CCITT SGXV
Working Party XV/1
Experts Group for ATM Video Coding

Source: **UK**
Title: **TM2 Compatibility Experiments**
Purpose: **Information**

Introduction

A layered coding approach has been taken to achieve compatible coding, each layer providing a specific picture resolution. A two-layer encoder and decoder are shown in figures 1 and 2. The base layer is MPEG-1 coding SIF resolution pictures. The top layer is MPEG-2 coding 601 resolution pictures.

In the experiments the coding has been restricted to two layers and the base layer is an MPEG-1 coder. However the coding scheme is flexible. There are several options:

1. The base layer could be MPEG-2 coding TV interlaced pictures. The second layer could then be HDTV interlace. Thus providing TV/HDTV compatibility.
2. Further layers can be added if required e.g. SIF, 601, and HDTV.
3. The coding in the base layer could be H.261.

Furthermore a layered coding algorithm provides cell loss resilience in an ATM environment (the base layer can be sent as high priority and the second or subsequent layers can be sent with lower priority).

Similarly a layered coding scheme can provide graceful degradation.

Compatible Experiment

This section describes an initial experiment to compare the performance of two-layered compatible coding and simulcast using TM2.

The compatible coding scheme is a two-layered coding scheme. The base layer codes SIF resolution pictures using MPEG-1 at a bit rate of 1.5Mbits/s. The second layer codes the CCIR601 pictures with the remaining bit rate of 2.5Mbits/s and selects the compatible prediction whenever it is best to do so.

The simulcast method codes the CCIR601 pictures with 2.5Mbits/s (assuming 1.5Mbits/s is used to code SIF pictures) with no compatible prediction.

There then follows an experiment in which the compatible prediction is made by an average of the mpeg-1 prediction and the normal prediction. In the case of intra_compatible macroblocks there is no averaging only straight prediction from mpeg-1.

Encoder Description

The encoder is TM2 with the following prediction modes only:
- Frame/Field adaptive
- Compatible prediction from the MPEG-1 locally decoded pictures.

For the compatible prediction the decision basis is on a 16*8 block as described in appendix G.1 of the TM. There is a two bit code at the end of the macroblock type to indicate whether field 1 or field 2 or both or none have been coded compatibly . The rate control used steps 1 to 3.

For the new compatible prediction method the syntax and decisions remain the same. Only the compatible predictions are redefined.

Results

Four simulations have been performed on Mobile and Calendar:

Table 1 - 4Mbits/s Incompatible coding,
Table 2 - 2.5Mbits/s Simulcast coding,
Table 3 - 4Mbits/s Compatible coding (1.5Mbits SIF + 2.5Mbits CCIR601),
Table 4 - 4Mbits/s Compatible coding (1.5Mbits SIF + 2.5Mbits CCIR601) with new compatible
prediction mode.

Conclusion

A layered coding scheme provides more flexibility to meet the varied requirements of MPEG-2.

It has been shown that the use of a base layer prediction in a two-layer coding scheme can improve the SNR picture quality over the simulcast approach. The new compatible prediction mode gives subjectively better pictures and warrants further study.
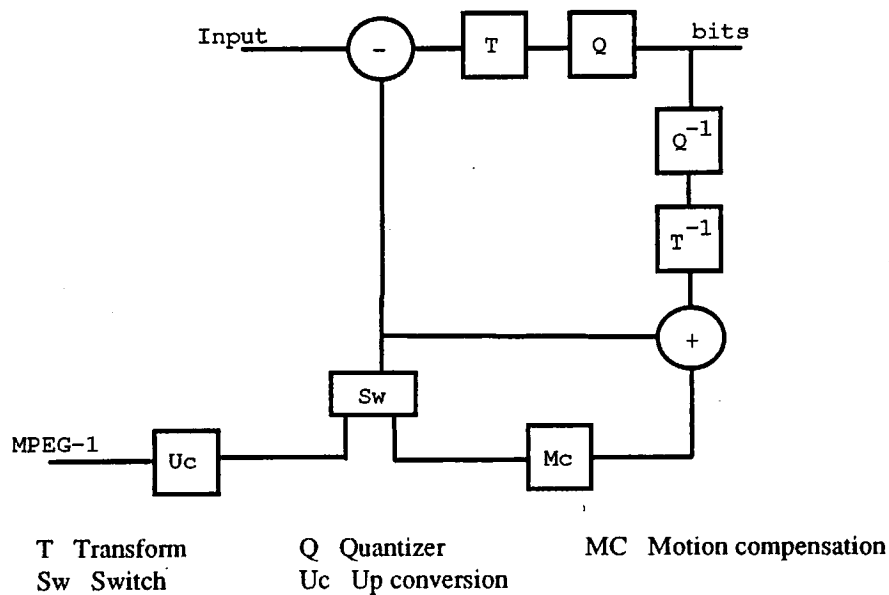

T   Transform   Q   Quantizer   MC   Motion compensation
Sw Switch   Uc Up conversion

Figure 1: MPEG-2 Encoder with prediction from a lower layer.

MPEG-2 bits ──[Q^{-1}]──[T^{-1}]──(+)──────────── 601

S
w ── Mc

Uc

MPEG-1 bits ──[Q^{-1}]──[T^{-1}]──(+)──────── SIF

Mc

T Transform   Q Quantizer   MC Motion compensation
Sw Switch   Uc Up conversion
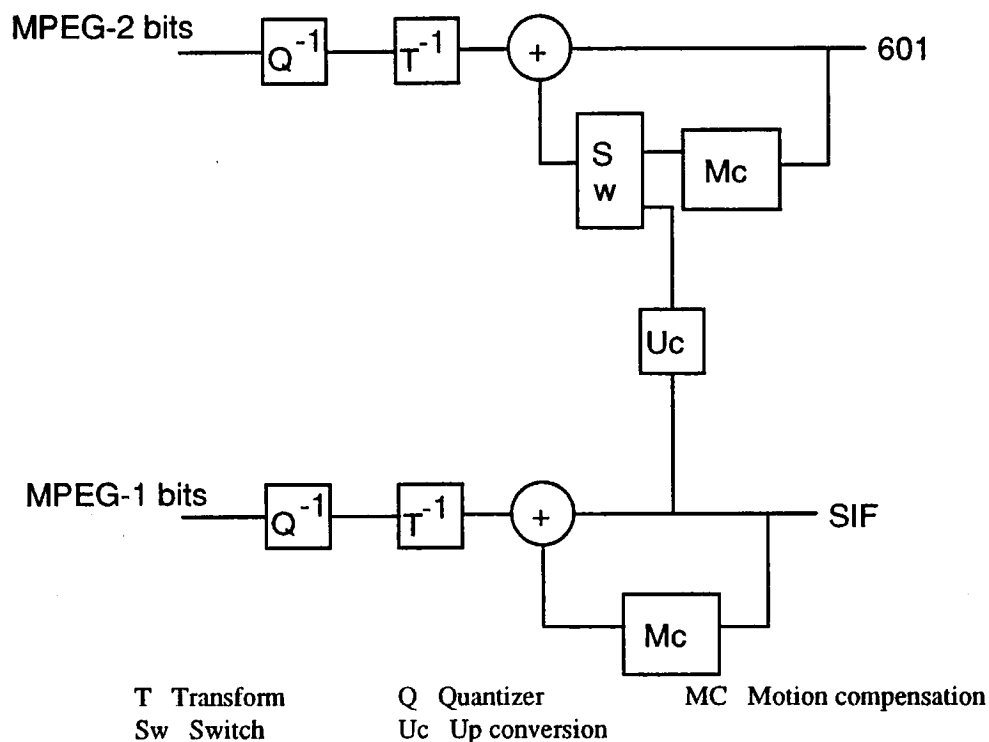
Figure 2: MPEG-2 Decoder with prediction from a lower layer.

Input ──(−)──[T]──[Q]── bits

Q^{-1}

T^{-1}

(+)

Sw

(+)   Mc

MPEG-1 ──[Uc]

T Transform   Q Quantizer   MC Motion compensation
Sw Switch   Uc Up conversion
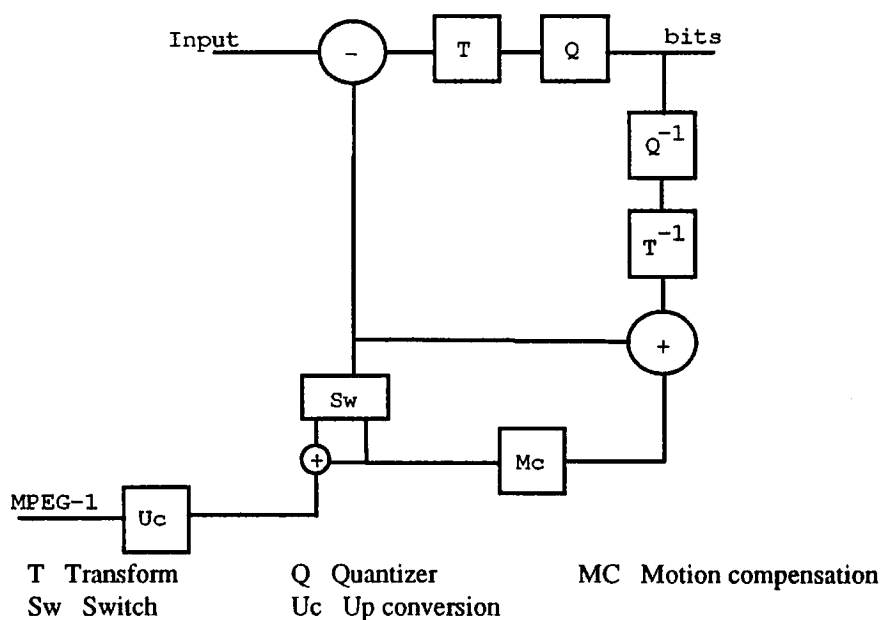
Figure3: MPEG-2 Encoder with new compatible prediction method from a lower layer.

Item	All	Intra	Predicted	Interpolated
Number of pictures	124	11	31	82
SNR for Y	28.55	28.95	28.69	28.45
SNR for U	34.17	34.39	33.93	34.22
SNR for V	35.24	35.52	35.01	35.3
Mean value of QP	11.3	9.22	8.95	12.47

Table 1. TM2 coding statistics for Calendar. Average bit rate 4.05Mbit/s.

Item	All	Intra	Predicted	Interpolated
Number of pictures	124	11	31	82
SNR for Y	26.39	26.46	26.3	26.42
SNR for U	32.49	32.57	32.22	32.58
SNR for V	33.51	33.66	33.24	33.6
Mean value of QP	17.77	14.64	14.13	19.57

Table 2. Simulcast coding statistics for Calendar. Average bit rate 2.53Mbit/s.

Item	All	Intra	Predicted	Interpolated
Number of pictures	124	11	31	82
SNR for Y	27.11	27.38	27.06	27.1
SNR for U	33.11	33.45	32.75	33.2
SNR for V	34.17	34.61	33.8	34.25
compatible prediction modes				
no compatibility	1009 (74.5%)	45 (2.8%)	1093 (69.6%)	1106 (89.0%)
field1 compatible	149 (11.0%)	0 (0.0%)	304 (19.4%)	110 (8.9%)
field2 compatible	14 (1.0%)	0 (0.0%)	27 (1.7%)	11 (1.0%)
field1 and field2 compatible	183 (13.5%)	1538 (97.2%)	146 (9.3%)	15 (1.2%)
Mean value of QP	15.39	12.35	12.16	17.02

Table 3. Compatible coding statistics for Calendar. Average bit rate 2.52Mbit/s.

Item	All	Intra	Predicted	Interpolated
Number of pictures	124	11	31	82
SNR for Y	27.2	27.39	27.24	27.15
SNR for U	33.21	33.45	32.97	33.27
SNR for V	34.3	34.61	34.05	34.35
compatible prediction modes				
no compatibility	776 (56.1%)	45 (2.8%)	617 (39.2%)	933 (72.7%)
field1 compatible	305 (22.0%)	0 (0.0%)	578 (36.7%)	243 (18.9%)
field2 compatible	33 (2.4%)	0 (0.0%)	55 (3.5%)	28 (2.2%)
field1 and field2 compatible	270 (19.5%)	1538 (97.2%)	323 (20.5%)	80 (6.2%)
Mean value of QP	15.54	12.32	12.27	17.21

Table 4. Compatible coding statistics for Calendar with new compatible prediction.
Average bit rate 2.53Mbit/s. Definition of compatibility modes is:

no compatibility — normal prediction
field1 compatible — average of mpeg-1 and normal prediction in field1, normal prediction in field2.
field2 compatible — average of mpeg-1 and normal prediction in field2, normal prediction in field1.
field1 and field2 compatible - average of mpeg-1 and normal prediction in both fields 1 and 2.