CCITT SGXV
Working Party on Visual Telephony
Specialists Group on Coding for Visual Telephony

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Source: UK,I,F,FRG

Title: Buffer size for the nx384kB/s codecs.

1.Buffer size

Many factors influence the choice of buffer size for the 384kB/s codec. These include:-

i. The desire to smooth the data generated of the source coder over a sufficiently long period to take advantage of the average compression achievable over a period of time.

ii. A need to store the coded data for sufficient time to get a measure of picture activity while leaving sufficient room to introduce various coding functions (temporal subsampling, spatial subsampling, motion sensitivity adaption etc.) and stabilise the codecs closed loop path.

iii. The need for the buffer to contain sufficient data to allow the encoder to stop coding (eg. during periods of temporal subsampling) without buffer underflow occurring.

iv. The requirement to keep the delay of the codec as short as possible.

If we assume a channel rate of 320kB/s for video and a minimum frame frequency of 10Hz then the codec will stop from putting data in its buffer for two consecutive frames and requirement iii above demands:-

2/30 x 320000= 21.33kB ___A

Item ii above demands that we store a further average coded frames worth of data:-

1/30 x 320000= 10.66kB ____B

The encoder buffer must be prevented from under flowing at all times. If we consider the case when the buffer is nearly empty and a field blanking period occurs there must be sufficient data in the buffer to prevent under flow. Thus the amount of data required below buffer empty is:-

25 x 128 microsecs x 320kB/s = 1024B ___C

The minimum encoder buffer size is therefore:-

A+B+C = 33.68kB

In practice the encoder buffer will have to be larger than this because:-

i. There will be delay in the closed loop feed back path to the source coder making it impossible to invoke the coding modes instantaneously. Also it is fair to assume that some computations will be performed on the buffer state (possibly using a microprocessor) which will incur further delay.

ii.The calculation "B" above takes account of an average coded frame rather than a worst case coded frame.

Therefore a buffer size of 50kBits is recommended.

3. Decoder Buffer Control

Ref.1 describes the problems of decoder buffer control. It is proposed that the technique of an extended decoder buffer memory is used. This will assist in maintaining buffer tracking during transmmision errors a significantly simplify mulipoint switching arrangements.

It is also proposed that clock justification bits are not transmitted as the temporal conversion required to meet the intermediate standard effectively negates their usefulness. Buffer state should be transmitted as part of the video multiplex to aid with buffer tracking.

4. Codec Delay Calculations

If we assume that the source encoder introduces negligible delay as far as transmission is concerned (true for all codec structures proposed) the delay at the encoder will comprise of half of one field time (because of interlace removal) plus the delay in the encoder buffer:-

10mS + 40kB/320kB/s = 165ms ____E

The delay at the decoder will comprise the 30mS in the extended buffer plus the time taken for decoding plus the output standards conversion. If we assume decoding takes one frame and conversion from the intermediate format to the local display standard takes on average half a frame period the decoder delay will be:-

30mS + 30mS + 20mS = 80mS ____F

In pracice the decoder will require some further margins in terms of buffer size to allow for inaccuracies in delay adjustment. If we allow 15mS for this then the total codec delay becomes 260mS.

5. Summary of Proposals

i. The minimum encoder buffer state should be 50kBits.

ii. Clock justification should not be transmmitted.

iii. The minimum frame frequency at 384kB/s should be 10Hz.

iv. Buffer state should be transmitted in the video multiplex.

NB. From a hardware point of view the codec should be designed with a buffer capacity of 64kBits.

References:

1. "Practical problems of implementing a Conditional Replenishment video codec over an error prone channel" , M.D.Carr, J.P.Temime, C.S.K.Clapp and J.C.Jolivet. Paper presented at the International Conference on Electronic Image Processing, University of York, appendix of IEE conference pub. No 224, April 1982.