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

Doc. # 568
November 7, 1989

Subject: Error-Correction Re-Lock Time

Source: Bellcore, PictureTel, VideoTelecom

A specification for frame re-lock time has been proposed by BTRL. Briefly, it argues for a decoder design so that: 1) 3 consecutive error correction frame Barker sequences should be received before frame lock is declared; and 2) frame re-lock always be re-established within 23200 bits of a change of error correction framing phase (i.e., .5 sec at 46.4 Kbps).

In BTRL's document it is not clear what factors have gone into the choice of the above objectives ? Framing time, in general, is a function of the logic adopted to implement the synchronizer. Its stated objective should therefore be compared to, for example, a "reference synchronizer". Here, assuming the video data contains no emulation of framing sequence, we derive maximum framing time, T_{FR} (see Annex 1 for the case where video data may actually emulate framing pattern). This corresponds to reframing time when starting from the worst-case position (i.e., the searching starts in the bit position right after the framing bit). For a channel rate of R, and recognition of 3 framing pattern in a row, it can be shown that:

$$T_{FR} = 4 \times T_f$$

$$T_f = \frac{8 \times 512}{R}$$

For R=46.4 Kbps, T_{FR} becomes equal to 0.35 sec which is close to the 0.5 sec maximum framing time limit set by BTRL. Taking into account hardware complexity and system design issues, we feel specification of maximum framing time needs to be further studied.

In addition, a rule specifying number of framing pattern violations, should also be established before an out-of-frame is declared. This is to avoid reframing due to channel transmission error (see Annex II for further detail).

ANNEX I

Let us denote by p the probability of having a false framing. Because of the random nature of the video data, p can be set to 2^{-8} (assuming an 8-bit pattern is used). We can then write average hold frames, F_{avg} as:

$$F_{avg} = \sum_{n=1}^{n=\infty} n(1-p)p^n = \frac{p}{(1-p)}$$

In the worst case we should therefore have:

$$(511 \times F_{avg} + 3) \times T_{fr} = 440 \text{ msec}$$

ANNEX II

Let p_e be the probability of bit error on the channel. Framing violation will not happen, if the 8-bit framing pattern is correct with probability

$$p = (1 - p_e)^8$$

Similarly, the probability, q, of observing a framing violation becomes $1 - p$. For an N-violation rule (i.e., a rule that declares out-of-frame when N violations are observed), and by using a Markov chain, we can show that

$$F_{avg} = \frac{1 - q^N}{pq^N}$$

where F_{avg} denotes average number of frames before declaring an out-of-frame. Following table illustrates average number of frames until an out-of-frame is declared vs. p_e, and N.

N \ p_e	10^{-3}	10^{-4}	10^{-5}	10^{-6}
1	1.25×10^{2}	1.25×10^{3}	1.25×10^{4}	1.25×10^{5}
2	1.5860×10^{4}	1.5648×10^{6}	1.562734×10^{8}	1.562523×10^{10}
3	1.989596×10^{6}	1.956742×10^{9}	1.953486×10^{12}	1.953161×10^{15}