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| *Title:* | **Refinements to Mastering Display Color Volume SEI message semantics that align to the year 2018 edition of SMPTE ST 2086** | | |
| *Status:* | Input document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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| *Source:* | MovieLabs | | |

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# Abstract

SMPTE ST 2086 is the official standard defining the Mastering Display Color Volume metadata set of values that essentially conveys the potential approved color volume, assumed by the nominal measurements of the mastering monitor that the witnessed content is observed through during the creative authoring process. In 2018, SMPTE will release an update (ST 2086:2018) that clarifies or further restricts some value ranges. AVC and HEVC specifications carry ST 2086:2014 values in bitstreams via their respective, essentially identical Mastering Display Color Volume (MDCV) SEI messages. This metadata set of values is often repacked and relayed into HDMI headers, and optionally applied in some (post-decoder) display processing or signal format conversion. This proposal provides delta text to the existing respective AVC and HEVC SEI messages to update the semantics to match the ST 2086:2018 revision. The summary of changes are: (1) the value 0 can represent “unknown” or “unspecified” for any element in MDCV, in scenarios where individual value measurements are unavailable, or the application does not want to convey a value; (2) primaries and white point elements expressed in CIE xy coordinates are restricted such that the x coordinate is in the practical visual range [0.0001, 0.84000] and the y coordinate in the range [0.0001, 0.8400]; (3) the maximum display mastering luminance value shall be a multiple of 1 candela per square meter; (4) the minimum display mastering luminance value shall be a multiple of 0.0001 candela per square meter (already aligning to existing AVC and HEVC text). Small NOTE additions to the SEI are suggested to reflect more semantic detail present in ST 2086: (5) SMPTE states xy chromatic measurements have 4 decimal digits; (6) a value in the range [5, 10000] candelas per square meter indicates nominal maximum display mastering luminance (7) a value in the range [0.0001, 5.0000] candelas per square meter indicates nominal minimum display mastering luminance. A liaison statement from SMPTE to MPEG ([m42452](http://wg11.sc29.org/doc_end_user/current_document.php?id=61523&id_meeting=174)) coincident to this JCT meeting attaches a copy of ST 2086:2018. Version 2 of this document updates text to address [issues](http://wftp3.itu.int/av-arch/jctvc-site/2018_04_AE_SanDiego/) raised during the JCT review of version 1 at this meeting.

# Background

Motivations for each of the intended applications backward-compatible changes introduced in the 2018 edition of ST 2086 are described below:

*Value 0*: A value of 0 can represent unspecified or unknown for any element, regardless of whether related elements are known or measurable. For example, sometimes the maximum luminance of a monitor is measured, while the minimum luminance is not. It is unusual however for the any of the three primaries to be unknown while the others are known. MovieLabs best practices [1] for mapping SDR source content into HDR distribution signals recommends setting minimum display master luminance to 0 candelas per square meter, as per common (inverse) tone mapping convention [2].

*CIE xy chromaticity coordinate range*: Restricting values to within practical visual limits.

*Maximum display mastering luminance shall be a multiple of 1 candela per square meter:* The precision of display luminance decreases with increasing intensity. For the intended applications of ST 2086, the peak display levels should be high enough such that any precision greater than 1 candela per square meter would be unnecessary. Note that HDMI can only express this element in units of 1 candela per square meter (CTA 861-G: bytes 19 and 20 of Dynamic Range and Mastering InfoFrame when Static Metadata Descriptor is Type 1).

*0.0001 units for minimum display mastering luminance*: The precision of minimum luminance display light is usually within several decimal places of 1 candelas per square meter.

*Four decimal digits of xy chromatic coordinate precision:* An appropriate precision for the modern era of displays and the intended applications of ST 2086.

*Lower bound for maximum display mastering luminance:* A minimum of 5 candelas per square meter for the maximum display brightness (highest intensity level) is an appropriate value for the intended applications of ST 2086.

*Upper bound for minimum display mastering luminance*: A maximum of 5 candelas per square meter is the minimum display brightness (darkest level) is an appropriate value for the intended applications of ST 2086.

# Proposed text changes

In section D.3.28 of the respective AVC and HEVC Mastering display color volume SEI message semantics, change the following sentence, and add three sentences:

The information conveyed in this SEI message is intended to be adequate for purposes corresponding to the use of SMPTE ST 2086 (2014).

To:

The information conveyed in this SEI message is intended to be adequate for purposes corresponding to the use of SMPTE ST 2086 (2018). Greater precision can by conveyed in this SEI message for some elements than is required by SMPTE ST 2018:2018. The extra precision can be ignored by devices or may be removed during the repacking and relaying of the metadata to downstream devices. A value of 0 of any element within this SEI message can indicate that the corresponding quantity is unspecified or unknown.

Add the following note between the semantic text of white\_point\_y and max\_display\_mastering\_luminance:

NOTE: ST 2086:2018 defines the precision of xy chromaticy coordinates with four decimal places, thus this SEI message provides 5 times as much precision. ST 2086:2018 also states that the x coordinate shall be in the decimal range [0.0001, 0.7400] and the y coordinate shall be in the decimal range [0.0001, 0.8400].

After the definition of max\_display\_mastering\_luminance, add the following notes:

NOTE: SMPTE ST 2086:2018 states that maximum display mastering luminance shall be a multiple of 1 candela per square meter, thus this SEI message syntax has 1000 times as much precision for this element.

NOTE: SMPTE ST 2086:2018 states that a value in the range [5, 10000] candelas per square meter indicates the nominal maximum display luminance.

After the definition of min\_display\_mastering\_luminance, add the following note:

SMPTE ST 2086:2018 states that a value in the range [0.0001, 5.0000] candelas per square meter indicates the nominal minimum display luminance.

Remove the following sentence, since it conflicts with the use of 0 value to indicate “unspecified”:

**max\_display\_mastering\_luminance** and **min\_display\_mastering\_luminance** specify the nominal maximum and minimum display luminance, respectively, of the mastering display in units of 0.0001 candelas per square metre. min\_display\_mastering\_luminance shall be less than max\_display\_mastering\_luminance.

# References

[1] MovieLabs, “MovieLabs Best Practices for Mapping BT.709 Content to HDR10 for Consumer Distribution v1.0”, [https://movielabs.com/download/938/](https://urldefense.proofpoint.com/v2/url?u=https-3A__movielabs.com_download_938_&d=DwMDaQ&c=uw6TLu4hwhHdiGJOgwcWD4AjKQx6zvFcGEsbfiY9-EI&r=L1LEMFOg_tTpsbHU896oCU-StIF6vVbJxlkDIo7DQM4&m=CIRQrtlqjaSxyLi0ZaCtuTNfy9cFkAPs76dKFdx563U&s=6mO9av2In3Aw1hrcq5nJGluLOCjqWgoL8pvnqVXCHAY&e=)

[2] ITU-R [BT.2390](http://www.itu.int/pub/R-REP-BT.2390), “High dynamic range television for production and international program exchange”

# Patent rights declaration(s)

**Motion Picture Laboratories does not have any current or pending patent rights relating to the technology described in this contribution.**