CCITT SGXV
Working Party XV/1
Experts Group for ATM Video Coding

Document AVC-221
March 1992

SOURCE: Australia

TITLE: Transport of Layered Video on B-ISDN

PURPOSE: Information

Abstract

Layering of video signals is advocated as a means of achieving efficient interworking of video terminals on the B-ISDN. In a multipoint call this efficiency is realized only when interworking layers are appropriately placed in separate virtual channels. Further layering within an interworking layer may be required to deal with ATM error characteristics.

1. Introduction

Coding schemes that allow interworking between a number of different video services is a recognised requirement for video services on the B-ISDN [IVS Baseline Document]. Layering of video signals into interworking components ie baseband video information, plus enhancement layers, may be an efficient way to provide interworking. Layers might be produced by decomposition of an image spatially, temporally, and/or by decomposition of some other attribute of the video service.

This contribution considers how the information produced from a codec capable of layering can best be transported on the B-ISDN. It is recognised that while layering is done primarily for the sake of interworking, additional layering may be required within each interworking layer to match the error characteristics of ATM.

2. Layering for Interworking

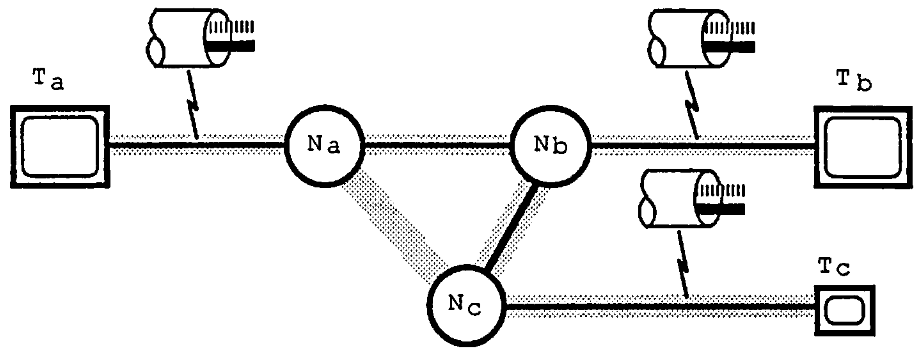
The use of multiple virtual channels to support multimedia calls was considered in AVC-39. It was also noted there that the layers of a layered video system might be transported in separate virtual channels. This point is examined here.

2.1. Point to Point

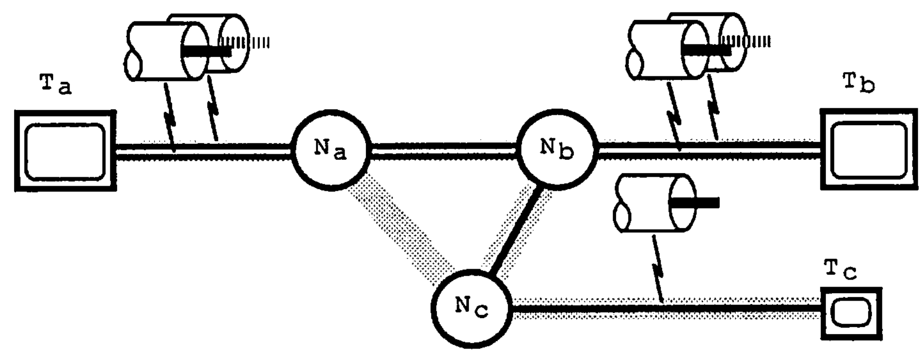
In a point to point video call, interworking between terminals of different capabilities could be achieved with one virtual channel, since all information is destined for the one receiving terminal. The virtual channel might carry a number of interworking layers and/or layers for ATM error concealment purposes.

2.2. Point to Multipoint

In order for a point to multipoint layered video call on the B-ISDN to be bitrate efficient, multiple virtual channels are required. An example is shown in Figure AVC-221/1.



a) Interworking layers placed in one virtual channel



b) Interworking layers within separate virtual channels

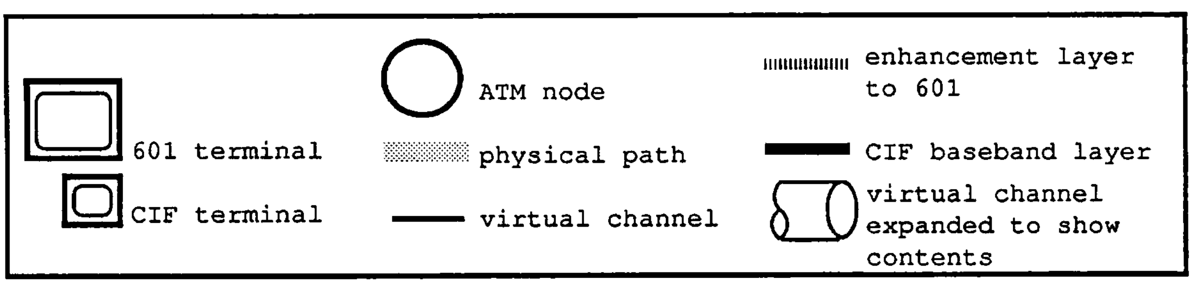


Figure AVC-221/1. Example of a point to multipoint layered video call.

In Figure AVC-221/1, terminal T_a transmits to terminal T_b, which has the same capabilities, and to terminal T_c, which has reduced capabilities. Interworking between the three terminals is satisfied with a baseband signal plus one enhancement layer. The figure illustrates alternatives as to how the interworking layers may be transported. The diagram assumes that some ATM nodes have multicast capabilities, in this case node N_b.

In Figure AVC-221/1 a), interworking layers are placed in one virtual channel. Terminal T_c receives the enhancement layer which it cannot use. The following points are recognised:

- capacity within the network between nodes N_b and N_c, and within the access network of terminal T_c, is wasted.
- terminal complexity is increased since the lower rate stream must be demultiplexed from a higher rate stream.
- flexibility to introduce charging mechanisms which reflect the quality of the received service is reduced, since the network is unable to determine the proportion of traffic being used by the user.

- backward compatibility is compromised since the introduction of a new service may require a change in the terminal demultiplex equipment.

In Figure AVC-221/1 b), each interworking layer is placed in its own virtual channel. This allows the baseband signal to be routed to each terminal, whereas the enhancement signal goes only to Tb. It is assumed that the network had knowledge of the capabilities of terminals T_b and T_c at call setup. It is noted that;

- bitrate capacity within the network and within the access network is used efficiently.
- backward compatibility is achieved, since existing terminals can receive only the lower layers of new higher rate services.
- network interworking may be simplified.

It is concluded that the bitrate efficiencies offered by the layered video codec in a multipoint call can only be realized when multiple virtual channels are used, as illustrated in Figure AVC-221/1 b). Layers are routed only to the terminals which require them.

The use of more virtual channels, beyond that which can be justified for efficient bitrate use, is to be avoided, since it is assumed that there is a network resource cost involved in using each virtual channel eg signalling, call and connection control and usage parameter control.

3. Layering for ATM Error Characteristics

ATM error characteristics must be taken into account when considering multiplexing of the components that make up each video interworking layer. Each interworking layer produces video information, perhaps represented as frequency coefficients of luminance and chrominance signals, plus address information, coding mode, quantizer and block activity information, and motion vectors. Figure AVC-221/2 provides examples of these components in terms of CCITT Rec. H.261, and ISO MPEG SM3 multiplex terminology.

coding data	H.261	MPEG SM3
address	GN,MBA	SVP,MBA
quantiser	GQUANT,MQUANT	SQUANT,MQUANT
coding mode	MTYPE	PTYPE,MTYPE
motion vectors	MVD	MVD1,MVD2,BMVD
loop filter	MTYPE	-
trans/not trans	CBP+MTYPE	CBP+MTYPE+BTYPE
signalling	TR, PTYPE	HORSIZE,VERSIZE,ASPARAT, FRATE,LOADMAT, TIMECODE,BROKENLOOP, CLOSEDGRP,TR
video	TCOEFF	TCOEFF

Figure AVC-221/2. Interworking layer components expressed in CCITT H.261 and ISO MPEG SM3 multiplex terminology.

Embedding control information within the video information may not be optimum for ATM. It may be convenient to put control information and video information into separate cell streams, and allow the ATM Adaptation Layer to segment them independently. This allows ATM cell priority, or error protection, to be applied in a manner that is optimum for each layer.

How components of each interworking layer are multiplexed together will be determined in part by the effect of cell loss upon the perceived quality of the received picture for that particular multiplex. Table AVC-221/1 lists some typical factors which need to be determined in regard to the structure of the Higher Layer packets.

- will embedded start codes be necessary given the multiplexing capability of the AAL?
- should variable length coded video codewords be allowed to overlap cell payload boundaries?
- are variable length coded resynchronization words required to be embedded with the video data?
- should address information be embedded with the video data?
- is it appropriate to place luminance and chrominance information in the same cells?

Table AVC-221/1. Some considerations regarding multiplex of video codec data in ATM.

The B-ISDN should be able to offer more than one Quality Of Service. Where statistical multiplexing of ATM cells from many virtual channels is used, the CLP bit of the ATM header allows two cell loss priorities within one virtual channel.

Cell loss priority can be applied to each interworking layer and the components within it, in a number of ways. Figure AVC-221/3 illustrates a possible choice for a codec producing three interworking layers.

interworking layer	error control layer	cell loss priority
2nd enhancement layer	video control and synch	low high
1st enhancement layer	video control and synch	low high
baseband layer	video control and synch	high high

Figure AVC-221/3. Possible application of cell loss priority to a three layer system.

Alternatively it may be possible to also apply low priority to the control information of the enhancement layers.

4. Conclusion

This document has recognised that,

- to use network capacity efficiently in a layered multipoint video call, multiple virtual channels are required;
- layering within an interworking layer, to control the effect of cell loss and match ATM cell loss priority, should be studied;
- the components within each layer need to be multiplexed in a way that minimises the impact of cell loss.