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Digitalna videoradiodifuzija (DVB) – Smernice za uvajanje uporabe sistemov MPEG -2, videa in avdia v satelitskih, kabelskih in prizemnih radiodifuzijskih aplikacijah

Digital Video Broadcasting (DVB); Implementation guidelines for the use of MPEG-2 Systems, Video and Audio in satellite, cable and terrestrial broadcasting applications

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Foreword

This ETSI Technical Report (ETR) has been produced under the authority of the Joint Technical Committee (JTC) of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECtrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

This ETR is based on the DVB document A001 revision 2, dated July 1997, and it may be converted into an ETS after market feedback. For this purpose, the wording of an ETS rather than an ETR is used.

ETRs are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature, relating to the use or the application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or an I-ETS.

NOTE: The EBU/ETSI JTC was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC 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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Digital Video Broadcasting (DVB) Project

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

This ETR presents guidelines covering coding and decoding using the MPEG-2 system layer, video coding and audio coding as defined in ISO/IEC 13818-1 [1], ISO/IEC 13818-2 [2] and ISO/IEC 13818-3 [3] respectively.

The guidelines presented in this ETR 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 bit-streams.

IRDs are classified in three dimensions as:

- "25 Hz" or "30 Hz", depending on whether the nominal video frame rates based on 25 Hz or 30000/1001 Hz (approximately 29,97 Hz) are supported. It is expected that 25 Hz IRDs will be used in those countries where the existing analogue TV transmissions use 25 Hz frame rate and 30 Hz IRDs will be used in countries where the analogue TV transmissions use 30000/1001 Hz frame rate. There are also likely to be "dual-standard" IRDs which have the capabilities of both 25 Hz and 30 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.

To give a complete definition of an IRD, all three dimensions need to be specified, e.g. 25 Hz SDTV Baseline IRD.

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 Main Profile at Main Level. The IRD receiving the bitstream may then up-convert the decoded picture for display at HDTV resolution. With suitable down-conversion and up-conversion, the quality of the resultant HDTV picture may be close to that of the original HDTV source.

Another notable feature of the DVB system is that a single Transport Stream (TS) 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 TS.

Where a feature described in this ETR 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 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 IRD's 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 bit-stream syntax;

- all "reserved" and "private" bits in MPEG-2 systems, video and audio 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 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 should be consulted for all definitions:

Systems:

- MPEG-2 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 TSs are used for digital VCR applications.

Video:

- MPEG-2 Main Profile at Main Level is used for SDTV;
- MPEG-2 Main Profile at High Level is used for HDTV;
- the 25 Hz SDTV IRD supports 25 Hz frame rate;
- the 25 Hz HDTV IRD supports frame rates of 25 Hz or 50 Hz;
- the 30 Hz SDTV IRD supports frame rates of 24000/1001, 24, 30000/1001 and 30 Hz;
- the 30 Hz HDTV IRD supports frame rates of 24000/1001, 24, 30000/1001, 30, 60000/1001 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;
- HDTV pictures have 16:9 or 2.21:1aspect ratio; IRDs support 16:9 and optionally 2.21:1 aspect ratio;
- 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.

Audio:

- MPEG-2 Layer I and Layer II is supported by the IRD;
- the use of Layer II is recommended for the encoded bit-stream;
- IRDs support single channel, dual channel, joint stereo, stereo and the extraction of at least a stereo pair from MPEG-2 compatible multi-channel audio;
- sampling rates of 32 kHz, 44,1 kHz and 48 kHz are supported by IRDs;
- the encoded bit-stream does not use emphasis.

1 Scope

This ETSI Technical Report (ETR) provides implementation guidelines for the use of MPEG-2 audio-visual coding in satellite, cable and terrestrial broadcasting distribution systems. Both Standard Definition Television (SDTV) and High Definition Television (HDTV) are covered. Guidelines for devices equipped with a digital interface intended for digital VCR applications are also given in this ETR. 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

This ETR incorporates by dated and undated reference, provisions from other publications. These references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETR only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ISO/IEC 13818-1 (1996): "Coding of moving pictures and associated audio - Part 1: Systems".

[2] ISO/IEC 13818-2 (1996): "Coding of moving pictures and associated audio - Part 2: Video".

[3] ISO/IEC 13818-3 rev1 (1997): "Coding of moving pictures and associated audio - Part 3: Audio".

[4] ISO/IEC 13818-9 (1996): "Coding of moving pictures and associated audio - Part 9: Extension for Real-Time-Interface for systems decoders ".

[5] ETR 289: "Digital Video Broadcasting (DVB); Common Scrambling (CS) system description".

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

[7] ETR 211: "Digital Video Broadcasting (DVB); Guidelines for the usage of Service Information (SI) in DVB systems".

[8] ISO/IEC 11172-1: "Information Technology - Coding of moving pictures and associated audio for digital storage media up to about 1,5 Mbit/s - Part 1: Systems".

[9] ITU-T Recommendation J.17 (1988): "Pre-emphasis used on sound-programme circuits".

[10] IEC CD - 100C/1883: Parts 1 and 4.

[11] EBU Recommendation R.68: "Alignment level in digital audio production equipment and in digital audio recorders".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETR, the following definitions apply:

25hz SDTV IRD: An IRD which is capable of decoding and displaying pictures based on a nominal video frame rate of 25 Hz from MPEG-2 Main Profile, Main Level bitstreams as specified in this ETR.

25hz SDTV bitstream: A bitstream which contains only Main Profile, Main Level video at 25 Hz frame rate as specified in this ETR.

25hz HDTV IRD: An IRD that is capable of decoding and displaying pictures based on a nominal video frame rate of 25 Hz or 50 Hz from MPEG-2 Main Profile, High Level bitstreams as specified in this ETR, in addition to providing the functionality of a 25 Hz SDTV IRD.

25hz HDTV bitstream: A bitstream which contains only Main Profile, High Level (or simpler) video at 25 Hz or 50 Hz frame rates as specified in this ETR.

30hz SDTV IRD: An IRD which is capable of decoding and displaying pictures based on a nominal video frame rate of 24000/1001(approximately 23,98), 24, 30000/1001 (approximately 29,97) or 30 Hz from MPEG-2 Main Profile at Main Level bitstreams as specified in this ETR.

30hz SDTV bitstream: A bitstream which contains only Main Profile, Main Level video at 24000/1001, 24, 30000/1001 or 30 Hz frame rate as specified in this ETR.

30hz HDTV IRD: An IRD that is capable of decoding and displaying pictures based on nominal video frame rates of 24000/1001, 24, 30000/1001, 30, 60/1001 or 60 Hz from MPEG-2 Main Profile, High Level bitstreams as specified in this ETR, in addition to providing the functionality of a 30 Hz SDTV IRD.

30hz HDTV bitstream: A bitstream which contains only Main Profile, High Level (or simpler) video at 24000/1001, 24, 30000/1001, 30, 60/1001 or 60 Hz frame rates as specified in this ETR.

baseline IRD: An IRD which provides the minimum functionality to decode transmitted bitstreams as recommended in this ETR. It is not required to have the ability to decode Partial Transport Streams (TSs) as may be received from a digital interface connected to digital bitstream storage device such as a digital VCR.

IRD with digital interface: An IRD which has the ability to decode Partial Transport Streams (TSs) received from a digital interface connected to digital bitstream storage device such as a digital VCR as specified in this ETR, in addition to providing the functionality of a Baseline IRD.

pan vector: Horizontal offset in video frame centre position.

Partial Transport Stream (TS): Bitstream derived from an MPEG-2 TS by removing those TS Packets that are not relevant to one particular selected programme, or a number of selected programmes.

3.2 Abbreviations

For the purposes of this ETR, the following abbreviations apply:

CA	Conditional Access
DVB	Digital Video Broadcasting
ES	Elementary Stream
ESCR	Elementary Stream Clock Reference
I-Frame	Intra-coded Frame
IRD	Integrated Receiver-Decoder
HDTV	High Definition TeleVision
MPEG	Moving Pictures Experts Group
NIT	Network Information Table
PAT	Program Association Table
PCR	Program Clock Reference

PES	Packetized Elementary Stream
PID	Packet IDentifier
PMT	Program Map Table
PSI	Program Specific Information
PSW	Pan and Scan Window
SI	Service Information
SDTV	Standard Definition Television
STD	System Target Decoder
TS	Transport Stream
TSDT	Transport Stream Description Table
T-STD	Transport Stream System Target Decoder
VCR	Video Cassette Recorder

4 Systems layer

This clause describes the guidelines for encoding the systems layer of MPEG-2 in DVB broadcast bit-streams, and for decoding this layer in the IRD. The source bitstream may be transmitted via a satellite, cable or terrestrial channel, or via a digital interface. Subclause 4.1 applies to the encoding of all source bitstreams and their decoding by a Baseline IRD. Subclause 4.2 gives specific information relating to bitstreams transmitted via a digital interface intended for VCR applications and decoding by IRDs equipped with such an interface.

4.1 Broadcast bitstreams and Baseline IRDs

The multiplexing of baseband signals and associated data conforms to ISO/IEC 13818-1 [1]. Some of the parameters and fields are not used in the DVB System and these restrictions are described below. *To allow full compliance to ISO/IEC 13818-1 [1] and upward compatibility with future enhanced versions, a DVB IRD shall be able to skip over data structures which are currently "reserved", or which correspond to functions not implemented by the IRD.* As an example of this capability, a descriptor tag not yet defined within the DVB System shall be interpreted as a no-action tag, its length field correctly decoded and subsequent data skipped.

For the same reason, IRD design should be made under the assumption that any legal structure as permitted by ISO/IEC 13818-1 [1] may occur in the broadcast stream even if presently reserved or unused. Therefore the following is assumed:

- *private data shall only be acted upon by decoders which are so enabled;*

- *filling out the bit-stream shall be carried out using the normal stuffing mechanism. Reserved fields shall not be used for this purpose. Data of reserved fields shall be set to 0xFF.*

The headings below in this clause are based on ISO/IEC 13818-1 [1]. The numbers in brackets after the headings are the relevant chapter and section headings of ISO/IEC 13818-1 [1].

4.1.1 Introduction (ISO/IEC 13818-1, section 0)

MPEG-2 systems specify two types of multiplexed data stream: the Transport Stream (TS) and the program stream.

Encoding: *The transmitted multiplex shall use the TS.*

Decoding: *All Baseline IRDs shall be able to demultiplex the MPEG-2 TS.* Demultiplexing of program streams (as described in sections 0.2 and 0.3 of [1]) is optional.

4.1.2 Packetized Elementary Stream (PES) (ISO/IEC 13818-1, section 0.4)

Encoding: The creation of a physical Packetized Elementary Stream (PES) by an encoder is not required. ESCR fields and ES rate fields need not be coded.

Decoding: ESCR fields and ES rate fields need not be decoded.