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TITLE : Video Codec Developped in the Belgian Broadband Experiment
PURPOSE : Discussion

1. Introduction

This document will describe the scheme of the video codec developed in the framework of the Belgian Broadband Expriment (BBE). BBE is a pilot ATM B-ISDN network experiment financially supported by the Belgian PTT (RTT Belgium).

This video codec has to be universal and to cope with both interactive and distributive videoservices in both ATM and STM environments. This codec has two working modes : variable bit rate mode (VBR) and adjustable fixed bit rate mode (AFBR).

2. Description of the codec

The general architecture of this codec is presented at the figure 1 [ref 1].

The input interface block decodes the CCIR 656 signal and merges the two fields to compose a pseudo-progressive frame on which the DCT transform is applied with 8 × 8 blocks.

Working in a VBR environment, this codec does not require motion compensation since very good quality can be achieved at the expense of higher peak bit rate when needed, during critical scenes. Indeed, intra-frame / inter-frame coding gives dramatic bit rate reduction. This fact implies that the DCT transform is located outside the loop.

The DCT transform coefficients are passed to a flexible processor (FXP) [ref 2] which implements a linear adaptative quantization with weighting. The computation of the quantization stepsize takes into account :

- on a stripe basis, the selected quality level, the buffer occupancy;
- on a block basis, the block criticality;
- on a coefficient basis, the perceptual weighting function.

The criticality computation is performed in the transform domain; four criticality classes are so defined . The frame memory for the temporal prediction in the transform domain is fed through a dedicated controller.

The quantized coefficients are thereafter entropy coded by the U-VLC *"universal variable length coder"* [ref 3] . The U-VLC is able to code optimally various kinds of sequences at various quality levels since it is fully self-adaptative and therefore is convenient for both distributive and interactive videoservices; it has to be efficient in a broad range of bit rate.

All bit rate at the VLC output is accumulated into a buffer; its size is 1.5 Mbit. The regulation mechanism [ref 4] aims to monitor both AFBR and VBR working modes. The buffer regulation is performed by a feedback loop which samples the level of buffer occupancy at the end of each stripe and computes an actualized value of the transmission factor to be applied in the quantizer.

In an ATM B-ISDN environment, the packetizer/multiplexer (PKX) implements the ATM Adaptation Layer (AAL) [ref 5] in order to guarantee an end to end user QOS of two hours error free against cell losses and bit errors and to guarantee a resynchronization of the decoder to the encoder clock.

Further functions located in the Terminal Communication Module (TCM) are intrinsically relevant to the ATM network physical layer, e.g. the header processing and line termination.

3. VLSI Implementation

The BBE video codec VLSI implementation is based on several ASICs, one for each function described hereabove plus memory chips, and will lead to a one board reversible encoding/decoding system.

4. Performances

The performances obtained with this video codec range among the following bit rates :

- 30-35 Mb/s for contribution
- 15-20 Mb/s for distribution
- 2- 5 Mb/s for high quality videotelephony

Some results will be shown on a D1 tape.

5. Conclusions

The state of the art BBE video codec has been presented in this document capable to cope with a broad range of videoservices applications both distributive and interactive in both ATM and STM environments.

References

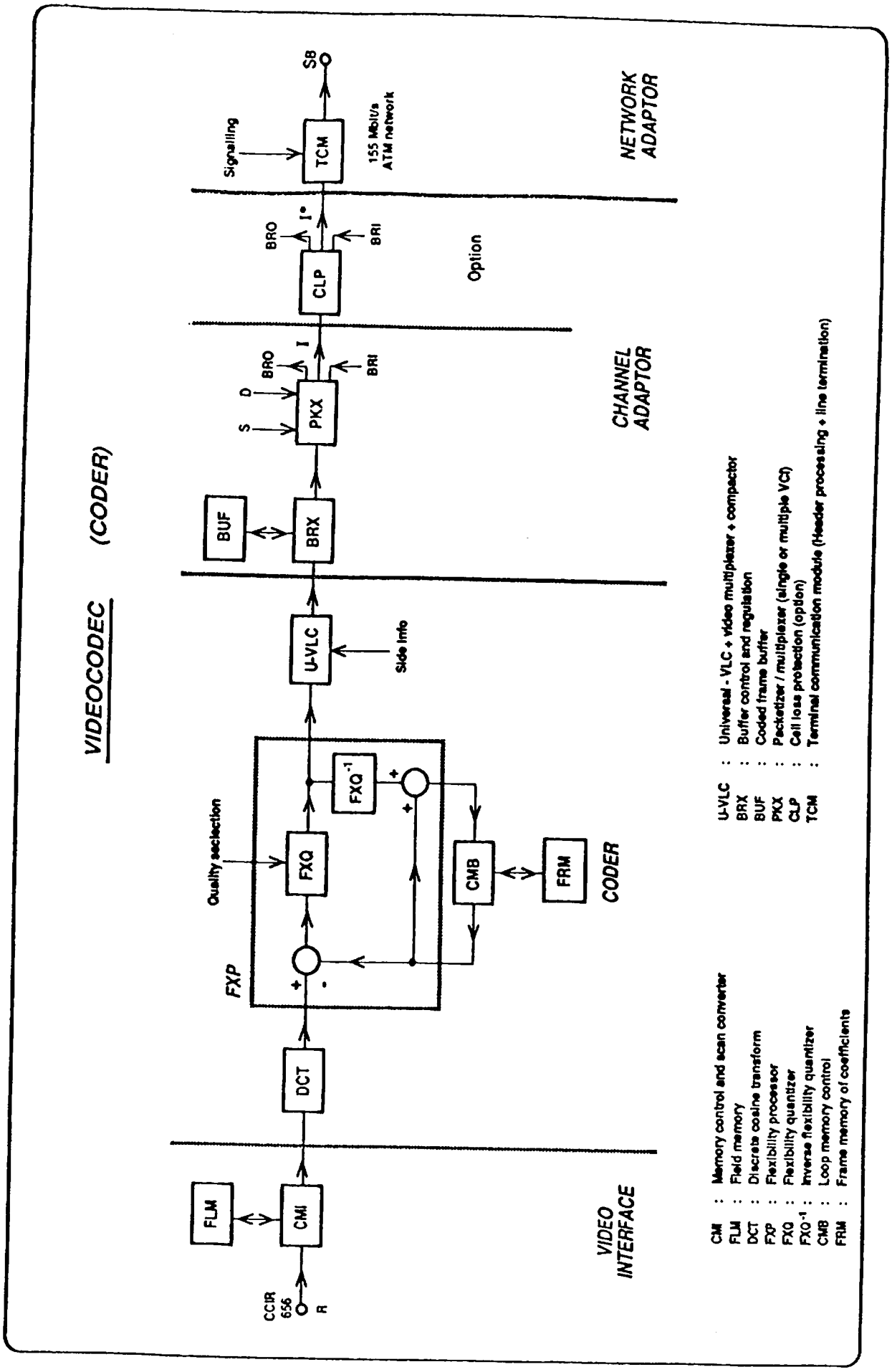
[1] S. D'Agostino "Universal Videocodec in the ATM Belgian Broadband Experiment" - *Third International Workshop on Packet Video, session E5, March 1990, Morristown, NJ, USA.*

[2] O. Poncin "Quantization Algorithm for Universal Videocodec in the ATM Belgian Broadband Experiment" - *Third International Workshop on Packet Video, session C9, March 1990, Morristown, NJ, USA.*

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

[4] J.-P. Leduc "Buffer Regulation for Universal Videocodec in the ATM Belgian Broadband Experiment" - *Third International Workshop on Packet Video, session C10, March 1990, Morristown, NJ, USA.*

[5] S. D'Agostino "ATM Adaptation Layer for real-time videoservices" - *CCITT COM XVIII, draft rec. I362/I363 Geneva, May 1990.*


VIDEOCODEC (CODER)
CCIR 656
R
FLM
CMI
DCT
FXP
Quality selection
FXQ
FXQ-1
CMB
FRM
CODER
U-VLC
Side info
BUF
BRX
S
D
PKX
I
BRO
BRI
CLP
I*
Option
Signalling
TCM
SB
155 Mbit/s ATM network
VIDEO INTERFACE
CHANNEL ADAPTOR
NETWORK ADAPTOR
CMI : Memory control and scan converter
FLM : Field memory
DCT : Discrete cosine transform
FXP : Flexibility processor
FXQ : Flexibility quantizer
FXQ-1 : Inverse flexibility quantizer
CMB : Loop memory control
FRM : Frame memory of coefficients
U-VLC : Universal - VLC + video multiplexer + compactor
BRX : Buffer control and regulation
BUF : Coded frame buffer
PKX : Packetizer / multiplexer (single or multiple VC)
CLP : Cell loss protection (option)
TCM : Terminal communication module (Header processing + line termination)

-Figure 1-