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Technical Specification

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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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).

The original TS 101 154 [i.1] was based on the DVB document A001 and it covered only the 25 Hz SDTV Baseline IRD. The first revision of TS 101 154 extended the scope to encompass both the 25 Hz SDTV Baseline IRD and the 25 Hz SDTV IRD with a digital interface intended for connection to a bitstream storage device such as a digital VCR. The second revision covered both the Baseline IRD and the IRD with digital interface for 25 Hz SDTV, 25 Hz HDTV, 30 Hz SDTV and 30 Hz HDTV. Subsequent revisions added optional support for H.264/AVC for video content and optional support of HE AAC and HE AACv2 for audio content, the video Active Format Description (annex B), AC-3 audio and Enhanced AC-3 audio, Ancillary Data for MPEG audio (annex C), the Coding of Data Fields in the Private Data Bytes of the Adaptation Field (annex D), optional support for DTS audio and receiver-mixed audio), optional support of VC-1 for video content, optional support of Closed Captions, Bar Data and RDS. This revision adds optional support for MPEG Surround, supplementary audio, optional support for Clean Audio (annex E) optional support for H.264/AVC High Profile at Level 4.2 for video content, and optional support for SVC for video content.

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.

The present document is complementary to TS 102 154 [i.2], which provides Implementation Guidelines for the use of Video and Audio Coding in Contribution and Primary Distribution Applications based on the MPEG-2 Transport Stream.

The present document is complementary to TS 102 005 [i.3], which provides the specification for the use of Video and Audio Coding in DVB services delivered directly over IP protocols.

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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Founded in September 1993, the DVB Project is a market-led consortium of public and private sector organizations in the television industry. Its aim is to establish the framework for the introduction of MPEG-2 based digital television services. Now comprising over 200 organizations from more than 25 countries around the world, DVB fosters market-led systems, which meet the real needs, and economic circumstances, of the consumer electronics and the broadcast industry.

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" or "HDTV", 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.

- "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, SVC 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.

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. Where a feature or constraint is mandatory, the word "shall" is used and the text is italic; all other features are 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 ETR 289 [5].
- 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 Scalable High Profile at Level 4.2 is used for 50 Hz and 60 Hz SVC HDTV.
- 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 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 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.
- 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.