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SOURCE : RTT Belgium
TITLE : ON BIT RATES IN A TWO-LAYER CODING SCHEME
PURPOSE : Information

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1. Introduction

The aim of this paper is to compare the efficiency of a 2-layer coding scheme with a 1-layer one devoted to distribution television applications. In this goal, some tests have been performed with the video-codec developed for the Belgian Broadband Experiment[1].

Two main factors create a loss of the efficiency of a 2-layer coding scheme :

- the first one is the efficiency loss of the VLC itself,
- the second one is the consequence of the poor prediction contained in the hybrid loop, only the low-accuracy layer is taken into account to refresh the loop memory.

This 2-layer scheme has been tried in two cases :

1. intra mode only,
2. inter/intra mode (without motion compensation);

The first case will determine the efficiency loss of the VLC whereas the second one will determine the efficiency loss of the complete coding scheme.

In order to compare bit rates of 1 and 2-layer schemes, the codec is used in VBR mode for each layer which has its own transmission factor (TxF). The transmission factor of the second layer is the one applied in the 1-layer scheme, so the picture quality is nearly the same in both cases.

2. Intra mode only

In this case no temporal prediction is performed, the efficiency loss of the coding scheme has to be found only in the VLC technique. Figures 1 and 2 present the 2-layer and 1-layer schemes.

Three sequences have been processed to cope with different complexity levels : "*Mobcal, Tempete, Interview*". The mean bit rate is computed on these three sequences.

TxF2 (transmission factor for layer 2 and for the 1-layer) is maintained constant at 20 in order to obtain a mean bit rate of 20 Mb/s for the 1-layer scheme. TxF1 varies in a range of 22 to 64. The quantization stepsize is expressed in terms of $2^{\frac{TxF}{16}}$, so adding 16 to the transmission factor corresponds to remove one LSB in the quantizer.

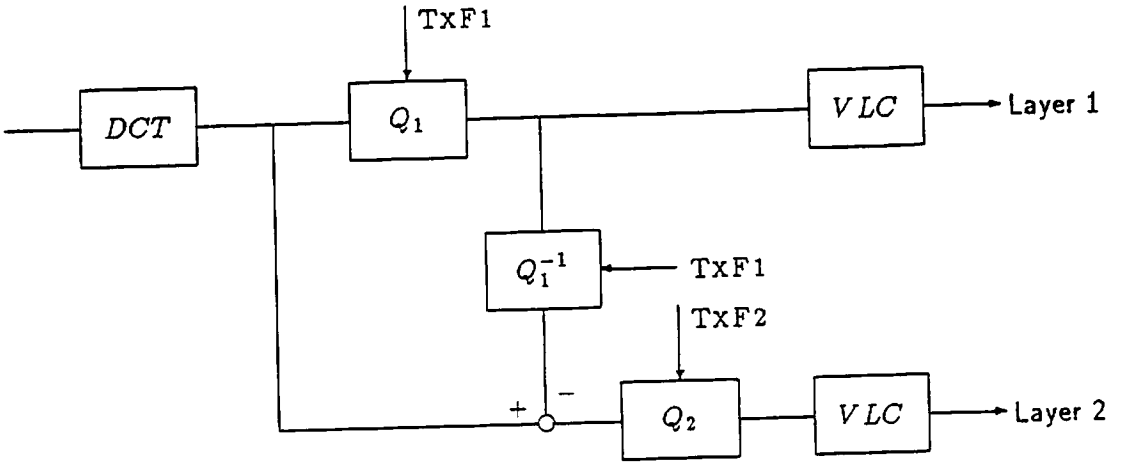

Figure 1 : 2-layer scheme : mode intra

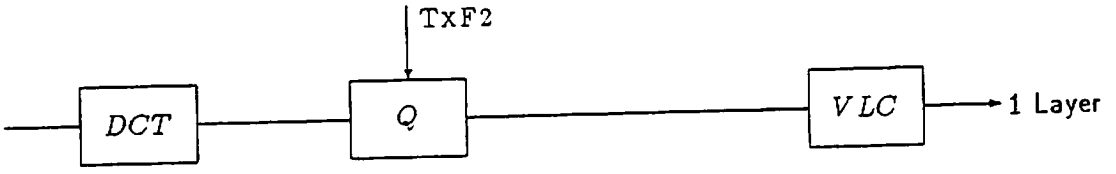

Figure 2 : 1-layer scheme : mode intra

It has appeared that the most important parameter is the difference between TxF1 and TxF2 but not TxF1 or TxF2 themselves. The results depicted at the figure 3 present the bit rate overhead (in %) as a function of "Delta TxF", where :

$$overhead = \frac{(Layer1 + Layer2) - (1Layer)}{(1Layer)}$$

$$Delta\ TxF = TxF1 - TxF2$$

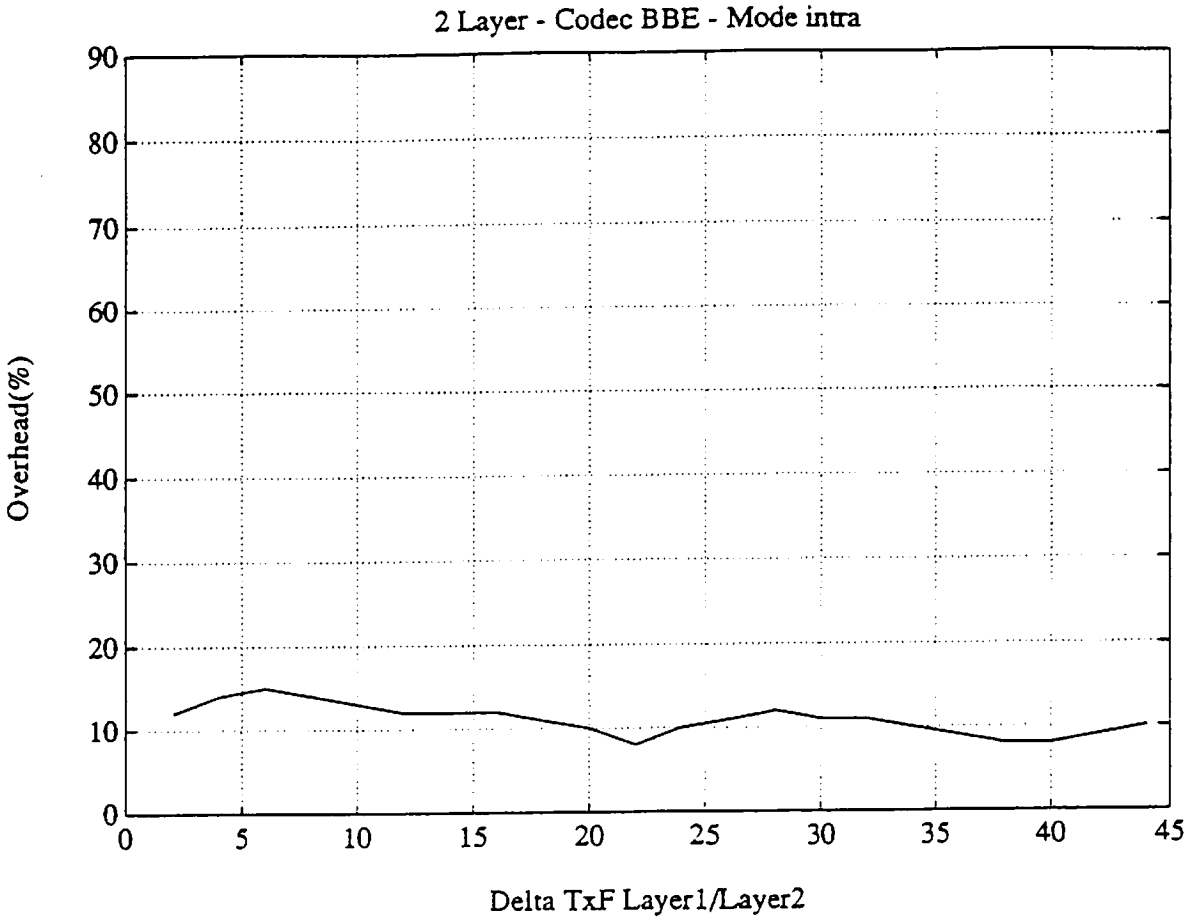

Figure 3 : Overhead of a 2-layer scheme : mode intra

This figure 3 presents the mean value computed on the three sequences. Results obtained sequence by sequence show that the relative overhead is quite independent of the picture complexity.

It is important to recall that the U-VLC does not provide any overhead if we transmit in the second layer one, two or more LSB of each coefficient. This advantage is due to the fact that the U-VLC works at the bit level and not at the coefficient one [2.] [3.].

3. Inter/intra mode

In this case the efficiency loss has two origins : the efficiency loss of the VLC itself but also the repercussion of the low-accuracy in the loop memory; that provides a poorer prediction.

Figures 4 and 5 present the 2-layer and 1-layer schemes. TxF2 is maintained constant at 20 (it corresponds to a mean bit rate of 13 Mb/s for the 1-layer scheme). TxF1 varies in a range of 22 to 64.

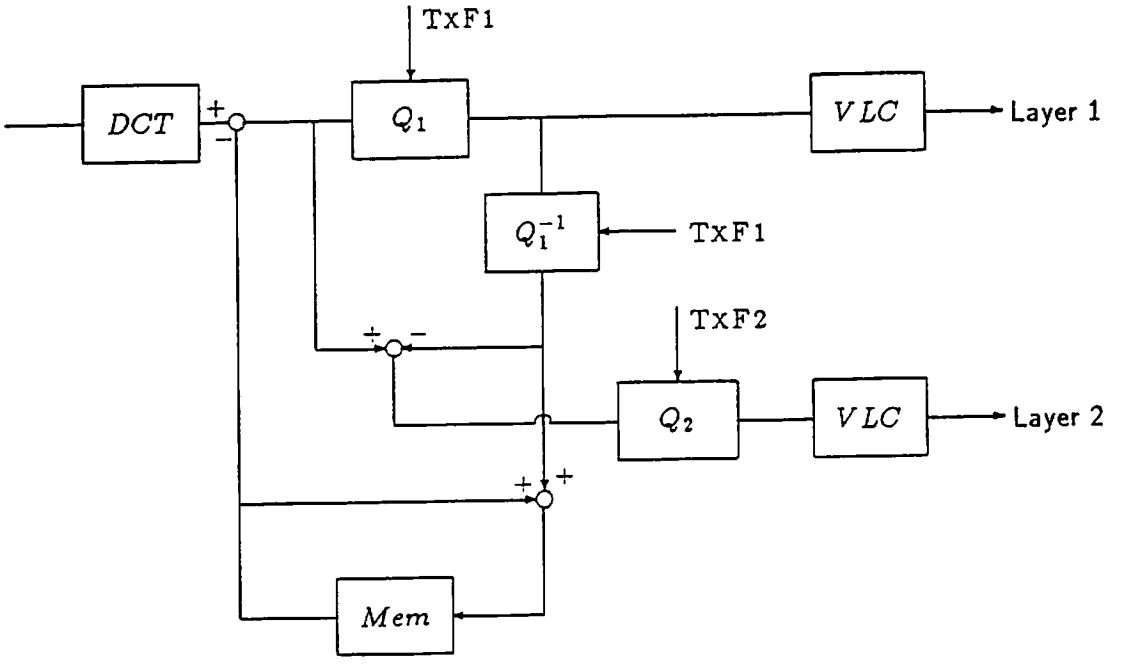

Figure 4 : 2-layer scheme : mode inter/intra (without MC)

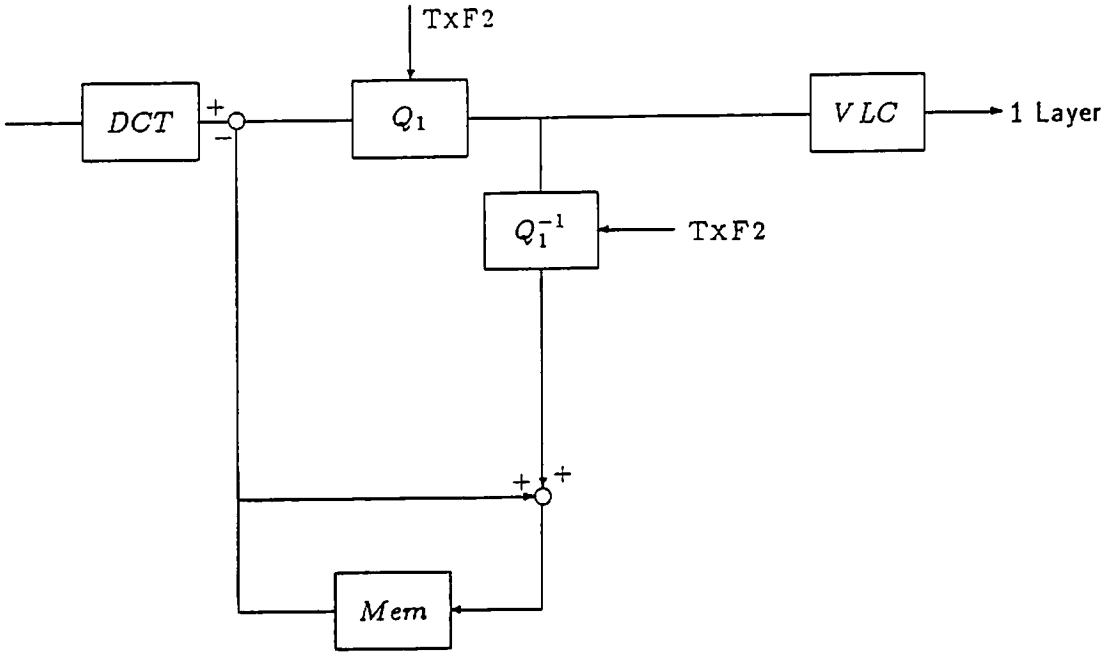

Figure 5 : 1-layer scheme : mode inter/intra (without MC)

The results depicted at the figure 6 present again the bit rate overhead (in %) as a function of "Delta TxF".

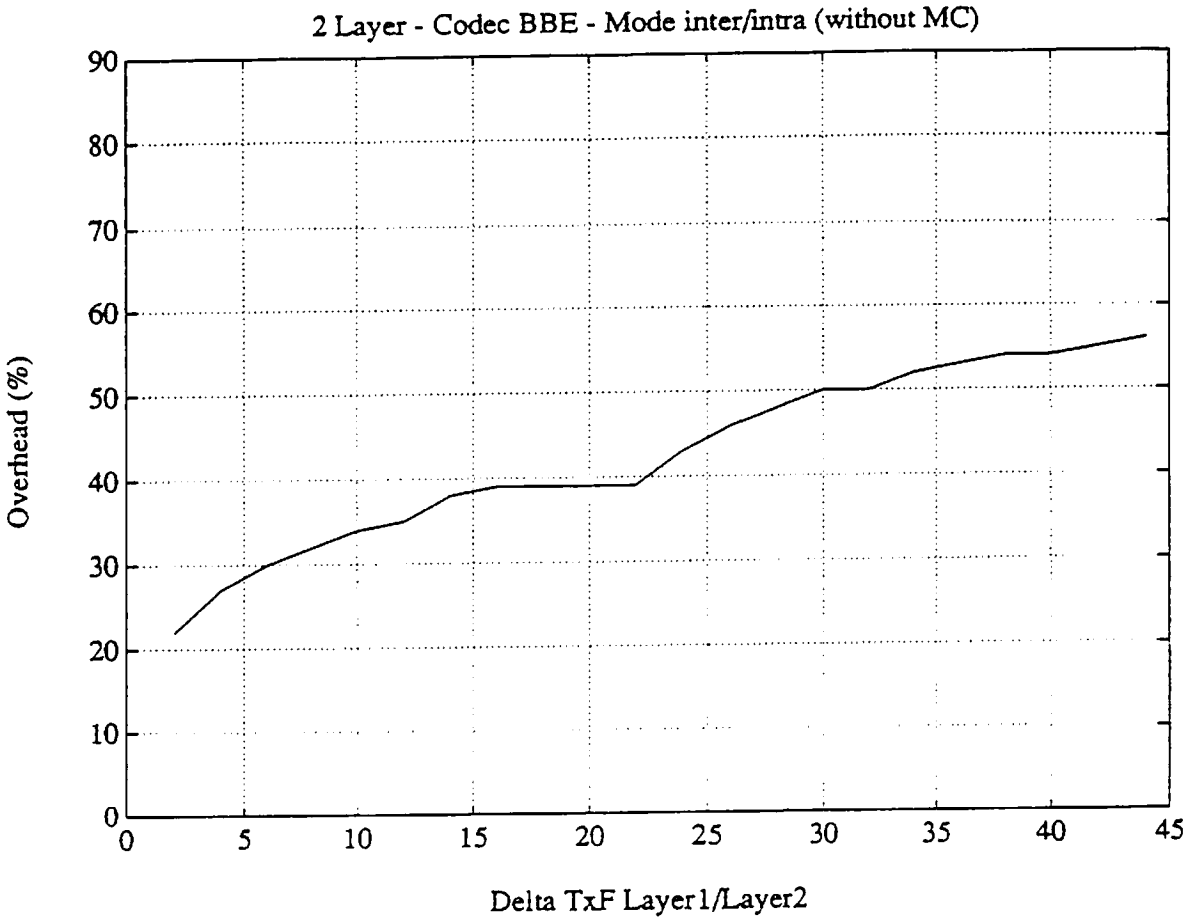

Figure 6 : Overhead of a 2-layer scheme : mode inter/intra

4. Conclusions

Those results show the important impact of a low accuracy prediction on the coding efficiency. The increase of bit rate of such a 2-layer scheme can reach 50 %, in other words several Mb/s when distribution television applications are concerned.

References

[1.]RTT Belgium "Video Codec Developped in the Belgian Broadband Experiment" - *Document AVC 19.*

[2.]RTT Belgium "U-VLC : Universal variable length coder" - *ETSI/NA3.1 doc(90)/29.*

[3.]B. Macq "An Universal Entropy Coder for Transform or Hybrid Coding" - *PCS, session 12.1, March 1990, Boston, USA.*