**Telecommunication Standardization Sector**
**Study Group 15**
**Experts Group for ATM Video Coding**
**(Rapporteur's Group on part of Q.2/15)**

**Document AVC-494**
**Version 20**
**March, 1993**

Source : ETRI
Title : Simulation results on CTV/HDTV compatible coding
Purpose : Information

## Introduction

The attempt of this contribution is to provide some information associated with the two compatibility approaches, pyramidal DCT coding and spatio-temporal weighted compatible coding. Both compatible schemes have been developed to provide layered coding with resolution scalability. In this document we compare the two compatibility approaches for compatible coding of CTV and HDTV. The higher layer is HDTV resolution(Y: 1920 x 1024, U/V: 960 x 1024) while the lower layer is CTV(Y: 960 x 512, U/V: 480 x 512).

## Simulation Conditions

Compatible coding can be achieved through use of layered coding schemes. Figure 1 shows an encoder for pyramidal DCT coding[1]. The encoder for spatio-temporal compatible coding[2] is shown in figure 2. The CTV images have been down-sampled(H:1/2, V:1/2) from HDTV images using a horizontal and a vertical filters such as those described in [3] is used in this experiment. The following settings were used;

- Picture format : 4 : 2 : 2
- Picture rate : 30 Hz
- GOP & prediction : N = 15, M = 1, Fr / Fi adaptive
- Motion vector search range : +/- 15 / frame
- Rate control : based on TM3

### *Pyramidal DCT coding*

The CTV pictures were coded at 15 Mbits/s using Test Model 3 with adaptive field/frame prediction. The resulting coded pictures were up-sampled back to HDTV resolution and used as a compatible prediction. The residual signal of HDTV sequences is encoded at 20 Mbits/s using TM3 with adaptive field/frame prediction(total bit rate : 35Mbits/s for HDTV)

### *Spatio-temporal coding*

The CTV codec processes CTV pictures at 15 Mbits/s. The HDTV codec can utilize a compatible prediction from the locally decoded pictures of the CTV codec after proper up-sampling. The compatible prediction uses the spatio-temporal weighting technique. The higher layer is encoded at 20 Mbits/s.

Some results are shown in figure 3.

## Conclusions

Simulation results of compatible coding schemes are presented for the purpose of information. It can be seen that the performance of the both compatible coding methods are quite similar. In addition, both compatible schemes give quite comparable picture quality.

## References

[1] CMTT/2-SRG-047,"Secondary distribution of TV and HDTV pyramidal DCT

proposal".
[2] CMTT/TG2-SRG1,"Preduction of a original decimated TV picture".
[3] ISO-IEC/JTC1/SC29/WG11 MPEG 93/225,"Test model 4"

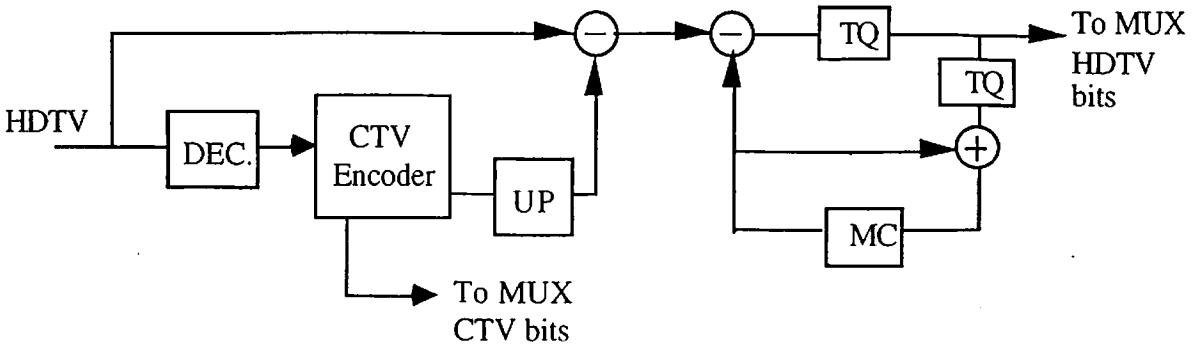


Figure 1. Pyramidal DCT coding scheme

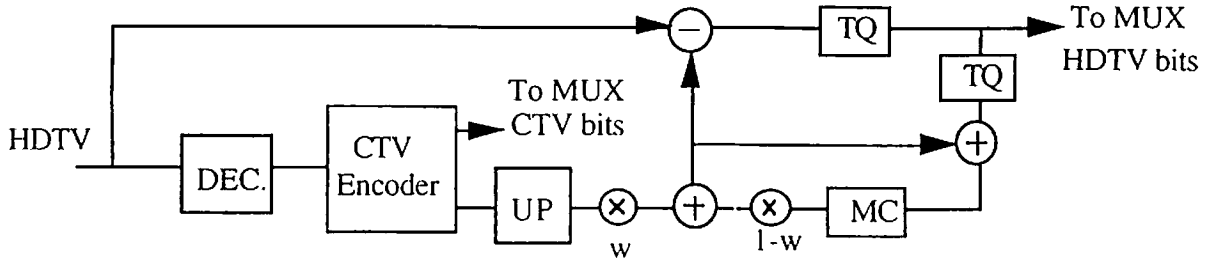


Figure 2. Spatio-temporal weighted coding scheme

| # | PSNR_T | PSNR_Y | PSNR_U | PSNR_V | Target | Total | MV_bit | MQP | Skip |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 39.94 | 38.47 | 41.44 | 43.06 | 1600000 | 1470115 | 0 | 4.6 | |
| 2 | 37.98 | 36.11 | 40.58 | 42.19 | 609277 | 476757 | 58864 | 5.6 | 380 |
| 3 | 38.08 | 36.27 | 40.52 | 42.11 | 619471 | 613140 | 55388 | 5.0 | 66 |
| 4 | 38.00 | 36.20 | 40.44 | 41.91 | 619999 | 613706 | 52748 | 4.9 | 69 |
| 5 | 37.97 | 36.21 | 40.33 | 41.73 | 620571 | 614579 | 52236 | 5.0 | 92 |
| 6 | 37.75 | 35.96 | 40.21 | 41.56 | 621170 | 614346 | 51342 | 5.0 | 89 |
| 7 | 37.70 | 35.93 | 40.12 | 41.46 | 621928 | 614265 | 50966 | 5.0 | 100 |
| 8 | 37.65 | 35.89 | 40.05 | 41.32 | 622886 | 621773 | 50624 | 5.0 | 96 |
| 9 | 37.58 | 35.84 | 39.94 | 41.18 | 623045 | 621591 | 50658 | 5.0 | 90 |
| 10 | 37.51 | 35.77 | 39.88 | 41.10 | 623288 | 622241 | 50296 | 5.0 | 85 |
| 11 | 37.49 | 35.77 | 39.80 | 41.04 | 623497 | 623036 | 50820 | 5.0 | 118 |
| 12 | 37.46 | 35.75 | 39.76 | 40.99 | 623612 | 620287 | 50890 | 5.0 | 78 |
| 13 | 37.44 | 35.73 | 39.72 | 40.93 | 624721 | 621660 | 50686 | 5.1 | 87 |
| 14 | 37.44 | 35.74 | 39.72 | 40.91 | 626252 | 622980 | 50810 | 5.1 | 107 |
| 15 | 37.45 | 35.76 | 39.72 | 40.89 | 629524 | 622852 | 51062 | 5.0 | 88 |

(a) Pyramidal DCT coding

Figure 3. Simulation results (Bitrate = 35 Mbps(15/20), M=3, 4:2:2)

| # | PSNR_T | PSNR_Y | PSNR_U | PSNR_V | Target | Total | MV_bit | MQP | Skip |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 39.52 | 38.09 | 40.95 | 42.53 | 1600000 | 1382022 | 0 | 3.8 | |
| 2 | 38.00 | 36.10 | 40.68 | 42.37 | 615569 | 486362 | 85902 | 5.6 | 261 |
| 3 | 38.13 | 36.28 | 40.64 | 42.33 | 625508 | 620021 | 91077 | 4.9 | 266 |
| 4 | 38.05 | 36.20 | 40.58 | 42.23 | 625966 | 625900 | 85746 | 4.9 | 353 |
| 5 | 37.98 | 36.14 | 40.49 | 42.14 | 625972 | 619778 | 87138 | 4.9 | 458 |
| 6 | 37.92 | 36.08 | 40.46 | 42.09 | 626591 | 623404 | 85128 | 4.9 | 337 |
| 7 | 37.89 | 36.05 | 40.39 | 42.05 | 626945 | 624231 | 87120 | 5.0 | 336 |
| 8 | 37.87 | 36.04 | 40.39 | 41.97 | 627285 | 620151 | 79801 | 4.9 | 478 |
| 9 | 37.85 | 36.04 | 40.34 | 41.85 | 628304 | 625012 | 80630 | 4.9 | 389 |
| 10 | 37.80 | 35.97 | 40.31 | 41.85 | 628853 | 619014 | 79401 | 5.0 | 377 |
| 11 | 37.84 | 36.02 | 40.32 | 41.87 | 630821 | 623415 | 76972 | 4.9 | 494 |
| 12 | 37.86 | 36.05 | 40.31 | 41.88 | 632672 | 629211 | 79770 | 4.9 | 349 |
| 13 | 37.87 | 36.07 | 40.28 | 41.84 | 633826 | 632033 | 82650 | 4.9 | 294 |
| 14 | 37.90 | 36.11 | 40.31 | 41.86 | 634723 | 625968 | 80105 | 4.9 | 404 |
| 15 | 37.94 | 36.15 | 40.35 | 41.87 | 643478 | 633291 | 79813 | 4.8 | 331 |

(b) Spatio-temporal compatible coding (w = 0.25)

| # | PSNR_T | PSNR_Y | PSNR_U | PSNR_V | Target | Total | MV_bit | MQP | Skip |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 39.52 | 38.09 | 40.95 | 42.53 | 1600000 | 1382022 | 0 | 3.8 | |
| 2 | 37.40 | 35.39 | 40.55 | 42.19 | 615569 | 506191 | 85893 | 5.8 | 186 |
| 3 | 37.43 | 35.48 | 40.32 | 41.98 | 623983 | 626983 | 89246 | 5.3 | 93 |
| 4 | 37.32 | 35.38 | 40.20 | 41.83 | 623733 | 619710 | 85933 | 5.3 | 76 |
| 5 | 37.33 | 35.40 | 40.14 | 41.79 | 624099 | 621675 | 87068 | 5.3 | 119 |
| 6 | 37.27 | 35.33 | 40.12 | 41.71 | 624341 | 624086 | 84807 | 5.3 | 80 |
| 7 | 37.20 | 35.27 | 40.05 | 41.63 | 624370 | 621830 | 86621 | 5.4 | 75 |
| 8 | 37.18 | 35.26 | 40.03 | 41.53 | 624687 | 623732 | 80663 | 5.3 | 86 |
| 9 | 37.13 | 35.21 | 39.98 | 41.43 | 624824 | 622565 | 80957 | 5.4 | 92 |
| 10 | 37.08 | 35.15 | 39.95 | 41.42 | 625201 | 621901 | 80738 | 5.4 | 64 |
| 11 | 37.06 | 35.14 | 39.94 | 41.42 | 625861 | 619066 | 78679 | 5.4 | 96 |
| 12 | 37.10 | 35.19 | 39.93 | 41.40 | 627559 | 621118 | 79595 | 5.4 | 76 |
| 13 | 37.11 | 35.21 | 39.90 | 41.39 | 629707 | 623690 | 83750 | 5.4 | 57 |
| 14 | 37.15 | 35.25 | 39.93 | 41.37 | 632715 | 625306 | 79218 | 5.3 | 78 |
| 15 | 37.20 | 35.32 | 39.95 | 41.39 | 640125 | 632921 | 79774 | 5.3 | 69 |

(c) Spatio-temporal compatible coding (w = 0.5)

Figure 3. Simulation results (Bitrate = 35 Mbps(15/20), M=3, 4:2:2)