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Title : <u>Ones density problem for nx384 kbit/s codecs</u>

1 - INTRODUCTION

As it is pointed out in CCITT Rec. G703, in some networks (USA in particular), the digital bitstream should not contain bit sequences with more than 15 "zeros". In addition, there should be at least 3 "ones" every 24 digits, ie, a ones density of 12,5 %, as a minimum.

To fulfil these two conditions, if both are to be considered as necessary, and to minimize the compelxity in the codecs, the simplest solution seems to prevent transmission of all zero bytes. This solution is harder than the two conditions themselves but could be very simple in some applications (for example, in u-law PCM audio coding, the character 0000 0000 is forbidden).

2 - H 120 Codecs

This problem of successive zeros was already raised for the frame structure at 1544 kbit/s in H 120 codecs. The solution adopted, described in Rec. H 130, takes only into account the first condition about the maximum of 15 zeros sequences.

The method consists in :

- scrambling of the bitstream, except bit 193 of each frame (need for synchronisation) and bit 7 of TS odd (scrambling indicator), by blocks of two frames (385 bits = 2 x 193 - 1).

- deleting the too long remaining sequences of zeros (as any scrambler can't eliminate all these sequences) by inverting the 16th bit of a sequence, and sigalling it in the next bit 7 (TS 2 odd).

Some confusions will occur at the decoder side if in a block, sequences with 15 zeros and with 16 zeros are present at the same time. In that case, the decoder will generate errors similar to transmission errors. The probability of such an occurence being less than 10^{-7}, it is not considered as inconvenient for the picture quality.

3 - AT&T proposal

The solution proposed by AT&T in Doc.252/XV (introduced in october 87 Red Bank meeting, Okubo Group) consists in changing every all zero bytes in the nx384 kbit/s frame by bytes certainely different from zero. The method is based on the use of bits in the Application Channel indicating in which part of the frame (divided in blocks) some zero bytes were present. In short, the zero bytes are replaced by the address of the following zero byte in the block.

This solution presents many disadvantages :

i) It uses an important number of bits in the application channel, from 8 bits within 64 for 384 kbit/s rate up to 20 bits for the 4x384 kbit/rate, whatever the number of all zero bytes in the frame. In principle, the AC must be used for other purposes.

ii) additional delay : the coder has to set indicator bits in the application channel after the end of frame and the decoder has to wait for these indicator bits before restoring zero bytes. The sum of the delays is 10 ms minimum.

iii) addition of complexity in the codecs due to this algorithm is quite important as many test sequences have to be provided in both coder and decoder parts. In particular the conditions are different between TS1 (bytes reduced to 7 bits) and the other TSs.

iv) if a transmission error occurs on a coded byte (previously a zero byte) containing the address of the following coded byte, this error will spread over several bytes in the block.

v) if a terminal changes its mode in an unframed one, for example during a change of service, the algorithm doesn't apply any longer. More generally, the codecs are in that case quite dependent on application channel availability.

4 - Nx384 kbit/s frame

The video multiplex for the future Rec. H12X will have the following features, concerning possible problems with long series of zeros :

- transform coefficients :

. with a single-VLC, the maximum length is 16 bits beginning by 8 bits at zero. Two coefficients in succession can't give a serie of 16 bits at zero.

. with a VLC-2D, in the same manner, VLC words have maximum length of 14 bits with the same conclusion as before. For the FLC words (20 bits) beginning by escape code, inside a word as for two successive words, the maximum length of zeros is 12.

- picture headers, group of blocks headers, or block data headers : these headers can have a length greater than 64 bits, with no particular conditions avoiding series of zeros.

5 - **Possible solutions**

5.1. The AT&T proposal, capable of coding all the zero bytes in the stream, fulfils the conditions layed down by american networks. In case of an encrypted service, bit 8 of TS1, used for framing, scrambling indicators, must not be encrypted. But for the reasons introduced before, it is not very desirable to adopt such a solution.

5.2. An easier solution to implement is the H130 one consisting in coding long series of zeros in the bit stream itself. This solution needs some regular additional bits giving information that invertions were done. The reliability of codecs against transmission errors has to be known. The solution is independent on encryption.

5.3. Assuming that these is no encryption need, a solution could be found by avoiding long series of zeros in the video multiplex itself, by forcing regular "1" in the headers.

If encryption is used, series of zeros could appear at the encryption unit output.

5.4. The last solution is to use an external unit, inside the network only when a minimum ones density is required. This unit is independent on the service and can be used for any of them.

6 - **CONCLUSION**

Solutions 5.2 and 5.3. are some examples that seem easier to implement and could be acceptable for network requirements.

The problem of ones density for videoconference service depends on :

- needs for encryption
- acceptance of transmission errors.