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| *Title:* | **Updated BT.2100 Hybrid Log-Gamma ICTCP equations** | | |
| *Status:* | Input document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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| *Source:* | MovieLabs | | |

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# Abstract

The December 2018 editorial update of ITU-R BT.2100 changed two equations in Table 7 in order to fit the Hybrid Log-Gamma (HLG) ICTCP color component signals within the real-value range [-0.5, +0.5]. In previous published versions of BT.2100, HLG systems shared the same CT, CP equations with PQ systems, but on corner cases would produce an output with nearly twice the range of [-0.5, +0.5]. Compared to the previous equations, the updated HLG equations now scale down the CT and CP coefficients by an additional factor of 1.823698 and 1.887755, respectively. This proposal suggests small text changes to the AVC and HEVC specifications Annex E matrix\_coeff Table E.5 and associated semantics to align with the updated BT.2100 publication. Unrelated to the ICTCP: it is also recommended that the colour\_primaries Table E.3 codes 11 and 12 table entries add a reference to SMPTE ST 2113, which is intended by participants in the professional video production industry to serve as the best, most modern definition of P3.

# Introduction

In prior publications of BT.2100 [1], the different PQ and HLG signals shared equations for the CT, CP step:

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Values PQ | | Values HLG |
| [..] | | | |
| Derivation of colour difference signals | |  | |

The December 2018 update of BT.2100 HLG equations are now different from the PQ equations:

|  |  |  |
| --- | --- | --- |
| Parameter | Values PQ | Values HLG |
| [..] | | |
| Derivation of colour difference signals |  |  |

# Proposed text changes

*The proposed change text, relative to the HEVC specification published in 2018, are highlighted in red:*

– Otherwise (matrix\_coeffs is equal to 14), the following equations apply:

E′Y = 0.5 \* ( E′L + E′M ) (E‑62)

– If transfer\_characteristics is not equal to 18:

E′PB = ( 6610 \* E′L − 13613 \* E′M + 7003 \* E′S ) ÷ 4096 (E‑63)

E′PR = ( 17933 \* E′L − 17390 \* E′M − 543 \* E′S ) ÷ 4096 (E‑64)

– Otherwise, the following applies:

E′PB = ( 3625 \* E′L − 7465 \* E′M + 3840 \* E′S ) ÷ 4096 (E‑65)

E′PR = ( 9500 \* E′L − 9212 \* E′M − 288 \* E′S ) ÷ 4096 (E‑66)

NOTE 13 – In this case, for purposes of the ICTCP nomenclature used in Table E.5, E′Y, E′PB, and E′PR of Equations E‑62, E‑63, and E‑64 may be referred to as I, CT, and CP, respectively.

*An addition to the above NOTE is suggested:*

Alternative scaling of the color difference signals may be desired in systems that combine coeff\_matrix 14 with transfer functions not listed in BT.2100. The formulae in equations E-63 and E-63 were designed specifically for BT.2100 PQ systems (transfer\_characteristics=16), while equations E-65 and E-66 were designed for BT.2100 HLG systems.

*The row entry for AVC and HEVC Table E.5 code point 14 is proposed to be modified as follows:*

|  |  |  |
| --- | --- | --- |
| 14 | ICTCP | Rec. ITU-R BT.2100-1 ICTCP  See Equations E‑62 to E‑64 for transfer\_characteristics = 16 (PQ)  See Equations E-62. E-66. E-67 for transfer\_characteristics = 18 (HLG) |

*Also suggested to update the Table E.3 (colour\_primaries) P3 entries to reference SMPTE ST 2113 [2]:*

|  |  |  |
| --- | --- | --- |
| 11 | primary x y  green 0.265 0.690  blue 0.150 0.060  red 0.680 0.320  white 0.314 0.351 | SMPTE RP 431-2 (2011)  SMPTE ST 2113 (2019) "P3DCI" |
| 12 | primary x y  green 0.265 0.690  blue 0.150 0.060  red 0.680 0.320  white D65 0.3127 0.3290 | SMPTE EG 432-1 (2010)  SMPTE ST 2113 (2019) "P3D65" |

# References

1. Recommendation ITU-R BT.2100-2 ([Dec. 2018](https://www.itu.int/rec/R-REC-BT.2100-2-201807-I/)), *Image parameter values for high dynamic range television for use in production and international programme exchange.*
2. SMPTE ST 2113 (2019), *Colorimetry of P3 Color Spaces*.

# Patent rights declaration(s)

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