Abstract

This document specifies how to use HDR10+ metadata within [AV1] bitstreams, including when carried in [CMAF].
1 Introduction

This document specifies how to use HDR10+ metadata within [AV1] bitstreams, including when carried in [CMAF]. HDR10+ metadata enables devices to optimize rendering of HDR content based on the display capabilities and on a scene-by-scene and frame-by-frame basis.

Various tools, services and devices support creation and use of HDR10+ metadata, which can be easily utilized directly in [AV1] systems. Carriage of HDR10+ metadata in [AV1] leverages mechanisms specified in [T35] and [CTA-861]. HDR10+ metadata is placed in metadata OBUs of
2. Use of HDR10+ in AV1 bitstreams

2.1. HDR10+ Metadata

In the context of this specification, the syntax and semantics of the HDR10+ Metadata are defined in [CTA-861] and [ST-2094-40] respectively.

An HDR10+ Metadata OBU is defined as HDR10+ Metadata carried in a Metadata OBU. The metadata_type of such Metadata OBU is set to METADATA_TYPE_ITUT_T35 and the itu_t_t35_country_code of the corresponding Metadata ITUT T35 element is set to 0xB5. The remaining syntax element of Metadata ITUT T35, itu_t_t35_payload_bytes, is interpreted using the syntax defined in Annex S of [CTA-861], starting with the itu_t_t35_terminal_provider_code, and the semantics defined in [ST-2094-40].

According to the definition of the HDR10+ Metadata, the first 6 bytes of the itu_t_t35_payload_bytes of the HDR10+ Metadata OBU are set as follows:

- 0x003C, which corresponds to itu_t_t35_terminal_provider_code from Annex S of [CTA-861]
- 0x0001, which corresponds to itu_t_t35_terminal_provider_oriented_code from Annex S of [CTA-861]
- 0x4, which corresponds to application_identifier from Annex S of [CTA-861]
- 0x1, which corresponds to application_mode from Annex S of [CTA-861]

All the remaining bytes of the itu_t_t35_payload_bytes identify as the HDR10+ Metadata and are associated with the syntax elements of the user_data_registered_itu_t_t35 structure that is defined in Annex S of [CTA-861]. For convenience, the structure of the HDR10+ Metadata OBU is illustrated in Figure 1.
NOTE: [AV1] defines the general Metadata OBU syntax for HDR10 Static Metadata and ITU-T T.35 Metadata.

**HDR10 Static Metadata** is defined as a combination of three types of HDR related metadata, including MDCV, MaxCLL and MaxFALL. MDCV shall be present while MaxCLL and/or MaxFALL may be present.

§ 2.2. HDR10+ bitstream constraints

The following sections define constraints that apply to [AV1] bitstreams when carrying HDR10+ Metadata.

§ 2.2.1. Color Configuration

Streams suitable for incorporating HDR10+ metadata as described in this specification shall use the following values for the [AV1] color_config:

- **color_primaries** = 9 [CICP], which corresponds to the ITU-R BT.2020 color primaries [BT-2020] [BT-2100],
- **transfer_characteristics** = 16 [CICP], which corresponds to the PQ transfer characteristics function [ST-2084] [BT-2100],
- **matrix_coefficients** = 9 [CICP], which corresponds to the non-constant luminance Y’CbCr representation [BT-2020] [BT-2100].

Additionally, the following recommendations apply:

- **color_range** should be set to 0,
- **subsampling_x** and **subsampling_y** should be set to 0,
As defined in [AV1], an AV1 coded video sequence consists of one or more temporal units. A temporal unit contains a series of OBUs starting from a Temporal Delimiter OBU, optional Sequence Header OBUs, optional Metadata OBUs, a sequence of one or more Frame Header OBUs, each followed by zero or more Tile Group OBUs as well as optional Padding OBUs.

Consequently, for each frame with show_frame = 1 or show_existing_frame = 1, there shall be one and only one HDR10+ metadata OBU preceding the Frame Header OBU for this frame and located after the last OBU of the previous frame (if any) or after the Sequence Header OBU (if any) or after the start of the temporal unit (e.g. after the Temporal Delimiter OBU, for storage formats where Temporal Delimiter OBUs are preserved).

HDR10+ Metadata OBUs are not provided when show_frame = 0. For non-layered streams, there is only one HDR10+ Metadata OBU per temporal unit. For [AV1] bitstreams encoded with multiple layers, HDR10+ Metadata may apply to one or more layers. However, the details are out of scope of this version of the specification.

Figure 2 shows a simplified example of placement of HDR10+ Metadata OBUs in an AV1 bitstream.

![Figure 2. Example of placement of HDR10+ Metadata OBUs in an AV1 bitstream](image)

2.2.2. Placement of HDR10+ Metadata OBUs

2.2.3. Provision for Film Grain Processing

It is possible that some [AV1] bitstreams may contain both HDR10+ Metadata and film grain synthesis information. It is recommended that decoders in such scenarios perform the film grain synthesis prior to any HDR10+ Metadata processing.

- **mono_chrome** should be set to 0,
- **chroma_sample_position** should be set to 2.
§ 3. Storage and Transport considerations

§ 3.1. Constraints on AV1CodecConfigurationRecord

For formats that use the AV1CodecConfigurationRecord when storing [AV1] bitstreams (e.g. ISO BMFF and MPEG-2 TS), HDR10+ Metadata OBUs shall not be present in the configOBUs field of the AV1CodecConfigurationRecord.

§ 3.2. ISO BMFF Constraints

AV1 Metadata sample group defined in [AV1-ISOBMFF] shall not be used.

[AV1-ISOBMFF] indicates that Metadata OBUs may be protected. This specification requires that HDR10 Static Metadata and HDR10+ Metadata OBUs are unprotected.

An ISOBMFF file or CMAF AV1 track as defined in [AV1-ISOBMFF] that also conforms to this specification (i.e. that contains HDR10+ metadata OBUs and complies to the constraints from this specification) should use the brand cdm4 defined in [CTA-5001] in addition to the brand av01. If the brand cdm4 is used in conjunction with [AV1] bitstreams, the constraints defined in this specification shall be respected.

§ 3.3. HTTP Streaming Constraints

The value of the Codecs Parameter String for [AV1] bitstreams that is used when using HTTP streaming technologies shall remain unchanged when HDR10+ Metadata OBUs are included in the [AV1] stream.

Additionally, [DASH] content following [DASH-IOP] should include a Supplemental Descriptor with @schemeIdUri set to "http://dashif.org/metadata/hdr" and @value set to "SMPTE2094-40" in manifest files. This can aid players to identify tracks containing HDR10+ Metadata OBUs.

§ 4. Example Streams and Tools

Information on this topic is found in the Wiki for this project.
§ Conformance

Conformance requirements are expressed with a combination of descriptive assertions and RFC 2119 terminology. The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in the normative parts of this document are to be interpreted as described in RFC 2119. However, for readability, these words do not appear in all uppercase letters in this specification.

All of the text of this specification is normative except sections explicitly marked as non-normative, examples, and notes. [RFC2119]

Examples in this specification are introduced with the words “for example” or are set apart from the normative text with class="example", like this:

EXAMPLE 1
This is an example of an informative example.

Informative notes begin with the word “Note” and are set apart from the normative text with class="note", like this:

Note, this is an informative note.

§ Index

§ Terms defined by this specification

**HDR10+ Metadata**, in § 2.1

**HDR10+ Metadata OBU**, in § 2.1

**HDR10 Static Metadata**, in § 2.1
§ Terms defined by reference

[AV1] defines the following terms:
- av1 coded video sequence
- chroma_sample_position
- color_config
- color_primaries
- color_range
- frame header obu
- itu_t_t35_country_code
- itu_t_t35_payload_bytes
- matrix_coefficients
- metadata itut t35
- metadata obu
- metadata_type
- metadata_type_itut_t35
- mono_chrome
- obu
- padding obu
- sequence header obu
- show_existing_frame
- show_frame
- subsampling_x
- subsampling_y
- temporal delimiter obu
- temporal unit
- tile group obu
- transfer_characteristics

[AV1-ISOBMFF] defines the following terms:
- av01
- av1 metadata sample group
- av1codeconfigurationrecord
- codecs parameter string
- configobus

[CTA-5001] defines the following terms:
- cdm4

[CTA-861] defines the following terms:
- application_identifier
- application_mode
- itu_t_t35_terminal_provider_code
- itu_t_t35_terminal_provider_oriented_code
- maxcll
- maxfall

[DASH] defines the following terms:
- @schemeiduri
- @value
- supplemental descriptor

[ST-2086] defines the following terms:
- mdcv

§ References

§ Normative References

[AV1]
AV1 Codec ISO Media File Format Binding. Standard. URL: https://aomedia codec.github.io/av1-isobmff/


[AV1-ISOBMFF]
[CTA-5001]
[CTA-861]
[DASH]
[RFC2119]
[ST-2086]
[ST-2094-40]
[T35]

Informative References

Recommendation ITU-R BT.2020-2 (10/2015), Parameter values for ultra-high definition television systems for production and international programme exchange. Standard. URL:
https://www.itu.int/rec/R-REC-BT.2020

[BT-2100]
URL: https://www.itu.int/rec/R-REC-BT.2100

[DASH-IOP]
Guideline for Implementation: DASH-IF Interoperability Points V4.3: On-Demand and Mixed Services, HDR Dynamic Metadata and other Improvements. Guidelines. URL:
https://dashif.org

[ST-2084]