RECOMMENDATION ITU-R BT.1121-1*,**

User requirements for the transmission through contribution and primary distribution networks of digital HDTV signals

(1994-1995)

The ITU Radiocommunication Assembly,

considering

a)   that the digital representation of Y, C_B, C_R based HDTV digital signals is going to be defined;

b)   that signals conforming to that standard are required to be transmitted through digital contribution and primary distribution networks;

c)   that coding algorithms are being devised to enable such transmission to be effected using bit rate reduction techniques;

d)   that prototype codec equipment using these algorithms is being developed and needs to be assessed;

e)   that general advice on methods of assessment is contained within ITU-R texts, and that in particular, subjective testing methods are defined in Recommendation ITU-R BT.710;

f)   that such assessment will need to take account of basic picture quality, the failure characteristic in the presence of errors on the transmission link, and the quality achieved after downstream processing;

g)   that both the design of codecs and their assessment will need to take account of user requirements;

h)   that in order to be complete, the user requirements should specify the test procedures and test material that should be used to check that the requirements are being met,

recommends

that the following user requirements should govern the specification design and testing of systems for the transmission of Y, C_B, C_R based HDTV signals through contribution and primary distribution networks.

1   User requirements for contribution codecs

Functional requirements relating to contribution codecs are given in Table 1 and performance requirements are given in Table 2 respectively.

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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.

TABLE 1

Functional requirements	
Source signals	Y, C_B, C_R
Destination signals	Y, C_B, C_R
Sound channel	Number of sound channels: max. 8 channels Primitive sampling: 48 kHz/16 bits
Ancillary data	Bit rate: around 100 kbit/s

TABLE 2

Performance requirements	
Basic picture quality	Number of codecs tested; 3 codecs in tandem:[1] Quality difference; $\leq$ 12% with DSCQS method using at least 4 sequences taken from Recommendations ITU-R BT.710 and ITU-R BT.1210, at least half of which must be high activity sequences. The given grade must be met using at least 75% of the sequences chosen, the rest must achieve $\leq 30\%$[2]
Basic sound quality	To be specified
Picture quality after modification to picture geometry and after slow motion	Quality difference; $\leq$ 18% between 2 codecs[1] with DSCQS method using[2] at least 2 sequences taken from Recommendations ITU-R BT.710 and ITU-R BT.1210.
Failure characteristic/error performance	BER; $1 \times \leq 10^{-4}$ including error burst $\leq$ 30 bits Impairment; less than 1 grade with DSIS method using at least 2 sequences taken from Recommendations ITU-R BT.710 and ITU-R BT.1210
Recovery time	$\leq$ 500 ms after a break of 50 ms[3]
Change in overall delay after signal interruption	As small as possible (under study)
Maximum relative sound/vision delay	$\pm$ 2 ms per codec

DSCQS: double stimulus continuous quality scale.

DSIS: double stimulus impairment scale.

[1] It is appreciated that there are problems in estimating or measuring the characteristics of codecs in tandem in particular if a number of codecs have to be considered. These quality criteria assume that direct codec tandem connections are entirely digital. For contribution applications, downstream processing should be inserted between codecs.

[2] Picture quality assessment ratings are carried out using the procedures given in Recommendation ITU-R BT.710 using the subjective assessment methods indicated.

[3] The recovery time can be measured as the number of fields of delay that is required between the connection of signal to the decoder, and switching the picture monitor input from a grey level signal (or a suitably delayed non-processed signal) to the decoder output signal such that no picture disturbance can be observed.

A similar procedure should be adopted to assess the recovery time associated with bit-slips, as might occur following, for example, a non-sync cut.

2 User requirements for primary distribution codecs

Functional requirements relating to primary distribution codecs are given in Table 3 and performance requirements are given in Table 4 respectively.

TABLE 3

Functional requirements	
Source signals	Y, C_B, C_R
Destination signals	Y, C_B, C_R
Sound channel	Number of sound channels: 5 channels[1] Primitive sampling: 48 kHz/16 bits
Ancillary data	Bit rate: around 100 kbit/s

[1]   Recommendation ITU-R BS.776 (Multi-channel stereophonic sound systems with and without accompanying picture).

TABLE 4

Performance requirements	
Basic picture quality	Number of codecs tested; 2 codecs in tandem[1] Quality difference; ≤ 12% with DSCQS method using at least 4 sequences taken from Recommendations ITU-R BT.710 and ITU-R BT.1210, at least half of which must be high activity sequences. The given grade must be met using at least 75% of the sequences chosen, the rest must achieve ≤ 30%[2]
Basic sound quality	To be specified
Failure characteristic/error performance	BER; $1 \times \leq 10^{-4}$ including error burst ≤ 30 bits Impairment; less than 1 grade with DSIS method using at least 2 sequences taken from Recommendations ITU-R BT.710 and ITU-R BT.1210
Recovery time	≤ 500 ms after a break of 50 ms[3]
Change in overall delay after signal interruption	As small as possible (under study)
Maximum relative sound/vision delay	± 2 ms per codec

DSCQS: double stimulus continuous quality scale.

DSIS: double stimulus impairment scale.

[1]   It is appreciated that there are problems in estimating or measuring the characteristics of codecs in tandem in particular if a number of codecs have to be considered. These quality criteria assume that direct codec tandem connections are entirely digital. For contribution applications, downstream processing should be inserted between codecs.

[2]   Picture quality assessment ratings are carried out using the procedures given in Recommendation ITU-R BT.710 using the subjective assessment methods indicated.

[3]   The recovery time can be measured as the number of fields of delay that is required between the connection of signal to the decoder, and switching the picture monitor input from a grey level signal (or a suitably delayed non-processed signal) to the decoder output signal such that no picture disturbance can be observed.

A similar procedure should be adopted to assess the recovery time associated with bit-slips, as might occur following, for example, a non-sync cut.

3   Tandem connection in broadcasting chain

Consideration should be given to coding algorithms which are modular in concept among the contribution, primary distribution and secondary distribution chains.

4 System complexity

The complexity of the codec should be such that it can be implemented with available technologies at a cost reasonably related to the transmission costs for the intended application.

5 System availability

Any relevant patents should be available without discrimination worldwide on equitable terms.