ITU-T Telecommunications Standardization Sector **AVC 774**

Study Group 15 **15 May 95**
Experts Group for Video Coding and Systems
in ATM and Other Network Environments

Source: AT&T (Amy Reibman and Hayder Radha)

Title: **Concealment of bit errors in MPEG-2 decoders**

Purpose: Information and Proposal

1. Introduction:

This describes the results of the study performed to examine the impact of bit errors on coded video, particularly high rate teleconferencing video, and whether error correction is necessary or not to produce "acceptable" pictures.

We use a 50-second head-and-shoulders sequence of "Dave" participating in a meeting. It was encoded at 6 Mbps with MPEG-2, using I-slices and not I frames (except the first) for updating. The BER=1e-7, which is expected to be the worst case for ATM networks. On average, this leads to 30 errors in the sequence.

Only random errors are explored to date. FEC is unlikely to be able to assist in the case of burst errors. Random errors are simulated by generating Geometric random variables to indicate which bit is the next bit that is in error.

We explored 2 different ways to send an errored bitstream to a decoder: (a) send the bitstream complete with bit errors directly to the decoder, (b) detect the bit errors (with AAL5's CRC which can detect up to 3 errors), discard the information in error, and inform the decoder as to the location of the missing information. In the latter case, we assume AAL5 packet sizes of 2 MPEG-2 Transport packets, or 8 ATM 47-byte cells. A single detected error in the payload causes 8 cells to be lost.

Results are demonstrated on video tape using 2 different random seeds.

2. Results:

Without detecting bit errors, bit errors may or may not be detected by the decoder in the decoding process (ie, the syntax and semantics of the errored bitstream may still be valid.) A single bit error can produce a profound effect on the visual quality. This often results in a square (macroblock) that is the wrong color in an area. However, sometimes bit errors do not produce large visual impact.

In case 1, 10 of the 32 bit errors were detected by the decoder and the other 22 were undetected. In case 2, 9 of the 33 bit errors were detected.

When bit errors are detected using AAL5's CRC, the packet loss may result in a visible artifact because of temporal error propagation. However, these are much less severe than those caused by undetected bit errors.

3. Conclusion:

Pretty good pictures can be obtained by detecting bit errors with AAL5's CRC and using simple error concealment at the decoder.

4. Proposal:

As explained above, the error detection capability of the AAL-5 common-part-convergence sublayer can be used effectively in conjunction with simple error concealment methods (e.g., the replacement of the effected segment of a slice by the corresponding region of the previous frame) to significantly reduce the impact of random bit error events on the decoded video signal. Therefore, it is proposed that Recommendation H.310 clearly states that AAL-5 based receive-only terminals do not include any FEC capabilities.

However, since (a) the AAL-1 convergence sublayer does not include an error detection capability, and (b) the AVC Experts Group agreed not to support the existing short-interleaver cell-recovery mechanism, it is proposed that Recommendations H.222.1/H.310 define a FEC method for AAL-1 based H.310 terminals (only).

In addition to reducing the complexity of H.310 terminals, this proposal can help the Experts Group by focusing their effort on the design of a FEC approach that is optimized for the AAL-1 scenario.

Finally, and to further assist the group in the design of the FEC frame for H.310 terminals (with AAL-1), the group may want to consider eliminating the requirement for aligning the FEC frame with (an integer multiple of) ATM cells. Although the alignment of the FEC frame with ATM cells may expedite the recovery of the signal in loss-of-synch events or at the start of a session, this requirement (i.e., the alignment) could increase the complexity or reduce the overall efficiency of the FEC approach.