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Digital Video Broadcasting (DVB);
Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream

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Contents

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Foreword

This Technical Specification (TS) has been produced by Joint Technical Committee (JTC) Broadcast of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECtrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

For a history of the revisions of the present document, please refer to Annex M.

The revisions to the TS have been developed in a largely backwards compatible manner, i.e. no changes to the mandatory functionality of a previously defined IRD have been made between one edition of the TS and the next.

NOTE: The EBU/ETSI JTC Broadcast was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC Broadcast became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the co-ordination of its members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has active members in about 60 countries in the European broadcasting area; its headquarters is in Geneva.

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The Digital Video Broadcasting Project (DVB) is an industry-led consortium of broadcasters, manufacturers, network operators, software developers, regulatory bodies, content owners and others committed to designing global standards for the delivery of digital television and data services. DVB fosters market driven solutions that meet the needs and economic circumstances of broadcast industry stakeholders and consumers. DVB standards cover all aspects of digital television from transmission through interfacing, conditional access and interactivity for digital video, audio and data. The consortium came together in 1993 to provide global standardization, interoperability and future proof specifications.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The present document presents guidelines covering coding and decoding using the MPEG-2 system layer, video coding and audio coding.

The guidelines presented in the present document for the Integrated Receiver-Decoder (IRD) are intended to represent a minimum functionality that all IRDs of a particular class are required to either meet or exceed. It is necessary to specify the minimum IRD functionality for basic parameters, if broadcasters are not to be prevented from ever using certain features. For example, if a significant population of IRDs were produced that supported only the Simple Profile, broadcasters would never be able to transmit Main Profile bitstreams.

IRDs are classified in five dimensions as:

- "25 Hz" ("50 Hz") or "30 Hz" ("60 Hz"), depending on whether the nominal video frame rates based on 25 Hz or 30 000/1 001 Hz (approximately 29,97 Hz) are supported. It is expected that 25 Hz IRDs and 50 Hz IRDs will be used in those countries where the existing analogue TV transmissions use 25 Hz frame rate and 30 Hz IRDs and 60 Hz IRDs will be used in countries where the analogue TV transmissions use 30 000/1 001 Hz frame rate. There are also likely to be "dual-standard" IRDs which have the capabilities of both 25 Hz (50 Hz) and 30 Hz (60 Hz) IRDs.

- "SDTV", "HDTV" or "UHDTV", depending on whether or not they are limited to decoding pictures of conventional TV resolution. The capabilities of an SDTV IRD are a sub-set of those of an HDTV IRD. An HDTV IRD capabilities are a sub set of those of an UHDTV IRD.

- "with digital interface" or "Baseline", depending on whether or not they are intended for use with a digital bitstream storage device such as a digital VCR. The capabilities of a Baseline IRD are a sub-set of those of an IRD with digital interface.

- MPEG-2 video, H.264/AVC, MVC, SVC, HEVC or VC-1 video coding formats.

- Audio coding formats according to clause 6.

To give a complete definition of an IRD, all five dimensions need to be specified, e.g.:

- 25 Hz SDTV Baseline IRD MPEG-2 video, MPEG-1 Layer II audio, for an IRD able to decode 720 × 576 interlaced 25 Hz video pictures.

- 30 Hz HDTV Baseline IRD H264/AVC video, HE AAC Level 4 audio, for an IRD able to decode up to 1 920 × 1 080 interlaced 30 Hz video pictures or 1 280 × 720 progressive 60 Hz video pictures.

- UHDTV IRD HEVC video, HE AAC Level 4 audio, for an IRD able to decode up to 3 840 × 2 160, 60 Hz video pictures.

All the formats supported by an IRD conforming to the present document are listed in annex A.

It should be noted that in DVB systems the source picture format, encoded picture format and display picture format do not need to be identical. For example, HDTV source material may be broadcast as an SDTV bitstream after down-conversion to SDTV resolution and encoding within the constraints of MPEG-2 video Main Profile at Main Level. The IRD receiving the bitstream may then up-convert the decoded picture for display at HDTV resolution.

Another notable feature of the DVB system is that a single Transport Stream may contain programme material intended for more than one type of IRD. A typical example of this is likely to be the simulcasting of SDTV and HDTV video material. In this case an SDTV IRD will decode and display SDTV pictures whilst an HDTV IRD will decode and display HDTV pictures from the same Transport Stream.

Where a feature described in the present document is mandatory, the word "shall" is used and the text is in italic; all other features are optional. The functionality is specified in the form of constraints on MPEG-2 systems, video and audio formats which the IRDs are required to decode correctly.

The specification of these baseline features in no way prohibits IRD manufacturers from including additional features, and should not be interpreted as stipulating any form of upper limit to the performance. The guidelines do not cover features, such as the IRDs up-sampling filter, which affect the quality of the displayed picture rather than whether the IRD is able to decode pictures at all. Such issues are left to the marketplace.

The guidelines presented for IRDs observe the following principles:

- wherever practical, IRDs should be designed to allow for future compatible extensions to the bitstream syntax;

- all "reserved" and "private" bits in MPEG-2 systems, video and audio formats should be ignored by IRDs not designed to make use of them.

The rules of operation for the encoders are features and constraints which the encoding system should adhere to in order to ensure that the transmissions can be correctly decoded. These constraints may be mandatory or optional.

Clauses 4 to 6 and the annexes, provide the guidelines for the Digital Video Broadcasting (DVB) systems layer, video and audio respectively. For information, some of the key features are summarized below, but clauses 4 to 6 and the annexes should be consulted for all definitions:

Systems:

- MPEG-2 Transport Stream (TS) is used.
- Service Information (SI) is based on MPEG-2 program-specific information.
- Scrambling is as defined in ETSI TS 100 289 [i.15].
- Conditional access uses the MPEG-2 Conditional Access CA_descriptor.
- Partial Transport Streams are used for digital VCR applications.

Video:

- MPEG-2 Main Profile at Main Level is used for MPEG-2 encoded SDTV.
- MPEG-2 Main Profile at High Level is used for MPEG-2 encoded HDTV.
- H.264/AVC Main Profile at Level 3 is used for H.264/AVC SDTV.
- H.264/AVC High Profile at Level 4 is used for 25 Hz and 30 Hz H.264/AVC HDTV.
- H.264/AVC High Profile at Level 4.2 is used for 50 Hz and 60 Hz H.264/AVC HDTV.
- H.264/AVC Scalable High Profile at Level 4 is used for 25 Hz and 30 Hz SVC HDTV.
- H.264/AVC Stereo High Profile at Level 4 is used for 25 Hz and 30 Hz MVC Stereo HDTV.
- H.264/AVC Scalable High Profile at Level 4.2 is used for 50 Hz and 60 Hz SVC HDTV.
- HEVC Main or Main 10 Profile at Level 4.1 is used for HEVC HDTV.
- HEVC Main 10 Profile at Level 5.1 is used for HEVC UHDTV and HEVC HDR UHDTV.
- HEVC Main 10 Profile at Level 5.2 is used for HEVC HFR UHDTV.
- VC-1 Advanced Profile at Level 1 is used for VC-1 SDTV.
- VC-1 Advanced Profile at Level 3 is used for VC-1 HDTV.
- The 25 Hz MPEG-2 SDTV IRD, 25 Hz H.264/AVC SDTV IRD and 25 Hz VC-1 SDTV IRD support 25 Hz frame rate.
- The 25 Hz MPEG-2 HDTV IRD, 25 Hz H.264/AVC HDTV IRD, 50 Hz HEVC HDTV IRD and 25 Hz VC-1 HDTV IRD support frame rates of 25 Hz or 50 Hz.
- The 30 Hz MPEG-2 SDTV IRD, 30 Hz H.264/AVC SDTV IRD and 30 Hz VC-1 SDTV IRD support frame rates of 24 000/1 001, 24, 30 000/1 001 and 30 Hz.
- The 30 Hz MPEG-2 HDTV IRD, 30 Hz H.264/AVC HDTV IRD, 60 Hz HEVC HDTV IRD and 30 Hz VC-1 HDTV IRD supports frame rates of 24 000/1 001, 24, 30 000/1 001, 30, 60 000/1 001 and 60 Hz.
- The HEVC UHDTV IRD and HEVC HDR UHDTV IRD support frame rates of 24 000/1 001, 24, 25, 30 000/1 001, 30, 50, 60 000/1 001 and 60 Hz.
- The HEVC HDR HFR UHDTV IRD supports frame rates of 24 000/1 001, 24, 25, 30 000/1 001, 30, 50, 60 000/1 001, 60, 100, 120 000/1 001 and 120 Hz.

- SDTV pictures may have either 4:3, 16:9 or 2.21:1 aspect ratio; IRDs support 4:3 and 16:9 and optionally 2.21:1 aspect ratio.
- MPEG-2 HDTV pictures have 16:9 or 2.21:1 aspect ratio; IRDs support 16:9 and optionally 2.21:1 aspect ratio.
- H.264/AVC HDTV pictures have 16:9 aspect ratio; IRDs support 16:9 aspect ratio.
- HEVC HDTV and UHDTV pictures have 16:9 aspect ratio; IRDs support 16:9 aspect ratio.
- SVC HDTV pictures have 16:9 aspect ratio; IRDs support 16:9 aspect ratio.
- MVC Stereo HDTV pictures have 16:9 aspect ratio; IRDs support 16:9 aspect ratio.
- VC-1 HDTV pictures have 16:9 aspect ratio; IRDs support 16:9 aspect ratio.
- MPEG-2 IRDs support the use of pan vectors to allow a 4:3 monitor to give a full-screen display of a 16:9 coded picture of SDTV resolution.
- IRDs may also optionally support the use of the Active Format Description (refer to annex B of the present document) as part of the logic to control the processing and positioning of the reconstructed image for display.
- IRDs may also optionally support frame compatible plano-stereoscopic 3DTV services (see annex H).
- IRDs may also optionally support service frame compatible plano-stereoscopic 3DTV services with HEVC coding (see annex J).

Audio:

- Audio content complies with MPEG-1 Layer I, MPEG-1 Layer II, MPEG-2 Layer II backward compatible, AC-3, Enhanced AC-3, AC-4, DTS Audio, DTS-HD, MPEG-4 AAC, MPEG-4 HE AAC, MPEG-4 HE AAC v2 or MPEG-H LC audio. MPEG-1 Layer II, MPEG-4 AAC, MPEG-4 HE AAC and MPEG-4 HE AAC v2 audio streams may optionally include MPEG Surround data.
- Sampling rates of 32 kHz, 44,1 kHz and 48 kHz are supported by IRDs.
- The encoded bitstream does not use emphasis.
- IRDs may also optionally support full multi-channel decoding of MPEG-2 Layer II backwards compatible multi-channel audio.
- The use of Layer II encoding is recommended for MPEG-1 audio bitstreams.
- IRDs may also optionally support the decoding of MPEG-1/-2/-4 audio streams which include ancillary data (see annex C).
- IRDs may also optionally support supplementary-mixed services (see annex E).

1 Scope

The present document provides implementation guidelines for the use of audio-visual coding in satellite, cable and terrestrial broadcasting distribution systems that utilize MPEG-2 Systems. Standard Definition Television (SDTV), High Definition Television (HDTV), Ultra High Definition Television (UHDTV) using HEVC coding, Frame Compatible Plano-Stereoscopic 3DTV and Full Resolution HD 3DTV using MVC Stereo are covered. More specifically, the present document covers the first and second phases of the DVB UHDTV specification, as well as DVB Next Generation Audio specification.

MPEG-2, H.264/AVC, SVC, MVC Stereo, HEVC and VC-1 video coding systems are covered. MPEG-1 Layer I, MPEG-1 Layer II, MPEG-2 Layer II backward compatible, Dolby AC-3, Enhanced AC-3, AC-4, DTS Audio, DTS-HD, MPEG-4 HE AAC, MPEG-4 HE AAC v2 and MPEG-H LC audio coding systems are covered. Furthermore, the combination of MPEG-1 Layer II with MPEG Surround and the combination of MPEG-4 AAC or MPEG-4 HE AAC or MPEG-4 HE AAC v2 with MPEG Surround are covered. Guidelines for devices equipped with a digital interface intended for digital VCR applications are also given in the present document.

It does not cover applications such as contribution services which are likely to be the subject of subsequent "Guidelines" documents.

The rules of operation for the encoders are features and constraints which the encoding system should adhere to in order to ensure that the transmissions can be correctly decoded. These constraints may be mandatory, recommended or optional.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] Recommendation ITU-T H.222.0 / ISO/IEC 13818-1: "Information technology - Generic Coding of moving pictures and associated audio information: Systems", Recommendation ITU-T H.222.0 / ISO/IEC 13818-1 / Amd5: "Generic coding of moving pictures and associated audio information - Part 1: Systems - Amendment 5".

NOTE: Please refer whenever possible to the latest version and subsequent amendments.

[2] Recommendation ITU-T H.262 / ISO/IEC 13818-2: "Information technology - Generic coding of moving pictures and associated audio information: Video".

[3] ISO/IEC 13818-3: "Information technology -- Generic coding of moving pictures and associated audio information -- Part 3: Audio".

[4] ISO/IEC 13818-9: "Information technology -- Generic coding of moving pictures and associated audio information -- Part 9: Extension for real time interface for systems decoders".

[5] Void.

[6] ETSI EN 300 468: "Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems".