RECOMMENDATION ITU-R BT.1203*

User requirements for generic bit-rate reduction coding of digital TV signals (SDTV, EDTV and HDTV) for an end-to-end television system

(1995)

The ITU Radiocommunication Assembly,

considering

a) that rapid progress is being made in bit-rate reduction coding techniques;

b) that bit-rate reduction coding of digital SDTV, EDTV and HDTV signals will find wide applications for studio production, for contribution, for both primary and secondary distribution and for emission by terrestrial means and satellite;

c) that in the total chain of broadcasting, a number of codecs will be used in cascade which leads to a loss of picture quality;

d) that ITU-T Recommendation J.81 is already used for codecs for SNG, contribution and primary distribution;

e) that there could be advantages in having a generic (i.e. related) bit-rate reduction coding in the various applications if maximum commonality among various applications can be utilized;

f) that interoperability between different video formats and distribution media should be achieved;

g) that digital and analogue broadcasting systems will both exist during a transition period,

recommends

1 that same picture format or closely related signal formats should be used as far as possible, through a total broadcasting chain;

2 that the picture format of both input and output signals for coding and decoding should be the same;

3 that the same or closely related coding schemes should be used as much as possible for terrestrial and satellite emission and secondary distribution in order to minimize the receiver cost and the quality degradation;

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

4 that the encoder should as far as possible allow non-changing parameters which may be used in subsequent coding processes, e.g. motion information to be down-loaded into the subsequent codecs;

5 that the interface between the codecs should be simple;

6 that the coding scheme can be used by composite and component signals without a perceptible loss of picture quality,

further recommends

1 that the values listed in Table 1 should be used for the input of the encoder and for the output of the decoder;

2 that the functional and operational requirements described in Table 4 should be satisfied;

3 that the benefits of generic coding applied to the total or to parts of the total broadcasting chain be studied in terms of ease of operation, equipment cost and picture quality.

Annex 1

TABLE 1

Signal format for codecs

Items		SNG[1]		Contribution	Studio production	Primary distribution	Primary distribution	Terrestrial	Satellite	Secondary distribution
		Mode 1	Mode 2			Case 1[2]	Case 2[3]			
No. of samples/line	HDTV EDTV SDTV	Examples are listed in Tables 2 and 3								
Interlace ratio	HDTV EDTV SDTV	Interlace format in the current state with transition to progressive format in the future								
No. of lines/frame	HDTV EDTV SDTV	Examples are listed in Tables 2 and 3								
Colour format	HDTV EDTV SDTV	4:2:2 processing required				4:2:2 should be used for the digital interface 4:2:0 may be used for internal coding				

(1) Mode 1: good transmission conditions.

Mode 2: poor transmission conditions.

(2) Case 1: digital primary distribution followed by analogue secondary distribution or emission.

(3) Case 2: digital primary distribution followed by digital secondary distribution or emission.

TABLE 2

Examples of picture formats

	50 Hz environment		60 Hz environment	
HDTV (16:9)	1 920 × 1 152 1 440 × 1 152	I I	1 920 × 1 035 1 920 × 1 080 1 920 × 1 080 1 440 × 1 080 1 280 × 720	I P I I P
EDTV (16:9)	960 × 576 960 × 576 720 × 576	P I I	960 × 483(1) 960 × 483(1) 720 × 483(1)	P I I
SDTV (4:3)	720 × 576	I	720 × 483(1)	I

I: interlaced scans

P: progressive scans

(1) The number of coded lines can be 480 in the case of emission and secondary distribution applications, but the aspect ratio should be defined using 483 active lines.

TABLE 3

Upper bounds for sampling density and luminance pel rate specified in MPEG-2

Level	Layer		Simple	Main	SNR	Spatial	High 4:2:2	High 4:2:0
High	Enhancement	pel/H line/V frame/s pel rate(1)					1 920 1 152 60 83.5584	1 920 1 152 60 62.6688
	Base	pel/H line/V frame/s pel rate		1 920 1 152 60 62.6688			960 576 30 19.6608	960 576 30 14.7456
High-1 440	Enhancement	pel/H line/V frame/s pel rate				1 440 1 152 60 47.0016	1 440 1 152 60 62.6688	1 440 1 152 60 47.0016
	Base	pel/H line/V frame/s pel rate		1 440 1 152 60 47.0016		720 576 30 10.3680	720 576 30 14.7456	720 576 30 11.0592
Main	Enhancement	pel/H line/V frame/s pel rate					720 576 30 14.7456	720 576 30 11.0952
	Base	pel/H line/V frame/s pel rate	720 576 30 10.3680	720 576 30 10.3680	720 576 30 10.3680		352 288 30	352 288 30 3.04128
Low	Enhancement	pel/H line/V frame/s pel rate						
	Base	pel/H line/V frame/s pel rate		352 288 30 3.04128	352 288 30 3.04128			

(1) Unit of pel rate: Msample/s.

Annex 2

TABLE 4

Functional and operational requirements for generic codecs

Item	SNG Mode 1	SNG Mode 2	Contribution	Studio production	Primary distribution Case 1	Primary distribution Case 2	Terrestrial	Satellite	Secondary distribution
No. of audio channels HDTV EDTV SDTV	Minimum 2 Minimum 2		Maximum 8 Maximum 6		Maximum 6 Maximum 6				
Range of bit rates HDTV EDTV SDTV	Up to 140 Mbit/s Further study Up to 34 or 45 Mbit/s				Corresponds to SNG and contribution bit rates	Corresponds to secondary distribution	Up to 80 Mbit/s Further study Up to 15 Mbit/s		
Prediction mode	I, P				(I, B, P) and (I, P) are used in non-live and live broadcasting, respectively				
Picture quality	12%	36%	12%		12%	18%			
Compatibility	Not required					Desirable			
Hierarchical coding	Not required					Required only for the graceful degradation system			
Scalability	Not required, however if needed then lower quality can be obtained with a standards converter					Desirable, needed for hierarchical coding			
Interoperability	Not required					A decoder should decode bit streams with any picture format for SDTV or EDTV or HDTV, but not necessarily all			

TABLE 4 (*end*)

Item	SNG Mode 1	SNG Mode 2	Contribution	Studio production	Primary distribution Case 1	Primary distribution Case 2	Terrestrial	Satellite	Secondary distribution
Editability				Required in the bit stream domain					
Bit-rate flexibility	A decoder should decode bit streams at any bit rate described in the item of "range of bit rates"								
Codec delay	An overall delay of less than 300 ms would be desirable for interactive talk-back applications								
Recovery time (after a break of 50 ms)	≤ 1 s		≤ 500 ms		≤ 500 ms				
Acquisition time	The major contributions to acquisition time are the decoding delay and the interval between I pictures. A desirable figure for this value is less than 500 ms								
Error concealment	Required, a decoder should support this functionality and should also provide a signalling function of error conditions for studio applications				Desirable				
Graceful degradation	Not required					Desirable, essential for mobile and portable reception			
Channel hopping latency	Not required					Less than 550 ms			
Relative delay between sound and vision	± 2 ms per codec						Under study		

I: interframe

P: P frame

B: B frame.

Annex 3

Definition and explanation of items listed in Tables 1, 3 and 4

Generic coding: digital coding of pictures based on family of related coding methods.

No. of samples/line: number of luminance samples per active line.

Interlace ratio: 1:1 is for a progressive format, where the input signal is frame-structured. 2:1 is for an interlaced format, where the input signal is field-structured.

No. of lines/frame: number of vertical lines per active frame.

Colour format: ratio between the number of the luminance pixels and the number of the co-sited chroma difference pixels or the ratio between the colour pixels *R*, *G* and *B*.

No. of audio channels: total number of sound channels per programme, together with a description how these channels can be combined for different applications.

Range of bit rates: minimum and maximum encoder output bit rates for several input formats.

Prediction mode: type of prediction used inside the encoder. This influences very strongly the maximal achievable picture quality of following codecs.

Picture quality: results of the subjective evaluation of the encoding and decoding performance in an error-free channel.

Compatibility: description whether the bit stream syntax allows the separate signal processing of parts of the total bit stream in subsequent codecs.

Hierarchical coding: method to achieve different resolution layers on the decoder side.

Scalability: access to several picture qualities in a single bit stream.

Interoperability: description of the grade of commonality between different bit streams inside the broadcasting chain.

Editability: ability to edit a programme taking into account the structure of the encoder output data.

Bit-rate flexibility: the coding algorithm may allow the use of either CBR (constant bit rate) – or VBR (variable bit rate) – coding.

Codec delay: the delay introduced by the coding/decoding algorithm.

Recovery time: the time period between a physical interruption inside the broadcasting chain and the achievement of full functionality.

Acquisition time: the maximal acceptable waiting time from start of the decoding process until the display of the picture. This might influence the choice of the generic coding scheme.

Error concealment: possibility of the decoder to react in a specified way to alarm signals coming from the FEC part of the decoder.

Graceful degradation: to avoid an abrupt degradation of the picture quality on the decoder side, the output of scalable encoders can be protected by different FEC schemes or by non-uniform modulation schemes. A combination of both methods is also possible.

Channel hopping: necessity to switch as quickly as possible between different programmes.