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HDR Signalling and Carriage of Dynamic Metadata for Colour Volume Transform; Application #1 for DVB compliant systems

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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).

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).

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Introduction

SMPTE ST 2094-10 [4] HDR dynamic metadata provides and describes dynamic information about the video signal. The usage of this information can be employed by the display to adapt the delivered HDR imagery to the capability of the display device. The information conveyed in the SEI message carrying SMPTE ST 2094-10 [4] HDR dynamic metadata is adequate for purposes corresponding to the use of Society of Motion Picture and Television Engineers SMPTE ST 2094-1 [3] "Dynamic Metadata for Color Volume Transform - Core Components" and SMPTE ST 2094-10 [4] "Dynamic Metadata for Color Volume Transform - Application #1".

1 Scope

The present document specifies the format of the HEVC SEI message for the carriage of SMPTE ST 2094-10 [4] HDR dynamic metadata.

The present document provides the guidelines for the carriage and signalling the presence of SMPTE ST 2094-10 [4] HDR dynamic metadata (carried in SEI messages defined in the present document) for DVB systems, using private data signalling methods compatible with those defined in ETSI TS 101 154 [8], ETSI TS 103 285 [9] and ETSI EN 300 468 [6].

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 referenced document (including any amendments) applies.

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

- [1] SMPTE ST 2084:2014: "High Dynamic Range Electro-Optical Transfer Function of Mastering Reference Displays".
- [2] SMPTE ST 2086:2014: "Mastering Display Color Volume Metadata Supporting High Luminance And Wide Color Gamut Images".
- [3] SMPTE ST 2094-1:2016: "Dynamic Metadata for Color Volume Transform - Core Components".
- [4] SMPTE ST 2094-10:2016: "Dynamic Metadata for Color Volume Transform - Application #1".
- [5] Recommendation ITU-T H.265 | ISO/IEC 23008-2: "Information technology - High efficiency coding and media delivery in heterogeneous environments - Part 2: High efficiency video coding".
- [6] ETSI EN 300 468: "Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems".
- [7] ETSI TS 101 211: "Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)".
- [8] 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".
- [9] ETSI TS 103 285: "Digital Video Broadcasting (DVB); MPEG-DASH Profile for Transport of ISO BMFF Based DVB Services over IP Based Networks".
- [10] Recommendation ITU-T T.35: "Procedure for the allocation of ITU-T defined codes for non-standard facilities".

2.2 Informative 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 referenced document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] Recommendation ITU-R BT.2246-2: "The present state of ultra-high definition television".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

display mapping: adapting the signal to the dynamic range and the colour gamut of the target display

dynamic range: the ratio of the maximum light intensity to the minimum light intensity [i.1]

NOTE: In digital cameras the dynamic range is normally measured in terms of stops, which describe the total light range by power of 2.

extended display mapping metadata: subset of the ST2094_data() structure

high dynamic range: typically, a dynamic range of more than 10 stops is referred to as high dynamic range

standard dynamic range: typically, a dynamic range of up to 10 stops is referred to as standard dynamic range

3.2 Symbols

3.2.1 Arithmetic operators

For the purposes of the present document, the following arithmetic operators apply:

+	Addition
-	Subtraction (as a two-argument operator) or negation (as a unary prefix operator)
x	Multiplication, including matrix multiplication
÷	Used to denote division in mathematical equations where no truncation or rounding is intended
/	Integer division with truncation of the result toward zero

EXAMPLE: $7/4$ and $-7/-4$ are truncated to 1 and $-7/4$ and $7/-4$ are truncated to -1.

3.2.2 Relational operators

For the purposes of the present document, the following relational operators apply:

>	Greater than
>=	Greater than or equal to
<	Less than
<=	Less than or equal to
==	Equal to
!=	Not equal to

3.2.3 Assignment operators

For the purposes of the present document, the following assignment operators apply:

=	Assignment operator
++	Increment, i.e. x is equivalent to $x = x + 1$; when used in an array index, evaluates to the value of the variable prior to the increment operation
--	Decrement, i.e. $x-$ is equivalent to $x = x - 1$; when used in an array index, evaluates to the value of the variable prior to the decrement operation
+=	Increment by amount specified, i.e. $x += 4$ is equivalent to $x = x + 4$, and $x += (-4)$ is equivalent to $x = x + (-4)$
-=	Decrement by amount specified, i.e. $x -= 4$ is equivalent to $x = x - 4$, and $x -= (-4)$ is equivalent to $x = x - (-4)$

3.2.4 Mathematical functions

For the purposes of the present document, the following mathematical functions apply:

$$\text{Abs}(x) = \begin{cases} x & ; \quad x \geq 0 \\ -x & ; \quad x < 0 \end{cases}$$

$$\text{Clip3}(x, y, z) = \begin{cases} x & ; \quad z < x \\ y & ; \quad z > y \\ z & ; \quad \textit{otherwise} \end{cases}$$

Floor(x) the largest integer less than or equal to x .

$$\text{Round}(x) = \text{Sign}(x) * \text{Floor}(\text{Abs}(x) + 0,5)$$

$$\text{Sign}(x) = \begin{cases} 1 & ; \quad x > 0 \\ 0 & ; \quad x = 0 \\ -1 & ; \quad x < 0 \end{cases}$$

3.3 Abbreviations

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

CVS	Coded Video Sequence
EIT	Event Information Table
EN	European Standard
HDR	High Dynamic Range
HEVC	High Efficiency Video Coding
HFR	High Frame Rate
IRD	Integrated Receiver-Decoder
ITU-R	International Telecommunications Union - Radiocommunications standardization sector
ITU-T	International Telecommunications Union - Telecommunications standardization sector
MPEG	Moving Picture Expert Group
PID	Packet Identifier
PQ	Perceptual Quantizer

NOTE: As defined in SMPTE ST 2084 [1].

SDT	Service Description Table
SEI	Supplemental Enhancement Information
SI	Service Information
SMPTE	Society of Motion Pictures and Television Engineers
ST	Standard
UHDTV	Ultra High Definition Television

4 ST2094-10_data() structure definition

4.1 Introduction

This clause specifies the syntax and semantics of ST2094-10_data() structure.

Clause 4.1 defines the syntax of the ST2094-10_data() structure.

Clause 4.2 defines the semantics of the ST2094-10_data() structure.

NOTE: The metadata elements of the ST2094-10_data() structure are defined according to the SMPTE standards ST 2086 [2], ST 2094-1 [3] and ST 2094 -10 [4].

4.2 ST2094-10_data() structure syntax

The parsing process of each syntax element by the descriptor u(n) is described in Recommendation ITU-T H.265 [5].

Table 1: ST2094-data() syntax

ST2094-10_data () {	Descriptor
app_identifier	ue(v)
app_version	ue(v)
metadata_refresh_flag	u(1)
if(metadata_refresh_flag) {	
num_ext_blocks	ue(v)
if(num_ext_blocks) {	
while(!byte_aligned())	
dm_alignment_zero_bit	f(1)
for(i = 0; i < num_ext_blocks; i++) {	
ext_dm_data_block(i)	
}	
}	
}	
while(!byte_aligned())	
dm_alignment_zero_bit	f(1)
}	

Table 2: ext_dm_data_block() syntax

ext_dm_metadata_block(i) {	Descriptor
ext_block_length [i]	ue(v)
ext_block_level [i]	u(8)
ext_dm_data_block_payload(ext_block_length[i], ext_block_level [i])	
}	

Table 3: ext_dm_data_block_payload() syntax

ext_dm_data_block_payload(ext_block_length, ext_block_level) {	Descriptor
ext_block_len_bits = 8 * ext_block_length	
ext_block_use_bits = 0	
if(ext_block_level == 1) {	
min_PQ	u(12)
max_PQ	u(12)
avg_PQ	u(12)
ext_block_use_bits += 36	
}	
if(ext_block_level == 2) {	
target_max_PQ	u(12)
trim_slope	u(12)
trim_offset	u(12)
trim_power	u(12)
trim_chroma_weight	u(12)
trim_saturation_gain	u(12)
ms_weight	i(13)
ext_block_use_bits += 85	
}	
if(ext_block_level == 5) {	
active_area_left_offset	u(13)
active_area_right_offset	u(13)
active_area_top_offset	u(13)
active_area_bottom_offset	u(13)
ext_block_use_bits += 52	
}	
while(ext_block_use_bits++ < ext_block_len_bits)	
ext_dm_alignment_zero_bit	f(1)
}	

4.3 ST2094-10_data() structure semantics

app_identifier identifies an application and shall be set equal to 1 according to constraints of the section 5 of SMPTE ST 2094-10 [4].

app_version specifies the application version in the application and shall be set equal to 1 according to constraints of the section 5 of SMPTE ST 2094-10 [4].

metadata_refresh_flag when set equal to 1 cancels the persistence of any previous extended display mapping metadata in output order and indicates that extended display mapping metadata follows. The extended display mapping metadata persists from the coded picture to which the SEI message containing ST2094-10_data() is associated (inclusive) to the coded picture to which the next SEI message containing ST2094-10_data() and with **metadata_refresh_flag** set equal to 1 in output order is associated (exclusive) or (otherwise) to the last picture in the CVS (inclusive). When set equal to 0 this flag indicates that the extended display mapping metadata does not follow.

num_ext_blocks specifies the number of extended display mapping metadata blocks. The value shall be in the range of 1 to 254, inclusive.

dm_alignment_zero_bit shall be equal to 0.

ext_block_length[i] is used to derive the size of the i-th extended display mapping metadata block payload in bytes. The value shall be in the range of 0 to 1 023, inclusive.

ext_block_level[i] specifies the level of payload contained in the i-th extended display mapping metadata block. The value shall be in the range of 0 to 255, inclusive. The corresponding extended display mapping metadata block types are defined in Table 4. Values of ext_block_level[i] that are reserved shall not be present in the bitstreams conforming to this version of this specification. Blocks using reserved values shall be ignored.

When the value of ext_block_level[i] is set equal to 1, the value of ext_block_length[i] shall be set equal to 5.

When the value of ext_block_level[i] is set equal to 2, the value of ext_block_length[i] shall be set equal to 11.