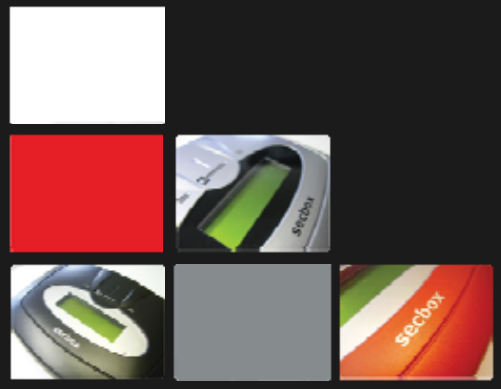
NAVAYO

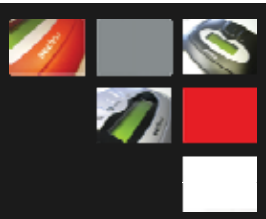
TECHNOLOGIES

SecVid MPEG-4 coding implementation



Laszlo Felfoldi

Secure Video Phone System

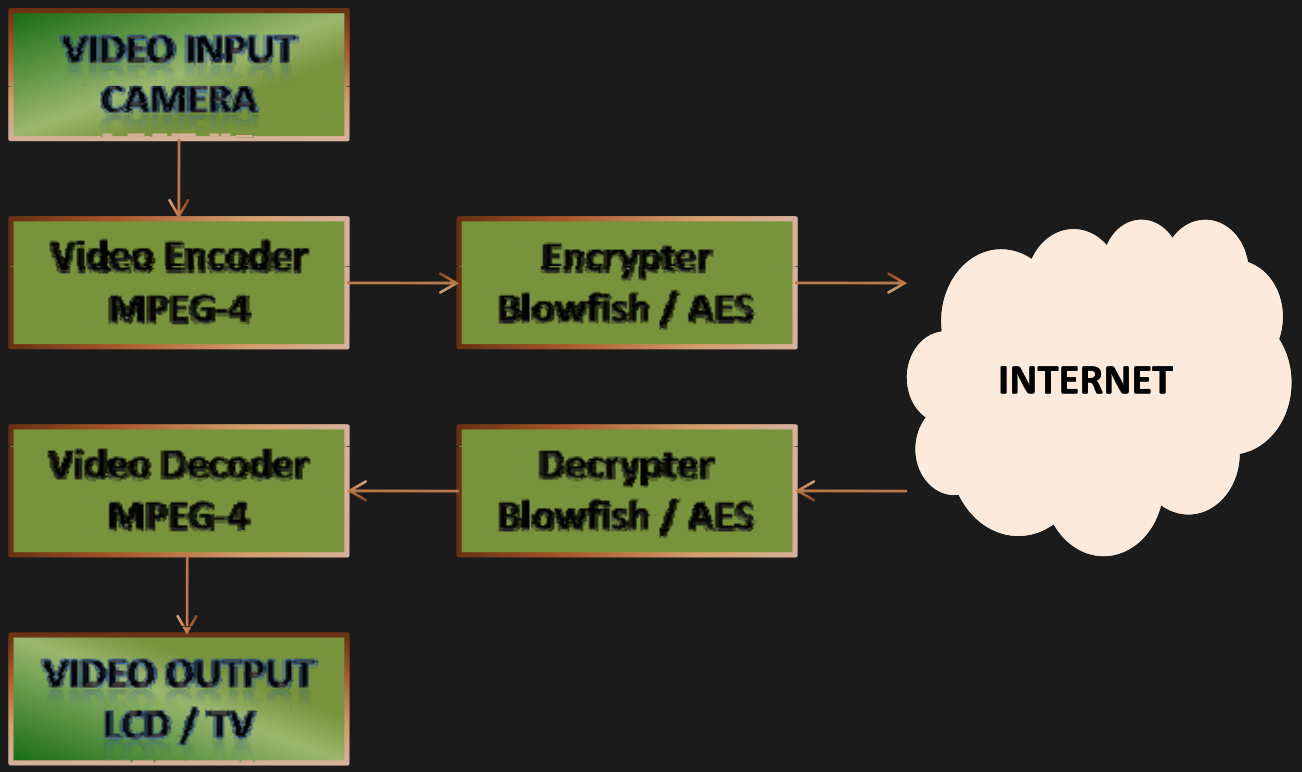


Features of the SecVid secure video phone system:

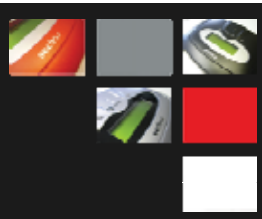
- **Records video input**
- **Encodes the video input using MPEG-4 coding**
- **Encrypts the coded MPEG stream (EAS / Blowfish)**
- **Sends the encrypted data to the receiver**

- **Receives the encrypted data from the other party**
- **Decrypts the data received**
- **Decodes the decrypted video stream**
- **Displays the decoded video**

SecVid video system architecture

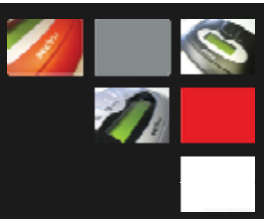


Alchemy Au1200



- **MIPS32 CPU core**
- **Camera Interface Module (CIM)**
  - Can connect CMOS or CCD sensors
  - Bayern RGB or CCIR 656
- **Integrated LCD controller**
  - Drives industry standard grayscale or color panels
  - Spatio-temporal dithering for STN panels
  - 4 overlay window with double buffering, alpha blending and optional 256 entry color palette
- **AES**
- **Media Accelerator Engine (MAE)**

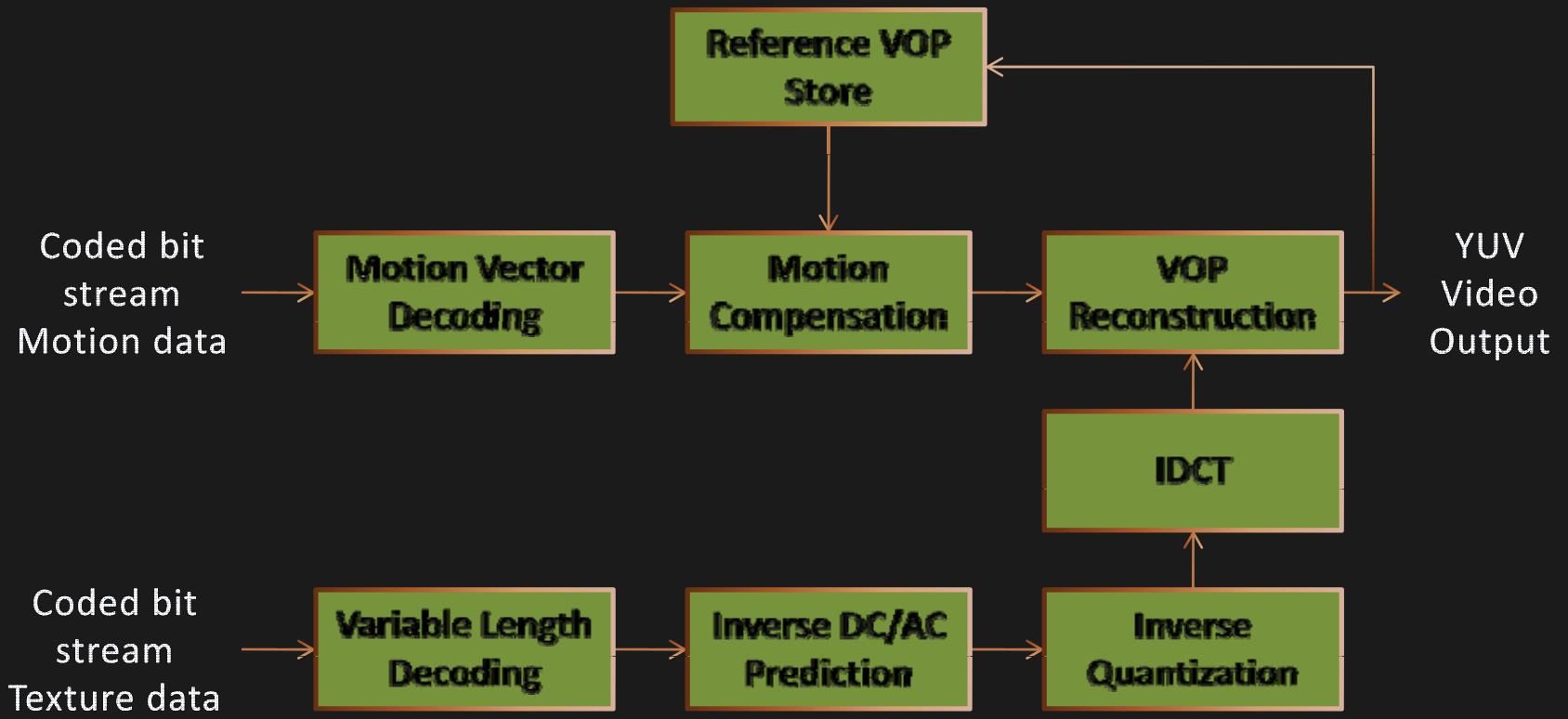
MPEG-4 decoding



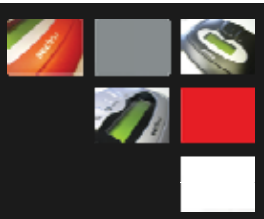
MPEG-4 decoding created YUV frames from the video stream:

- The video stream is parsed and decoded into motion and texture sub-streams
- Using the motion vectors of the macroblocks the corresponding regions of the reference page are copied into the actual frame
- Texture sub-stream holds the data that describes the whole macroblock completely (I frames), or compensates the pixel differences of the moved macroblock (P and B frames)

MPEG-4 decoding



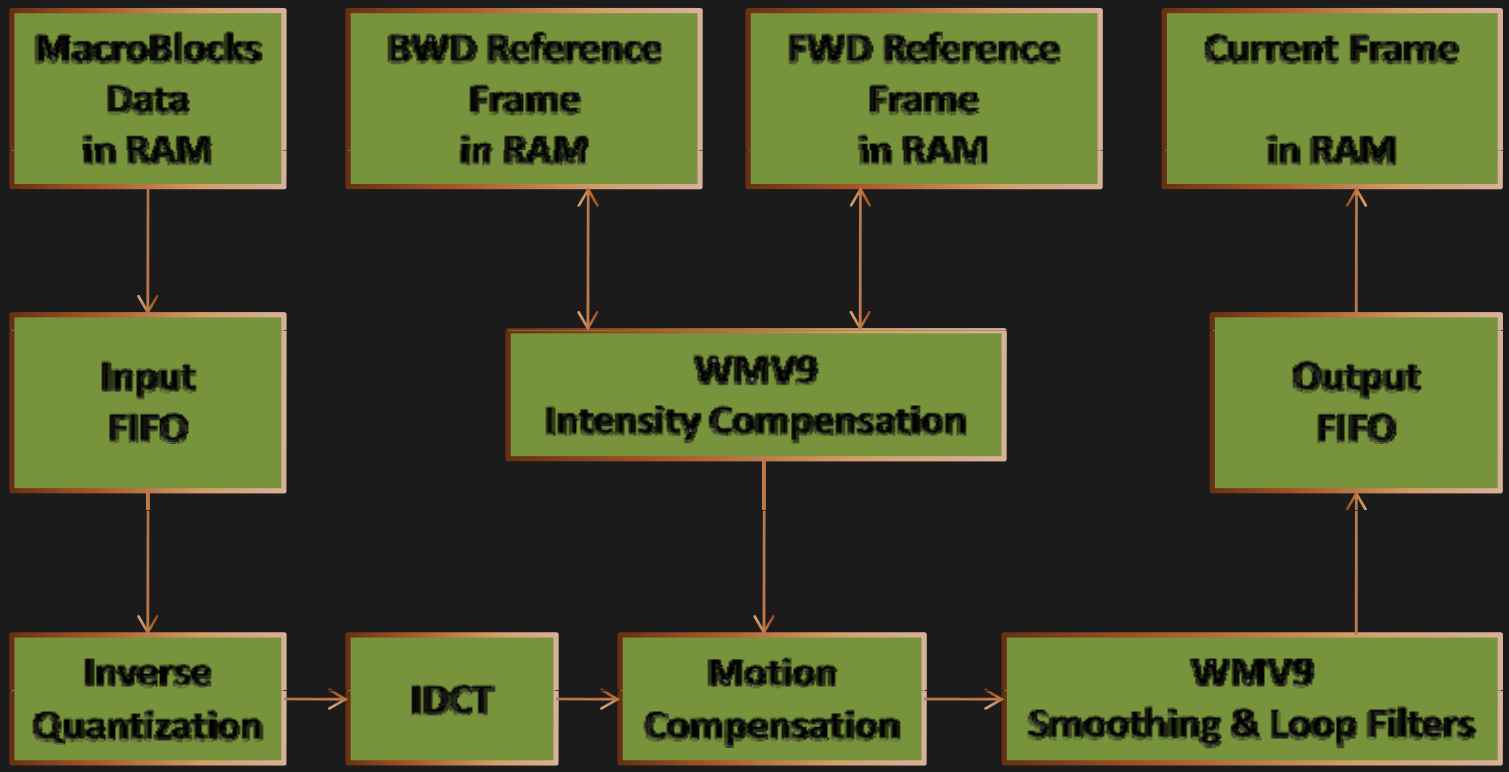
Au1200 MAE decoding features



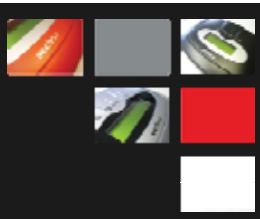
- **Au1200 Front End Features**
  - Supports up to 720 x 480 / 30 fps MPEG4 decoding
  - Flexible inverse discrete cosine transformation (iDCT)
  - Motion compensation for P and B frames
  - Supports 1, 2, and 4 motion vectors
  - Supports interlaced decoding (field prediction)
  - Full, half and quarter pel motion compensation
  - WMV9 overlap smoothing and in-loop deblocking

- **Au1200 Back End features**
  - Color space converter (YUV <-> RGB)
  - Frame buffer filtering / scaling

Au1200 Front End decoding features



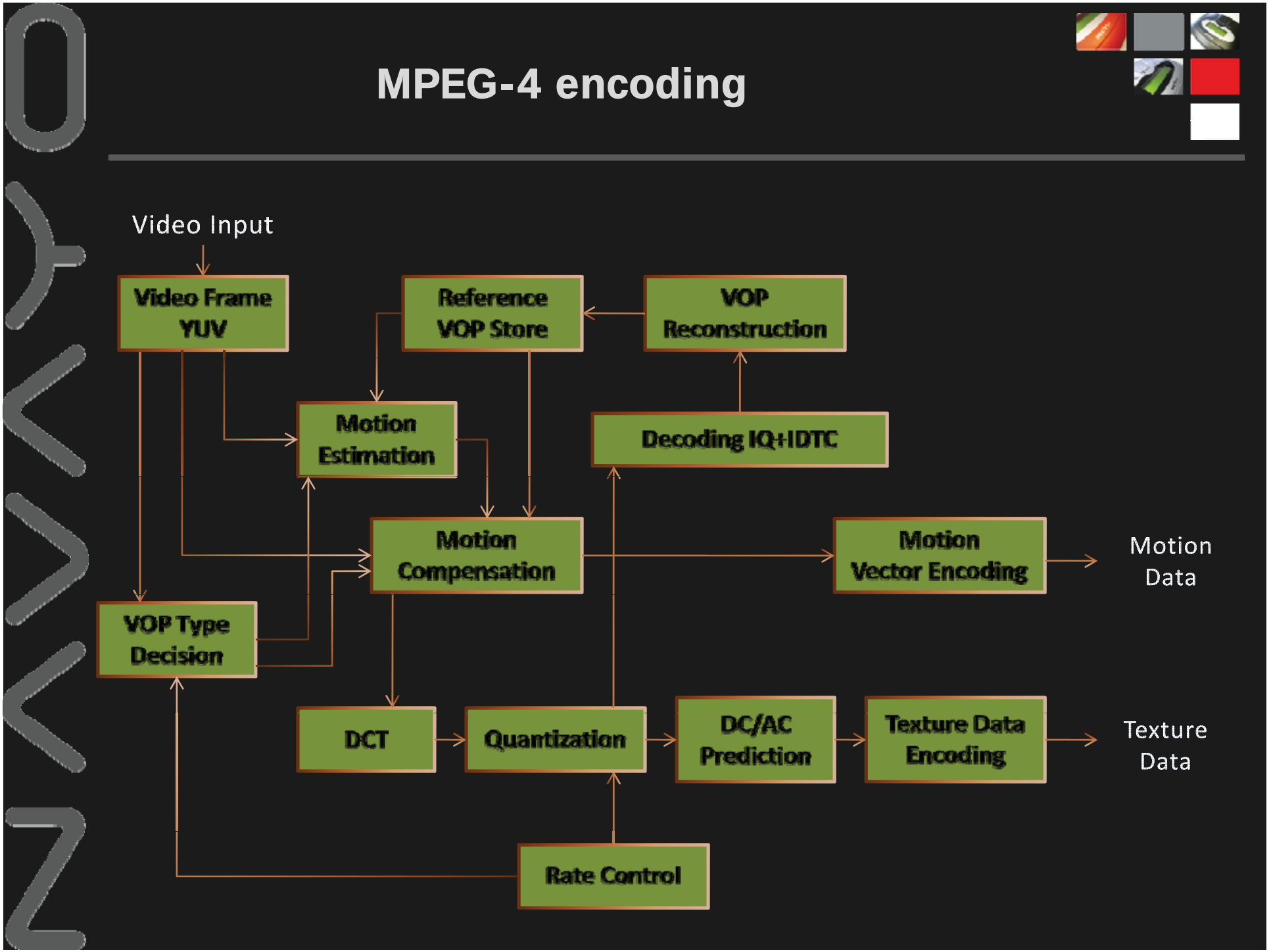
MPEG-4 encoding



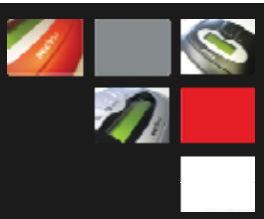
MPEG-4 encoding creates the video stream form the video input stored in YUV format:

- The first step is to decide the frame type (I or P)
- For P frames the motion vectors should be computed
- Motion Compensation step calculates the differences between the current and reference plane
- DCT step transforms these values into frequency domain, quantization removes the coefficients with lower importance
- The quantized values are scanned in a special order and coded with VLE and Huffman encoding
- Compressing rate can be controlled by configuring quantization or frame type decision

MPEG-4 encoding



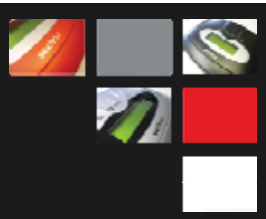
MPEG-4 Encoding implementation



- **Motion estimation**
  - Diamond searching [1]
  - Fast three-step searching [2]
  - Adaptive rood pattern searching [3]
  - SAD (Sum of Absolute Differences) value calculation
  - Half pixel Motion vector estimation [4]

- **DCT and Quantization**
  - Prediction of not coded block from SAD values
  - Last position of non-zero coefficient
  - Multiplications instead of division

MPEG-4 Encoding implementation



- **Bitstream creation**
  - Using stored last positon of non-zero coefficient
- **Architecture level optimizations**
  - Using MAE Front-end iDCT and inverse Quantization
  - Reducing function all overhead
  - Bit-stream packing

References

[1] S. Zhu and K-K Ma. A new diamond search algorithm for fast block-matching motion estimation. IEEE Trans. Image Process., 9 (2) : 287-290, February 2000.

[2] B. Zeng, R. Li and M. L. Liou. A new three-step search algorithm for fast block-matching motion estimation. IEEE Trans. Circuits Syst. Video Technol., 3 (4) : 438-443, August 1994.

[3] Y. Nie and K-K Ma. A new three-step search algorithm for fast block-matching motion estimation. IEEE Trans. Image Process., 11 (12) : 1442-1448, December 2002.

[4] Pssbk Gupta and Ramkishor Korada. Mpeg-4 Video Encoder On Adi Blackfin Dsp For Digital Imaging Applications