

CCITT SGXV
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Experts Group for ATM Video Coding
(Rapporteur's Group on part of Q.3/XV)

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Title: Demonstration of TV and Interlaced SIF compatibility
Purpose: Information

1. Introduction

There is a requirement that MPEG-2 shall support HDTV/TV compatibility. The difference between this compatibility requirement and previous compatibility experiments is that interlaced picture formats are present in both layers. This document demonstrates that the compatibility extensions provided by the MPEG-2 syntax can support compatible coding with interlaced pictures in all the layers. Two layer coding is shown, although there is no reason why more layers can not be used. The higher layer is TV, while the lower layer is interlaced SIF (ISIF): 352x144 fields at 50Hz.

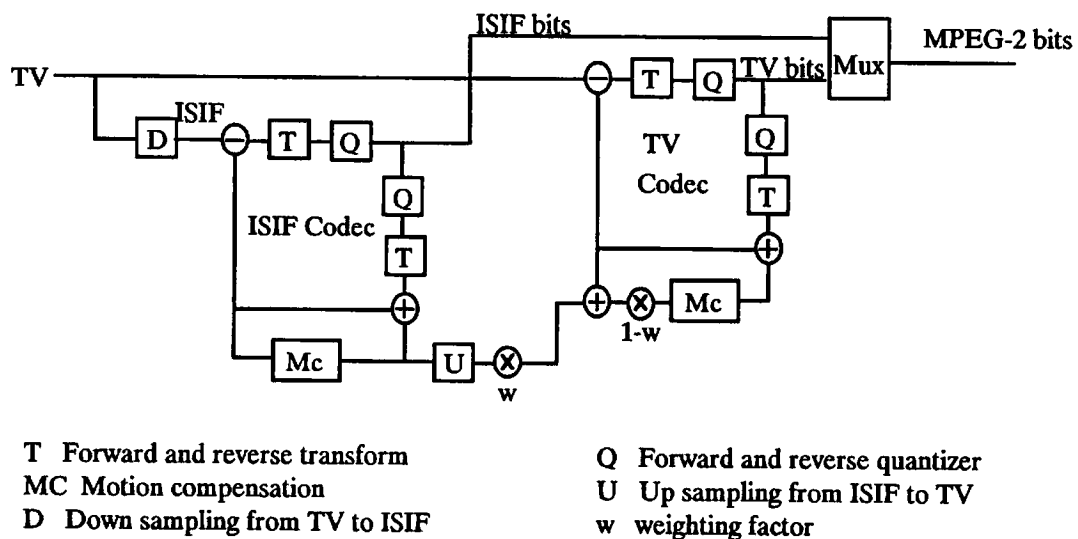


Figure 1. MPEG-2 TV/ISIF compatible encoder.

2. Compatibility

Compatible coding is achieved by the use of layered coding. Figure 1 shows an encoder for TV with embedded ISIF. The ISIF codec processes images that have been down-sampled from TV. This down-sampling process is not subject to standardisation and can be simple or complex.

The TV codec processes the TV images. This part of the coding can utilise a prediction from the locally decoded pictures of the ISIF codec after suitable up-sampling. The up-sampling process is subject to standardisation and is still under study.

The corresponding decoder is shown in figure 2. It should be noted that many of the functions for the ISIF coder/decoder and TV coder/decoder are the same. Hence additional hardware is not needed for these functions provided a 25% increase in throughput can be achieved.

3. Interlace to Interlace Down and Up Conversion

Standards conversion between TV and ISIF requires horizontal and vertical-temporal sample rate changing. For horizontal sample rate conversion, a horizontal filter such as those described in Test Model 3, section 3.3, can be used. For the vertical sample rate conversion, a vertical-temporal filter is required to give good motion performance and vertical resolution.

In these experiments, good quality down conversion was achieved using non-adaptive filtering with a three field aperture. Up-sampling to provide prediction for the upper layer was performed using a simple one field aperture. These pictures are also shown on the demonstration tape, although better pictures could be produced for display purposes by using a three field aperture. The use of the one field aperture simplifies the implementation of the coding loop.

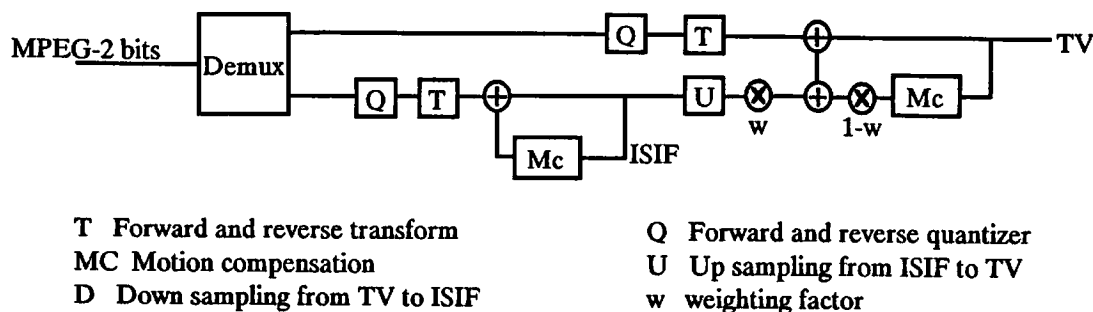


Figure 2. MPEG-2 TV/ISIF compatible decoder.

4. Encoder Parameters

The encoder is Test Model 3, with $M=3$ and $N=12$, using frame/field adaptive prediction and compatible prediction from the locally decoded ISIF resolution pictures. The syntax for compatibility used the proposal of MPEG92/651 from the London MPEG meeting. This involves indicating, at the sequence layer, the macroblock tables to be used. This greatly simplifies the syntax at the macroblock layer.

For the frame/field prediction, the motion estimation is done on the source pictures to half pel accuracy (these were then refined in the coding loop by ± 1.5 pels). The compatible prediction uses the spatio-temporal weighting technique. Table 1 gives the weightings and the fixed length codes used to represent them.

Code	Field 1		Field 2	
	ISIF	TV	ISIF	TV
00	1.0	0.0	0.0	1.0
01	0.0	1.0	1.0	0.0
10	0.5	0.5	0.5	0.5
11	1.0	0.0	1.0	0.0

Table 1. Spatio-temporal weightings.

The decision to use compatible coding is made on a macroblock basis. The weightings of table 1 apply to predicted macroblocks. In the intra picture only two modes are allowed: pure compatible or pure intra.

5. Simulation

The source interlaced TV sequences were down-converted from CCIR recommendation 601 resolution to ISIF (352x144 fields at 50Hz). These ISIF pictures were then coded at 1.5Mbit/s using Test Model 2 with frame/field adaptive prediction. The resulting coded pictures were up-sampled back to TV resolution and used as the compatible prediction when coding the source TV pictures at 2.5Mbit/s using Test Model 2 with frame/field adaptive prediction and compatible prediction.

These two-layered coded TV pictures were also compared with single-layered coded TV pictures. The TV pictures were coded according to the simulcast concept: single-layered coding at 2.5Mbit/s. They were also coded incompatibly, that is, with all the bits allocated to the TV layer.

The following source sequence was used: Mobile and Calendar.

6. Results

The results are summarised below..

It can be seen that the two-layered scheme achieves better performance than the simulcast scheme.

Item	All	Intra	Predicted	Interpolated
Number of pictures	124	11	31	82
SNR for Y	26.80	26.65	26.73	26.85
SNR for U	32.51	32.72	32.24	32.59
SNR for V	33.54	33.82	33.26	33.60
Mean value of QP	18.00	14.06	14.04	20.03

Table 2. TM2 statistics for simulcast coding of Calendar. Average bit rate 2.5Mbit/s.

Item	All	Intra	Predicted	Interpolated
Number of pictures	124	11	31	82
SNR for Y	27.39	27.61	27.42	27.36
SNR for U	32.74	32.83	32.61	32.77
SNR for V	33.77	33.91	33.65	33.79
Mean value of QP	14.86	9.32	11.88	16.73

Table 3. TM2 statistics for compatible coding of Calendar. Average bit rate 2.5Mbit/s.

Item	All	Intra	Predicted	Interpolated
Number of pictures	124	11	31	82
SNR for Y	29.06	29.46	29.25	28.93
SNR for U	34.31	34.73	34.13	34.32
SNR for V	35.40	35.88	35.22	35.40
Mean value of QP	10.81	8.47	8.46	12.01

Table 4. TM2 statistics for incompatible coding of Calendar. Average bit rate 4.0Mbit/s.

7. Conclusion

It has been shown that the Test Model 3 provides the possibility of compatible coding with interlaced pictures in the lowest layer .

It has been shown that the simplified compatible syntax, proposed to MPEG in November in MPEG92/651, is valid.

It was shown that the two-layered scheme achieves better performance than the simulcast scheme.