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Subject : **Error sensitivity of the TM1 syntax**

Source : **PTT Research, The Netherlands**

Purpose : **Discussion, proposal**

1 Introduction

At this moment, much attention is paid to the source coding for MPEG2. As the future MPEG2 standard is likely to be used for H.26x, in an early state attention has to be paid to the error sensitivity of the new scheme (bit errors, ATM cell loss). For this, the experience of the implementation and use of H.261 for narrow-band ISDN can be used as a starting point. In this document, the TM1 syntax is compared with the H.261 syntax. Some proposals are made to improve the robustness of the TM1 syntax to errors.

2 TM1 versus H.261

Comparing the error sensitivity of the syntaxes of H.261 and TM1, five important items can be distinguished:

- resynchronization
- error protection
- forced updating
- layered coding (error conceilment)
- picture slicing (error recovery)

In the next subsections, each of these items will be discussed.

2.1 Resynchronization

2.1.1 Resynchronization for H.261

If during decoding of an H.261 bitstream the decoder detects data corruption, then the decoder can search for the next start code and resume decoding the picture from that point. When no other errors occur afterwards, an H.261 decoder can always decode the rest of the bitstream. Only the contents of the frame memory may differ from the contents from the encoder frame memory, but by sophisticated error recovery and forced updating (see section 2.4) this can be kept to a minimum.

2.1.2 Resynchronization for TM1

If a bit error or ATM cell loss occurs during transmission of a TM1 bitstream, the same actions can be undertaken as for H.261. However, resynchronizing of the decoder may be much more difficult in two cases:

1. *The first startcode after the error or cell loss is an extension start code.* The extension start code is not unique; when during resynchronization an extension start code is found, at the decoder it is unknown whether this start code is part of the sequence header, the group-of-pictures header, or the picture header.

2. *A sequence header or a picture header is corrupted or lost.* In the TM1 syntax many bit fields are optional, depending on variables sent in the sequence and picture header. When one of these headers is corrupted, the decoder does not know which bit fields should be expected and will lose synchronization again very soon after having resynchronized. This process of resynchronizing and losing synchronization again will continue until a correct new picture or sequence header is decoded.

2.1.3 Improving resynchronization for TM1

The resynchronization of a TM1 decoder can be improved as follows:

1. Signal directly after each extension start code in which header the present extension start code was sent (see also paragraph 3);

2. - Transmit only one sequence header per connection, to reduce the chance of a corrupted sequence header;
   - When the sequence header is corrupted, the decoder signalles a New Sequenceheader Request by in-band signalling.

   For the picture header, possible solutions are sophisticated decoder handling (for example: use information from previous picture headers), use of the CLP-bit in case of transmission over ATM-networks and additional error protection for headers. Another possibility is fixing the parameters for specific applications. Further study is needed on that point.

2.2 Error Protection

For H.261, the coded video signal is protected against bit errors by a BCH(511,493) Forward Error Correction Code. The MPEG2 standard however will not include such a protection because it is aimed to be service and medium independent. How protection must take place for transmission of MPEG2 bitstreams depends on the type of network used. It also depends on the multiplexing structure: are separate audio and video bitstreams available or is one system multiplexed ISO 11172- like stream inputted to the network multiplexer? For narrow-band ISDN, the same FEC as for H.261 can be used when a separate video bitstream is available.

2.3 Forced Updating

For H.261 as well as for MPEG1, each macroblock must be intra-coded at least once per every 132 times it is transmitted (for MPEG1: in a P-picture). This is for control of accumulation of IDCT mismatch error, but it is also useful for error recovery from bit errors or ATM cell loss. So it is necessary that CCITT and MPEG consider a similar requirement for the new standard as well.

2.4 Layered coding (error conceilment)

At this moment, a lot of work is done on layered coding for TM1. In CCITT document AVC-287 the influence of ATM cell loss is described for a TM1 pure field based codec for two cases:

- only one layer;
- two layers: MPEG1 in the (guaranteed) base layer, MPEG2 in the upper layer.

With the same overall bitrate and error probability, the results of the two-layered coding appeared to be much better than the results of one-layered coding. So, layered coding can be very useful for transmission over ATM-networks when the base layer bitstream can be sent over a guaranteed channel.

2.5 Picture slicing (error recovery)

In H.261, the arrangement of GOBs in a picture is completely fixed. In TM1 however, the coding structure permits great flexibility in dividing a picture up into slices. Slices can be of different sizes within a picture, and the division in one picture need not be the same as in any other picture. The minimum number of slices in a picture is one, the maximum number is equal to the number of macroblocks.

This flexibility can possibly be used to make an improved error recovery possible. However, the possibility of very few slices per picture may be a disadvantage to error recovery. Therefore, it is worthwile to consider some bounds on the number of slices per picture. A starting point could be:

- The number of slices per picture must be greater or equal than the number of rows of macroblocks per picture.

3 Proposal

To make an improved resynchronization of a TM1 decoder possible, the following is proposed:

Add directly after each extension start code a field of two bits, signalling which extension start code is meant:

```
if (nextbits() == extension-start-code) {
  extension-start-code          32      bslbf
  extension-type                 2      uimsbf
```

extension-type - This is a two-bit integer defined in the following table.

binary value	extension type
00	sequence header
01	gop header
10	picture header
11	reserved

4 Conclusion

TM1 is compared with H.261 with respect to several techniques used to overcome error sensitivity. Several ideas on the use of the TM1-syntax for conversational services are given. A modification of the TM1 syntax is proposed, to make an improved resynchronization of the TM1 decoder possible.

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