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Title: Core Experiment on Compatibility
Purpose: Proposal

This document proposes a method of modifying simulation model 3 to produce a first test model for MPEG-2 which maintains compatibility with MPEG-1. The way in which this is achieved is by the incorporation of a compatible prediction mode.

1. Suggestion for test model 0

1.1. The concept of compatible coding

The concept of compatible coding is to have a single bitstream from which a limited capability decoder can decode low resolution images, such as SIF, and from which an enhanced decoder can decode high resolution images. There are many implementations, ranging from simulcast to extension of the MPEG-1 syntax.

This document assumes that compatibility is achieved by multiplexing two independent bitstreams using the MPEG system multiplex. One of these satisfies the MPEG-1 syntax and represents a low resolution image sequence, the other represents an enhanced resolution image sequence. This document suggests ways in which the picture data obtained by decoding the MPEG-1 bitstream can be used to reduce the bit rate needed by the other bitstream to represent enhanced resolution images.

1.2. Incorporation of a compatible prediction mode into SM3

This section suggests how SM3 can be extended for the compatible coding of higher resolution images.

Coding is performed on CCIR601 resolution images reduced to 4:2:0 format. Pictures are coded all at once, that is, ignoring the interlace. They consist of 36 slices of 44 macroblocks at 25Hz or 30 slices of 44 macroblocks at 30Hz. Macroblocks consist of 4 8x8 luminance blocks and 2 8x8 chrominance blocks.

Compatibility is introduced by including new macroblock types which define prediction from MPEG-1. To implement this mode, the up-sampling of MPEG-1 decoded images must be standardized; this could be done by the up-sampling algorithm described in section 3.1.3, 'Conversion of SIFs to CCIR601 formats', of SM3. When this mode is chosen for a macroblock, the prediction is taken from the macroblock, co-sited both spatially and temporally, in the up-sampled MPEG-1 image.

For the intra-coded pictures (I-pictures) the macroblock type table is extended as follows.

VLC code	macroblock_quant	macroblock_motion forward	macroblock_motion backward	macroblock_pattern	macroblock_intra	macroblock_mpeg1
001	0	0	0	0	0	1
0001	1	0	0	0	0	1

For the predictive-coded pictures (P-pictures) the macroblock type table is extended as follows.

VLC code	macroblock_quant	macroblock_motion_forward	macroblock_motion_backward	macroblock_pattern	macroblock_intra	macroblock_mpeg1
0000001	0	0	0	0	0	1
00000001	1	0	0	0	0	1

For the bidirectionally predictive-coded pictures (B-pictures) the macroblock type table is extended as follows.

VLC code	macroblock_quant	macroblock_motion_forward	macroblock_motion_backward	macroblock_pattern	macroblock_intra	macroblock_mpeg1
0000001	0	0	0	0	0	1
00000001	1	0	0	0	0	1

The coefficients of the new macroblock types are coded exactly as the coefficients of intra macroblock types.

The macroblock type selection is a simple extension of SM3. The MPEG-1 prediction mode is compared with the other prediction modes of section 6.4.1. The best prediction mode is then compared against intra (section 6.4.2).

1.3. Multiplexing
The MPEG-1 and enhanced bitstreams are multiplexed using the MPEG system multiplex. They are multiplexed as independent video streams. Consequently, the bitstream appears as a standard MPEG-1 bitstream to a standard MPEG-1 decoder.

2. CORE experiment

2.1. Simulcast vs Compatibility
This is to compare the performance of the model when at the encoder the macroblock types for prediction from MPEG-1 are enabled or not. This is to investigate the effect of MPEG-1 prediction macroblock types on the performance of the model.

The model is run in the following modes at the following bit rates.

	MPEG-1 Prediction	MPEG-2 Bit rate Mbits/s	MPEG-1 Bit rate Mbits/s
Compatible	allowed	2.85	1.15
Simulcast	not allowed	2.85	1.15
Compatible	allowed	7.85	1.15
Simulcast	not allowed	7.85	1.15

The up-sampling of MPEG-1 decoded images for prediction referenced above is a simplified method: it does not produce temporally correct output pictures. This could effect the picture quality of the enhanced pictures. As part of the CORE experiment the performance of various up-conversion schemes will be evaluated.

The down-sampling performed to generate the SIF for coding by the MPEG-1 algorithm could be improved to provide better prediction for the enhanced coding. This too should form part of the CORE experiment.

3. Improved Performance

The performance in the compatible mode may be further enhanced by the use of other techniques, such as applying motion compensation to the MPEG-1 prediction. This would be work for future core experiments.