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

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SOURCE : Japan
TITLE : ATM Adaptation Layer (AAL)
PURPOSE: Discussion

1. Introduction

The ATM Adaptation Layer (AAL) is used for segmenting the next higher layer information into cells at sending side and reassembling them at receiving side. Although it has been discussed in SGXVIII with relation to Recommendation I.363, the definition of AAL appropriate for variable bitrate video/audio coding is not finished up to now, and is considered an urgent issue. This contribution aims to clarify what is the problem, particularly from multimedia multiplex point of view, and what should be discussed in this group by giving some information about AAL.

2. Investigation Method

Four types of AAL (1 to 4) are described in I.363 (note). Although it is not clear what type of AAL is the most suitable for variable bitrate video coding, we think that AAL type 2 is a good starting point for our study. According to the results, it may happen that the derived AAL be included in other type of AAL.

AAL can be divided into two sublayers: Convergence Sublayer (CS) and Segmentation And Reassembler sublayer (SAR). The header and trailer of each sublayer requires standardization.

Note - Necessity of AAL type 0, which has no adaptation layer, seems to be recognized. It is, however, not yet described in I.363.

For information about AAL type2, the following two figures are attached at the end of this contribution:
Appendix 1. Mapping for ATM cells into the STM-1 signal
Appendix 2. Packet and cells (AAL type 2)

3. Discussion points based on AAL type 2

AAL type 2 SAR consists of SN (Sequence Number), IT (Information Type), LI (Length Indication check) and CRC (Cyclic Redundancy Code).

3.1 SN : Sequence Number

Basic principle

SN aims to detect lost or misinserted cells. Therefore, SN should be able to count the maximum number of consecutively lost cells. There is another possibility that one bit in SN or one sequence number is used for synchronization of cell interleaving.

Discussion points

SN-a. Is the bit for the cell interleaving synchronization necessary?
Cell interleaving technique may not be applicable to low bitrate coding because it increases the delay.

SN-b. How many consecutive cells will be lost in the worst case?
A question should be directed to SGXVIII.

SN-c. How large is the cell loss or cell misinsertion ratio?
Our group should show a permissible value for each ratio to SGXVIII.

SN-d. Is the detection of lost or misinserted cells always needed?
The lower the bitrate, the smaller the effect of lost or misinserted cells.
If the cell loss ratio is less than 10^{-10}, for example, we may need not worry about it at any bitrates less than 135 Mbit/s.

SN-e. Should SN be protected by CRC?

3.2 IT : Information Type

Basic principle

I.363 shows three usages of IT. The first is segmentation indicator; Beginning of Message (BOM), Continuation of Message (COM), End of Message (EOM). The second is timing information. The third is component indicator of the video or audio signal.

(1) Segmentation indicator

The necessity of segmentation indicator depends on how the next higher layer information (output signal from the terminal) is structured.

(Structure 1) : intermittent bit/byte type information

In the AAL, bit/byte information is gathered until a SAR-PDU payload becomes full and is sent. In this case, segmentation indicator is not

necessary because there is no packet. This structure is suitable to get the compatibility with N-ISDN terminals. There is a disadvantage in this method: if the information is fewer than the SAR-PDU capacity, it would not be sent.

(Structure 2) : Packet type information

In this case, the beginning and end of packet should be detected. For this purpose IT and LI are considered to be useful. The affinity with LAN is good.

(Structure 3) : Short size (identical with the SAR-PDU payload length) packet type information

A specific case of the packet type information. Segmentation indicator is not necessary. The affinity with LAN is bad.

Discussion points

IT-a. How do we think about the compatibility with N-ISDN terminals and/or the affinity with LAN?

IT-b. Which structure is suitable for ATM?

(2) Timing Information

It is not clear about timing information. One usage is for synchronizing video and audio signals when the differential delay of two signals is greater than human perceptibility. The other usage is for transmitting video sampling frequency information.

Discussion points

IT-c. Is timing information necessary for synchronization?
Our group should show permissible limits for differential delay and delay jitter to SGXVIII.

IT-d. What kind of multimedia multiplex method should be used?

It-e. Should the video sampling frequency be synchronized between the coder and the remote decoder?

(3) Component indicator (Media indicator)

It is not clear what "component indicator" means. However, we think that it can be used to indicate media which are included in the audiovisual terminal. The necessity of media indicator depends on the multimedia multiplex method. (see Figure 1)

(Multiplex 1) : Cell multiplex

Each medium has its own VC (Virtual Channel). Namely, each medium is identified by the cell header. Cell by cell multiplex is available.

(Multiplex 2) : Message multiplex

IT of SAR is used for media indication. Cell by cell multiplex is available.

(Multiplex 3) : Media multiplex

Media indicator is included in CS-PDU header. Multiplexing is done on a packet by packet basis.

(Multiplex 4) : User multiplex

The user multiplexes several media in the terminals. Then, AAL does not distinguish whether the information is multiplexed or not. In this case, bit by bit multiplex is available.

Table 1 shows advantages and disadvantages of each multiplex method.

Table 1 Multimedia multiplex method

	Media identifier	Merit / Demerit
Cell	VC(Cell header)	M: Flexibility for handling multimedia. D: Differential delay between media. Network charge for multiple VCs?*1
Message	IT of SAR	M: No differential delay between media. D: Restriction to the number of media, depending on the length of IT.
Media	CS-PDU header	M: No differential delay between media. Flexibility for handling multimedia. D: Delay due to packet multiplexing.
User	user protocol	M: High flexibility of terminal. Compatibility with N-ISDN terminal. D: Affinity with other medium.

*1 : Network charge is not clear now. However from stand point of view that each VC needs some network resource, this idea seems to be reasonable. If the "group of VC", for which the network polices only total maximum/average bitrate and does not police that of each VC, this demerit may vanish.

Discussion points

IT-f. What are criteria to select a multimedia multiplex method? If cell multiplex is selected, should our group propose to SGXVIIIthat the "group of VC" or such kind of charging sysytem is useful for video terminals?

IT-g. How many bits are needed for IT?
How many media should be taken into account for multimedia multiplex? (note)

IT-h. What audio codings are used in ATM?

Note - In H.221, seven media are defined: Audio, Video, Low Speed Data (LSD), High Speed Data (HSD), Multi-Layered Protocol Data (MLP), High Speed MLP Data (H-MLP) and Encryption Control Signals (ECS).

(4) Others

Discussion points

IT-i. Should cell priority bit in the cell header be under users control? If so, one bit in the AAL should be assigned for this purpose, otherwise there is no way to indicate it from the AAL to the ATM layer. This bit should be in IT if cell by cell control is required, or in CS if packet by packet control is required.

3.3 LI : Length Indicator

Basic principle

LI indicates the boundary between user information and stuffing bytes (or bits) in the SAR payload.

Discussion points

LI-a. Is it necessary?
It depends on wether the user information is packet based or not.

LI-b. How many bits are required?
Does it indicate the number of bytes or that of bits? This is related to whether each element signal is byte aligned or not.

LI-c. The necessity of audio packets. Is audio also variable bit rate coded?

3.4 CRC : Cyclic Redundancy Code

Basic Principle

I.363 suggests that it can correct up to two correlated bit errors.

Discussion points

CRC-a. Is CRC for the header and trailer of SAR-PDU or also for PDU-payload?

CRC-b. Is this CRC universal for different bitrate video terminals?
There are three scenarios for this problem.

1 - CRC should be designed that the AAL provide substantially error-free connection for the higher layer, even in the worst case.

2 - CRC should be designed to cope with general cases.
If the resulting error performance is not enough for some type of video service, video terminal should have its particular error protection method (resilience/correction/concealment).

3 - Several CRCs should be defined in according to different bitrate and/or service classes.

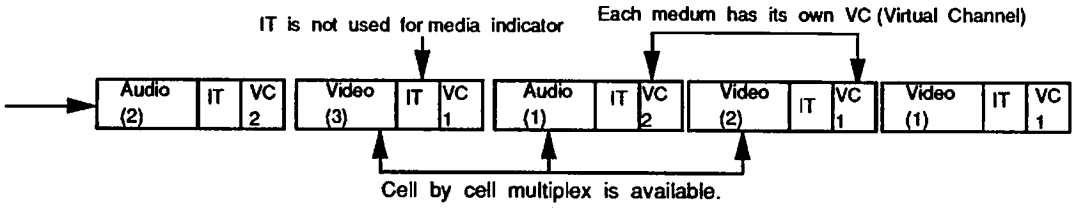
CRC-c. Is the bit error rate of ATM networks different from that of STM networks?
Our group should show permissible bit error rates to SGXVIII.

4. Conclusion

Several discussion points have been listed up to standardize the AAL appropriate for audiovisual terminals. A framework for multimedia multiplex in ATM environments should be established at the earliest stage. It is also important that the study results be reflected in the network design.

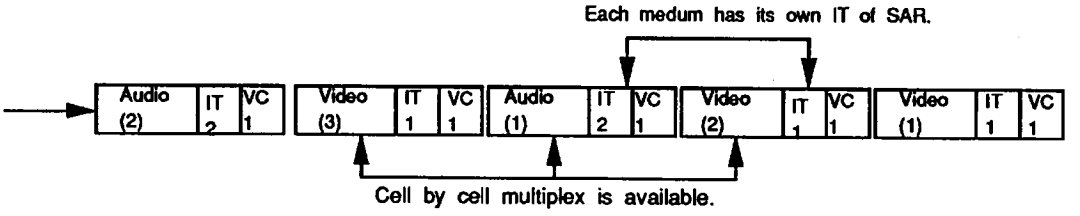
1.Cell Multiplex

Each medium is identified by the cell header.



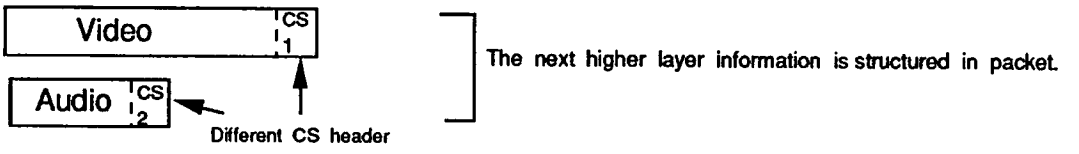
2.Message Multiplex

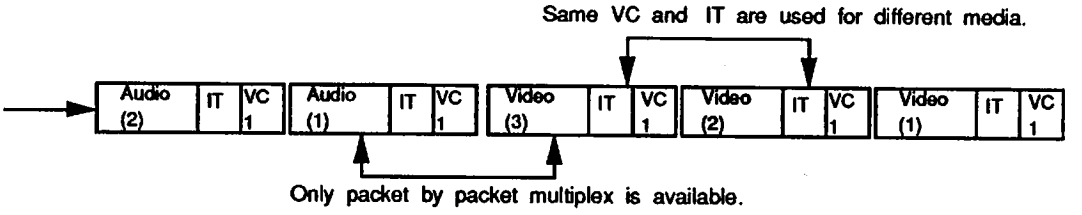
Each medium is identified by the IT of SAR.



3.Media Multiplex

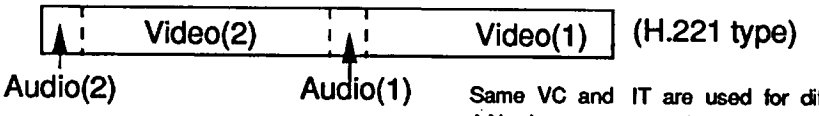
Each medium is identified by the CS header .



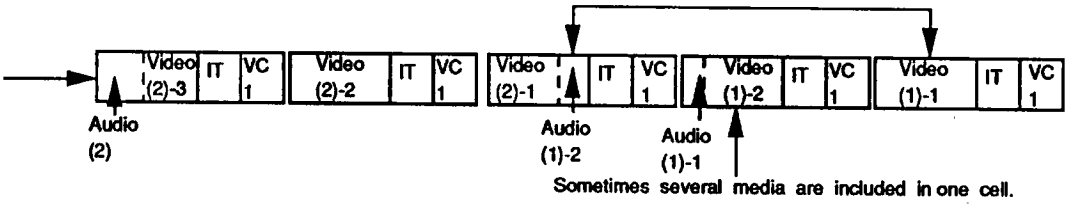


4.User Multiplex

The user multiplexes several media in the terminal.



Same VC and IT are used for different media.
AAL does not recognize whether the information is multiplexed or not.



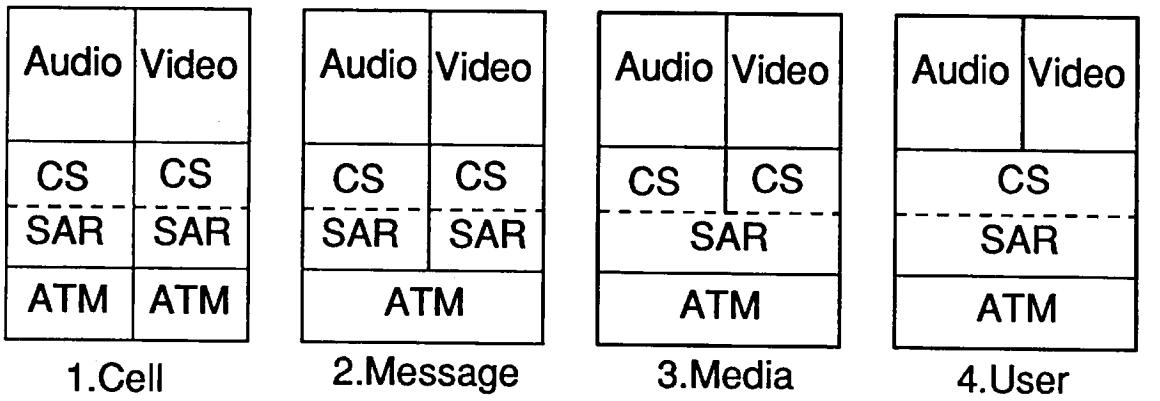
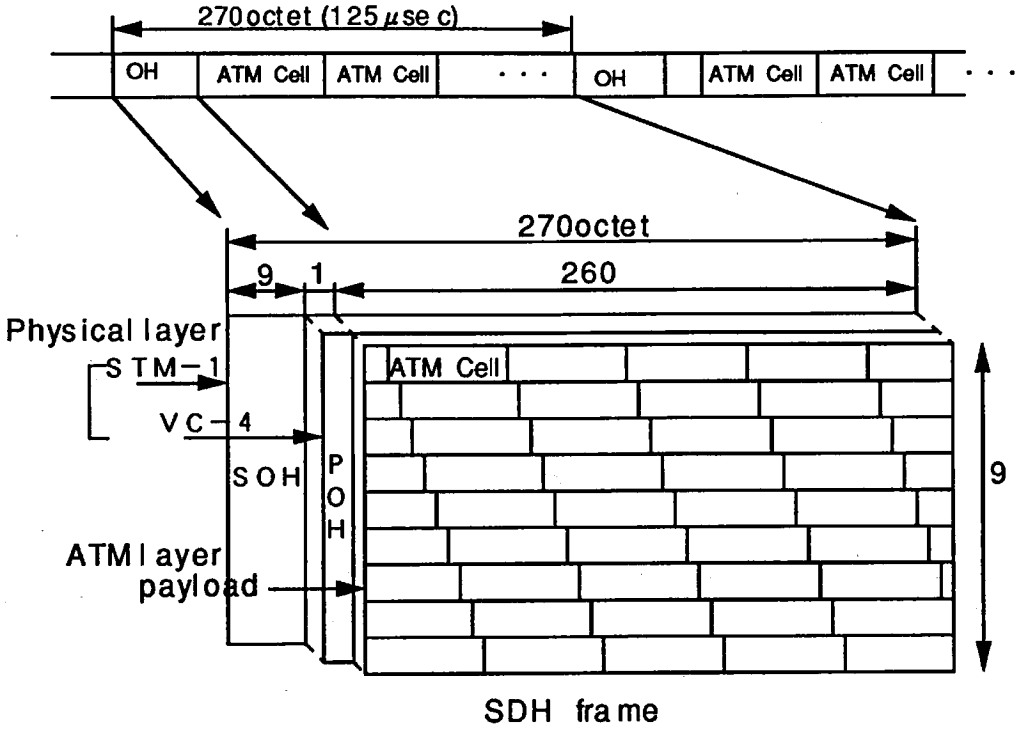
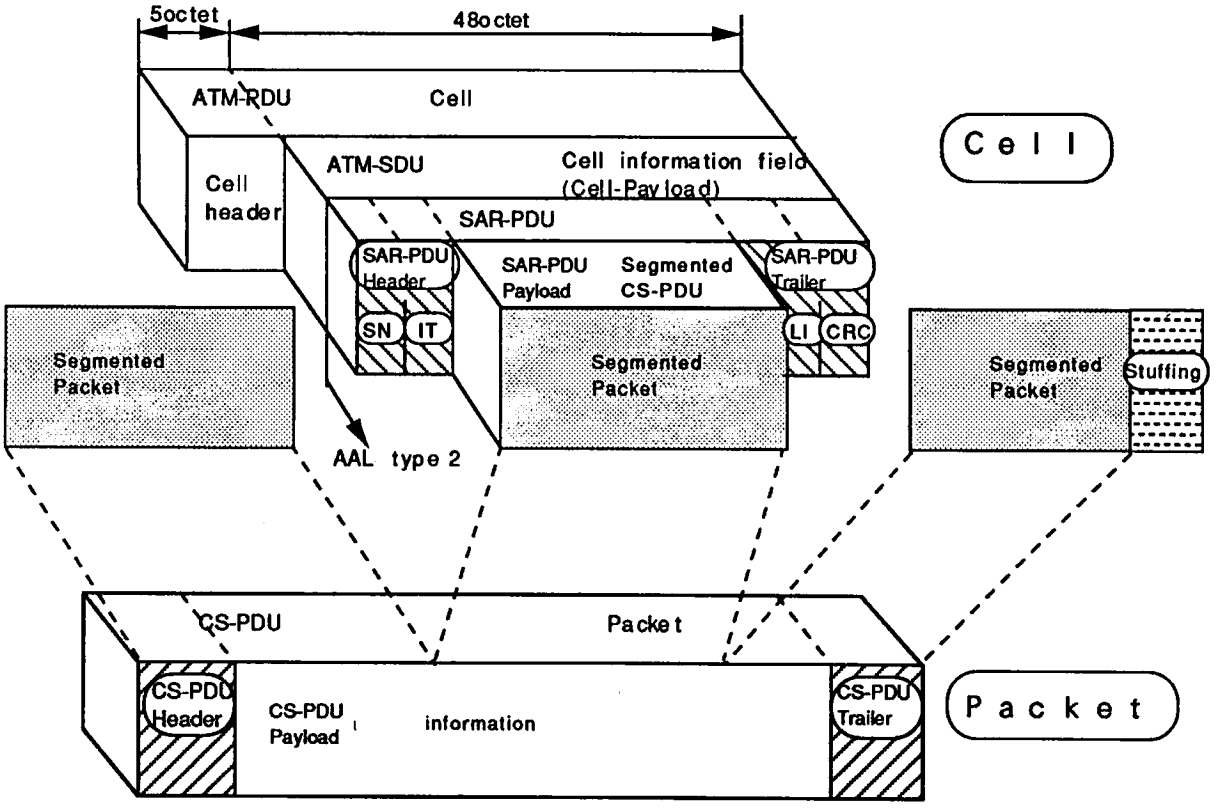


Fig.1 Multimedia multiplex methods



Appendix 1.
Mapping for ATM cells into the STM-1 signal



SN : Sequence Number, to detect lost or misinserted cells.
A specific value of the sequence number may indicate a specified purpose;
IT : Information Type
This is used to indicate Begininng of Message (BOM), Continuation of Message (COM), End of Message (EOM), timing information and also component of the video or audio signal;
LI : Length indicator, to indicate that the number of octet of the CS-PDU are included in the SAR-PDU payload field;
CRC: Cyclic Redundancy code, to correct up to two correlated bit errors.

Appendix 2. Packet and Cell (AAL type 2)