CCITT SGXV
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Specialists Group on Coding for Visual Telephony

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Title: **H.261 Buffer Specification**

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This is a discussion document which seeks to further clarify the concept established at the last meeting of the CCITT Experts Group.

To finalise the concept, a proposal is made for actual numerical values.

BACKGROUND

The Stuttgart meeting advanced the understanding of the buffer specification problem but did not manage to find agreed wording for inclusion in H.261.

Also, concerns were expressed about the means of ensuring that a coder conforms to the buffer specification while it is operating.

DISCUSSION

For a codec where all the buffering is after the coding loop, as is common in pipelined hardware coders, setting an upper limit on that buffer size will guarantee conformance. Of course a smaller buffer may be used in coders and this will not affect compatibility with decoders.

The formula derived in Stuttgart can be applied to coders where some or all of the buffering is before or inside the coding loop as typically occurs in DSP based coders. However, that formula must be evaluated several times to find the applicable value. Hence it is preferable that the coder can be constructed in such a way and with such parameters that conformance is guaranteed by design rather than by some monitoring function.

The Stuttgart formula is essentially a jitter specification. By setting the minimum number of bits to code a particular picture, taking account of history, it is actually specifying the maximum "phase advance" of the jitter.

A DSP implementation with a pre-coding buffer which grabs one input picture and then processes it will conform provided the Picture Start Code it sends to line and the Temporal Reference in it are obtained from that picture. That is, the encoder must not generate extra PSCs spontaneously. The reason is that such an encoder cannot get in advance since the input picture rate is limited. If fewer bits are needed to code a picture than the product of the the output bit-rate and the picture period then the coder must stuff until the next picture is available for coding. It is evident that for such a coder the minimum time spacing of PSCs on the channel can never be less than the picture period and no "phase advance" can occur.

If additional picture stores are provided before the source coder, then after coding a picture it is no longer necessary to wait for a picture to arrive at the coder input. A new image for processing can be taken immediately from store. Thus it becomes possible for the minimum time spacing for PSCs on the channel to become less than the picture period. Thus the encoder can introduce some "phase advance" each time a picture is coded with few enough bits. However the amount of such advance is limited because eventually all the stored pictures are used up, that is the precoding buffer becomes empty. This is just the same as a post-coding buffer emptying. So, by a designer limiting the number of pre-coding buffers it is possible to guarantee compliance in the same way as happens with post-coding buffers.

For a coder which employs both pre- and post-coding buffers it should be possible to ascertain the "phase advance" which each can introduce and add them together.

CONCLUSION

From the above it seems that is it possible to retain the hypothetical decoder and the resulting Stuttgart formula as the definitive method of specification yet design coders which do not have to continually check that they are abiding by it.

PROPOSAL

There remains the task of deciding what the limit of this "phase advance" should be. Probably some linkage to the value of 'p' will be needed. It should be noted that values of "phase advance" are quantised for pre-coding buffer coders. For example a coder operating at 10 Hz and with 1 queued picture in addition to the one being compressed cannot generate a phase advance of more than 100 milliseconds.

We propose that the buffer be specified such that the maximum time maximum remains the same at all bit-rates. We propose that this time be 4 CIF picture periods (133 milliseconds).

$$B = 4R/29.97$$

where B = buffer size of reference decoder
R = video bit-rate

NOTE on MAXIMUM NUMBER of BITS/PICTURE

The above has concerned pictures coded with fewer bits than the average. At the other extreme the maximum number of coded bits per picture is separately specified. As this limit is specified independently for each picture only one counter or timing function is necessary.

End