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SOURCE: Australia

TITLE: Proposal for Cell Loss Core Experiments on Layered and Non-Layered Coders

PURPOSE: Proposal

Abstract

In this document possible advantages of layered coding schemes for ATM cell loss concealment are summarized. Layered coding schemes provide an inherent method of cell loss concealment in contrast to non-layered coding schemes. It is proposed to establish cell loss Core Experiments with the aim of comparing the performance of layered and non-layered coders. We further propose to follow the MPEG scalability syntax extension for initial Core Experiments on cell loss.

1. Introduction

In ATM based networks video data will be transmitted in fixed length cells. During times of congestion the network can discard cells. These lost cells have to be concealed at the receiver terminal to reduce visible artifacts. Cell loss characteristics will depend on various conditions but it is expected that cell loss will occur in bursts in times of network congestion. Future video coding schemes for ATM transmission will have to be designed to retain an acceptable image quality under these conditions.

In this paper the possible impact of layered and non-layered coder implementations on cell loss concealment is summarised. It is proposed to adapt the MPEG scalability syntax extension for future core experiments on ATM cell loss.

2. Packetization

The bit-stream generated from encoding the video data can be placed into cells in a way that cell loss is less visible at the receiver terminal. A comparison of some of these methods is outlined in document AVC-298 [1]. The aim is to provide the ability to detect lost cells as early as possible at the receiver. This is highly desirable to enable a fast resynchronization of the decoder and to minimize the effect of lost cells on image

quality. The decoder then has the task of concealing and recovering lost image content to reduce visible artifacts at the receiver terminal.

3. Error Concealment

3.1 Non-Layered Coder Implementations

At the decoder lost image data, e.g. lost image blocks, have to be concealed on the basis of blocks received without transmission errors. In non-layered coder implementations not using spatial layering, for instance MPEG SM3, only spatially or temporally adjacent blocks can be used to predict the content of the blocks which have been lost.

4. Layered Coder Implementations

Layered coding schemes decompose video data into a hierarchical structure of layers where each layer is coded independently. Spatial layering is implemented in the MPEG scalability syntax extension introduced recently to provide a layered bitstream [3]. In this implementation image data for each frame is decomposed and encoded into three spatial layer bitstreams. A reduced quality video sequence can be reconstructed from the bitstream if only the most basic layer is decoded. Accepting additional layers at the receiver side will enhance the quality of the reconstructed video sequence.

This spatially layered ATM transmission of video data can provide an inherent method for cell loss concealment if each cell transmitted carries only information from one layer. The loss of information due to the loss of a cell will only cause a reduction of image quality assuming the remaining spatial layers were received correctly. No prediction of lost image block content from spatially or temporally adjacent blocks is necessary compared to cell loss concealment in non-layered coders which may be preferable in terms of performance and complexity.

Moreover the ATM network is capable of supporting the transmission of layered video data. Priority can be achieved in two ways. The first is using the Cell Loss Priority (CLP) bit of the ATM header. The second is using multiple virtual channels with different loss priorities. This is outlined in more detail in document AVC-297 [2]. For example the spatial layer containing most important image data can be transmitted at highest priority with reduced cell loss likelyhood.

5. Proposal for Core Experiments on Cell Loss

The performance of coding schemes in the presence of cell loss will be strongly dependent on packetization and coding strategies, e.g. layered and non-layered coding, as outlined above. This has also been reported in document AVC-287.

- We propose that cell loss Core Experiments be defined with the aim of comparing the performance of layered and non-layered MPEG coding schemes.
- Initial cell loss probabilities can be calculated on the basis of the Gilbert network model outlined in the MPEG TM1 draft document [3]. Long term characteristic of cell loss should be taken into consideration as described in document AVC-296 [4].
- The separation of high and low priority information has been shown to be advantageous in AVC-298. A framework for Core Experiments therefore should include a reference AAL and the ability to take advantage of ATM cell loss priority.

An example AAL is described in AVC-297 and is proposed as a reference AAL for Core Experiments.

- It is proposed that the MPEG scalability syntax extension as defined in TM1 document [3] be followed for cell loss experiments on a layered MPEG coder.

The MPEG scalability syntax extension provides a convenient and useful way for bitstream layering and requires only minor changes to the encoder and decoder structure and should be adapted for Core Experiments. The MPEG scalability syntax enables full MPEG1 bitstream compatibility as a fall back mode. As an additional advantage this extension provides the possibility to decode video sequences at different scales, such as different qualities and resolutions using decoders with various degrees of complexity.

6. Conclusion

Layered coding schemes provide an inherent method for cell loss concealment in contrast to non-layered coding schemes. It is proposed to compare the performance of layered and non-layered coders in cell loss Core Experiments. Sufficient information on AAL and ATM functionality, and cell loss characteristics, exists to define Core Experiments.

References

[1] Australian input to CCITT Experts Group SGXV WPXV/1 and MPEG, Doc. AVC-298, "Adapting MPEG 1 for ATM Transmission", July 1992.

[2] Australian input to CCITT Experts Group SGXV WPXV/1 and MPEG, Doc. AVC-297, "The ATM Adaptation Layer for Video Services on the B-ISDN", July 1992.

[3] ISO/IEC JTC1 SC29/WG11, "Coded Representation of Picture and Audio Information", Test Model 1, May 1992.

[4] Australian input to CCITT Experts Group SGXV WPXV/1 and MPEG, Doc. AVC-296, "Cell Loss Characteristics for Statistical Multiplexed Video Sources", July 1992.