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TITLE: A hybrid AAL packing scheme
PURPOSE: Information

# Introduction

This document presents a hybrid AAL packetisation scheme which offers the quick decoder resynchronisation of the structured packing scheme [1, 2] while still remaining within the MPEG video bitstream syntax. This work follows on from that described in AVC-427 (*Spatial localisation for cell loss resilience*) [3] and also makes use of the comparative performance measure of macroblocks lost per cell loss.

# How It Works

Structured packing has the effect of enabling resynchronisation to occur with the first cell received after a cell loss, but this is achieved at the cost of requiring changes to the MPEG video bitstream syntax. To conform to the bitstream syntax, resynchronisation is only possible by receiving a slice start code. Decreasing the slice size increases the occurrence of the slice header, decreasing the overall coding efficiency.

The proposed hybrid scheme requires the first macroblock in every cell to also be the first macroblock of a slice (and hence accompanied by a slice start code). Figure 1 shows how a stream of macroblocks are packed into cell. The 32 bit start codes can be reduced in length (for transmission) by the process described below, reducing the penalty of more frequent slice headers. A variation of this hybrid scheme is to start a slice in every $N$th cell, rather than in every cell.

Two ATM cell header fields are required, one compulsory and the other present only if the first field has the value TRUE. The compulsory header (Slice Start Present – SSP, 1 bit) indicates if the cell contains a slice start code. If a slice start code is present, the second field (Slice Start POSition — SSPOS, 9 bits) indicates where in the cell the slice start code begins.

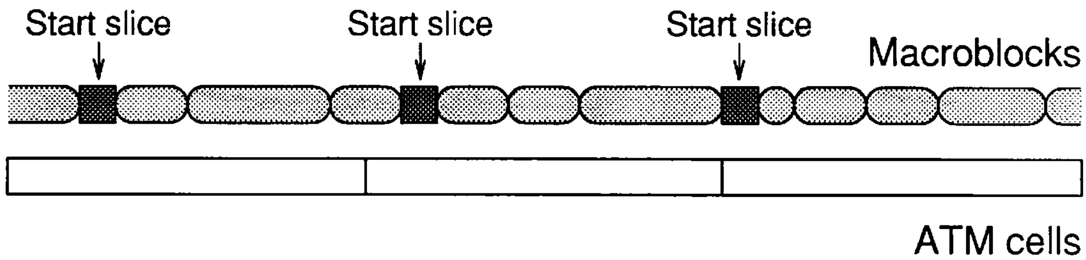


Figure 1: How a stream of macroblocks are packed into cells, indicating where slice headers are required.

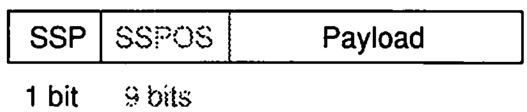


Figure 2: The header fields required for this hybrid packing scheme.

Because the slice start code is pointed to in this fashion, only the last 8 bits of the start code need be present, as the network interface can reconstruct the missing 24 bits (23 zeros followed by a 1).

The actual implementation of this system may be in a manner similar to that of message mode. The coder generates the bits from a slice and passes them to the network interface. The network interface then adjusts the slice header (easily located at the start of the data received from the encoder) and then places the bits into cells for transmission. Unlike message mode, however, this scheme doesn't require that slices start at the beginning of a cell, causing some cells to be partially filled. At the receiver the network interface will perform the inverse role, reconstructing the missing bits from the slice header before passing the data onto the decoder. The ATM cell header fields simplify the task of locating the slice headers, eliminating the need for the network interface to scan through the entire bitstream.

This hybrid scheme is similar to the short slice work described in [4], except that in this case the slice size is varied to ensure that decoding can resume with the first macroblock in a cell. The encoder must keep track of the number of bits generated for each macroblock, and must also know about the cell payload size in order to meet this requirement. The advantages of the hybrid scheme over small slice sizes are:

- Resynchronisation will always occur with the first macroblock in a cell, whereas with small slices some macroblocks in a cell may be discarded before the slice start code has been received.
- As the number of macroblocks which can fit into a cell varies between 1 and at least 20, using the small slice approach (with a fixed slice size) can result in either multiple slice start codes in the same cell, or a slice start code every few cells. The first case wastes bandwidth by offering several resynchronisation points within the same cell, whereas the second reduces how often resynchronisation can occur.

## Results

The graph in Figure 3 shows the variation in the amount of overhead information as a function of the number of cells per slice. The overhead information is due to the two header fields and extra slice headers, and is measured by comparing with a sequence coded with 1 slice per frame. The results presented can be compared with those in Figure 1 of [3] (*Spatial localisation for cell loss resilence*), which indicates that this hybrid scheme has a lower overhead than either of the two schemes which use macroblock resynchronisation.

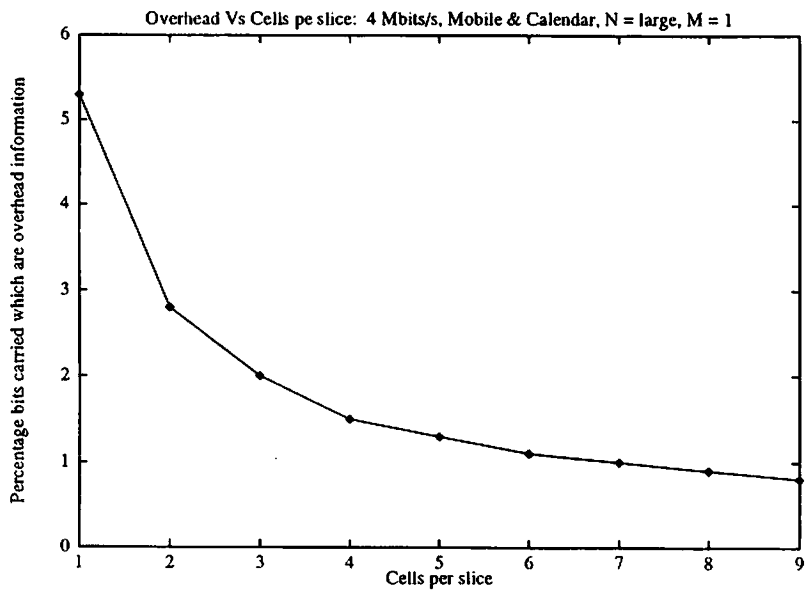


Figure 3: The amount of overhead information as the number of cells per slice varies. (Sequence: *Mobile & Calendar*, rate = 4 Mbits/s, N = large, M = 1)

The performance of the hybrid scheme under cell loss is presented in Figure 4, which shows the number of macroblocks lost per cell loss plotted against the cell loss ratio and the number of cells per slice. By again comparing with the results presented in AVC-427, it can be seen that for one cell per slice the results are very similar to those obtained for either of the two schemes using macroblock resynchronisation.

## Conclusions

This document has presented an AAL packetisation scheme which combines features from the structured packing and small slice size approaches, in order to enable quick recovery from lost cells. This scheme operates within the current MPEG video bitstream syntax, and provides a way in which the overhead of frequent slice headers can be reduced. The performance under cell loss conditions is very comparable to that of the structured packing approach.

## References

[1] Japanese contribution to CCITT SGXV Experts group for ATM video coding. *Cell-loss compensation scheme*, March 1992. Document AVC-235, MPEG92/184.

Macroblocks lost per cell loss Vs Cell loss ratio & Cells per slice

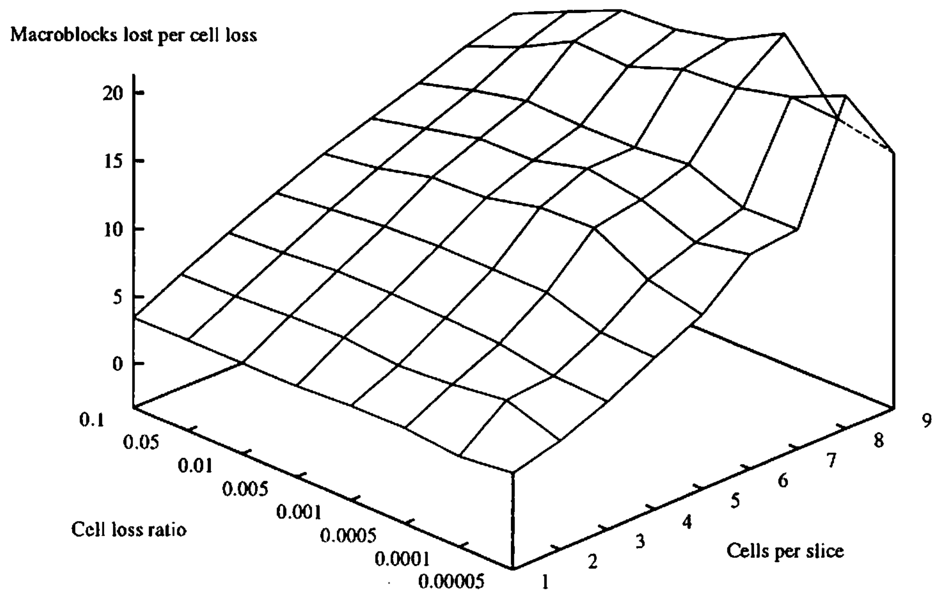


Figure 4: The number of macroblocks lost per cell loss as a function of the number of cells per slice and cell loss ratio. (Sequence: *Mobile & Calendar*, rate = 4 Mbits/s, N = large, M = 1)


[2] Japanese contribution to CCITT SGXV Experts group for ATM video coding. *Structured packing*, October 1992. Document AVC-360, MPEG92/579.

[3] Australian UVC consortium contribution to CCITT SGXV Experts group for ATM video coding. *Spatial localisation for cell loss resilience*, January 1993. Document AVC-427.

[4] Japanese contribution to CCITT SGXV Experts group for ATM video coding. *Re-synchronisation by slice size reduction*, October 1992. Document AVC-368, MPEG92/587.