ISO/IEC JTC1/SC29 WG11
MPEG 92/
October 1992

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

Document AVC-375
October 1992

SOURCE: Australian UVC Consortium
TITLE: Results on layered coder error resilience
PURPOSE: Information

## Introduction

This document presents results of cell loss experiments performed on a two layer frequency scalable coder, as proposed in AVC-345 (MPEG 92/490). A number of cell loss ratios are tested, with and without cell loss in the lower layer. Three different distribution of bits between the two spatial layers are used. A comparison is also made with the performance of a single layered coder.

## Experimental Conditions

The conditions used for this experiment are described in AVC-345 (MPEG 2/490) except that no intra refresh pictures are used, in order to isolate the effect of predictive frames. A summary of the experimental conditions is as follows:

| | |
|---|---|
| Picture format | 4:2:0 |
| GOP structure | IPPPPPPPP... |
| Picture structure | Frame |
| Cell loss ratios used | $0.0005 \rightarrow 0.01$ |
| Average error burst length | 1 |
| AAL functionality | Streaming mode with a 4 bit sequence number per cell |
| Bit rate | 4 Mbits/second |
| Layered coder | MPEG frequency scalable two layer coder with a single encoding loop |

The variation in the distribution of bits between the two layers was obtained by scaling the quantiser used for the lower layer. Scaling factors of 1.0, 1.2 and 1.4 are used to give 75%, 60% and 45% of the bits in the lower layer.

The cell loss ratios used for the layered coder are obtained from the single layer cell loss ratio (shown in the above table) and the distribution of bits between layers, using the equation described in AVC-345 (MPEG 92/490). The following table summarises the cell loss ratios applied to the upper and lower layers:

| % bits in lowest layer | CLR in lowest layer | Range of CLRs used for upper layer |
|---|---|---|
| 45 | 0.0000 | 0.0009 → 0.0182 |
| | 0.0010 | 0.0001 → 0.0174 |
| 60 | 0.0000 | 0.0013 → 0.0250 |
| | 0.0010 | 0.0000 → 0.0235 |
| 75 | 0.0000 | 0.0020 → 0.0400 |
| | 0.0010 | 0.0000 → 0.0370 |

The error concealment techniques used in both the single layer and two layered decoders are:

| | |
|---|---|
| Upper layer: | Expand scale-4 macroblock data. |
| Lower layer: | Replace with macroblock in same spatial location from the previous frame. Discard upper layer data. |
| Single layer: | Replace with macroblock in same spatial location from the previous frame. |

## Results

Two sequences are used for the tests, *Flower Garden* and *Ballet*. 50 frame portions of the sequences are coded, cells dropped from the resulting bitstreams, and the errored bitstreams decoded. The last two steps are repeated a total of 20 times, giving an effective decoded sequence length under cell loss of 1000 frames. After each of the 50 frame sequence are decoded, the SNR compared to the original uncoded sequence is obtained, and the 20 SNR values obtained are averaged.

Figures 1 and 2 show a combination of the results for each of the two test sequences. In each case, the top three curves represent the SNR for three different bit distributions, when there are no errors in the lowest (baseband) layer. The next curve is for the case when 60% of the bits are in the lower layer, and a cell loss rate of 0.001 is applied to the lower layer. The final curve is the SNR of the single layer coder for a range of cell loss ratios. The cell loss ratio on the horizontal axis is the overall cell loss ratio. For layered coders it is a combination of the loss on both of the layers, and is calculated using the equation given in AVC-345 (MPEG 92/490).

## Conclusions

The graphs in Figures 1 and 2 show the expected result, which is that for a layered coder the quality under cell loss decreases as the percentage of bits in the upper layer increases.

The difference between the top set of curves and the middle curve arise from the errors present in the lower layer. With errors present in the lower layer, the graphs show that additional errors in upper layer don't affect the quality as much as when there are no errors in the lower layer.

In all cases, the layered coder without lower layer loss performs better than the single layer coder, as does the layered coder with lower layer loss as the overall error rate increases. Further work is required to investigate the effect of adding more sophisticated concealment techniques to the single layer coder.

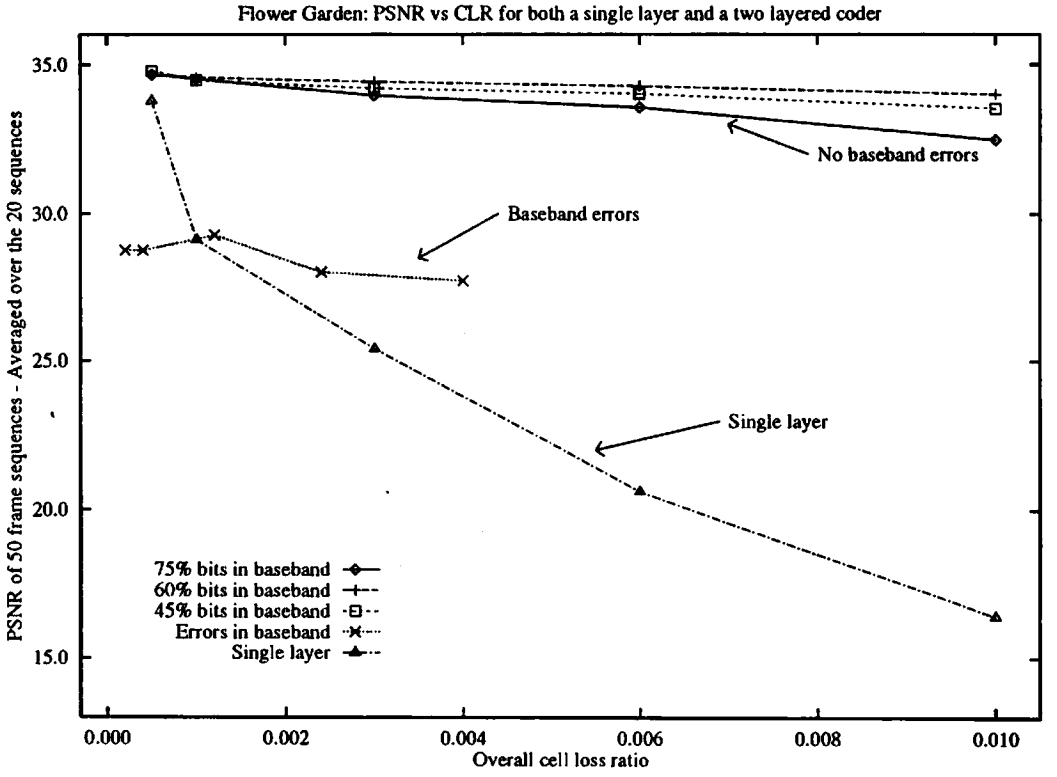


Figure 1: Total results for the *Flower Garden* sequence.

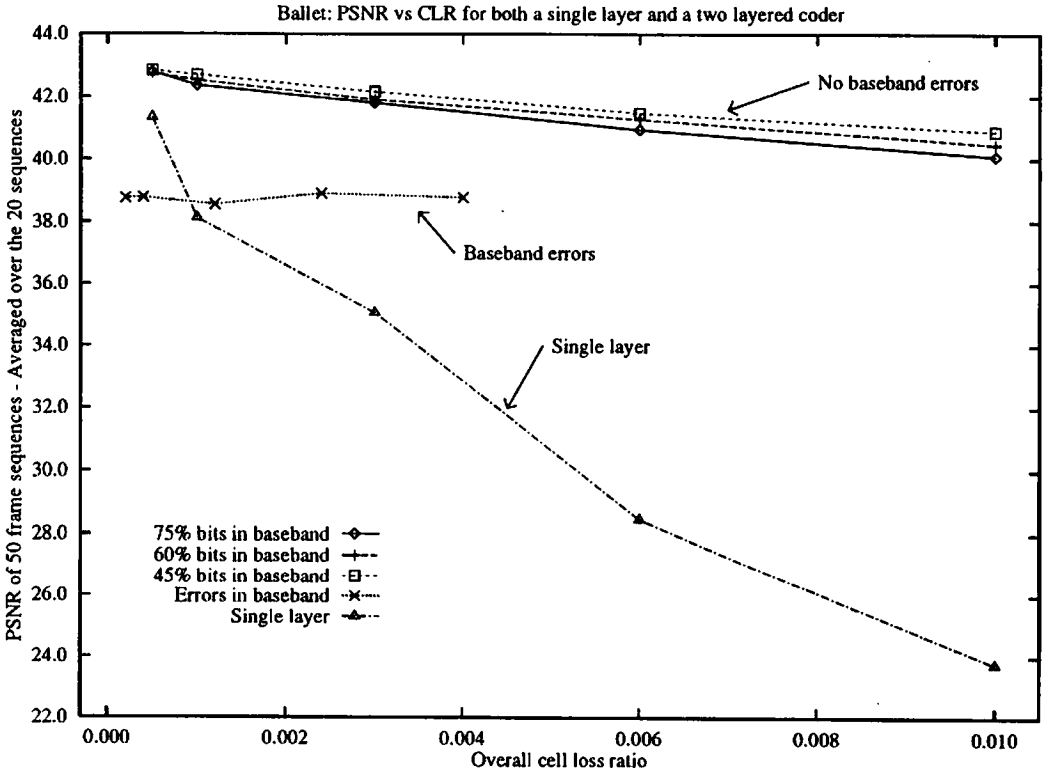


Figure 2: Total results for the *Ballet* sequence.