Telecommunication Standardization Sector
Study Group 15
Experts Group for ATM Video Coding
(Rapporteur's Group on Part of Q.2/15)

Document AVC-657
July, 1994

SOURCE: Japan
TITLE : Consideration on error correction functionality in H.222.1/AAL
PURPOSE: Discussion

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1. Introduction

Necessity of error correction functionality in H.222.1/AAL is not clear yet. At Paris meeting, it was agreed that this necessity should be discussed based on network QOS scenarios. This document clarifies what range of error correction functionality is necessary for each scenario.

2. Network QOS scenarios

Cell loss ratio (CLR) and bit error ratio (BER) for each network scenario are shown in Table 1 [1].

Table 1 Performance Parameters Assumption

	Worst case	Average case	Best case
CLR;Cell loss ratio	10**-6	10**-9	10**-11
BER;Bit Error Ratio	10**-5	10**-7	10**-9

3. Mean Error Free Time (MEFT)

MEFT is the key parameter to decide the necessity of error correction. METF is derived from the following equations.

MEFT from cell loss ; MEFT (sec) = P / (R * CLR)
MEFT from bit error ; MEFT (sec) = 1 / (R * BER)
where R ; user information bitrate (bits/sec)
P ; 376 (bits/cell) that is user information length of one cell. AAL type 1 is assumed.

METF is calculated for the value of R being 6 Mbits/sec. The results are shown in Table 2. Based on table 2, it becomes clear that bit error correction is mandatory even if network QOS is of the best case. On the other hand, cell loss correction is not necessary except for the worst case.

Table 2 Mean Error Free Time

	Worst case	Average case	Best case
from cell loss	64 sec	64000sec=17hours	6400000sec=1700hours
from bit error	1/60 sec	1.5 sec	2.5 min.

note; If cell losses and bit errors occur consecutively, MEFT becomes longer.

4. Alternatives for error correction method

Case 1 ; AAL type 1 short interleaver [I.363.x]
This case can cope with the cell loss.

Case 2 ; 4 bytes Reed Solomon (RS) for 255 bytes frame
(RS is not aligned to either of both TS packet or cell boundary)

- case 2-1 ; RS frame with synch. byte
- case 2-2 ; Structured data transfer (SDT)is used for indication of RS frame boundary.

Case 3 ; 4 bytes Reed Solomon (RS) for 188 TS packet

- case 3-1 ; Sync. byte in TS packet is used for indication of the RS frame.
- case 3-2 ; RS frame and cell are aligned. One bit user information in ATM header is used for indication of the RS frame.

Case 4 ; RS and CRC for 47 Transport packets [2].

Table 3 Several alternatives for error correction method

	AAL	H.222.1 specific for error correction*1	CBR/VBR	layering *3
case 1	Type 1 short interleaver	none	OK/?*2	good
case 2-1	Type 1	RS frame with sync. byte	OK/?*2	good
case 2-2	Type 1 SDT	RS frame without sync. byte	OK/?*2	bad
case 3-1	Type 1 / Type 2?	RS	OK/?*2	?*4
case 3-2	Type 2? including RS	none	OK/OK	good
case 4	Type 1 interleaver RS/CRC	none	OK/?*2	good

*1 ; Other functionalities such as jitter removal are out of consideration.

*2 ; VBR operation may be supported under minimum bitrate constrained.
However, it should not be called as AAL type 1.

*3 ; Layering "good" means that upper layer can work without lower layer functionality, such as synchronization.

*4 ; RS and sync. byte is not AAL. Therefore, layering between AAL and H.222 is good. However, layering between H.222.0 (sync. byte) and H.222.1 specific (RS) is not good.

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Case 1;

```
   +----------------------------+
   | PS/TS bitstream            |      H.222.0 PS/TS
   +----------------------------+
  ==================================   AAL-SAP (Service Access Point)
                                         -SDU = Byte/bit stream
```

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      AAL Type 1 short interleaver    generic AAL

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Case 2-1;
   +---------------------------+
   | PS/TS bitstream           |      H.222.0 PS/TS
   +---------------------------+
  =================================  H.222.1 specific-SAP
                                       -SDU = Byte/bit stream
        255 byte
   <---------------->
   +-----+------+--+-----+------+--+
   |sync.|PS/TS |RS|sync.|PS/TS |RS|  H.222.1 specific (sync.+RS)
   +-----+------+--+-----+------+--+
  =================================  AAL-SAP
                                        -SDU = Byte/bit stream

      AAL Type 1                     generic AAL

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Case 2-2;
   +---------------------------+
   | PS/TS bitstream           |      H.222.0 PS/TS
   +---------------------------+
  =================================  H.222.1 specific-SAP
                                       -SDU = Byte/bit stream
        255 byte
   <---------------->
   +------------+--+------------+--+
   |  PS/TS     |RS|  PS/TS     |RS|  H.222.1 specific (sync.+RS)
   +------------+--+------------+--+
  ================|===============|  AAL-SAP
                  *               *     -SDU = Byte/bit stream with
                                               structure
      AAL Type 1 structure data transfer  generic AAL

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Case 3-1;
   +-----+------------+
   |sync.| TS packet  |              H.222.0 TS
   +-----+------------+
  =================================  H.222.1 specific-SAP
                                       -SDU = TS packet
        188 byte
   <------------------->
   +-----+------------+--+           H.222.1 specific (RS)
   |sync.  TS packet  |RS|           RS sync. rely on TS sync..
   +-----+------------+--+
  =================================  AAL-SAP
                                        -SDU = Byte/bit stream

      Type 1 / Type 2?               generic AAL

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```
Case 3-2;
   +-----+------------+
   |sync.| TS packet  |                H.222.0 TS
   +-----+------------+
  =|==================|=============   AAL-SAP
   *                  *                   -SDU = 188byte (TS packet)
        188 byte
   <------------------>
   +-----+------------+--+             AAL SSCS (Service Specific CS)
   |sync.  TS packet  |RS|
   +-----+------------+--+

   +-----+ +-----+ +-----+ +-----+     1bit user-user information in
   |cell.| |cell | |cell | |cell |     ATM header is used to indicate
   +-----+ +-----+ +-----+ +-----+     the position of RS.

      Type 2?                          Specific AAL
```

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```
Case 4;
   -----+-----+------------+---
        |sync.| TS packet  |          H.222.0 TS
   -----+-----+------------+---
  =========================|========  AAL-SAP
                           *             -SDU =  47 TS packets
                          47 TS
                                      47 TS packets are mapped on
                                      the interleave matrix.
      Type 1 interleaver RS/CRC       Specific AAL
```

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5. Consideration on AAL type 5

AAL type 5 is one of the alternatives for audiovisual communication. However, if error correction functionality is necessary, it may not be good solution to use AAL type 5. The reason is that the error correction (H.222.1) after the error detection (AAL type 5) at the receiving side is ridiculous.

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```
AAL type 5;
   +------------------+
   |    PS/TS         |                H.222.0 PS/TS
   +------------------+
  ==================================   H.222.1 specific-SAP
                                          -SDU = Packetized PS/TS

   +------------------+---+
   |    PS/TS         |RS |            H.222.1
   +------------------+---+            Bit error correction

  =|=====================|=========   AAL type 5 -SAP
   *                     *               -SDU = RS frame?
   +------------------+---+--+---+
   |    PS/TS         |RS |  |CRC|     generic AAL type 5
   +------------------+---+--+---+     Error detection
```

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6. Conclusion

The necessity of error correction functionality is discussed. Based on the network QOS scenarios assumed at the Paris meeting, it becomes clear that bit error correction is mandatory even if network QOS is of the best case. On the other hand, cell loss correction is not necessary except for the worst scenario. Several alternatives for error correction are shown.

References

[1] AVC-635 ; ATM performance assumptions (Experts Group), Paris, 1994.3

[2] AVC-658 Annex ; A study of the interaction with the AAL for the ATM transmission of TS packets (Japan), Grimstad, 1994.7