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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); DVB implementation guidelines for the use of MPEG-2 Systems, Video and Audio in satellite and cable broadcasting applications

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Digital Video Broadcasting (DVB); Implementation guidelines for the use of MPEG-2 systems; Video and audio in satellite and cable 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 1, dated June 1995, 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 ETSs 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 organisations 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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Introduction

This ETR presents guidelines covering coding and decoding using the MPEG-2 system defined in ISO/IEC 13818 [1].

The guidelines presented in this ETR for the Integrated Receiver-Decoder (IRD) are intended to represent a minimum functionality that all IRDs are assumed 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.

Where a feature is mandatory, the word "shall" is used and the text is in *italics*; 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 by Baseline IRDs. These may be mandatory or optional. Where a feature or constraint is mandatory, the word "shall" is used and the text is *italics*; all other features are optional.

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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 summarised below, but clauses 4 to 6 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 by the Conditional Access (CA) Technical Group;
- conditional access uses the MPEG-2 Conditional Access CA_descriptor.

Video:

- MPEG-2 Main Profile at Main Level is used;
- the frame rate is 25 Hz;
- encoded 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 ratios;
- 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;
- IRDs support a full-screen display of 720 x 576 pixels (and a nominal full-screen display of 704 x 576);
- IRDs provide appropriate upconversion to produce a full-screen display of 544 x 576 and 480 x 576 and a nominal full-screen display of 352 x 576 and 352 x 288 pixels.

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 ETR provides implementation guidelines for the use of MPEG-2 audio-visual coding [1] in satellite and cable broadcasting systems offering conventional resolution digital television. It does not cover applications such as terrestrial broadcasting, interactive services or High Definition Television (HDTV) which are likely to be the subject of subsequent "Guidelines" deliverables.

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 by Baseline IRDs. These may be 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 IS 13818-1 (1995): "Coding of moving pictures and associated audio - Part 1: Systems".
- [2] ISO/IEC IS 13818-2 (1994): "Coding of moving pictures and associated audio - Part 2: Video".
- [3] ISO/IEC IS 13818-3 (1994): "Coding of moving pictures and associated audio - Part 3: Audio".
- [4] Not available for this edition of the ETR. The DVB Project planned an ETR XXX: "Final Technical Report of the Conditional Access Specialists Group (TM 1244)". The substance of this future ETR is contained in the DVB document TM 1244 which is available at the DVB Project Office in the EBU.
- [5] ETS 300 468 (1995): "Digital broadcasting systems for television, sound and data services, Specification for Service Information (SI) in Digital Video Broadcasting (DVB) systems".
- [6] ISO/IEC 11172-1 (1993): "Information Technology - Coding of moving pictures and associated audio for digital storage media up to about 1,5 Mbit/s - Part 1: Systems".
- [7] ITU-T Recommendation J.17 (1988): "Pre-emphasis used on sound-programme circuits".

3 Definitions and abbreviations

3.1 Definitions

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

baseline IRD: An IRD which provides the minimum functionality recommended in this ETR.

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

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
STD	Standard Target Decoder
TS	Transport Stream
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 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 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 Introduction (ISO/IEC 13818-1 [1], section 0)

MPEG-2 systems specify two types of multiplexed data stream: the transport stream and the program stream.

Encoding: *The transmitted multiplex shall use the transport stream.*

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

4.2 Packetized Elementary Stream (PES) (ISO/IEC 13818-1 [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.

4.3 Transport stream system target decoder (ISO/IEC 13818-1 [1], section 2.4.2)

Encoding: *The system clock frequency shall conform to the tolerance specified in section 2.4.2.1 of ISO/IEC 13818-1 [1]. It is recommended that the tolerance is within 5 parts per million.*

Decoding: *The IRD shall operate over the full tolerance range of the system clock frequency specified in section 2.4.2.1 of ISO/IEC 13818-1 [1].*

4.4 Transport packet layer (ISO/IEC 13818-1 [1], section 2.4.3.2)**4.4.1 Null packets**

Encoding: *The encoding of null packets (those with PID value 0x1FFF) shall be as specified in ISO/IEC 13818-1 [1].*

4.4.2 Transport packet header**4.4.2.1 transport_error_indicator**

Encoding: It is recommended that any error detecting devices in a transmission path should set the **transport_error_indicator** bit when uncorrectable errors are detected.

Decoding: The **transport_error_indicator** flag is set in the transmitted stream it is recommended that the IRD should then invoke a suitable concealment or error recovery mechanism.

4.4.2.2 transport_priority

Decoding: The **transport_priority** bit has no meaning to the IRD, and may be ignored.

4.4.2.3 transport_scrambling_control

Encoding: *The transport_scrambling_control bits shall be set according to table 1, in accordance with ETR XXX [4].*

Table 1: Values for transport_scrambling_control

Value	Description
00	no scrambling of TS packet payload
01	reserved for future DVB use
10	TS packet scrambled with Even key
11	TS packet scrambled with Odd key

Decoding: *These bits shall be read by the IRD, and the IRD shall respond in accordance with table 1.*

4.4.2.4 Packet Identifier (PID) values for Service Information (SI) Tables

Encoding: The assignment of PID values for SI data is given in ETS 300 468 [5].

4.5 Adaptation field (ISO/IEC 13818-1 [1], section 2.4.3.4)**4.5.1 Random_access_indicator**

Encoding: It is recommended that the **random_access_indicator** bit is set whenever a random access point occurs in video streams (i.e. video sequence header immediately followed by an I-frame).

4.5.3 elementary_stream_priority_indicator

Decoding: The **elementary_stream_priority_indicator** bit may be ignored by the IRD.

4.5.4 Program Clock Reference (PCR)

Encoding: *The time interval between two consecutive PCR values of the same program shall not exceed 100 milliseconds as specified in section 2.7.3 of ISO/IEC 13818-1 [1]. It is recommended that this interval should be no greater than 40 milliseconds.*

Decoding: *The IRD shall operate correctly with PCRs for a program arriving at intervals not exceeding 100 milliseconds.*