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| *Title:* | **Technology under consideration for future editions of CICP** | | |
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# Abstract

This document contains draft text for several changes under consideration for future editions of the Coding-independent code points (CICP) Video specification (ISO/IEC 23091-2). The changes include support for the carriage and indication of depth and alpha map information in single-layer coded video bitstreams and extensions for the indication of chroma subsampling for formats beyond 4:2:0.

# Changes that have been integrated:

The changes noted below correspond to aspects of JVET-AH0154 and JVET-AH0217. In particular, the following aspects are added:

* new values for the indication of depth and alpha map information in the colour primaries code point
* new values for the indication of monochromatic signals in the matrix coefficients code point.
* new code points and values for signalling chroma subsampling and sample location for formats beyond 4:2:0.

# Changes to the specification text:

*Additions to CICP subclause 8.1, Table 3 for supporting the direct indication of depth and alpha signals*

1. **Video code points**

**8.1 Colour primaries**

*Type: Unsigned integer, enumeration*

*Range: 0 to 255, inclusive*

**ColourPrimaries** indicates the chromaticity coordinates of the source colour primaries as specified in Table 3 in terms of the CIE 1931 definition of x and y, which shall be interpreted as specified by ISO/CIE 11664‑1.

An 8-bit field should be adequate for representation of the ColourPrimaries code point.

Table 3 — Interpretation of colour primaries (ColourPrimaries) value

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Value** | **Colour primaries** | | | | **Informative remarks** |
| 0 | Reserved | | | | For future use by ITU-T | ISO/IEC |
| 1 | primary | x | y | | Rec. ITU-R BT.709-6  Rec. ITU-R BT.1361-0 conventional colour gamut system and extended colour gamut system (historical)  IEC 61966-2-1 sRGB or sYCC  IEC 61966-2-4  SMPTE RP 177 (1993) Annex B |
| green | 0.300 | 0.600 | |
| blue | 0.150 | 0.060 | |
| red | 0.640 | 0.330 | |
| white D65 | 0.3127 | 0.3290 | |
| 2 | Unspecified | | | | Image characteristics are unknown or are determined by the application. |
| 3 | Reserved | | | | For future use by ITU-T | ISO/IEC |
| 4 | primary | x | y | | Rec. ITU-R BT.470-6 System M (historical)  United States National Television System Committee 1953 Recommendation for transmission standards for colour television  United States Federal Communications Commission Title 47 Code of Federal Regulations (2003) 73.682 (a) (20) |
| green | 0.21 | 0.71 | |
| blue | 0.14 | 0.08 | |
| red | 0.67 | 0.33 | |
| white C | 0.310 | 0.316 | |
| 5 | primary | x | y | | Rec. ITU-R BT.470-6 System B, G (historical)  Rec. ITU-R BT.601-7 625  Rec. ITU-R BT.1358-0 625 (historical)  Rec. ITU-R BT.1700-0 625 PAL and 625 SECAM |
| green | 0.29 | 0.60 | |
| blue | 0.15 | 0.06 | |
| red | 0.64 | 0.33 | |
| white D65 | 0.3127 | 0.3290 | |
| 6 | primary | x | y | | Rec. ITU-R BT.601-7 525  Rec. ITU-R BT.1358-1 525 or 625 (historical)  Rec. ITU-R BT.1700-0 NTSC  SMPTE ST 170 (2004)  (functionally the same as the value 7) |
| green | 0.310 | 0.595 | |
| blue | 0.155 | 0.070 | |
| red | 0.630 | 0.340 | |
| white D65 | 0.3127 | 0.3290 | |
| 7 | primary | x | y | | SMPTE ST 240 (1999)  (functionally the same as the value 6) |
| green | 0.310 | 0.595 | |
| blue | 0.155 | 0.070 | |
| red | 0.630 | 0.340 | |
| white D65 | 0.3127 | 0.3290 | |
| 8 | primary | x | | y | Generic film (colour filters using Illuminant C) |
| green | 0.243 | | 0.692 (Wratten 58) |
| blue | 0.145 | | 0.049 (Wratten 47) |
| red | 0.681 | | 0.319 (Wratten 25) |
| white C | 0.310 | | 0.316 |
| 9 | primary | x | | y | Rec. ITU-R BT.2020-2  Rec. ITU-R BT.2100-2 |
| green | 0.170 | | 0.797 |
| blue | 0.131 | | 0.046 |
| red | 0.708 | | 0.292 |
| white D65 | 0.3127 | | 0.3290 |
| 10 | primary | x | | y | SMPTE ST 428-1 (2019)  (CIE 1931 XYZ as in ISO/CIE 11664‑1) |
| green (Y) | 0.0 | | 1.0 |
| blue (Z) | 0.0 | | 0.0 |
| red (X) | 1.0 | | 0.0 |
| centre white | 1 ÷ 3 | | 1 ÷ 3 |
| 11 | primary | x | | y | SMPTE RP 431-2 (2011) |
| green | 0.265 | | 0.690 |
| blue | 0.150 | | 0.060 |
| red | 0.680 | | 0.320 |
| white | 0.314 | | 0.351 |
| 12 | primary | x | | y | SMPTE EG 432-1 (2010) |
| green | 0.265 | | 0.690 |
| blue | 0.150 | | 0.060 |
| red | 0.680 | | 0.320 |
| white D65 | 0.3127 | | 0.3290 |
| 13 to 21 | Reserved | | | | For future use by ITU-T | ISO/IEC |
| 22 | primary | x | | y | No corresponding industry specification identified |
| green | 0.295 | | 0.605 |
| blue | 0.155 | | 0.077 |
| red | 0.630 | | 0.340 |
| white D65 | 0.3127 | | 0.3290 |
| 23 to 127 | Reserved | | | | For future use by ITU-T | ISO/IEC |
| 128 | Alpha map | | | | This signal is an alpha map |
| 129 | Depth map | | | | This signal is a depth picture |
| 130 to 255 | Reserved | | | | For future use by ITU-T | ISO/IEC |

*Additions to CICP subclause 8.3, Table 5 for supporting the direct indication of depth and alpha maps signals*

**Table 5 — Interpretation of the matrix coefficients (MatrixCoefficients) value**

|  |  |  |
| --- | --- | --- |
| **Value** | **Matrix coefficients** | **Informative remarks** |
| 0 | Identity | The identity matrix.  Typically used for GBR (often referred to as RGB); however, may also be used for YZX (often referred to as XYZ);  IEC 61966-2-1 sRGB  SMPTE ST 428-1 (2019)  See pseudocode operations (48) to (50) |
| 1 | KR = 0.2126; KB = 0.0722 | Rec. ITU-R BT.709-6  Rec. ITU-R BT.1361-0 conventional colour gamut system and extended colour gamut system (historical)  IEC 61966-2-4 xvYCC709  SMPTE RP 177 (1993) Annex B  See pseudocode operations (45) to (47) |
| 2 | Unspecified | Image characteristics are unknown or are determined by the application |
| 3 | Reserved | For future use by ITU-T | ISO/IEC |
| 4 | KR = 0.30; KB = 0.11 | United States Federal Communications Commission Title 47 Code of Federal Regulations (2003) 73.682 (a) (20)  See pseudocode operations (45) to (47) |
| 5 | KR = 0.299; KB = 0.114 | Rec. ITU-R BT.470-6 System B, G (historical)  Rec. ITU-R BT.601-7 625  Rec. ITU-R BT.1358-0 625 (historical)  Rec. ITU-R BT.1700-0 625 PAL and 625 SECAM  IEC 61966-2-1 sYCC  IEC 61966-2-4 xvYCC601  (functionally the same as the value 6)  See pseudocode operations (45) to (47) |
| 6 | KR = 0.299; KB = 0.114 | Rec. ITU-R BT.601-7 525  Rec. ITU-R BT.1358-1 525 or 625 (historical)  Rec. ITU-R BT.1700-0 NTSC  SMPTE ST 170 (2004)  (functionally the same as the value 5)  See pseudocode operations (45) to (47) |
| 7 | KR = 0.212; KB = 0.087 | SMPTE ST 240 (1999)  See pseudocode operations (45) to (47) |
| 8 | YCgCo or YCgCo-R | See pseudocode operations (51) to (57) for YCgCo (when BitDepthC is equal to BitDepthY)  See pseudocode operations (58) to (65) for YCgCo-R (when BitDepthC is equal to BitDepthY + 1) |
| 9 | KR = 0.2627; KB = 0.0593 | Rec. ITU-R BT.2020-2 (non-constant luminance)  Rec. ITU-R BT.2100-2 Y′CbCr  See pseudocode operations (45) to (47) |
| 10 | KR = 0.2627; KB = 0.0593 | Rec. ITU-R BT.2020-2 (constant luminance)  See pseudocode operations (66) to (75) |
| 11 | Y′D′ZD′X | SMPTE ST 2085 (2015)  See pseudocode operations (76) to (78) |
| 12 | See pseudocode operations (39) to (44) | Chromaticity-derived non-constant luminance system  See pseudocode operations (45) to (47) |
| 13 | See pseudocode operations (39) to (44) | Chromaticity-derived constant luminance system  See pseudocode operations (66) to (75) |
| 14 | ICTCP | Rec. ITU-R BT.2100-2 ICTCP  See pseudocode operations (79) to (81) for TransferCharacteristics value 16 (PQ)  See pseudocode operations (82) to (84) for TransferCharacteristics value 18 (HLG) |
| 15 | IPT-C2 | SMPTE ST 2128 (2023)  See pseudocode operations (85) to (87) |
| 16 | YCgCo-Re | See pseudocode operations (58) to (65) |
| 17 | YCgCo-Ro | See pseudocode operations (58) to (65) |
| 18 | 1st colour component | A monochromatic representation with only the first colour component in the original representation present in the coded image. Typically used for Green only; however, may also be used for the Y tristimulus value (luminance), when the colour primaries are set to XYΖ, or to indicate that the representation contains only the first component of an image not representing texture. |
| 19 | 2nd  colour component | A monochromatic representation with only the second colour component in the original representation present in the coded image. Typically used for Red only; however, may also be used for the X tristimulus value, when the colour primaries are set to XYΖ, or to indicate that the representation contains only the second component of an image not representing texture. |
| 20 | 3rd  colour component | A monochromatic representation with only the third colour component in the original representation present in the coded image. Typically used for Blue only; however, may also be used for the Z tristimulus value, when the colour primaries are set to XYΖ, or to indicate that the representation contains only the third component of an image not representing texture. |
| 21 | Luma only KR = 0.2126; KB = 0.0722 | A monochromatic representation of the luma component of the Rec. ITU-R BT.709-6 representation. See Formula (E‑28) |
| 22 | Luma only KR = 0.2627; KB = 0.0593 | A monochromatic representation of the luma component of the Rec. ITU-R BT.2020-2 non-constant luminance representation. See Formula (E-28) |
| 23 | I only - ICTCP | A monochromatic representation of the I component of ICTCP representation. See Formula (E-75) |
| 24 to 255 | Reserved | For future use by ITU-T | ISO/IEC |

NOTE In a previous edition of this document, the IEC 61966-2-1 sYCC representation was identified as corresponding to MatrixCoefficients equal to 1. Closer study later determined that this representation should correspond to MatrixCoefficients equal to 5 instead (which is functionally the same as the value 6). This document was therefore revised to correct the error.

*Addition of new subclause 8.8 to CICP for signalling chroma subsampling and sample location beyond 4:2:0 formats.*

**8.8 Generic subsampling and sample location**

**8.8.1 Generic subsampling type**

*Type: Unsigned integer, enumeration*

*Range: 0 to 15, inclusive*

**GenericSubsamplingType** indicates the subsampling of a channel compared to a channel that has not been subsampled. It is specified explicitly or implicitly per channel in a frame. At least one channel in a frame shall have a GenericSubsamplingType value of 0.

**Table 9 — Interpretation of generic subsampling type indicator (GenericSubsamplingType)**

|  |  |
| --- | --- |
| **Value** | **Interpretation of GenericSubsamplingType** |
| 0 | No subsampling |
| 1 | 2x horizontal subsampling (4:2:2) |
| 2 | 2x horizontal and vertical subsampling (4:2:0) |
| 3 | 4x vertical subsampling (4:1:1) |
| 4 | 2x vertical subsampling (4:4:0) |
| 5-14 | Reserved |
| 15 | Undefined |

Table 9 describes the meaning of the GenericSubsamplingType values. As an example, 4:4:4 subsampled content would be described with GenericSubsamplingType as [0,0,0], 4:2:0 as [0,2,2] and 4:2:2 as [0,1,1].

**8.8.2 Generic subsampling sample location**

*Type: Unsigned integer, enumeration*

*Range: 0 to 15, inclusive*

**GenericSubsamplingSampleLocType** indicates the sample alignment of a channel compared to a channel that has not been subsampled. It is specified per channel in a frame. It is assumed that at least one channel in a frame is not subsampled.

The meaning of GenericSubsamplingSampleLocType depends on the value of GenericSubsamplingType for the same channel. The relative spatial positioning of the sample compared to a channel that is not subsampled, can be expressed by defining two variables HorizontalOffset and VerticalOffset as a function of GenericSubsamplingSampleLocType as given by Table 10. HorizontalOffset is the horizontal (x) position of the centre of the top-left sample of the current channel relative to the centre of the top-left sample of a channel that is not subsampled in units of non-subsampled samples. VerticalOffset is the vertical (y) position of the centre of the top-left sample of the current channel relative to the centre of the top-left sample of a channel that is not subsampled in units of non-subsampled samples.

**Table 10 — Interpretation of the value of GenericSubsamplingSampleLocType for**

**different GenericSamplingType values in terms of [HorizontalOffset,VerticalOffset]**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **GenericSubsamplingType** | | | | |
| **Value** | 0 | 1 | 2 | 3 | 4 |
| 0 | (0.0, 0.0) | (0.0, 0.0) | (0.0, 0.5) | (0.0, 0.0) | (0.0, 0.5) |
| 1 | (0.0, 0.0) | (0.5, 0.0) | (0.5, 0.5) | (0.25, 0.0) | (0.0, 0.5) |
| 2 | (0.0, 0.0) | (0.0, 0.0) | (0.0, 0.0) | (0.0, 0.0) | (0.0, 0.0) |
| 3 | (0.0, 0.0) | (0.5, 0.0) | (0.5, 0.0) | (0.25, 0.0) | (0.0, 0.0) |
| 4 | (0.0, 0.0) | (0.0, 0.0) | (0.0, 1.0) | (0.0, 0.0) | (0.0, 1.0) |
| 5 | (0.0, 0.0) | (0.5, 0.0) | (0.5, 1.0) | (0.25, 0.0) | (0.0, 1.0) |
| 6-14 | Reserved | Reserved | Reserved | Reserved | Reserved |
| 15 | Undefined | Undefined | Undefined | Undefined | Undefined |

Table 10 describes the meaning of the GenericSubsamplingSampleLocType values given the GenericSubsamplingType for the current channel. For the case of GenericSubsamplingType equal to

2 (4:2:0), the values of GenericSubsamplingSampleLocType have the same meaning as Chroma420SampleLocType. The meaning for the other cases of GenericSubsamplingSampleLocType have the corresponding HorizontalOffset and VerticalOffset as for GenericSubsamplingType 2, where applicable.

If a channel has a GenericSubsamplingType of 0, the value of GenericSubsamplingSampleLocType for that channel is ignored.

Examples:

* GenericSubsamplingType [0,2,2] and GenericSubsamplingSampleLocType [2,1,1] corresponds to 4:2:0 subsampling with centre-centre chroma location (i.e. Chroma420SampleLocType 1).
* GenericSubsamplingType [0,3,3] and GenericSubsamplingSampleLocType [2,1,1] corresponds to 4:1:1 subsampling with centre chroma location.