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

Document AVC-50
17 May 1991

SOURCE : JAPAN
TITLE : Considerations on Cell Loss in ATM Networks
PURPOSE : Discussion

....

1 INTRODUCTION

In ATM networks cell loss may occur due to network congestion or header error. At this moment the probability of cell loss in the usual network environment has not yet been given, but several protection methods are however applicable for some possible probabilities of cell loss. This document is intended to start discussions on cell loss.

2 CELL LOSS PROBABILITY

If a very low cell loss ratio of 10^{-10} is achievable, which corresponds to one error for every 10 hours at the bit-rate of 100 Mbit/s, no cell loss protection method would be necessary except for protecting catastrophic errors in received pictures. Since this is highly desirable from the terminal cost point of view, we should keep requesting this value to SGXVIII.

If, on the other hand, the cell loss ratio is higher than 10^{-3}, it would not be suitable for real time applications of coded video transmissions.

3 MERITS AND DRAWBACKS OF PROTECTION METHODS

For a cell loss ratio of 10^{-4} to 10^{-9}, the methods listed in the table below will be used.

TABLE Cell Loss Protection Methods

<table>
<tr><th>Position</th><th>Method</th><th colspan="2">Effect</th></tr>
<tr><td rowspan="2">Transmisson Codec</td><td>Cell Interleaving</td><td colspan="2">Decrease cell loss ratio</td></tr>
<tr><td>Packetization</td><td rowspan="6">Ease the damage of decoded picture</td><td>Localize damaged area</td></tr>
<tr><td rowspan="5">Source Codec</td><td>Layered Coding</td><td rowspan="2">Avoid visible errors</td></tr>
<tr><td>Error Concealment</td></tr>
<tr><td>Cyclic Refresh</td><td rowspan="3">Achieve the fast recovery from erroneous pictures</td></tr>
<tr><td>Demand Refresh</td></tr>
<tr><td>Leaky Prediction</td></tr>
</table>

(1) Cell Interleaving

Cell interleaving reduces the cell loss ratio, using error correcting codes and bit interleaving technique. Considering possible long bursts of cell loss at network congestions, the interleaving cell units should be rather long, but this increases the delay. In this method, delay and transmission efficiency are in a trade-off relation with one another.

For example, when BCH (511, 493) 6-bit-burst error correcting code is used, the unit must be longer than 86 cells for a single cell loss. The transmission efficiency comes to around 0.95. This generates a delay of 0.5 msec at 150 Mbit/s, 5 msec at 15 Mbit/s and 50 msec at 1.5 Mbit/s (including packing and unpacking delay). The values are multiplied by N when N-cell-burst errors are considered. A shorter delay time will be achievable only with lower transmission efficiency by using shorter error correcting codes.

In conclusion, cell interleaving is suitable for higher bit-rate coding and applications where delay time is not important.

(2) Packetization

Catastrophic errors in decoded pictures such as a long synchronization loss of coded data should be avoided even when cell loss occurs. Some packetization method, therefore, is required in any application for quick recovery of received data synchronization.

Two synchronization schemes are possible as follows.

(a) A unique word is inserted at the head of the data unit (MB, GOB, Picture frame, etc.). No relative position between the word and CS-PDU is specified.

(b) The head of the data unit always coincides with that of CS-PDU.

In both methods, transmission efficiency and picture deterioration caused by cell loss are in a trade-off relation. Our feeling is that method (b) would be preferable from these points, and in this case, the length of CS-PDU should be variable and able to be defined by users.

(3) Layered Coding

This method assumes the prioritized channels specified by CLP. The cell loss characteristics of the lower priority channel, therefore, dominates this method. Further, loss of coding efficiency should be evaluated.

4 CONCLUSION

We have given a desirable value of cell loss ratio and described some protection methods for cell loss, which should be employed when the cell loss ratio is not negligible.