CCITT SGXV
Working Party XV/1
Specialists Group on
Coding for Visual Telephony

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Title: Buffer Specification

Source: UK, France, FRG, Italy, Netherlands, Norway, Sweden

This contribution presents our thoughts on the buffer specification.

BACKGROUND

The main reason for including buffering in the H.261 codec is that the rate of generation of bits by the coding kernel is not constant but is permitted to vary with the picture statistics. The benefit obtained is that bits saved on 'easy' parts of the sequence can be allotted to more difficult parts so that they can be better coded than if they were given the average rate. The network, however, transports the bits at a constant rate and therefore a smoothing action is required at the coder. Conversely, the decoder will utilise the received information at a non-constant rate when reconstructing the picture sequence and therefore also requires a buffer.

The result is that the picture rate on the transmission path has a long term average value with a close tolerance and related to CIF but measured over short time intervals can vary considerably. The size of the buffers at encoder and decoder is related to the permitted excursions about the mean. A specification is required so that the decoder buffer is sufficiently large to cope with the permitted excursions.

A previous solution, adopted for example in the H.120 codec, was to specify the size of the transmitter buffer which was situated between the coder and the transmission system. Because of the common architecture employed in all codecs conforming to that recommendation, the specification of transmitter buffer size automatically constrained the excursions that could be generated by the coder.

The H.261 specification will cover a wide range of bit-rates and may be implemented in various ways. Some architectures may have some or all of their buffering before the coder kernel. We have not found a simple way to relate the sizes of buffers in different places because they are separated by data compression of varying and undefined magnitude. Also, sources can be envisaged, such as test pattern generators, which have no visible buffer and therefore cannot be tested against a buffer size criterion.

PREVIOUS ATTEMPTS AT SPECIFICATION

The Oslo meeting agreed to place a limit on the maximum number of bits per coded picture. The possibility to have non-transmitted pictures is equivalent to a minimum number of bits per coded picture. However, these two parameters are not sufficient as they apply only to individual pictures. Buffering operates over more than one picture. Some form of memory of previous coding history must be incorporated.

Also at the Oslo meeting, document #485 from Japan addressed the topic and included two schemes for consideration:

1. To define the permitted limit of deviation from the constant picture reference timing.

2. To define the permitted limit of delay from the time that a picture is given to the source coder to the time that PSC of the coded picture is sent to the transmission line.

That contribution was useful in understanding the problem but neither suggestion is a complete answer. The first is analogous to a jitter specification. But how is the absolute timing reference derived?

The second method of specification does not cover the possibility of a source which generates PSCs which are not derived from input pictures, eg a test generator. Further, there are concerns in Europe that such a specification would be too restrictive. For example, consider that picture 'n' is coded in intra mode but takes 1 seconds worth of transmitted data. The coder should not be constrained to ensuring that the next coded picture is in the close vicinity of 'n+30' but allowed to be, say, 'n+10'.

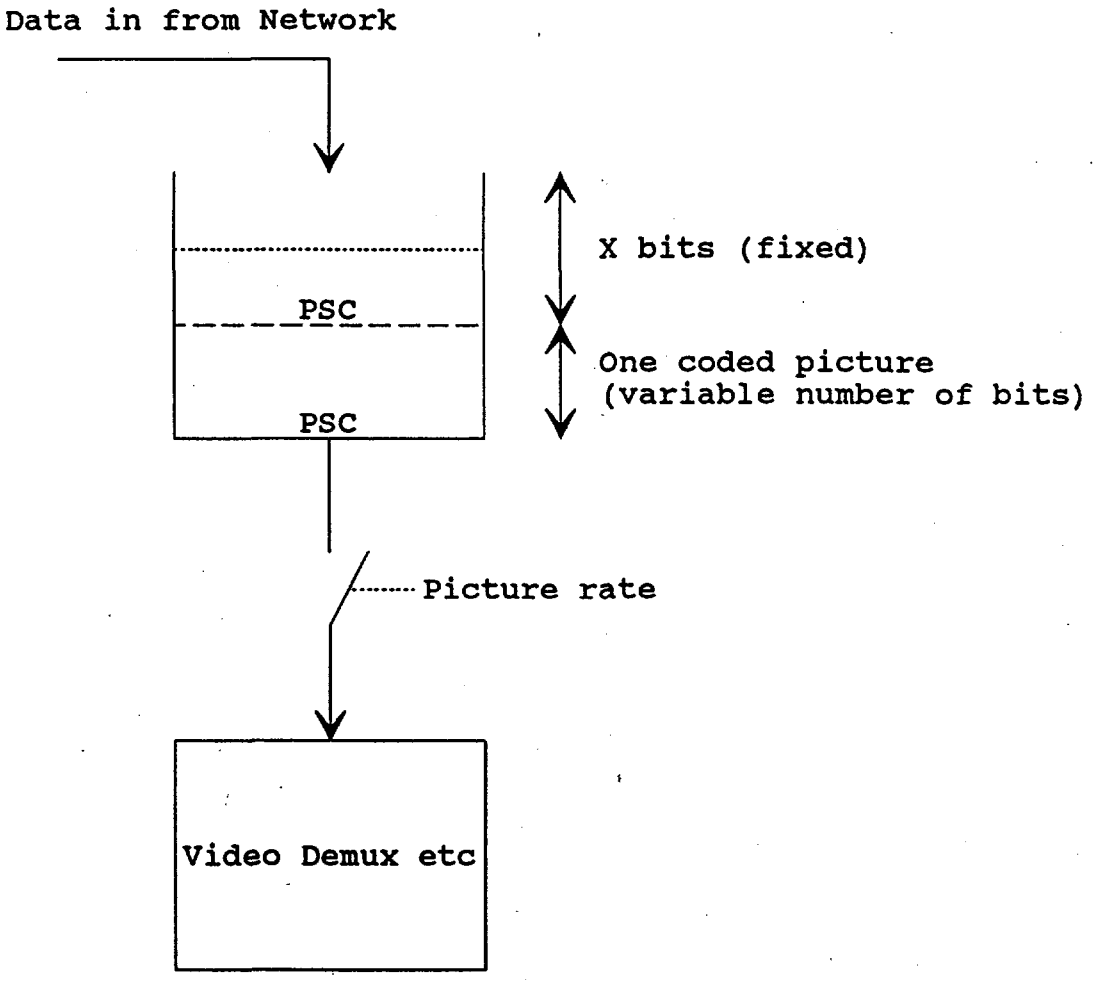
OUR THOUGHTS

After extensive discussions in Europe during which many ideas were investigated and rejected we now present the concept of a Reference Decoder. It must be emphasised that this Reference Decoder is merely for the purpose of ascertaining whether the coded bit-stream from any source complies with the specification. The Reference Decoder architecture is not required to be implemented or emulated in actual decoders.

The Reference Decoder is illustrated in the figure below and consists of an input buffer followed by the remainder of the decoder. The buffer is not of a fixed size but holds one coded picture plus X bits. All of the data for the coded picture at the output end of the buffer is removed instantaneously at the picture rate. This is the CIF rate of 29.97 Hz -50ppm or submultiples thereof if restrictions on maximum rates apply.

In line with the previous agreement, a CIF coded picture is not more than 256 Kbits and a QCIF one not more than 64 Kbit/s. Corresponding values of X are for discussion and may be related to the operating value of 'p' (p*64 kbit/s).

The coded data stream must not cause data loss by buffer overflow in this Reference Decoder. There are no restrictions on buffer underflow and actual decoders should take appropriate action.



REFERENCE DECODER