SMPTE ST 2086:2018
Revision of ST 2086:2014

SMPTE STANDARD

Mastering Display Color Volume Metadata Supporting High Luminance and Wide Color Gamut Images

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Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices, and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in its Standards Operations Manual. This SMPTE Engineering Document was prepared by Technology Committee 10E.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Engineering Document. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

Introduction

This section is entirely informative and does not form an integral part of this Engineering Document.

The content mastering process begins when the creative talents (Director/Director of Photography/Studio) select a viewing environment and a look for the production. The creative intent is established in this environment. The most common display color space examples are Digital Cinema P3 for theatrical distribution and Recommendation ITU-R BT.709 for home distribution of HD content. For distribution to the homes, the mastering process could be redone with creative adjustments performed on a mastering display.

The mastering display is the display where creative work (adjustments and approval) is done during the mastering process.

To improve the color reproduction of this mastered content when shown on other displays, it is useful to have optional information that can be used to more closely reproduce the creative intent originally achieved in the mastering suite. This document provides a specification of the metadata defining the color volume (the color primaries, white point, and luminance range), which can be used to assist in achieving consistent results on different displays. The color volume metadata are values that a mastering display is configured to. In a simple mastering process, the device native value, i.e., the value configured at the production plant, can be used. In a multifaceted mastering process, the set up value, i.e., the value configured at the viewing environment of the mastering room, would be used. This standard provides a first step towards improving color reproduction, but does not define the mastering environment or the method of measurement of color volume metadata that would be needed in the case of a multifaceted mastering process.

The final archived master of digital imagery commonly includes encoded images only. In order to exactly reproduce the creative intent, it is useful to know the color volume specification of the original mastering display. This need is especially critical as the display technology continues to advance.

This standard is well suited to describe the metadata for the current state of the art displays as well as the new generation of displays that exhibit high luminance and wide color gamut.

This standard is entirely devoted to providing the color volume metadata of the display, and does not cover any additional layers of metadata regarding the visual appearance of images, or the color and tonal

transformations that would be used to convert between different display color volumes. The information described herein is not the complete set of metadata required for all of the image processing required for all steps in every workflow. Each implementation of a production and post-production workflow requires other types of metadata to characterize the image acquisition, processing and mastering environment. However, the information described in this standard represents the anticipated minimum metadata required for all implementations of any image processing workflow. Specific implementations of image processing workflows will require additional metadata, some specific to those particular implementations, which are out of scope of this standard.

If an application uses a digital representation with a precision exceeding that specified for the item, it is expected to round to the nearest value with the precision specified for that item before using it pursuant to this standard.

1 Scope

This standard specifies the metadata items to specify the color volume (the color primaries, white point, and luminance range) of the display that was used in mastering video content. The metadata is specified as a set of values independent of any specific digital representation.

This standard is applicable to three-color additive display systems, such as RGB displays.

This standard does not specify the measurement methodologies and procedures for capturing the parameters of the metadata as well as any description of the mastering environment. Additionally, this standard does not fully specify all the information that would be necessary to preserve the creative intent on displays with color volumes different from the mastering display color volume. As a specific example, this standard does not specify the Electro-Optical Transfer Function (EOTF) of the mastering display since it does not affect the color volume.

This standard only defines the mastering display color volume metadata items. System-specific solutions for storing, packaging, transmission, and end-use of this metadata are allowed, however the specification of these solutions is outside the scope of this standard.

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this engineering document. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this engineering document are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

ISO 11664-3:2012/CIE S 014-3/E:2011, Colorimetry – Part 3: CIE Tristimulus Values

4 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

4.1 color volume

solid in colorimetric space containing all possible colors a display can produce.

4.2 xy chromaticity coordinates

chromaticity coordinates x and y, as defined in ISO 11664-3:2012 Section 7

4.3 display primaries

colors of a display from which all other colors of such display are formed through additive combinations, such as RGB displays

4.4 mastering display

three-color additive display or projection system that has been configured to the mastering color volume

4.5 nominal

as designed, behaving within expected norm or operating level

5 Metadata

5.1 Metadata Set

The group comprising Display Primaries, Chromaticity of White Point, Maximum Display Mastering Luminance and Minimum Display Mastering Luminance shall define the color volume of the mastering display.

5.2 Value Ranges

This standard defines value ranges for luminance and chromaticity coordinates.

Values outside the ranges defined in this document can be used for purposes outside the scope of this standard. See Annex A. For example, a value of 0 can indicate that the corresponding quantity is undefined.

5.3 xy Chromaticity Coordinates

xy chromaticity coordinates shall be calculated as specified in ISO 11664-3:2012 Section 7, and shall be specified with four decimal places. The x coordinate shall be in the range [0.0001, 0.7400] and the y coordinate shall be in the range [0.0001, 0.8400]

5.4 Display Primaries

The nominal primaries of the mastering display, as configured for the mastering process, shall be represented as three xy chromaticity coordinates.

5.5 Chromaticity of White Point

The nominal chromaticity of the white point of the mastering display, as configured for the mastering process, shall be represented as an xy chromaticity coordinate.

Note: At minimum luminance, the mastering display has the same nominal chromaticity as the white point.

5.6 Maximum Display Mastering Luminance

The nominal maximum display luminance of the mastering display, as configured for the mastering process, shall be represented in candelas per square meter (cd/m2). The value shall be a multiple of 1 candela per square meter.

A value in the range [5, 10000] shall indicate the nominal maximum display luminance.

5.7 Minimum Display Mastering Luminance

The nominal minimum display luminance of the mastering display, as configured for the mastering process, shall be represented in candelas per square meter (cd/m2). The value shall be a multiple of 0.0001 candelas per square meter.

A value in the range [0.0001, 5.0000] shall indicate the nominal minimum display luminance.

Annex A Usage of Out-of-Range Values (Informative)

Values outside the specified ranges of luminance and chromaticity values are not reserved by SMPTE, and can be used for purposes outside the scope of this standard.

Example 1: CTA 861-G uses the maximum luminance of 0 nit and the minimum luminance of 0.0000 nit to signal that the values are unknown.

Example 2: Values outside the specified range of luminance values can be used to signal that the display has been configured using PLUGE.

Example 3: CTA 861-G uses an xy chromaticity coordinate of (0.0000, 0.0000) to signal that the white point chromaticity is unknown.

Bibliography (Informative)

CTA 861-G, A DTV Profile for Uncompressed High Speed Digital Interfaces, November 2016