RECOMMENDATION ITU-R BT.1208-1*

Video coding for digital terrestrial television broadcasting

(Question ITU-R 31/6)

(1995-1997)

The ITU Radiocommunication Assembly,

considering

a) that digital terrestrial television broadcasting (DTTB) will be introduced in the VHF/UHF bands;

b) that the source signals for this service may be of standard, extended or high-definition quality, and of different scanning formats;

c) that compatibility with the scanning formats for conventional television emission systems might be desirable;

d) that the maximum bit rate available is limited by the bandwidth of the channels (6-8 MHz) in the VHF/UHF bands;

e) that it is desirable that the bit-rate reduction method used for terrestrial emissions is based on a generic coding algorithm;

f) that maximum commonality is also desirable between digital systems for different emission and secondary distribution media (e.g. to the home receivers);

g) that methods for subjective assessment of the quality of television pictures is the subject of Recommendations ITU-R BT.500, ITU-R BT.710 and ITU-R BT.1129,

recommends

1 that DTTB systems should use the video-coding standards described in the International Organization for Standardization/International Electrotechnical Commission Standard 13818-2 (ISO/IEC Standard 13818-2) or ITU-T Recommendation H.262 with the constraints shown in Annex 1. (See Annex 2 for information leading to this Recommendation.)

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

Annex 1

The following constraints apply to the use of ISO/IEC Standard 13818-2 for DTTB:

1 Video formats

TABLE 1

Video format constraints

horizontal_ size_value	vertical_size_value	aspect_ratio information	frame_rate_code	progressive _sequence	Format
1920	1152	3	3, 6	1	A
1920	1152	3	3, 6	0	B
1920	1080	1, 3	1, 2, 3, 4, 5, 6, 7, 8	1	C
1920	1080	1, 3	3, 4, 5	0	D
1920	1035	3	4, 5	0	E
1440	1152	3	3, 6	0	F
1280	720	1, 3	1, 2, 4, 5, 7, 8	1	G
720	576	2, 3	3, 6	1	H
720	576	2, 3	3, 6	0	I
720	480	2, 3	4, 5	0	J
720	480	2, 3	1, 2, 4, 5, 7, 8	1	K
720	483	2, 3	4, 5	0	L
720	483	2, 3	1, 2, 4, 5, 7, 8	1	M
704	576	2, 3	3, 6	1	N
704	576	2, 3	3, 6	0	O
704	480	2, 3	1, 2, 4, 5, 7, 8	1	P
704	480	2, 3	4, 5	0	Q
640	480	1, 2	1, 2, 4, 5, 7, 8	1	R
640	480	1, 2	4, 5	0	S
352	288	2, 3	3	0	T

All profiles are main profile using main level or higher.

A format is a set of constraint values in any horizontal row.

1.1 Coded values in Table 1

aspect_ratio_information
1 = square samples
2 = 4:3 display aspect ratio
3 = 16:9 display aspect ratio

frame_rate_code
1 = 23.976 Hz
2 = 24 Hz
3 = 25 Hz
4 = 29.97 Hz
5 = 30 Hz
6 = 50 Hz
7 = 59.94 Hz
8 = 60 Hz

progressive_sequence 0 = interlaced scan
1 = progressive sequence

2 Colour primaries

Value	colour_primaries
1	Recommendation ITU-R BT.709
5	Recommendation ITU-R BT.470, System B, G
7	SMPTE 240M (1987)

3 Transfer characteristics

Value	transfer_characteristic
1	Recommendation ITU-R BT.709
4	Recommendation ITU-R BT.470, System M
5	Recommendation ITU-R BT.470, System B, G
7	SMPTE 240M (1987)

4 Matrix coefficients

value	matrix_coefficients
1	Recommendation ITU-R BT.709
4	FCC
5	Recommendation ITU-R BT.470, System B, G
7	SMPTE 240M (1987)

NOTE 1 – A unified colorimetry system is defined in Recommendation ITU-R BT.1361.

Annex 2

Considerations for the selection of an Moving Pictures Expert Group (MPEG-2) video-coding conformance point for digital terrestrial television broadcasting

The MPEG-2 family of video-coding standards provides the capability of a universal coding and compression method to be compatible with various broadcasting requirements due to the ability of the higher profiles and levels to decode lower profiles and levels. It is therefore possible to choose an appropriate profile and level for a receiver that could universally decode SDTV, EDTV, and HDTV broadcasts. Furthermore, it would still provide the flexibility to broadcasters to provide different functionalities for SDTV, EDTV, and HDTV to meet local technical and service requirements and constraints.

The family of MPEG-2 standards is shown in Table 2.

TABLE 2

MPEG-2 profiles and levels

Levels	Profiles				
	Simple 4:2:0	Main 4:2:0	SNR scalability 4:2:0	Spatial scalability 4:2:0	Professional 4:2:2
High 1920 × 1152	Undefined	80 Mbit/s	Undefined	Undefined	100 Mbit/s
High-1440 1440 × 1152	Undefined	60 Mbit/s	60 Mbit/s	60 Mbit/s	80 Mbit/s
Main 720 × 576	15 Mbit/s	15 Mbit/s	15 Mbit/s	15 Mbit/s	20 Mbit/s
Low 352 × 288	Undefined	4 Mbit/s	4 Mbit/s	4 Mbit/s	Undefined

NOTE 1 – It is recognized that at very high compression rates, depending on picture content, visible artefacts may be produced. A better overall quality may be achieved with a lower number of samples per line which may be derived by subsamplery.

Systems for DTTB that have been developed are making use of the Main Profile/Main Level for SDTV services for DTTB services, including multi-programme television broadcasting services. For HDTV services, the Main Profile at the High Level has been selected.

In order for a television receiver to be able to decode all these various television services it has to have functionality of the highest profile and highest level proposed for these services. This leads for the universal television receiver decoder to the choice of the Main Profile at the High Level as the conformance point in the MPEG-2 standard.

This profile and level is able to decode all lower levels of this profile as well as all the levels of the Main and Simple Profiles. However, a functionality at the Simple Profile and the Low Level at all Profiles is thought unlikely to be attractive to broadcasting. The shaded area in Table 2 reflects these considerations.

Since there is no obligation at the encoder to use all the functionalities as permitted by the MPEG-2 Main Profile/High Level standard, only a subset of the functionalities may be used to provide SDTV, EDTV, or HDTV. Therefore, it is possible to provide DTTB services with different functionalities.

The choice of a conformance point for the receiver video decoder at a profile and level as high as possible provides a high level of flexibility to the broadcaster. A broadcast service may be started with very modest functionality and can be upgraded when required without consideration having to be given to already existing receivers. It is also possible to use different functionalities (resulting in different qualities) depending on the time and nature of the programme.

In the following the expected implementation for SDTV, EDTV and HDTV will be discussed.

SDTV and EDTV

For the majority of programme sequences, a quality of SDTV equivalent to PAL, SECAM or NTSC may be obtained with the Main Profile/Main Level coding at approximately 5 Mbit/s. An adequate level of quality for EDTV can be obtained in the range of 9 to 10 Mbit/s.

HDTV

Different functionalities for this HDTV service are considered in different countries. Implementation of this service is proposed at the Main Profile/High Level.

See Appendix 1 to Annex 2 for further information and considerations.

Appendix 1
to Annex 2

Note on video-decoding standard for digital terrestrial broadcasting

Various countries are seriously considering implementing DTTB in the near future. All or some of the possible qualities for digital television, that is SDTV, EDTV and HDTV, will be offered by several countries. While there appears to be a general consensus that video codecs should comply with the ISO/IEC MPEG-2 family of standards, different profiles and levels of this standard are considered for different quality of TV services, furthermore the particular choice of a standard for a given service.

The World Broadcasting Union has clearly expressed strong support for the use of a standard that could lead to a universal digital TV receiver that would be able to decode digital television services of varying qualities in any country.

The ISO/IEC MPEG-2 family of standards is an ideal vehicle to meet this requirement, provided that the appropriate profile and level in this standard is chosen.

The philosophy of this family of standards is to define for each profile and level certain functionalities from a large but limited set of functionalities (syntax elements).

The lowest functionalities, using the lowest number of the available syntax elements, are associated with low profiles and low levels. As one moves from low profiles and levels to higher profiles and levels increasingly more functionalities are added. Consequently higher profile level decoders can decode signals that are at the same level but lower profile or at a lower level in the same or lower profile. This capability indicates the advantage of using a standard for the decoder at as high a profile and level as possible. Since the transmission, that is the encoding, can be done at any lower functionality than the receiver decoder is capable to decode, the broadcaster has the freedom to provide services at different qualities and functionalities without being restricted by the receiver capabilities. Therefore broadcasters could provide services that may be changed (improved) over time, as well as offering services with different functionalities in different countries. The lower the profile and level for the receiver decoder is chosen, the more limited the service functionality choices for the broadcaster will be.

Furthermore, since DTTB services are expected to start in a few years' time, there will be improvements in solid state devices and cost reductions in components and equipment continuing for some time after service introduction. The standards selected should thus allow for improvements and evolution in the future and should not be constrained by short-term concerns. It is essential that the standards adopted should be effective over a long period of time.