional exchange of information between users or between users and hosts. Interactive services are subdivided into three classes of services : conversational* services, messaging* services and retrieval* services. (Rec I.113)

interworking :

layered coding :

multicast : unidirectional communication from a single access-point to a limited number of specified destination access-points. (Rec I.140)

multiconnection call :

multimedia conference :

multimedia bridge :

multimedia communication :

multimedia mail :

multimedia multiplexing :

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* Further definitions relating to these terms can be found in Recommendation I.113

multimedia service : a service in which the interchanged information consists of more than one type, such as text, graphics, sound, image and video. (Rec I.113)

multimedia service interaction :

multimedia terminal :

multiparty call :

multipoint : a value of the attribute "communications configuration: which denotes that the communication involves more than two network terminations. (Rec I.113).

multipoint communication : communication between the following access-points (Rec I.140 - revised) :

a. one source access-point to multiple destination access-points (point-to-multipoint)
b. multiple access-points to a single destination access point (mulitpoint-to-point) e.g. polling station.
c. multiple source access-point to multiple destination access-points (multipoint-to-multipoint)

multipoint connection : connection between the following end-points (Rec I.140 - revised) :

a. one source endpoint to multiple destination endpoints (point-to-multipoint)
b. multiple endpoints to a single destination endpoint (multipoint-to-point)
c multiple source endpoints to multiple destination endpoints (multipoint-to-multipoint)

multipoint-to-point service : e.g. televoting

network interworking :

network node interface : the interface at the network node which is used to interconnect with another network node. (Rec I.113)

peak cell rate :

peak bit rate :

point-to-point :

point-to-point communication : communication between only two access points. (Rec I.140)

point-to-point connection : a connection in which only two end points are provided. (Rec I.140)

point-to-multipoint :

periodic frame : a transmission segment which is repeated at intervals of equal duration and may be delineated by incorporating fixed periodic patterns into the bit stream. (rec I.113).

physical frame : a segment of a serial logical bit stream at an interface, partitioned into successive segments. (Rec I.113)

plesiochronous :

picture formats :

quality of service : the collective effect of service performances which determine the degree of satisfaction of a user of a specific service. (Rec I.350)

resource management :

service bit rate : the bit rate which is available to a user for the transfer of user information. (Rec I.113)

service interworking :

simulcast :

supplementary service :

switched (connection) : ISDN

syntatic extension :

teleservice : ref I.210

traffic characteristics :

traffic shaping :

transfer mode : aspects covering transmission, multiplexing and switching in a telecommunications network. (Rec I.113)

usage parameter control : the taking of appropriate action if usage monitoring establishes that the negotiated values of the information transfer parameters of a virtual channel or a virtual path are exceeded. (Ref I.113)

variable bit rate service : a type of telecommunication service characterised by a service bit rate specified by statisically expressed parameters which allow the bit rate to vary within defined limits. (Rec I.113)

variable bit rate coding : a type of service coding (e.g. video) characterised by a varying output bit rate.

video-on-demand :

virtual channel : a concept used to describe unidirectional transport of ATM cells associated by a common unique identifier value. (Ref I.113)

virtual channel connection : a concatenation of virtual channel links that extends between two points where the adaptation layer is accessed. (Ref I.113)

virtual path : a concept used to describe unidirectional transport of ATM cells belonging to virtual channels that are associated by a common identifier value. (Ref I.113)

virtual path connection : a concatenation of virtual path links that extends between the point where the virtual channel identifier values are assigned and the point where those values are translated or removed. (Ref I.113)