RECOMMENDATION ITU-R BT.1199*,**

Use of bit-rate reduction in the HDTV studio environment

(1995)

The ITU Radiocommunication Assembly,

considering

a) that most signal processing in the HDTV studio environment will be done in digital form;

b) that the source bit rate of a HDTV digital studio signal is in excess of 1 Gbit/s;

c) that there is a need for equipment interconnections in the digital domain within HDTV studio complexes;

d) that current studies on bit-rate reduction of HDTV signals indicate that such techniques may be appropriate for use in HDTV programme production;

e) that bit-rate reduction will be applied to video signals at several places along the HDTV chain that extends from the production of programmes to their final delivery;

f) that it is essential that any video artefacts due to the combined effect of such bit-rate reduction processes be statistically kept below the level of perceptibility up to the end of the HDTV chain;

g) that signal processing in studio should be taken into account in determining the effect of bit-rate reduction processes,

recommends

1 that when bit-rate reduction is used in HDTV studios, the bit-rate reduction factor used should be sufficiently small to provide virtually transparent (quasi-lossless) coding both in terms of the subjective quality of stationary and moving pictures, and in terms of picture post-processability in the studio***;

2 that the picture treatment should remain virtually transparent to picture quality and picture post-processability when the bit-rate reduction algorithm used in HDTV studios is repeatedly cascaded with the bit-rate reduction algorithm used for digital recording in studios. The same

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* This Recommendation should be brought to the attention of Telecommunication Standardization Study Group 9.

** Radiocommunication Study Group 6 made editorial amendments to this Recommendation in 2003 in accordance with Resolution ITU-R 44.

*** Several experts currently believe that a moderate video bit-rate reduction factor in the region of 2 or 3, even without motion compensation, is most likely to fulfil this requirement, if state-of-the-art algorithms are used. Further examination on quality of bit-rate reduced picture will be necessary. For example, the evaluation on quality of bit-rate reduced pictures which have a relatively high reduction factor is shown in Annex 1.

algorithm, or algorithms belonging in the same family, should preferably be used for all applications in the studio;

3 that the bit-rate reduction algorithms used in HDTV studios should not give rise to additional perceptible picture artefacts when they are cascaded with the algorithms used in contribution and distribution circuits and for programme delivery to the home*.

Annex 1

Relation between picture quality and bit rate in actual HDTV digital codecs

1 Introduction

So far various kinds of HDTV codecs, including MPEG-2, have been developed. However, it is not clear that a standard can be recommended based on their performance.

In view of this situation, the Broadcasting Technology Association (BTA) of Japan carried out a subjective evaluation test using actual hardware codecs, with the aim of examining picture quality versus bit rate using the most popular and typical coding scheme, MC-DCT. This coding scheme is extensively applied to standards such as ITU-T Recommendations J.81 and H.261, MPEG-1 and MPEG-2.

2 Evaluation test

The subjective evaluation test was carried out using the double-stimulous continuous quality-scale (DSCQS) method recommended by Recommendation ITU-R BT.500. Fifteen observers participated in the test as experts under a viewing condition based on Recommendation ITU-R BT.710.

The evaluation result obtained was for very critical test sequences.

Two HDTV codecs were provided for the test. Their system specifications are given in Table 1.

3 Evaluation result

Figure 1 shows evaluation results of degradation for both codecs.

The results obtained lead to the conclusion that a much higher bit rate than that assumed for MPEG-2 is actually needed to meet the quality requirements for contribution, even when the coding scheme employed in the codecs does not conform strictly to MPEG-2.

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* Several experts currently believe that this requirement will most likely be fulfilled if algorithms belonging in the same family will be used for most or all applications along the HDTV chain.

This means that further evaluation tests are necessary for the digital HDTV codec where MPEG-2 is used.

Current developments within the International Organization for Standardization (ISO)/the International Electrotechnical Commission (IEC) MPEG that are of interest in these studies include the 4:2:2 (professional) profile for the encoding of SDTV signals at the level of Recommendation ITU-R BT.601 within the MPEG-2 tool-kit and the new work on low bit rate, object-oriented coding in the MPEG-4 activities. Extension of the techniques of the 4:2:2 profile to HDTV appears feasible and the results of tests on this profile at the SDTV level (in the region 25-50 Mbit/s) are encouraging. The work within MPEG-4 may lead to methods for the coding at very low bit rates of UHDTV or HDTV stills, transparencies, etc.

TABLE 1

Specification of codecs 1 and 2

Parameter		Codec 1	Codec 2
Video	Standard	1125/60/2:1	
	Sampling frequency (MHz)	$Y = 74.25$ $P_B P_R = 37.125$	$Y = 55.6875$ $P_B P_R = 27.84375$
	Bandwidth (MHz)	$Y = 30$ $P_B P_R = 15$	$Y = 24$ $P_B P_R = 12$
	Quantization (bit)	8	
	Interface	Analogue: GBR/YP_BP_R Digital: BTA S-002 (bit parallel)	Analogue: GBR/YP_BP_R
	Format	4:2:2	
Source coding	Coding scheme	Motion compensated DCT, 8×8 DCT block	
	Coding mode	Intrafield/motion compensated interfield/interframe	Intrafield/motion compensated interfield/motion compensated interframe
	Variable length coding	B2 code	
Audio		48 kHz, 16 bits, 4 channels Digital interface; IEC-958 (AES/EBU)	48 kHz, 16 bits, 2 channels/4 channels Digital interface; IEC-958 (AES/EBU)
FEC		BCH (15,11) for transmission factor, mode information and motion vectors Product construction double Reed-Solomon codes (RS (64,60) and RS (192,188))	
Bit rate (Mbit/s)		139.264/120.832/59.94	139.264/44.736

AES: Audio Engineering Society

DCT: discrete cosine transfer

EBU: European Broadcasting Union.

FIGURE 1

Picture quality (degradation) versus bit rate