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Digital Video Broadcasting (DVB) - Subtitling systems

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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.

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Date of withdrawal of any conflicting National Standard (dow):	31 July 2019

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Modal verbs terminology

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1 Scope

The present document specifies the method by which subtitles, logos and other graphical elements may be coded and carried in DVB bitstreams. The system applies Colour Look-Up Tables (CLUTs) to define the colours of the graphical elements. The transport of the coded graphical elements is based on the MPEG-2 Transport Stream described in ISO/IEC 13818-1 [1].

2 References

2.1 Normative references

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

[1] ISO/IEC 13818-1: "Information technology - Generic coding of moving pictures and associated audio information. Part 1: Systems".

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

[3] Recommendation ITU-R BT.601: "Studio encoding parameters of digital television for standard 4:3 and wide-screen 16:9 aspect ratios".

[4] Recommendation ITU-R BT.656-4: "Interface for digital component video signals in 525-line and 625-line television systems operating at the 4:2:2 level of Recommendation ITU-R BT.601 (Part A)".

[5] ETSI EN 300 743 (V1.2.1): "Digital Video Broadcasting (DVB); Subtitling systems".

[6] ETSI EN 300 743 (V1.3.1): "Digital Video Broadcasting (DVB); Subtitling systems".

[7] ETSI EN 300 743 (V1.4.1): "Digital Video Broadcasting (DVB); Subtitling systems".

[8] ETSI EN 300 743 (V1.5.1): "Digital Video Broadcasting (DVB); Subtitling systems".

[9] ETSI TS 101 154: "Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream".

[10] Recommendation ITU-R BT.709: "Parameter values for the HDTV standards for production and international programme exchange".

[11] Recommendation ITU-R BT.2020-2: "Parameter values for ultra-high definition television systems for production and international programme exchange".

[12] Recommendation ITU-R BT.2100-1: "Image parameter values for high dynamic range television for use in production and international programme exchange".

[13] Recommendation ITU-R BT.1886: "Reference electro-optical transfer function for flat panel displays used in HDTV studio production".

[14] IETF RFC 1950: "ZLIB Compressed Data Format Specification", (Version 3.3).

[15] IETF RFC 1951: "DEFLATE Compressed Data Format Specification", (Version 1.3).

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[16] ISO/IEC 15948: "Information technology, Computer graphics and image processing, Portable Network Graphics (PNG): Functional specification".

[17] ETSI ETS 300 743: "Digital Video Broadcasting (DVB); Subtitling systems".

2.2 Informative references

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Not applicable.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

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ancillary page: means of conveying subtitle elements that may be shared by multiple **subtitle services** within a **subtitle stream**, used for example to carry logos or character glyphs

Colour Look-Up Table (CLUT): look-up table applied in each region for translating the objects' pseudo-colours into the correct colours to be displayed

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CLUT family: family of CLUTs sharing the same CLUT_id, which consists of three CLUTs for rendering in Recommendation ITU-R BT.601 [3] colour space, each of which is pre-populated with a **default CLUT**; - one with 4 entries, one with 16 entries, and one with 256 entries; and optionally one or more alternative CLUTs (provided in the ACS) for rendering in colour and/or dynamic range systems other than Recommendation ITU-R BT.601 [3]

composition page: means of conveying subtitle elements for one specific **subtitle service**

default CLUT: CLUT populated with a set of preset colour entries that provide a useful range of colours within the limit of the maximum number of entries in the respective CLUT

display definition: definition of the video image display resolution for which a subtitle stream has been prepared

display set: set of **subtitle segments** of a specific **subtitle service** to which the same **PTS** value is associated

epoch: period of time for which the decoder maintains an invariant memory layout, in the form of the defined **page compositions**

next_bits(n): function that provides the next 'n' bits in the bitstream, without advancing the bitstream pointer, which permits the comparison of those bit values with another sequence of bit values of the same length

object: graphical unit, identified by its own object_id, that can be positioned within a **region**; examples of an object include a character glyph, a logo, a map, etc.

Packet IDentifier (PID): Transport packet identifier, as defined in ISO/IEC 13818-1 [1].

page: set of subtitles for a **subtitle service** during a certain period, consisting of one or more **page instances** whereby each page update or refresh will result in a new page instance. A page contains a number of **regions**, and in each region there can be a number of **objects**

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page composition: composition (use and positioning) of **regions** that may be displayed within the **page**, whereby only one page composition is active for displaying at any one time, and changes can occur at any new **page instance**, for example some regions might not be displayed yet, or some regions might no longer be displayed

page instance: period of time, typically initiated with the **PTS** of a **display set,** during which that **page** does not change i.e. there is no change to the **page composition**, to any **region composition**, to any **object** within a **region** or any applicable **CLUT**

PES packet: See ISO/IEC 13818-1 [1].

pixel-data: string of data bytes that contains, in coded form, the representation of a graphical object

Presentation Time Stamp (PTS): See ISO/IEC 13818-1 [1].

region: rectangular area on the **page** in which **objects** can be positioned

region composition: composition (use and positioning) of **objects** within a **region**

reserved: When used in a clause defining the coded bit stream, this field indicates that the value may be used for extensions in the future. Unless specified otherwise within the present document, all "reserved" bits are expected to be set to "1".

reserved_zero_future_use: When used in clauses defining the coded bit stream, this field indicates that the value may be used in future revisions for ETSI-defined extensions. All "reserved_zero_future_use" bits are expected to be set to "0".

subtitle element: subtitle data used within a **page composition** and contained within a **subtitle segment**, for example r**egions**, **region compositions**, **CLUT** definitions and **object** data

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subtitle segment: basic syntactical element of a **subtitle stream**

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subtitle service: service, displayed as a series of one or more **pages**, that provides subtitling for a program for a certain purpose and to satisfy a single communication requirement, such as subtitles in a specific language for one program or subtitles for the hard of hearing

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subtitle stream: stream containing one or more **subtitle services** and consisting of **subtitling segment**s carried in **transport packet**s identified by the same **PID**

transport packet: See ISO/IEC 13818-1 [1].

transport stream: stream of **transport packet**s carrying one or more MPEG programs, as defined in ISO/IEC 13818-1 [1].

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

3DTV	plano-stereoscopic Three-Dimensional TeleVision
ACS	Alternative CLUT Segment
B	Blue value of colour representation in default CLUT
bslbf	bit string, left bit first
Cb	Chrominance value representing B-Y colour difference signal

NOTE: As defined in Recommendation ITU-R BT.601 [3], clause 7.2.3.

CLUT	Colour Look-Up Table
CLUT_id	CLUT identifier
Cr	Chrominance value representing R-Y colour difference signal

NOTE: As defined in Recommendation ITU-R BT.601 [3], clause 7.2.3.

DDS	Display Definition Segment
DSS	Disparity Signalling Segment
DTV	Digital TeleVision
DVB	Digital Video Broadcasting

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EDS End of Display Set Segment

NOTE: As defined in ETSI EN 300 468 [2].

G Green value of colour representation in default CLUT
GOP Group Of Pictures
HDR High Dynamic Range
HDTV High Definition TeleVision
HLG Hybrid Log-Gamma
IRD Integrated Receiver Decoder
MPEG Moving Pictures Experts Group

NOTE: WG11 in SC 29 of JTC1 of ISO/IEC.

PCR Programme Clock Reference

NOTE: As defined in ISO/IEC 13818-1 [1].

PCS Page Composition Segment
PES Packetized Elementary Stream

NOTE: As defined in ISO/IEC 13818-1 [1].

PID Packet IDentifier

NOTE: As defined in ISO/IEC 13818-1 [1].

PMT Program Map Table

NOTE: As defined in ISO/IEC 13818-1 [1].

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PNG Portable Network Graphics

NOTE: As defined in ISO/IEC 15948 [16].

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PQ Perceptual Quantization
PSI Program Specific Information

NOTE: As defined in ISO/IEC 13818-1 [1].

PTS Presentation Time Stamp

NOTE: As defined in ISO/IEC 13818-1 [1].

R Red value of colour representation in default CLUT
RCS Region Composition Segment
ROM Read-Only Memory
SDR Standard Dynamic Range

NOTE: As defined in ETSI EN 300 468 [2].

SDTV Standard Definition TeleVision
SI Service Information
STC System Time Clock

NOTE: As defined in ISO/IEC 13818-1 [1].

T Transparency value
TS Transport Stream

NOTE: As defined in ISO/IEC 13818-1 [1].

UHDTV Ultra-High Definition TeleVision
uimsbf unsigned integer, most significant bit first
tcimsbf two's complement integer, msb (sign) bit first

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Y	luminance value

NOTE: As defined in Recommendation ITU-R BT.601 [3], clause 7.2.3.

CDS	CLUT Definition Segment
ODS	Object Data Segment
RGB	Red Green Blue
CRC	Cyclic Redundancy Check
AV	Audio Video
PLTE	Palette Table
IDAT	Image Data
IHDR	Image Header

4 Introduction to the DVB subtitling system (informative)

4.1 General

The present clause provides an informative introduction to the DVB subtitling system.

Clause 4.2 first provides an account of the evolution of the present document in relation to the continual enhancement of video formats used by DVB services.

Clause 4.3 introduces the basic concepts and terminology for DVB subtitling.

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Clause 4.4 describes the composition of the DVB subtitling data structure.

Clause 4.5 describes the DVB subtitling segment coding method.

Clause 4.6 describes the method of transport of DVB subtitling content.

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Clause 4.7 describes the subtitling data hierarchy.

Clause 4.8 describes the subtitling temporal hierarchy and terminology.

The normative specification of the subtitling system is contained in clauses 5 to 10.

4.2 Subtitling system evolution and service compatibility

4.2.1 Introduction

The present document has been revised several times in order to introduce new features and maintain its applicability as new types of DVB service emerged, namely HDTV, 3DTV, and most recently UHDTV, all of which are specified in ETSI TS 101 154 [9] as regards codec usage, and ETSI EN 300 468 [2] as regards signalling. Maintenance revisions have been made in addition to these. The remainder of the present clause summarizes the history of the present document in relation to its revisions, whereas clause 4.2.6 provides a summary of subtitle service compatibility issues resulting from the multiple versions of the present document.

4.2.2 V1.1.1 and V1.2.1

The first edition of the present document [17], published in 1997, specified the subtitling system only for SDTV services, as defined in ETSI TS 110 154 [9] and ETSI EN 300 468 [2].

ETSI EN 300 743 [5] (V1.2.1) of the present document was a general maintenance revision.

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4.2.3 V1.3.1

ETSI EN 300 743 [6] (V1.3.1) of the present document added support for subtitles for HDTV services, as defined in ETSI TS 101 154 [9] and ETSI EN 300 468 [2]. In V1.3.1 a new optional segment was specified, namely the **display definition segment** (DDS). The DDS explicitly defines the display resolution for which that stream has been created, i.e. it allows subtitles with display resolutions other than that for SDTV to be provided, and optionally allows subtitles to be positioned within a window that constitutes only a part of the full display resolution.

The DDS is not needed with subtitle streams associated with SDTV services, thus they can be encoded in accordance with ETSI EN 300 743 (V1.2.1) [5]. Such streams will nevertheless be decodable by decoders compliant with any later versions of the present document.

Subtitles are encoded using Recommendation ITU-R BT.601 [3] colorimetry, i.e. the same as that used in video components of SDTV services. HDTV systems use Recommendation ITU-R BT.709 [10] colorimtery, but that distinction was not taken into account when the present document was revised to include HDTV-resolution subtitles in ETSI EN 300 743 (V1.3.1) [6]. Due to the small differences between these two systems, in practice it does not matter which one is ultimately used to render the subtitles.

4.2.4 V1.4.1 and V1.5.1

Version 1.4.1 of the present document added support for subtitles for 3DTV services, as defined in ETSI TS 101 154 [9] and ETSI EN 300 468 [2]. In ETSI EN 300 743 (V1.4.1) [7] a new optional subtitling segment was specified, namely the **disparity signalling segment** (DSS). The DSS enables a region or part of a region to be attributed with a disparity value, to facilitate the optimal rendering of subtitles over 3DTV content.

ETSI EN 300 743 (V1.5.1) [8] of the present document was a general maintenance revision.

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4.2.5 V1.6.1

Version 1.6.1 of the present document adds explicit support of subtitling for UHDTV services, as defined in ETSI TS 101 154 [9] and ETSI EN 300 468 [2].

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The latest revision of the present document, V1.6.1, introduces technical extensions specifically for progressive-scan subtitle object coding and the capability to provide the subtitle CLUT in other colour systems in addition to Recommendation ITU-R BT.601 [3]. These extensions are partitioned clearly by the definition of a new *subtitling_type* to be used in subtitle services that make use of any of these new features, so that no changes for existing implementations according to V1.5.1 or earlier versions of the present document are implied.

Video content for UHDTV services, as defined in ETSI TS 110 154 [9], uses Recommendation ITU-R BT.2020-2 [11] colorimetry. Since that colour system is vastly enhanced compared to Recommendation ITU-R BT.709 [10] and Recommendation ITU-R BT.601 [3], the capability was introduced in V1.6.1 of the present document to enable the subtitle service to provide the CLUT for rendering in Recommendation ITU-R BT.2020-2 [11] / Recommendation ITU-R BT.2100-1 [12] colour volume, using the **alternative CLUT segment** (ACS), in addition to the legacy CLUT(s) defined by the default CLUTs and the CLUT definition segment (CDS). This allows IRDs that support graphics rendering in Recommendation ITU-R BT.2020-2 [11] and, if applicable, HDR to render directly both video and bitmap subtitles without conversion of colour and dynamic range.

Version 1.6.1 of the present document also adds support of subtitles in progressive-scan format, whereby the subtitle objects are in a format that can be converted conveniently from a suitably coded PNG [16] file. Such subtitle objects are not compatible with IRDs that were designed to be compatible with version 1.5.1 of the present document or earlier.

The DDS is also included in subtitle streams intended for UHDTV services, whereby subtitle graphics rendering is constrained to HDTV resolution. Where the display window feature of the DDS is not used, the UHDTV IRD upscales the subtitles spatially before rendering them on a UHDTV resolution display.

Subtitle streams associated with SDTV or HDTV services and intended to be decoded by decoders designed to ETSI EN 300 743 (V1.5.1) [8] or an earlier version naturally make use of neither the alternative CLUT segment (ACS), nor of the new object coding method for progressively coded subtitle bitmaps.