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

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Title: **A proposal for AAL Type 2**

Purpose : Proposal

## 1. Introduction

CCITT SGXVIII have now drafted the definition for the ATM Adaptation Layer (AAL) Type 1 (I.363 section 2), which details the AAL requirements for services that use asynchronous or synchronous circuit transports (e.g. G703 and N-ISDN).

With the growing interest in variable bit rate (VBR) video coding there is an increasing demand for a definition for an AAL Type 2. The purpose of this document is to highlight the requirements for an AAL Type 2. The document also attempts to define the user layer services that would use such an AAL. A proposal for a suitable AAL Type 2 is also presented to stimulate discussion.

The advantage of VBR transmission over constant bit rate (CBR) transmission is that the transmitted bit rate can dynamically adapt to the requirements of the user service. The user video service that has most to benefit from this form of transmission is low bit rate video coding. By using VBR transmission for this service the opportunity exists to improve the picture quality, achieving near constant quality as well as reducing the end-to-end delay. The latter improvement being of great benefit to real-time interactive services such as Videotelephony and Videoconferencing.

## 2. User services for AAL Type 2

The perceived user services that may require the use of AAL Type 2 are:

### 2.1. Videotelephony and Videoconferencing

The existing CCITT H.261 video codec specification has been designed for Videotelephony and Videoconference applications using fixed bit rate networks. However, studies have shown that this scheme can be extended, using multi-layer techniques, to provide improved picture quality. To obtain near constant quality, the enhancement layers are transported using VBR transmission, ranging from hundreds of kbit/s to several Mbit/s. Similar techniques may be used in the evolving H.26x standard for coding higher resolution pictures (CCIR 601) for interactive real-time video services.

### 2.2. Image Storage and Retrieval

ISO MPEG1 is the existing video coding standard for image storage and retrieval applications using a typical constant bit rate of 1.15Mbit/s. The new ISO MPEG-2 video coding standards currently under development will offer improved picture resolution (CCIR 601) at bit rates

approaching 10Mbit/s. It is possible that this standard will allow transmission at variable bit rates.

### 2.3. TV/HDTV (17Mbit/s - 140Mbit/s)

Currently there are a range of video coding schemes which cover both TV and HDTV applications. In the future, it is possible that even these services may benefit from using VBR transmission, the main benefit being more efficient usage of the transmitted bit rate.

## 3. AAL and Convergence Sub-layer (CS) Requirements

Listed below are a range of requirements that must be addressed in order that video services can be successfully transported over ATM networks using VBR transmission.

### 3.1. Efficient usage of bits

It is desirable to maintain high efficiency of bit usage within a cell so that transmission overheads do not become a predominant portion of the Segmentation and Reconstruction (SAR), Payload Data Unit (PDU). In order to maintain bit efficiency it is essential that only generic overheads are included in the AAL definition and not overheads that are required for a specific user service.

### 3.2. Delay considerations

The delay incurred by utilising the AAL Type 2 must kept to a minimum. It is essential to the success of VBR transmission for low bit rate services that the end-to-end delay is small and bounded.

### 3.3. Extendibility

Even though the AAL should only define the generic overheads, provision should be made for extending the overheads if it is deemed necessary for future user services.

### 3.4. Cell loss detection

Information transported by cells over ATM networks can experience large transmission errors in the form of mis-inserted cells or more probably lost cells, which affects the quality of service (QoS) offered to the user service. The network does not provide an indication of the occurrence of cell loss so a mechanism for detecting cell loss has to be provided. In AAL Types 1,3 and 4 this detection mechanism has been supported within the SAR-PDU and defined in the relevant AAL. It is foreseen that these AAL types will not experience large bursts of cell loss and if they do the user services may invoke defensive measures such as re-transmission to overcome the loss of contiguous data. However for VBR video transmission such defensive measures may not be appropriate and such services may suffer greatly from large bursts of cell loss due the highly compressed nature of the user data.

Two approaches can be made to overcome the detection of large bursts of cell loss:

a) Use a Sequence Number (SN) generated at the transmitter, of sufficient size to facilitate the accurate detection of a burst of cell loss at the receiver,
b) Invoke a protection mechanism against large cell loss burst in the higher user layer. *This approach raises the issue of should the AAL Type 2 be an empty SAR-PDU.*

### 3.5. Bit error protection

Current video coding schemes for existing networks already invoke bit error protection mechanisms such as Forward Error Correction (FEC) to maintain adequate QoS for the user service. This technique, working in the user layer, may also be applied to video services using AAL Type 2. However, some other video services may require the use of FEC or CRC to protect the SAR-PDU Payload.

### 3.6. Compatibility issues

An increasing customer base exists for Videotelephony and Videoconferencing services and hence there is a need to maintain compatibility with existing multiplexing schemes for video and associated audio/data (e.g. CCITT H.221).

### 3.7. Multipoint and multimedia considerations

Multipoint is an important requirement of existing low bit rate video services and its implementation is eased by the use of in-band transportation of audio, video and signalling. Studies are required to determine if alternative methods for conveying each component data are more applicable for use on ATM networks particularly with the increasing need for other multimedia services. Whatever the outcome a means to maintain compatibility with existing multipoint schemes must be implemented without incurring further delay.

### 3.8. End-to-end timing and multi-layer synchronisation

The AAL Type 2 may have to support end-to-end timing as it may be necessary for some video services to maintain source timing over the network to assist in the synchronisation of multiple sources at the receiver. Recovery of source video clocks may also be desirable for the synchronisation of services which use multiple Virtual Channels.

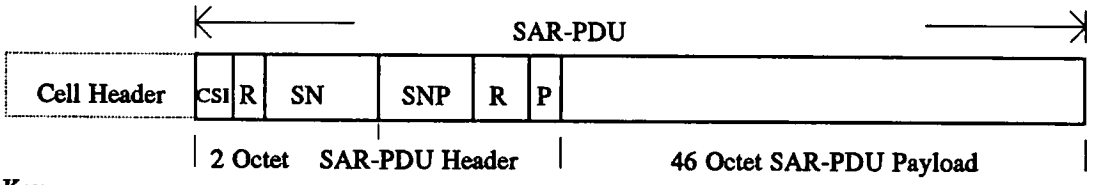
### 3.9. Interleaving

This technique has been adopted by some video coding schemes using relatively high bit rates (i.e. tens of Mbit/s). CMTT has proposed an interleaving scheme to provide resilience to high cell loss bursts; the framing is signalled by the CS indicator. It should be realised that whilst this approach is acceptable for high bit rate services, it is not appropriate to very low bit rate service because of the delay incurred by the interleave framing.

## 4. A proposal for AAL Type 2

The proposal for AAL Type 2 outlined here attempts to take account of the AAL requirements previously discussed. Emphasis has been placed on making efficient usage of the SAR-PDU bits for the benefit of low bit rate coding whilst still providing mechanisms for extending the SAR-PDU Header (or even introducing a SAR-PDU Trailer) for the more demanding user services. The SN and its related SNP have also been modified from that used in other AAL types in order to better accommodate cell loss detection which may suffer large bursts for this form of transmission.

### Suggested GENERIC AAL Type 2



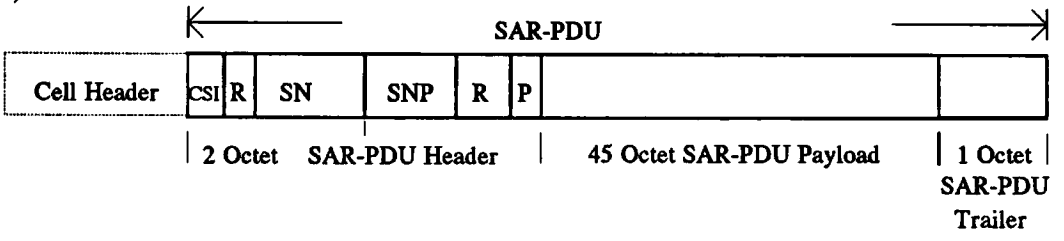

Key

| | |
|---|---|
| CSI | - Convergence Sub-layer Indicator (1 bit) |
| P | - EVEN Parity bit (1 bit) |
| R | - Reserved bits for future use - *is protection needed for these bits?* |
| SN | - Sequence Number (*suggested expansion to 6 bits*) |
| SNP | - Sequence Number Protection (*possibly 4 bits*) |

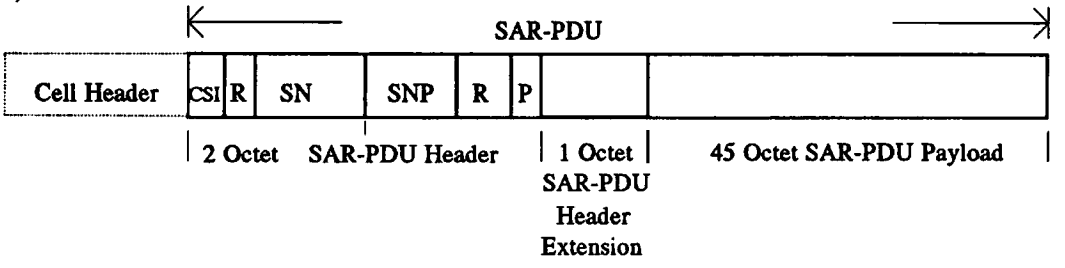
### Possible extensions to the GENERIC AAL Type 2

The following examples show how the GENERIC AAL Type 2 may be extended to include additional information or protection which are required for specific video services. The use of these extensions to the GENERIC format may be signalled by a suitable code transmitted by some of the reserved bits.

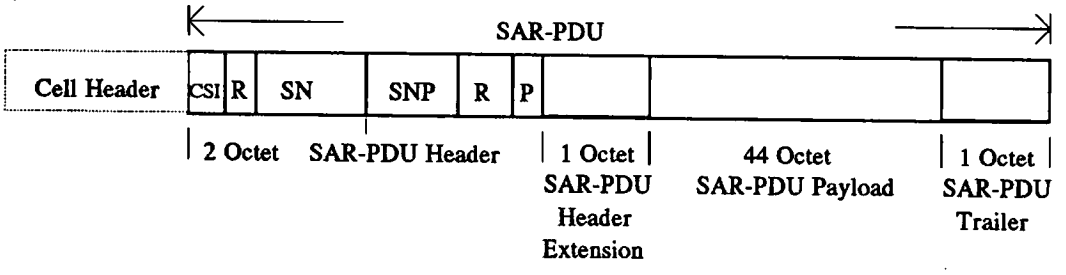
a)




b)



c)




The SAR-PDU Trailer [in (a) and (c)] could incorporate protection for the SAR-PDU Payload by using FEC or a CRC. The Header Extension [in (b) and (c)] may be useful for signalling further information about the SAR-PDU Payload to the CS layer (e.g. Length Indication for partly filled cells).

Note that the size of the SAR-PDU Header/Trailer may be insufficient for some purposes.

## 5. Conclusions

The basic requirements for an AAL Type 2 suitable for use with VBR transmission of video services has been highlighted. To aid discussion on the definition for AAL Type 2, an attempt has been made to present a general purpose AAL definition which whilst seeming to favour services using low bit rate coding does offer facilities for other services. It should be realised that VBR transmission is perceived as being of greater benefit to low bit rate coding than higher rate coding and it is therefore felt that the bias is justified.