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The text of the IVS Baseline Document has been updated to show, as far as possible, the result of drafting activity during the June 1992 meeting of CCITT SGXVIII. Text amended during this meeting is indicated by sidebars, strikethroughs and italics. Amendments include corrections to align the IVS Baseline with revised I-series Recommendations, material from other standards bodies and new issues identified by the drafting group.

INTEGRATED VIDEO SERVICES (IVS) BASELINE DOCUMENT
June 1992

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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.

IVS does not imply any specific service, but is the concept of aiming at maximum integration of video services through harmonisation of the terminal and network capabilities of B-ISDN.

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~~ *may* 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~~ *could* 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~~ *Recommendation I.211* 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.

While it is anticipated that B-ISDN will eventually become the ubiquitous telecommunications network, serving all market sectors, ~~it is clear that~~ the business sector will be first to make use of the new network's features. Indications from computer manufacturers ~~are that~~ *suggest* here is ~~already~~ a significant need for broadband, reserved capacity telecommunications to support the emerging generation of multimedia computer equipment. This equipment will integrate the presentation of a wide range of video material with audio, graphics and text in many diverse applications. These will include access to remote information sources, windowed videophone applications and collaborative working methods. A wide range of video material, with different quality requirements, and displayed sizes and shapes, ~~will have to be supported~~*require support*. Traditional communicative video services like videoconferencing are likely to have a smaller, but still significant, role and the greater bandwidth may encourage high quality conferencing systems. Despite these early service expectations, the longer term delivery of entertainment television and HDTV to domestic users must also be accommodated in the Integrated Video Services architecture.

5. Evolution to Integrated Video Services in B-ISDN

~~It is clear that the~~ *The* development of B-ISDN Recommendations will follow a staged approach~~. Similarly it can be expected that~~ *and* 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.

Annex 1. Work Plan

A1.1 General

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

* Last amended September 1991

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+
5.1 STM/ATM 5.2 CBR/VBR 5.3 Bit Rate 5.4 Design Features 5.5 Service Types 5.6 Other Features 5.7 Interworking 5.8 Depedencies	MPEG 1	MPEG 2 (not transmission based) CBR and/or VBR up to 10 Mbit/s Generic Coding Digital VTR Digital Disc Cable TV TG CMTT/2 CCITT SGXV	MPEG 3 CBR and/or VBR Up to 40 Mbit/s Generic Coding High resolution TV Systems (HDTV)

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	
Broadband Video Delivery service			Rec. F.vds
Broadband Video on Demand service			Rec.F.vod
Broadband Multimedia Teleservice and Applications			Rec. F.mms

Integrated Video Services (IVS) Baseline Document

Annex 2. Network Aspects

Note : With the ending of the current study period of CCITT SGXVIII, new or enhanced versions of I-series Recommendations relating to Broadband ISDN have become available. While Annex 2 of the IVS Baseline attempts to reflect major impacts on video service support, the original text of Recommendations should be used as the basis of detailed assessments.

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~~ occur 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~~ 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~~ *must* conform to the relevant CCITT standards ~~for communication to take place~~.

These two types of basic services may ~~be supported by~~ *support* 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.

A2.2.1 Application of Virtual Channel and Virtual Path Connections

Revised Recommendation I.311 (1992) identifies the following point-to-point applications of Virtual Channel Connections:
- *User-user applications - in which the Virtual Channel Connection extends between the T_B or S_B reference points.*
- *User-network application - in which the Virtual Channel Connection extends between a T_B or S_B reference point and a network node.The user-network application of a VCC can be used to provide customer equipment access to a network element.*
- *Network-network application - in which the Virtual Channel Connection extends between two network nodes. The network-network application of this Virtual Channel Connection includes network traffic management and routing.*

Revised Recommendation I.311 (1992) identifies the following applications of Virtual Path Connections :
- *User-user application - in which the Virtual Path Connection extends between T_B or S_B reference points. The ATM network elements transport all cells associated with a VPC along the same route.*
- *User-network application - in which the Virtual Path Connection extends between a T_B or S_B reference point and a network node.*
- *Network-network application - in which the Virtual Path Connection extends between two network nodes. The network-network application includes network traffic management and routing. At the network nodes where the Virtual Path Connection is terminated, the Virtual Channels within the Virtual Path are switched or cross-connected to Virtual Channels within other Virtual Paths.*

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.

A2.3.1 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). *Establishment can be on-demand, semi-permanent or permanent, and should comply with requested connection characteristics.*

  - 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. *The simultaneous establishment of multiple connections should not be significantly slower than the establishment of a single connection.*

  - Add and remove connection from an existing call

  - Ability to correlate (when requested) connections composing a multiconnection call. *This correlation is handled by the origination and destination B-ISDN switches, which may be public or private.*

  - 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

A2.3.2 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 (e.g.. 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~~ *for* the transfer of information only when required ~~will~~ *may* 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.

A2.6.1 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.

Recommendation I.211 also notes that the transfer over 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.

A2.6.2 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 622.08 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. *The maximum service bit rate which can be supported on this interface may be equal to or less than 542.526 Mbit/s (ref. Recommendation I.211 Revised, June 1992). The actual maximum service bit rate is for further study.*

A2.6.3 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.

A2.6.4 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.~~

• *constant and variable bit rates are expressed by a number of parameters related to the traffic characteristics described in Recommendation I.371.*

• 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.

• *for reasons including network operation, interworking and service development - a number of specific bit rates will be standardised. This comment applies to both constant and variable bit rate service support.*

A2.6.5 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.

A2.6.6 Allocation and control of network resources

• does not present new problems for CBR services

• there may be advantages from the statistical multiplexing of uncorrelated VBR sources. *The applicability of VBR coding to specific service types is for further study. (Ref I.211 Revised - June 1992)*

A2.6.7 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.

A2.6.8 Traffic Control and Congestion Control - The Impact on Video Services

A2.6.8.1 CCITT SGXVIII Perspective

Draft Recommendation I.371 entitled Traffic Control and Congestion Control describes the parameters and procedures necessary to protect the network and user in order to achieve network performance objectives.

Traffic Contract

A traffic contract at the T_B reference point is specified between the suer and network for each ATM connection.

In establishing a connection on an ATM network, a user must specify the characteristics of the offered traffic and the required QoS for the connection. Additional information describing the maximum cell delay variation is also required. It has not yet been decided whether this cell delay variation tolerance is negotiated on a subscription or per connection basis.

Traffic Specification

The Source Traffic Descriptor is a set of traffic parameters used during connection setup to capture the intrinsic characteristics of the connection requested by the source. So far, only the peak cell rate of an ATM connection has been specified. However, a user may request two levels of priority for an ATM connection as indicated by the Cell Loss Priority (CLP) bit. In this case, traffic parameters describing both the high priority flow (CLP=0) and aggregate flow (CLP=0+1) are included in the source traffic descriptor.

Quality of Service

The ATM layer QoS is defined by a set of parameters such as delay, delay variation and cell loss ratio. The network provides an ATM layer QoS for both the high priority (CLP=0) and aggregate (CLP=0+1) components of an ATM connection. The network must meet the requested QoS as long as the user complies with the traffic contract.

Impact of Cell Delay Variation

When cells from two or more ATM connections are multiplexed, cells of one connection may be delayed while cells of another connection are being inserted at the output of the multiplexer. Similarly, some cells may be delayed while physical layer overhead or OAM cells are inserted. Proper design of mechanisms controlling access to network resources requires that this cell delay variation be specified.

Usage Parameter Control/ Network Parameter Control

The UPC/NPC mechanism should not discard or tag cells in an ATM connection if the source conforms to the Source Traffic Descriptor negotiated at connection establishment. A method to determine whether a traffic flow is conforming to the negotiated peak cell rate at a given interface is defined in draft Recommendation I.35B.

When an ATM connection uses the CLP capability as requested by the user, network resources are allocated to both high and low priority traffic flows. By allocating adequate resources and by controlling both the high priority (CLP=0) flow and the aggregate (CLP=0+1) flow, a network operator may provide the requested QoS classes.

A2.6.8.2 CCITT SGXV ATM Experts Group Perspective

The Experts Group is concerned about UPC/NPC algorithm standardisation. The NPC technique must be mirrored in the terminal to ensure that no violation of the network agreement (which could lead to discarded cells) occurs. It is therefore considered essential that, for anything other than peak rate monitoring, the UPC/NPC algorithm must be standardised; it cannot be left to individual operators to choose.

The Experts Group is interested in receiving information on the details of UPC/NPC algorithm development as they emerge. These algorithms may have a significant impact on video service provision and efficient utilisation of network resources from a service point of view. It would be impractical to consider that terminals could adapt to different parameter control algorithms depending on which network, or combination of networks is used.

The Experts Group will continue to study UPC mechanisms from the video services viewpoint. Current indications are that Leaky Bucket techniques have some advantages in terms of efficient implementation.

~~A2.6.13 Merit of Using CLP bit~~

A2.6.9 Cell Loss Resilience and Coding Aspects

~~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.~~

As noted in Recommendation I.211 (Revised 1992), the layered signal approach offers improved cell loss protection. Decomposing the coded video information into separate layers allows information from different layers to be placed in separate cells. This technique therefore provides some measure of statistical error protection. Advantages can be further enhanced by allowing the network to selectively discard cells when necessary by use of the Cell Loss Priority (CLP) indicator. This requires layer identification on a cell-by-cell basis and 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 suable 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.

A2.7.1 Quality of Service Indication and Negotiation

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

• QOS related to Virtual Channel Connections (VCCs)
The user of a VCC is provided with one of a number of QOS classes supported by the network. The QOS class of a given connection will not change for the duration of the connection, any renegotiation of the QOS classs may require establishment of a new connection.

• QOS related to Virtual Path Connections (VPCs)
A user with a VPC is provided with one of a number of QOS classes supported by the network. The QOS class will not change for the duration of the VPC.

Several Recommendations make reference to QOS negotiation issues.

• Recommendation I.211 *(Revised 1992)*, 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. *For several reasons, including network operation, interworking and service development, a limited number of specific QOS will be standardised.*

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.

The Cell Loss Ratio for high priority cells will be defined, and assured by the network if cell traffic does not exceed the negotiated values. Handling of low priority cells is for further study.

• 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.

A2.7.2 General Aspects of ISDN Performance

A2.7.2.1 Performance Parameters

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 (Recommendation 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.

A2.7.2.2 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. It is possible however that some AAL types may improve bit error and cell loss performance provided by the ATM layer. These AAL issues will continue to be studied in WP XVIII/8, in co-operation with WP XVIII/6 who will also continue studies on the relationship of transmission network performance objectives to ATM network performance.

• 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.

~~**A2.7.2.4 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.

The need for end-to-end timing recovery has been recognised by the ATM Experts Group of SGXV. Precise requirements are under consideration. The availability of a network reference clock will be essential to ensure timing recovery necessary for high quality video applications.

An 8 kHz structured data reference will be required for circuit emulation support of existing audiovisual systems based on Recommendation H.221. Recommendation I.211 (Revised 1992) indicates that mechanisms should be provided to enable the full requirements regarding network provided timing and synchronisation to enable services with 8 kHz integrity to be supported. For some services the SRTS method of source

clock frequency recovery will rely on a network provided clock to meet timing requirements.

The SRTS timing recovery approach adopted by SGXVIII at its Melbourne meeting has been investigated, by the ATM Experts Group of SGXV. It appears appropriate for timing recovery for CBR video services. Some extensions may be necessary for VBR, and this is currently a topic for study. Whether timing recovery is achieved using AAL functionality or as part of the video codec function is also under consideration within SGXV.

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 clarification are listed in the following sections.

A2.9.1 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.

A2.9.2 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
Annex 2

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

TABLE 1, ANNEX 2 (continued)

(*) 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.

A2.9.3 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 occur (i.e. resource management 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?

A2.9.4 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?

A2.9.5 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 multiplexing 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 availability 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?

A2.9.6 Bit Error Ratios

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 ratio 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 ratio 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.

A2.9.7 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.

A2.10 Access Network Issues

The ATM Experts Group of SGXV recognises that access to B-ISDN may, at least for a considerable interim period, be via other networks such as LANs and MANs. Video services must also be supported over these access networks. The implications of the differing network characteristics, in terms of resource allocation, timing requirements, protocol conversions, UPC control, etc, require study.

A2.11 Network Capabilities to Support Charging for B-ISDN Services

Recommendation I.311 (Revised) notes that services to be taken into account in B-ISDN's based on ATM technique include connection oriented as well as connectionless services, in different communication configurations as e.g. point-to-point, multipoint, broadcast and other service connections.

Network capabilities to support the charging of these B-ISDN services are for further study.

A2.12 Multipoint Networking

A2.12.1 General

There exists an obvious need to consider the multipoint capabilities which may be required in both early and longer term B-ISDN. Applications requiring multipoint networking include broadcast and narrowcast video/multimedia and multicast data.The stage introduction of signalling capabilities agreed for B-ISDN indicates that initially multipoint connections would need to be established on the basis of user requests to the network provider, rather than established on demand using network signalling.

Relevant issues requiring further study include :

• the impact of multipoint access, including multiaccess and multi-CPE access. This would also include the development of procedures to co-ordinate the access of multiple terminals to a single interface. The need for multipoint access is for further study.
• multipoint network connectivity to allow the interconnection, at the network level, of more than one ATM source-destination pair, which are assumed to be on two or more physical interfaces. This will require ATM multicasting and also possibly ATM channel merging. Multicasting refers to the capability of an ATM switch or network to copy an input ATM cell stream and deliver it to multiple output ATM cell streams. ATM channel merging refers to the capability of a single ATM switch or network to combine multiple ATM cell streams and deliver to a single ATM output stream. Higher layer information is used to determine from which source a particular cell originated.

The need for limitations to the number of multicast or merged streams supported at UNI/NNIs is for further study.

A2.12.2 Connection Topologies

Multipoint connection topologies requiring consideration include :
• point-to-multipoint i.e. a single source broadcasting identical information to more than one endpoint. This basic topology can be expanded and used as a building block in describing other multipoint topologies.
• multipoint-to-point.- Revised Recommendation I.150 notes that for multipoint-to-point virtual channel connection, cell sequence integrity is preserved for cells from each VCC endpoint of the VCC.
• multipoint-to-multipoint

Further study is required of the arrangements suitable for ATM link implementation, identifier management, bandwidth issues, connectivity descriptions, establishment and billing.

A2.12.3 Multipoint Functional Requirements

For further study

A2.12.4 Multipoint Performance Requirements

For further study

Annex 3. ATM Adaptation Layer

A3.1 ATM Adaptation Layer Type 1

SG XVIII thought AAL type 1 for circuit transport is stable for 1992 Recommendation. Review and assessment of protocol for this layer service is useful and necessary to progress in development of AAL Type 1 and/ or Type 2 for video signal transport, which is scheduled to be complete at 1994 Recommendation by joint and cooperative work between SG XVIII and coding groups.

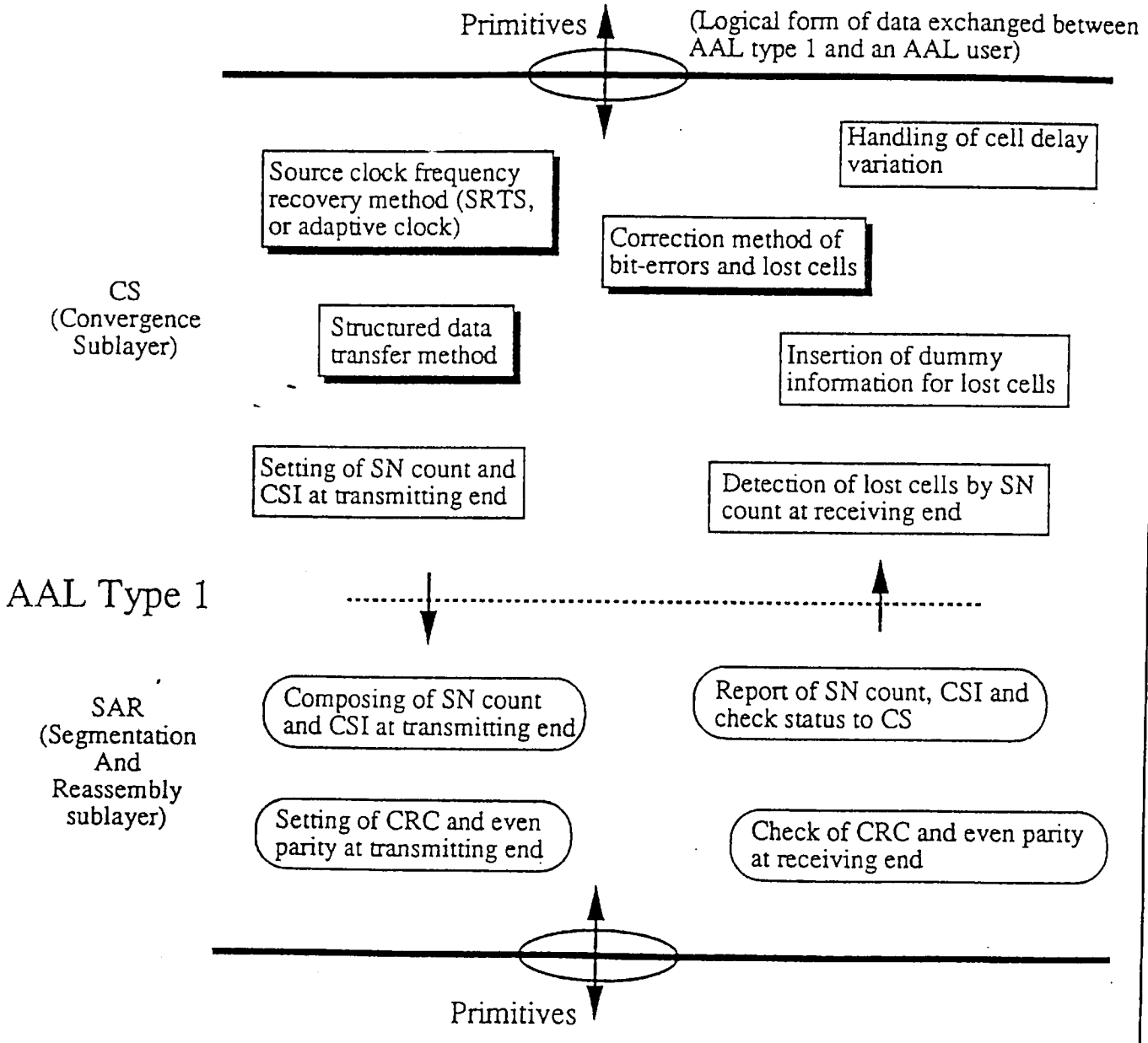
This Annex 3 presents figures and explanations of AAL Type 1 for supplementing I.363, since the text of Recommendation I.363 is strict for completing specifications and may not be so understandable for people outside SG XVIII. Purpose of this Annex 3 is to give tutorial and getting-started information of AAL Type 1, as well as background and overview of some specific functions and procedures such as source clock frequency recovery and structured data transfer. It does not describe detailed procedures, since articles are drafted from AAL user's viewpoint. Note that figures included in this Annex 3 are not equal to those of Recommendations.

Five layer services provided by AAL type 1 to an AAL user ;

1. Asynchronous circuit transport (e.g. G.702 signals such as 1.544, 2.048, 6.312, 8.448 Mbits) [1992 Rec.]
2. Synchronous circuit transport (e.g. N-ISDN signals such as 64, 384, 1536, 1920 kbit/s) [1992 Rec.]
3. Video signal transport [1994 Rec.]
4. Voice-band signal transport [1994 Rec.]
5. High-quality audio signal transport [ffs]

AAL User

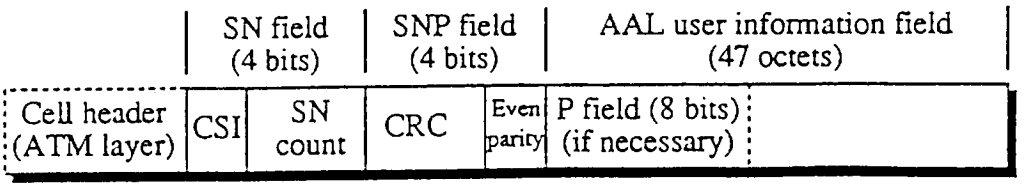
Specific layer service is realized by a DEFINED SET of CS functions and protocols. (All CS functions and protocols are not always necessary for a specific layer service.)



SN : Sequence Number
CSI : CS Indication

Fig. 1 Overall Structure of AAL Type 1

Annex 3



CSI (CS Indication) : 1 bit

- Conveyance of SRTS information, when SRTS is used, for SN count 1, 3, 5 and 7,
- Indicating existence of P field, when structured data transfer method is used, for SN count 0, 2, 4 and 6,
- Indicating the first cell of the octet-interleaved matrix, when error correction method of Reed-Solomon code combined with octet interleaver is used,
- CSI value is provided by CS to SAR at transmitting end, and reported by SAR to CS at receiving end.

Note) When both SRTS and structured data transfer method are to be used ; P field should be always placed for SN count 0, 2, 4 and 6, and if P field operation is not needed it should be filled with all"1"s.

SN count (Sequence Number count) : 3 bits

- Counter numbered modulo 8,
- Counter value is provided by CS to SAR at transmitting end, and reported by SAR to CS at receiving end.

CRC (3 bits) and even parity (1 bit)

- Polynomial to be used is x3+x+1,
- Two modes of operation ; Correction mode capable of single-bit error correction, and Detection mode capable of multiple-bit error detection.

P field (Pointer field) : 8 bits

- This field is placed, when structured data transfer method is used,
- Indicating the first octet of the structured data within AAL user information field,
- The pointer should be used as often as necessary to ensure robustness of protocol.

Fig. 2 Format and Coding of AAL Type 1

Annex 3

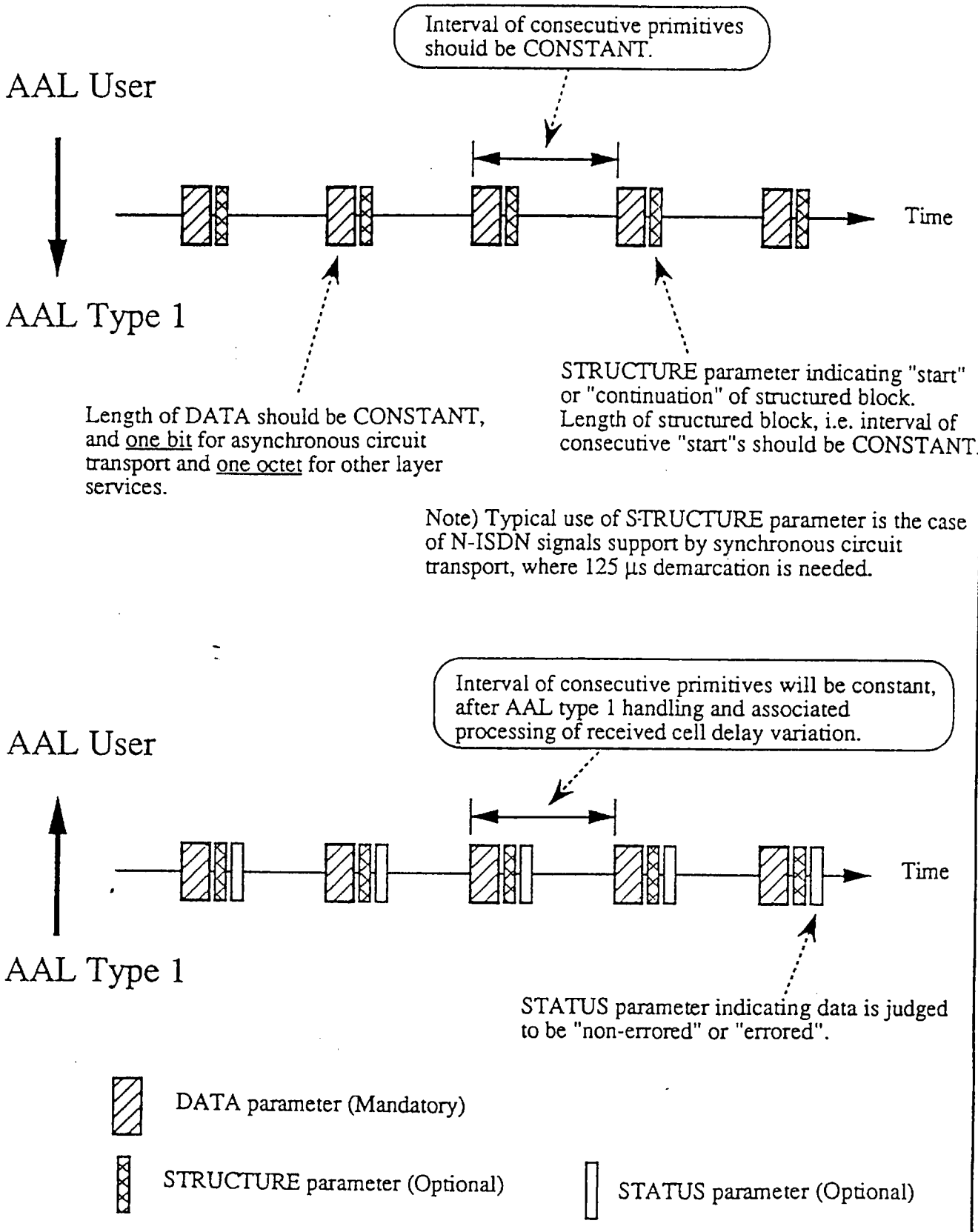
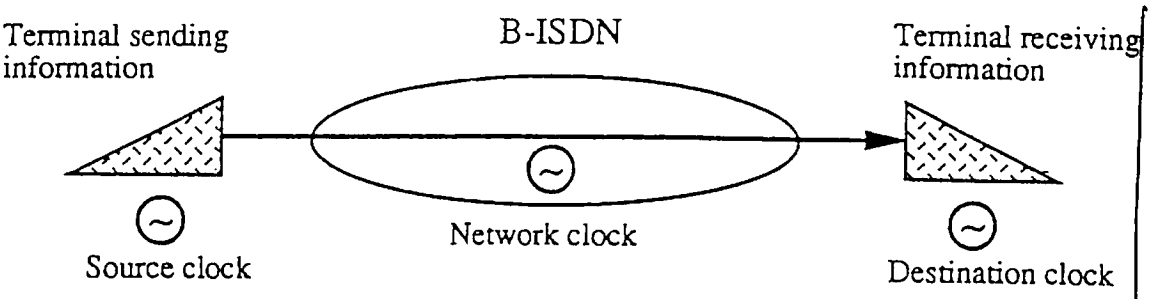


Fig. 3 Primitives between AAL Type 1 and an AAL User

Annex 3



Source clock frequency recovery is required when ;

- Source clock is not locked to the network clock, and
- Destination clock should be locked to source clock.

Examples of need for source clock frequency recovery are ;

- G.702 signals transport by asynchronous circuit transport, when source and destination clock are not locked to the network clock,
- Camera clock delivery from source to destination terminal, when sufficient jitter performance is required.

Note 1) Source clock frequency recovery is not always required for a given layer service. It will also depend on detailed layer service requirement such as jitter performance.

Three methods are recommended ;

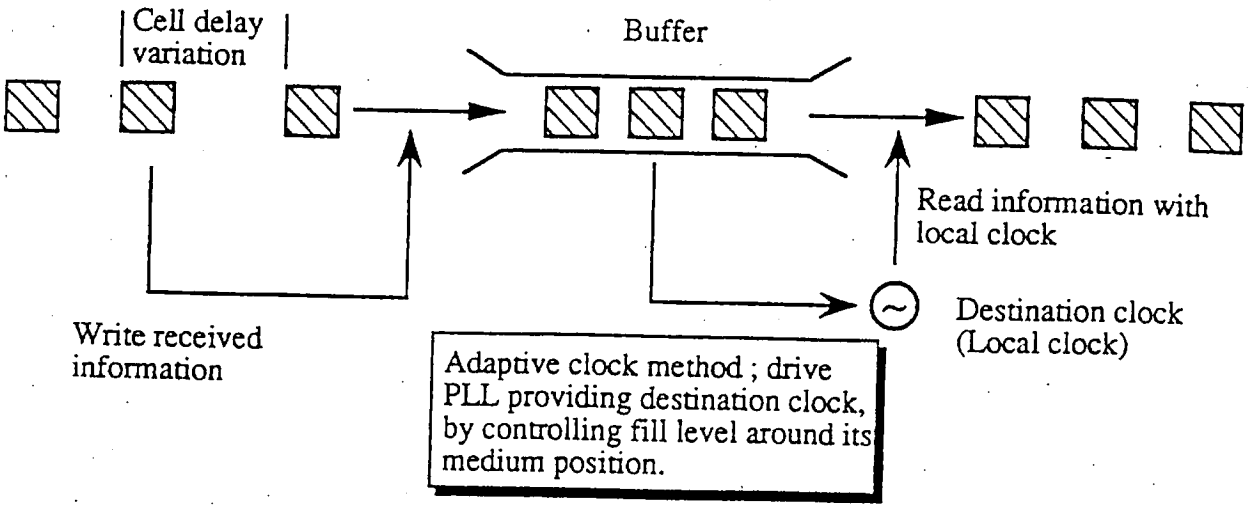
- Use of adaptive clock supported by AAL type 1 (See Fig. 5),
- Use of SRTS supported by AAL type 1 (See Fig. 6),
- Use of synchronization pattern within AAL user information flow (AAL type 1 is not involved for source clock frequency recovery).

Note 2) SRTS will provide for better jitter performance but require complicated protocol compared to adaptive clock method.

Note 3) For service aspects of timing and synchronization issues including source clock frequency recovery, see Recommendation I.211 section 2.5.

Fig. 4 Source Clock Frequency Recovery

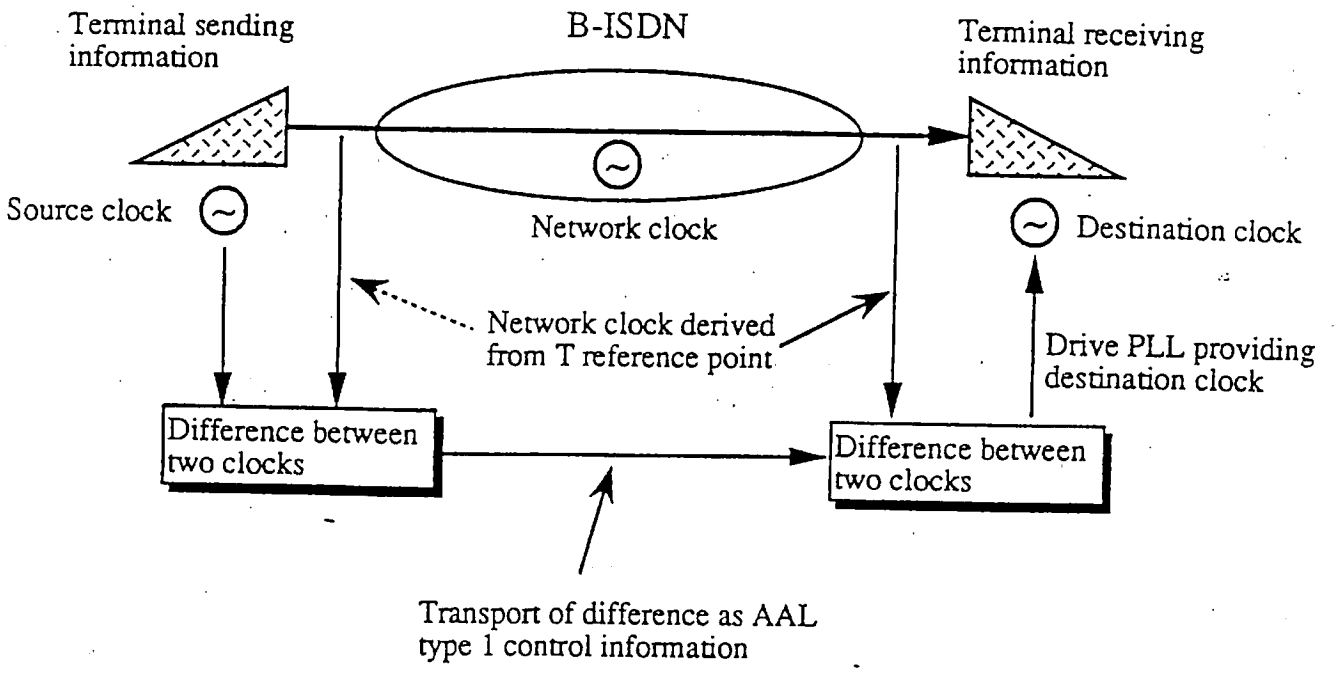
Annex3



Note) When source clock frequency is not required, e.g. N-ISDN signals transport, local clock will be locked to the network clock.

Fig. 5 Handling of Cell Delay Variation and Adaptive Clock

Annex 3



Note) Typical example of the use of SRTS is G.702 signals transport to meet jitter performance specified in Recommendations G.823 and G.824.

Fig. 6 SRTS (Synchronous Residual Time Stamp)

Annex 3

A3.2 ATM Adaptation Layer Type 2

A3.2.1 ATM Experts Group of CCITT SGXV

The ATM Experts Group of CCITT SGXV is studying requirements for support of video services by both AAL Type 1 and Type 2. The Experts Group believes the details of AAL Type 2 are likely to differ from those of Type 1, but recognise the value in maintaining common types of function.

Possible AAL functions identified by the Experts Group are :
- multiplexing capabilities
- sequence number
- cell payload length indication
- requests for priority level
- alignment of packet data to cell boundary

Work is ongoing to define precise requirements, and other functions may be added to this list. It is possible to avoid the use of a cell payload length indicator by using embedded end-of-data code words, and both options are under study.

Detailed requirements for sequence number cannot be determined without more knowledge of anticipated cell burst lengths. The differing cell loss tolerance of video data from that of other data types suggests that a 3 bit sequence number may not be sufficient.

It is also recognised that functions of AAL Type 1 for video signal transport require further consideration. Use of AAL Type 1 or 2 may depend on decisions regarding video coding in VBR or CBR for H.26X.

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:

The following three methods have been identified as relevant to video service interworking :

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 *may* provide different levels of compatibility, impose different constraints on coding algorithm design and are better matched to different applications. *For example*, 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.

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~~ *in 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~~ *potentially* 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~~ *a* 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~~ *The* AAL (ATM Adaptation Layer~~), and it has to be~~ *is* 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.

Consideration must also be given to capabilities required to support existing and emerging coding schemes, such as MPEG1. Further study is required to identify the options available for the support of lower rate coding schemes e.g. 4Mbit/s, 9 Mbit/s.

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

Note : Aspects of multimedia service support are described in a number of I-series recommendations. Of particular relevance are the 1992 revisions to Recommendations I.211, I.311 and draft Framework Recommendation I.37y. Details concerning the status of these recommendations may be found in Annex 8.

A6.1 Multimedia Service Categories

Multimedia services may be categorised on the basis of how they appear to the customer *or the support capabilities required within a network.*

Possible examples include :

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.

Revised Recommendation I.140 indicates that multimedia services are characterised by service dependent attributes (service attributes) describing the means of communication offered by interactive or distribution services and by service components describing the characteristics of the information to be transferred. The revised form of this Recommendation provides details of the service attributes for Broadband ISDN monomedia and multimedia bearer and teleservices.

Also of interest in the development of multimedia and hypermedia applications is the standardisation activity within ISO/IEC JTC1/SC29/WG12 - responsible for the coded representation of audio, picture, multimedia and hypermedia information. This group is developing standards for the coded representation of final form multimedia and hypermedia information objects that will be interchanged as a whole within or across services and applications, by any means of interchange (storage media, local area, wide area telecommunication or broadcast networks). The Multimedia Hypermedia Expert's Group (MHEG) works with : CCITT SGVIII/Q.9 (Protocols for Audiovisual Telematic Services), JTC1/SC18/WG8 (Document Processing and Communication for Hypermedia, Multimedia, Publishing and Office Systems - Document Description and Processing Languages), SC29/WG11 - Moving Picture Expert's Group and JTC1/SC18/WG3 - Open Document Architecture.

A6.2. Network Issues and Capabilities

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~~.call. *From a network perspective, user multiplexed media enter the network as a single information stream and are carried over monomedia bearer services.*

Draft Framework Recommendation I.37y describes the concepts of service components and service control elements for multimedia services. A service component is a part of a service which describes a monomedia communication related to a single information type.A user involved in a call may request the allocation or deallocation of individual service components from his call. Each service component of a telecommunications service is associated with transfer capability information. In this way it is possible to describe multimedia services separately from the specification of the information types of the service components they include.

The transfer capability parameters of an ATM connection may include :
- telecommunication service class
- network resources (e.g. peak bit rate, mean bit rate, burstiness)
- quality of service (e.g. cell loss ratio, cell transfer delay, cell delay variation)
- symmetrical/asymmetrical connection

The relationship between service components and transfer capability is important. Under normal conditions it would be expected that a one-to-one relationship applies i.e. a service component would use a single transfer capability for a given call. However it is possible that the characteristics at the user-network interface may differ from those used within the network for the same service component.

Draft Framework Recommendation I.37y also defines service control elements as procedures executed at the calling and called sides to provide a multimedia service. Service control elements are used for : call control, connection control and media control. The separation of call, connection and media control is expected to applicable to any network - however the extent of application may be constrained by the available network infrastructure e.g. switching and signalling capable of supporting multiple connections. The need for, and extent of, separate definition for networks without a Broadband service support capability is for further study.

Network capabilities required for the support of multimedia services have been initially identified under the general areas of connection management, service management, multimedia interaction, multimedia multiplexing and multimedia resource management. Annex A of Draft Framework Recommendation I.37y lists the following as open issues requiring resolution :

1. *The restrictions necessary to generic network capabilities to allow them to be offered over 64kbit/s ISDN.*

2. *The number of distinct information types within a multimedia call - this will affect whether multimedia can be defined as involving two cases of the same information type.*

3. *Mechanisms for the allocation and deallocation of service components by users.*

4. *Transfer of control (ownership) between users during a multimedia call and mechanisms to achieve this.*

5. *Mandatory versus optional service components.*

6. *Additional service attributes and sub-attributes required for multimedia services.*

7. *Issues involved in call set-up which are not media or connection related.*

8. *Services where the right to release the call is asymmetric - 'invitation to release' and 're-connect' may be needed as service control elements to achieve this.*

9. *Relationship between the concepts in this document and those of the evolving Intelligent Networks.*

10. *The splitting of a multipoint call into more than one call.*

11. *The support of connections in which the call originator is not one of the endpoints of the connection, e.g. when information is obtained from a distributed data base on behalf of the user.*

12. *Network capabilities for synchronisation between service components/media.*

13. *Network capabilities required to support the interchange of synchronised multimedia objects.*

14. *Impact of usage parameter control on multimedia services.*

15. *Charging capabilities for multimedia services*

16. *Multipoint networking, including the use of media specific bridging facilities.*

17. *The support of network/service interworking for multimedia services.*

18. *Determination of the performance limits acceptable to network operators for the signalling and resource management facilities provided within a network to support dynamic reallocation of capacity. Studies in this area should include consideration of the user's perception of acceptable delay between a request for change in a particular medium's presentation and the realisation of that change.*

19. *The need for decoupling the transfer capability of the access and transport network.*

A6.2.2 Signalling for Multiparty Multimedia Services

Call and connection control for multimedia services is a new ~~consideration~~ issue 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~~ *Revised* Recommendation I.311 *(1992)* 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;
- Capability to support simple multiparty and multiconnection call;
- Processing related functions;

Further information concerning the signalling for multimedia within Recommendation I.311 can be found in Annex 2, Section 2.3.1.

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 multiconnection 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, however additional material describing developments in this area may be found in ~~?????~~ Rec. I.371.

• 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.

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 ATM Experts Group of SGXV 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 Multimedia Multiplexing

A6.3.1 The CCITT SGXV ATM Experts Group

The Experts Group is considering the support on B-ISDN of audiovisual and other multimedia services. Virtual Channel based multiplexing has been identified as a long-term target, but early service implementation may have to use other means of multiplexing, since :

• interworking with audiovisual equipment on other networks (64 kbit/s ISDN) will require a user multiplex mode of operation.

• an understanding that the network will not be able to support Virtual Channel based multimedia multiplexing at the early stages of standardisation.

Table 6.1 summarises multimedia multiplexing options as viewed by the Experts Group (June 1992).

The Experts Group has also developed a reference terminal configuration (Figure 6.1) which shows where the alternate multiplexing options are performed. The Experts Group is concerned about the measurement of Traffic Descriptors by the user at the AAL-SA_ and by the network at the T Reference Point, and of the effect on Cell Delay Variation from multiplexing and the NT2.

In supporting multiple media and different streams representing the one medium (e.g. different layers of a layered video signal representation), the Expert's Group recognises the value of matching the channel Quality of Service to the characteristics of the signal being carried.

It is the Experts Groups understanding that all Virtual Channels in a given Virtual Path will have the same Quality of Service, though two different Cell Loss Ratios will be available according to the selected value of the Cell Loss Priority bit. It therefore seems that there is no advantage in supporting the different bit streams in different Virtual Channels of the one Virtual Path. Furthermore, the efficient delivery of layered video signals in configurations that provide for interworking between terminals of different capabilities, the different signal streams may need to be routed over different parts of the network.

These considerations imply optimum service support will require the establishment of multiple Virtual Paths, each carrying a subset of the total number of multiplexed signal streams.

Open issues, from the viewpoint of the Experts Group :
• Is this scenario possible from a network viewpoint?
• Will signalling be developed to allow a single end-to-end call to be allocated multiple VPs?
• What other options exists for multiplexing audiovisual/multimedia information streams?

A6.4 Customer Premises Network Issues

For further study.

A6.5 Customer Premises Equipment Issues

For further study.

A6.6 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. synchronisation 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

Table 1 : The comparison of three multi-media multiplex methods

Annex 6

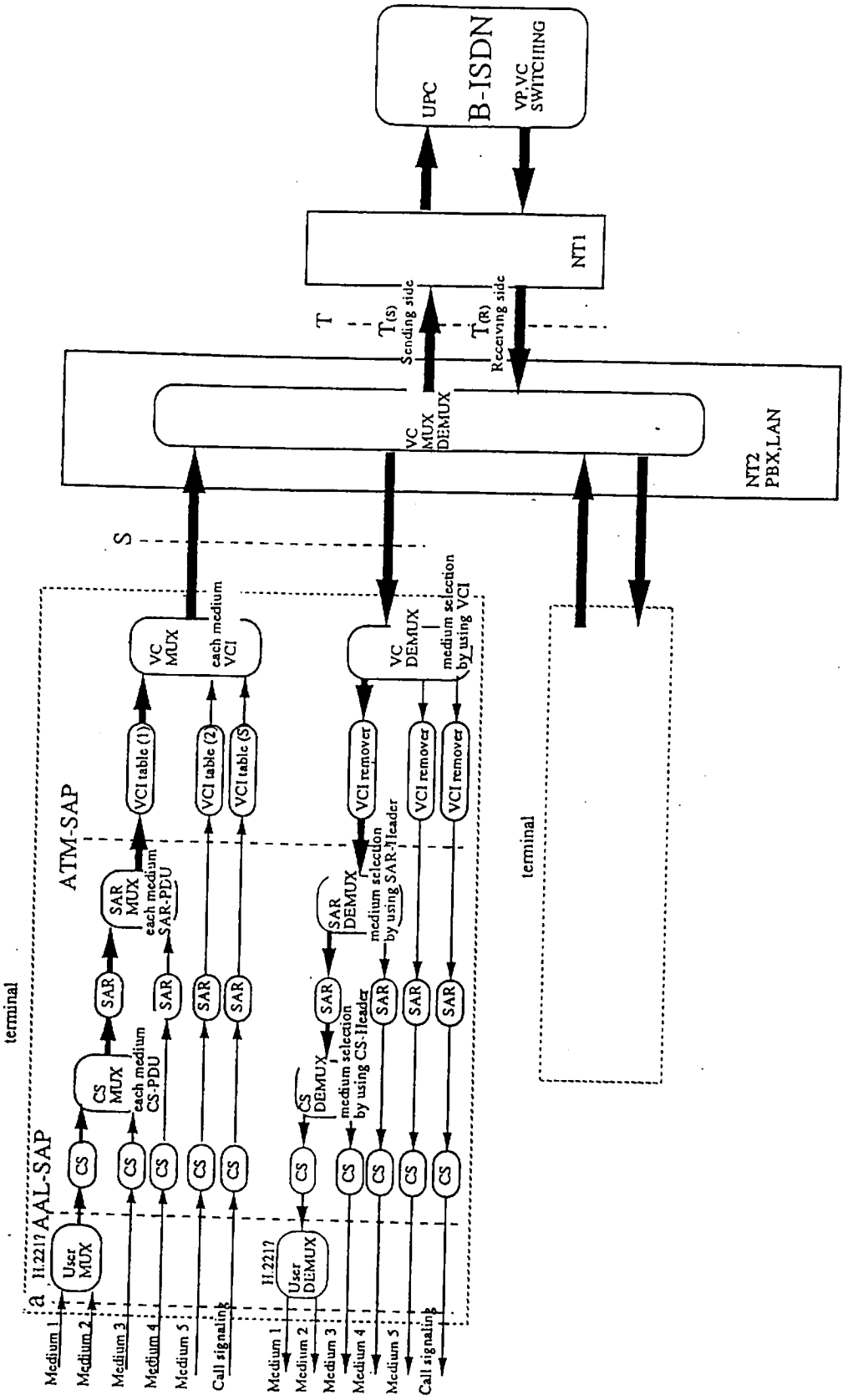
REQUIREMENTS \ SCHEMES		Cell multiplex (VC multiplex : VCI approach) merit : Variety of services	SAR multiplex (SAR-PDU multiplex : Packet approach) merit : Easiness for VBR?	User multiplex (Bit multiplex : H.221 approach) merit : Compatibility with H.320
1.Efficient channel utilization	Over head	0	192/(packet size+192) + 4/384 - (UW) (dummy bits) (IT bits) (Unique Words) *1)	16/p*640
	Sharing with other media	Impossible	Possible	
2.Multiplexing delay		No delay due to multiplexing.		
3.Compatibility	with H.320	H.221 is necessary (switchable)		Easy (Embedded)
	with MPEG	MPEG bit stream should be transmitted as data. MPEG demultiplexer is necessary.		
4.Multi-media	Media identification	HLC or user information at call setup	Indicated by IT?	BAS
	Bit rate identification	Call signaling	User protocol?	BAS
	Cross media synchronization	Not guaranteed now	Guaranteed	
5.Media selectability in Multi-point conference		Easy but copy function for each medium in network or MCU is required. Otherwise mesh type connection is required.	Difficult but possible by MCU with some transmission efficiency loss.	
6.Real time transmission for the low bit rate (eg. 2400bps) data		Delay and transmission efficiency is a trade off. delay = 384bits/bit rate*efficiency		300/1200/4800 bits etc.
7.The influence of one cell loss		One medium Recover at the next packet?		Several media Recover at the next packet? (The probability of FAS,BAS errors due to cell losses is assumed significantly low.)
8.Easy to implement		Easy by using media-VCI's table	Easy by using media-IT table	Already implemented in H.221 using LSI chip
9.QOS(Quality of Service)		Any QOS for each medium	QOS must be that of the most demanding medium	
10.Transmission cost		Multiple VCs may be expensive because of OAM for each VC	-	

*1) If GOB is aligned with cell, UW is GOB start code. If such alignment is not used, first term and third term can be deleted.

TABLE 1
ANNEX 6
~~Table 6.1~~ : The Comparison of Three Multimedia Multiplex Methods (June 1992)

Figure 1
Annex 6

~~Figure 6-1~~ : Reference Terminal Configuration Developed by ATM Experts Group (June 1992)



Annex 7. Service Requirements

A7.1 Requirements Associated with Recommendation H.261

A7.1.1 Status Notation

(A) Agreed
(P) Preferable
(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---> Recommendation H.26X		(P,FFS)
MPEG2---> Recommendation H.26X		(P,FFS)
"CMTT/2"* --> Recommendation	H.26X	(P,FFS)

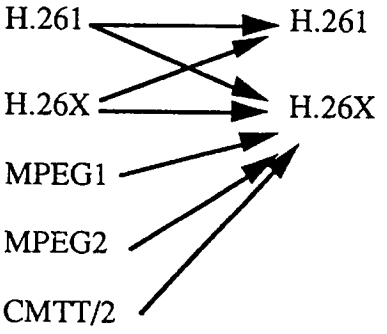


Figure 7.1 : Coder/Decoder Compatibility Relationships

* 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)

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

A7.1.6 Delay

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

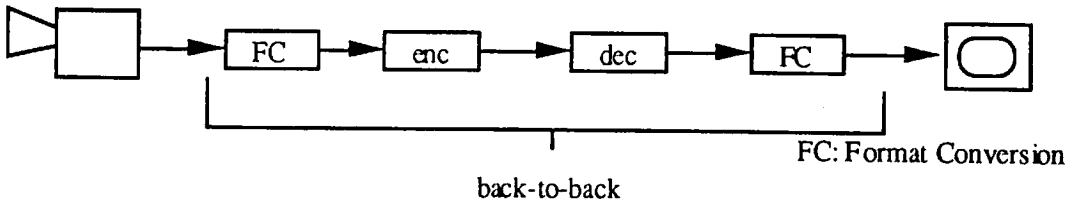


Figure 7.2 : Delay Sources in a Coding Chain

A7.1.7 Codec Complexity

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

A7.1.8 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)

A7.1.9 Multipoint

Continuous presence possible (P,FFS)

- Time-sliced decoding
- Editing without decoding-recoding

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

A7.1.10 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)

A7.2 Traffic Characteristics

Traffic Characteristics of voice telephony calls are well known and documented. Similar studies should be undertaken to determine the traffic patterns of video users. (Question source - CCIR IWP 11/9)

A7.3 HDTV/HRI Based Services

CCIR IWP11/9 have identified the need for further studies are needed to determine the signalling requirements for various types of HDTV/HRI based services.

Annex 8. Related Recommendations

CCITT SGXVIII

Note : some further editing of this Annex may be necessary to reflect the full range of new and revised Recommendations arising from the Geneva meeting of CCITT SGXVIII in June 1992.

Recommendation I.113 - Vocabulary of terms for Broadband aspects of ISDN ~~*(Revised Geneva 1992)*~~

Recommendation I.140 - Attribute Technique for the Characterisation of Telecommunication Services Supported by an ISDN and Network Capabilities of an ISDN. *(Revised Geneva 1992)*

Recommendation I.150 - B-ISDN ATM Functional Characteristics *(Revised Geneva 1992)*

Recommendation I.210 : Principles of Telecommunication Services Supported by an ISDN and the Means to Describe Them. *(Revised Geneva 1992)*

Recommendation I.211 - B-ISDN Service Aspects *(Revised Geneva 1992)*

Recommendation I.311 - B-ISDN General Network Aspects *(Revised Geneva 1992)*

Recommendation I.321 - B-ISDN Protocol Reference

Recommendation I.327 - B-ISDN Functional Architecture

Draft Recommendation I.35B - B-ISDN ATM Layer Cell Transfer Performance

Recommendation I.361 - B-ISDN ATM Layer Specification *(Revised Geneva 1992)*

Recommendation I.362 - B-ISDN Adaptation Layer (AAL) Functional Description *(Revised Geneva 1992)*

Recommendation I.363 - B-ISDN Specification *(Revised Geneva 1992)*

Draft Recommendation I.371 : Traffic Control and Congestion Control *(new Geneva 1992)*

Draft Framework Recommendation I.37~~9~~4 - Network Capabilities for the Support of Multimedia Services *(new Geneva 1992)*

Recommendation I.413 - B-ISDN User-Network Interface *(Revised Geneva 1992)*

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

Recommendation I.610 - *B-ISDN Operations and Maintenance Principles and Functions (Revised Geneva 1992)*

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

HRI : High Resolution Imagery

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 : National Television System Committee

P : Preferable

PAL : Phase Alternation Line

PCM : Pulse Code Modulation

PDU : Protocol Data Unit

QCIF : Quarter Common Intermediate Format

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)

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 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.

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 : Reference Recommendation I.35B

cell error ratio : Reference Recommendation I.35B

cell loss ratio : Reference Recommendation I.35B

cell misinsertion ratio : Reference Recommendation I.35B

cell tagging : Reference Draft Recommendation I.371

cell transfer delay : Reference Recommendation I.35B

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 : provides the capability of transferring information between end-points. It represents the association between end-points together with the incremental information regarding the information transfer integrity. (Rec.I.311 - Revised Draft Dec 1991)

connection (ATM) : An ATM layer connection consists of the concatentation of ATM layer links in order to provide an end-to-end transfer capability to access points. (Recommendation I.150)

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)

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

continuous presence : a form of multipoint conferencing, in which the video signal from more than one remote participating site can viewed simultaneously.

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)

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)

layered coding : a method of representing a video signal, in which an incremental improvement in picture quality can be achieved by accepting an additional "layer" of information from the coded bitstream. An alternative definition is that a useable picture can be decoded using only a subset of the available encoded picture data.

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

multiconnection call : to be defined

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 : Ref draft Framework Recommendation I.37y.

multiparty call : to be defined

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 (multipoint-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)

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

c multiple source endpoints to multiple destination endpoints (multipoint-to-multipoint)

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

network interworking : ref. I.500-series recommendations. Refers to the functions and requirements for interworking of networks with different low layers capabilities in order to support the interworking of services across the network boundary.

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

peak cell rate : in the Source Traffic Descriptor specifies an upper bound on the traffic that can be submitted on an ATM connection. (Draft Recommendation I.371)

point-to-multipoint : Ref Rec. I.140

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)

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)

picture formats : the parameters that define picture resolutions (horizontal and vertical pixels, luminance and chrominance sampling patterns and relationships) and frame rates.

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 : ref Draft Recommendation I.371

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

service/s interworking : reference Draft Recommendation I.501. Specific ISDN service descriptions, as viewed from a user perspective are provided in the I.200-series. Network interworking recommendations are provided in the I.500-series. Draft Recommendation I.580 describes general arrangements for interworking between B-ISDN and 64 kbit/s-ISDN.

simulcast : the simultaneous transmission of the same video signal encoded in multiple formats and, in particular, at different quality levels for reception by decoders of different capabilities.

switch (virtual channel): a virtual channel switch is a network element that connects virtual channel links; it terminates virtual path connections and translates virtual channel identifier values and is directed by control plane functions.

switch (virtual path) : a virtual path switch is a network element that connects virtual path links; it translates Virtual Path Identifiers (not Virtual Channel Identifiers) values and is directed by control plane functions.

switched (connection) : Ref I.140 and I.311

teleservice : Ref Rec I.210

traffic parameters : a specification of a particular traffic aspect. It may be qualitative or quantitative. (ref Draft I.371)

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. (Rec I.113)

variable bit rate service : a type of telecommunication service characterised by a service bit rate specified by statistically 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 : the ability to request, on a per-terminal basis and with individual control, the delivery of particular video material. An example would be selection and playback of a movie over the network.

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

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

virtual channel switch : a network element which connects virtual channel links; it terminates virtual path connections and it translates virtual channel identifier values. It is directed by control plane functions.(proposed revision of Rec 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. (Rec 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. (Rec I.113)

virtual path switch : is a network element which connects virtual path links, it translates virtual path identifier values and is directed by control plane functions.