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

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TITLE: ATM Adaptation Layer Type 2 Functionality

PURPOSE: Information

Abstract

Attention within SGXVIII/8-3 has now turned to AAL type 2. Some functions required of AAL type 2 are discussed and recommendations made. Liaison to SGXVIII is requested.

1. Introduction

SGXVIII/8-3 has specified the ATM Adaptation Layer (AAL) type 1 protocol for constant bit rate services. It is now turning its attention to AAL type 2, which is for transport of real time, variable rate services, including video, where cell retransmission is not prcatical. Some of the functions not offered by AAL type 1, but likely to be required by AAL type 2, are discussed in this report.

2. AAL Type 2 Support of CBR

In addition to variable bit rate, the AAL type 2 will also be able to handle constant rate video services, since constant rate is just a special case of variable rate. This should not be interpreted as a desire for commonality between AAL type 1 and AAL type 2. The AAL type 2 has different performance requirements, one of which is to be able to handle a wide range of variable rate signals in a statistically multiplexed environment.

The AAL type 2 should be developed independently of AAL type 1, so that its performance for variable rate signals is maximised.

3. Framing of data and length indication

Framing of video data assists in minimising error propagation. By coding and segmenting the information from a specific area of screen pixels independently, loss of one cell effects only one part of the image.

The ISO MPEG coding standard uses such a strategy with its concept of a slice. The standard allows for the number of lines in a slice to be selected according to the bit error rate of the storage/transmission medium. To be successful in the ATM environment, this framing needs also to be carried into the AAL. The use of this, dynamically or on a per connection basis, needs further study. The start of each slice should begin a new higher layer packet[1].

The number of pixels to be coded at a time is chosen with respect to efficiency and error propagation. Study is required as to whether the number of pixels should be fixed, or selected according to the error rate of the connection, at connection setup. Since the last segment of each packet may be only partially filled, the efficiency of framing, particularly at low bit rates, needs to be studied.

Framing of user data within the Segmentation And Reassembly (SAR) sublayer may be by indication of segment type. The position of the segment from within the higher layer packet is indicated with signals of Beginning of Message (BOM), Continuation of Message (COM), End of Message (EOM), and Single Segment Message (SSM).

The last two segment types, at least, have partially filled payloads. This suggests the use of a length indicator field within each SAR. Alternatively the field length could be implied ie Coded Block Pattern, or indicated with an embedded end of payload code word.

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[1] Also called an AAL user packet, or AAL-SDU.

4. Sequence Number

Sequence numbers are required for detection of cell loss and cell insertion for video services on the B-ISDN. Reliable detection is required at the earliest opportunity, so that corrective actions can be taken.

Sequence numbers are applied independently to each SAR sublayer, using a modulo N count. Loss of up to N-1 cells can be detected reliably. The value of N, and hence the field length required, must be selected such that the probability of N cells being lost in succession is made small.

Cell loss in a statistically multiplexed environment occurs primarily when queue buffers at ATM nodes overflow. That cell loss may occur in bursts has been recognised [AVC-75]. Where many virtual channels are statistically multiplexed ie the cell generation rate of a particular virtual channel is small compared to the bearer rate, this cell burst could be expected to be spread over many channels. Hence a long cell loss burst within one channel would be unlikely. Where a few high rate sources are carried on the one bearer, statistical multiplexing would be of little value: bandwidth would be allocated on a peak rate basis. Again, long cell loss bursts would be unlikely.

For AAL type 3 and AAL type 4, other higher layer protocols exist, including retransmission, which ensure the reliable delivery of messages. Such protocols are not applicable to AAL type 2, which must support video services in which retransmission is not practical. The performance requirement of cell loss detection for AAL type 2 may therefore be more demanding than that of AAL type 3 and AAL type 4.

AAL type 2 should be able to satisfy the requirements of a range of variable bit rate video services, operating in a statistically multiplexed environment. So that the AAL type 2 sequence number field length can be selected, more knowledge on the basic cell loss characteristics of B-ISDN is required.

5. Multiplexing

Layering of video is advocated as a means of interworking between terminals with different capabilities. Further layering within each interworking layer may be required, for example to match B-ISDN cell loss priority. Layering ensures that information from different interworking or priority layers does not occupy the same cell payload. AAL type 2 may therefore require a multiplexing function.

Where framing of video data is used, a higher layer (HL) packet might correspond to a GOB or slice. The packets of each layer from each GOB or slice may be multiplexed within the AAL in either the Convergence Sublayer (CS) or the SAR sublayer. This is illustrated in Figure AVC-222/1.

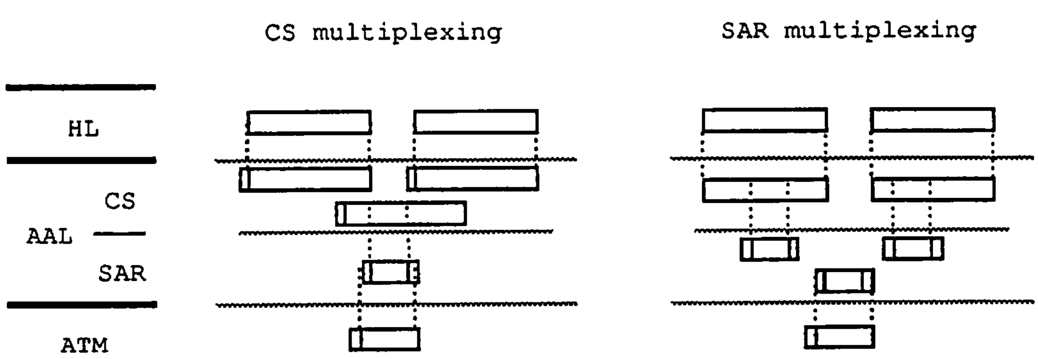

Figure AVC-222/1. Illustration of multiplexing of two layers within the Convergence Sublayer and the Segmentation And Reassembly sublayer.

In the case of CS multiplexing, higher layer packets from each GOB or slice are segmented in turn. All the cells with segments from one higher layer packet appear in the ATM stream before the cells with segments from the next higher layer packet. A layer identifier is included at the start of each higher layer packet.

In SAR multiplexing, higher layer packets are first segmented independently, and layer identifiers are included within each segment. Cells carrying segments from different higher layer packets may thus be interspersed within the ATM stream.

SAR multiplexing is less efficient than CS multiplexing, but may be more secure ie identification occurs every segment rather than once per higher layer packet. For the sake of efficiency, the SAR multiplexing identifier field length should be kept small.

Where framing of video data does not occur, CS multiplexing is not possible. In this case, only SAR layer multiplexing can be done ie after the segmentation of each cell stream.

6. Conclusion

The following points have been raised in relation to AAL type 2 in this document, and should be communicated to SGXVIII:

- commonality between AAL type 2 and AAL type 1 is not required.
- framing of video data may assist in minimising error propagation.
- cell payload length indication may be required.
- cell loss characteristics of the B-ISDN are required in order to set cell loss detection performance requirement ie sequence number length.
- multiplexing capabilities within the AAL may be required.