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Title: **PROPERTIES OF DCT BASED HYBRID CODER**

In this document we mention some desirable properties of a standardized coding algorithm. We also describe how some of the parameters of a DCT based algorithm can be chosen to meet these requirements. Certainly, some of the properties are automatically met by any kind of coding algorithm.

(1) Possibility to decode different bit rates, up to a certain limit.
(2) Possibility to use different spatial resolutions.
(3) Possibility to use different frame rates (i.e. 30, 15, 10, 7.5 ... Hz).
(4) Possibility to adapt coding algorithm from frame to frame and block to block.
(5) Low bit rate for chrominance.

1. Compatibility between bit rates.

An important requirement of the coding algorithm is that it is common for different bit rates. This implies that a low rate coder can easily speek directly to a high rate decoder. The low bit rate DCT coder (64 kbit/s) must be designed with a large block size (16×16) to decrease the number of overhead bits (see block budget). For higher bit rates the block size is more a question of hardware complexity and picture quality. The 16×16 transform requires more operation per second than the 8×8 transform. We believe there are more possibilities left to improve picture quality with 16×16. To allow for compatibility with very low bit rates, using the same common intermediate format, we propose the use of 16×16 block for the DCT. Hardware considerations are not taken into account.
Although nothing is yet said about transmission of motion field, it is worth considering block matching with one fixed motion vector for each block. The same arguments as for the DCT then also hold for the motion compensation block size. Furthermore, there are several arguments to motivate the same block size for DCT and motion compensation.

Block budget (no of blocks per second)

	5 Hz	7.5 Hz	10 Hz	15 Hz
8×8	12 060	18 090	24 120	36 150
16×16	2 970	4 455	5 940	8 910

2. Different spatial resolutions.

A DCT based coder can use a spatial resolution which is different from the decoder as long as the block size is scaled in such a way that it represents the same physical size. In other words, the number of blocks in the picture must be constant. An example: A 64 kbit/s coder with resolution 180×144 uses 8×8 DCT blocks. The bit stream from such a coder can be decoded as 16×16 blocks in a 360×288 picture if the high "missing" frequency components are set to zero.

3. Variable frame rate.

A possibility that is easily implemented in any kind of coding algorithm is to use a special word, in combination with a frame synchronization word, indicating the time duration of the frame. The time duration can be 1, 2, 3, ... 8 x $\frac{1}{30}$ s. If motion compensation is used, the decoder may or may not utilize the transmitted motion field also for motion compensated interpolation between frames.

4. Adaptive coding algorithm.

To cope with different kind of pictures (still pictures, normally moving pictures, scene changes) it is advantageous to be able to switch between different coding modes. These are intra-frame coding, inter-frame coding and inter-frame coding with motion compensation. For still pictures and scene changes it is wasteful to transmit bits for the non-existing motion field, while for moving pictures it is very advantageous to transmit bits for motion. For still pictures it is unnecessary to allow for intra-frame coding, and for scene changes, only intra-frame coding should be used. For moving pictures it may be worth using side information to indicate whether intra- or inter-frame coding is used. To save bits, we propose the use of side information on frame basis to indicate to the decoder whether to expect side information for each block about motion field and/or intra/inter-frame coding.

5. Chrominance.

Hardware is simplified if the same coding algorithm is used on chrominance as on luminance. Experience has shown that chrominance can be efficiently coded (requiring 5-20 percent of the bit rate) if its spatial resolution is half that of the luminance (180×144) and coded with the same scheme as the luminance (same DCT, quantizer, varialbe length code etc.). Simulations have shown that special motion estimation on chrominance does not improve picture quality (the side information does not pay). On the other hand, the motion field from the luminance improves the prediction also on chrominance, and therefore the motion field should be common for both luminance and chrominance.