

HDR10+ AV1 Metadata Handling Specification

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Abstract

This document specifies how to use [HDR10+ metadata](#) within [\[AV1\]](#) bitstreams, including when carried in [\[CMAF\]](#).

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§ 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

[metadata_type](#) equal to [METADATA_TYPE_ITUT_T35](#). This document covers details of the placement of these [OBUs](#) in [\[AV1\]](#) bitstreams.

§ 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.

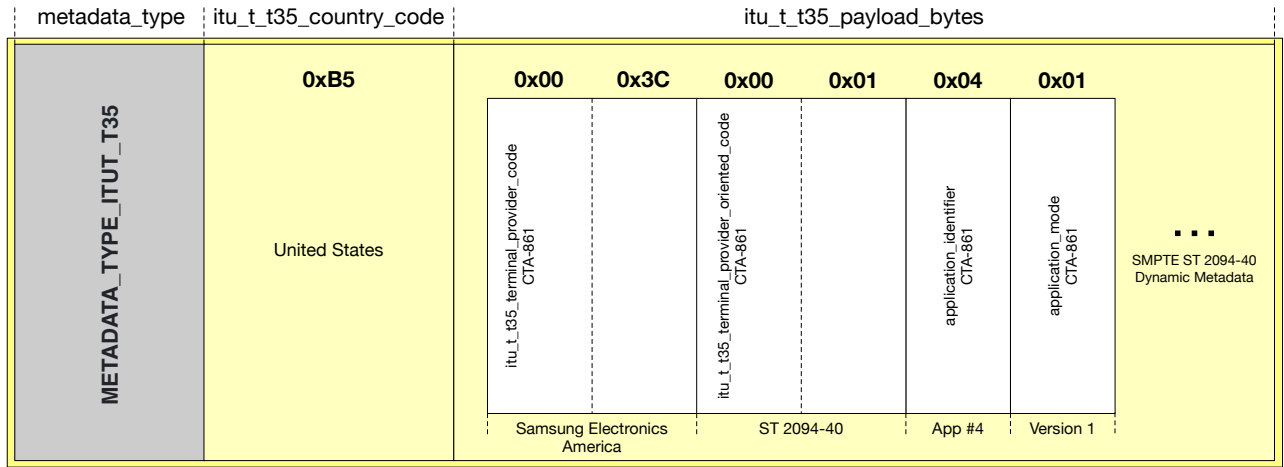


Figure 1. HDR10+ Metadata OBU

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,

- [mono_chrome](#) should be set to 0,
- [chroma_sample_position](#) should be set to 2.

§ 2.2.2. Placement of HDR10+ Metadata OBUs

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.

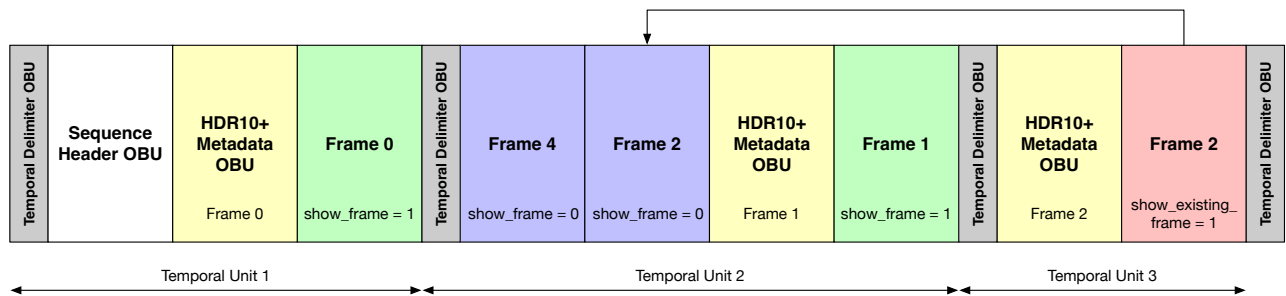


Figure 2. Example of placement of [HDR10+ Metadata OBUs](#) in an AV1 bitstream

§ 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.

§ 3. Storage and Transport considerations

§ 3.1. Constraints on AV1CodecConfigurationRecord

For formats that use the [AV1CodecConfigurationRecord](#) when storing [\[AV1\]](#) bitstreams (e.g. ISOBMFF and MPEG-2 TS), [HDR10+ Metadata OBUs](#) shall not be present in the [config0BUs](#) field of the [AV1CodecConfigurationRecord](#).

§ 3.2. ISOBMFF 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:

mdev

§ References

§ Normative References

[AV1]

AV1 Bitstream & Decoding Process Specification. Standard. URL: <https://aomedia-codec.github.io/av1-spec/av1-spec.pdf>

[AV1-ISOBMFF]

AV1 Codec ISO Media File Format Binding. Standard. URL: <https://aomediacodec.github.io/av1-isobmff/>

[CICP]

Recommendation ITU-T H.273 | ISO/IEC 23091-2, Coding-independent code points for video signal type identification. Standard. URL: <https://www.itu.int/rec/T-REC-H.273>

[CMAF]

ISO/IEC 23000-19, Information technology – Multimedia application format (MPEG-A) – Part 19: Common media application format (CMAF) for segmented media. Standard. URL: <https://www.iso.org/standard/71975.html>

[CTA-5001]

CTA-5001-C, Web Application Video Ecosystem - Content Specification. Standard. URL: <https://shop.cta.tech/products/web-application-video-ecosystem-content-specification>

[CTA-861]

ANSI/CTA-861-H, A DTV Profile for Uncompressed High Speed Digital Interfaces. Standard. URL: <https://shop.cta.tech/products/a-dtv-profile-for-uncompressed-high-speed-digital-interfaces-cta-861-h>

[DASH]

ISO/IEC 23009-1, Information technology – Dynamic adaptive streaming over HTTP (DASH) – Part 1: Media presentation description and segment formats. Standard. URL: <https://www.iso.org/standard/79329.html>

[RFC2119]

S. Bradner. *Key words for use in RFCs to Indicate Requirement Levels*. March 1997. Best Current Practice. URL: <https://datatracker.ietf.org/doc/html/rfc2119>

[ST-2086]

SMPTE ST 2086:2018, Mastering Display Color Volume Metadata supporting High Luminance and Wide Color Gamut Images. Standard. URL: <https://ieeexplore.ieee.org/document/8353899>

[ST-2094-40]

SMPTE ST 2094-40:2020, Dynamic Metadata for Color Volume Transform - Application #4. Standard. URL: <https://ieeexplore.ieee.org/document/9095450>

[T35]

Recommendation ITU-T T.35 (02/2000), Procedure for the allocation of ITU-T defined codes for non standard facilities. Standard. URL: <https://www.itu.int/rec/T-REC-T.35-200002-I>

§ Informative References

[BT-2020]

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]

Recommendation ITU-R BT.2100-2 (07/2018), Image parameter values for high dynamic range television for use in production and international programme exchange. Standard.

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]

SMPTE ST 2084:2014, High Dynamic Range Electro-Optical Transfer Function of Mastering Reference Displays. Standard. URL: <https://ieeexplore.ieee.org/document/7291452>