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**Abstract**

This document contains a draft of an amendment (version 2- AG1011) to the technical report (developed in AG1003) on video signal property description code points and their combinations that are widely used in production and video content workflows. This report will add in additional features and details to the first addition of the Technical Record that provide additional combinations or extend the type of combination of video properties.

DRAFT TECHNICAL REPORT

Draft ISO/IEC 23091-4 : 201x (E)

Draft ITU-T H Suppl. XX (201x E)

DRAFT ITU-T SUPPLEMENT

USAGE OF VIDEO SIGNAL TYPE CODE POINTS

# Scope

# Normative references

* 1. **Identical Recommendations | International Standards**
  2. **Paired Recommendations | International Standards equivalent in technical content**
  3. **Additional references**

-- SMPTE ST 2115 (FCD Draft):2019 Free Scale Gamut and Free Scale Log Characteristics of Camera Signals

-- SMPTE ST 2113 (FCD Draft):2018 Colorimetry of P3 Color Spaces

# Definitions

For the purposes of this document, the following definitions and the definitions in the HEVC (Rec. ITU-T H.265 | ISO/IEC 23008-2), AVC (Rec. ITU-T H.264 | ISO/IEC 14496-10), and CICP (Rec. ITU-T H.273 | ISO/IEC 23001-8) specifications apply.

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| **3.1** |  |

# Abbreviations

For the purposes of this document, the following abbreviations apply.

# Overview

*Add after 4th Paragraph*

Table XX indicates some popular applications that uses these widely used industry practices with types of restrictions described in later sections.

[ED/YS Should this table be split into consumer and professional target applications?]

Table 1 Target applications for widely used content workflows for video production and distribution workflows

|  |  |  |  |
| --- | --- | --- | --- |
| **System** | **Format** | **Other restrictions** | **Notes** |
| CD Video | BT.601 525  BT.601 625 | 8-bit 4:2:0 (MPEG-1 bitstreams) |  |
| DVD | BT.709 YCC  BT.601 525  BT.601 625 | 8-bit 4:2:0 (MPEG-2 Main Profile bitstreams) |  |
| Blu-Ray | BT.709 YCC | 8-bit 4:2:0  (MPEG-2 Main Profile, AVC Main, AVC High Profile) |  |
| Ultra HD Blu-Ray (4K) HDR | BT.2100 YCC( ?) | 10-bit 4:2:0 (HEVC Main 10 Profile) |  |
| Ultra HD Blu-Ray (4K) WCG | BT.2020 YCC NCL | 10-bit 4:2:0 (HEVC Main 10 Profile)  TransferCharacteristics = 14 |  |
| DVB 1.0 | BT.709 YCC | 8-bit 4:2:0 |  |
| DVB UHD WCG | BT.2020 YCC NCL | 8-bit 4:2:0 (HEVC Main Profile)  10-bit 4:2:0 (HEVC Main 10 Profile)  TransferCharacteristics = 14 |  |
| DVB UHD HDR | BT.2100 PQ YCC  BT.2100 HLG YCC | 10-bit 4:2:0 (HEVC Main 10 Profile) |  |
| ATSC v1.0 | BT.709 YCC | 8-bit 4:2:0 (MPEG-2 Main Profile) |  |
| ATSC v3.0 WCG UHD | BT.2020 YCC NCL | 10-bit 4:2:0 (HEVC Main 10 Profile)  TransferCharacteristics = 1 |  |
| ATSC v3.0 HDR UHD | BT.2100 PQ YCC | 10-bit 4:2:0 (HEVC Main 10 Profile) |  |
| ARIB HDR (B32 v3) | BT.2100 HLG YCC | 10-bit 4:2:0 (HEVC Main 10 Profile) |  |
| ARIB WCG (B32 v3 ?) | BT.2020 YCC NCL | 10-bit 4:2:0 (HEVC Main 10 Profile)  TransferCharacteristics = 14 |  |
| SCTE (cable TV) SDR | BT.709 YCC | 8-bit 4:2:0  (MPEG-2 Main Profile, AVC Main, AVC High Profile) |  |
| SCTE (cable TV) HDR | BT.2100 PQ YCC | 10-bit 4:2:0 (HEVC Main 10 Profile) |  |
| HD Broadcast contribution SDR | BT.709 YCC | 10-bit 4:2:2 (JPEG-2000 Broadcast Contribution Single Tile Profile) | used internally for IP contribution and during live events production,  now available with embedded H.273 signaling per<http://www.videoservicesforum.org/download/technical_recommendations/VSF_TR-01_2018-06-05.pdf> |
| HD Broadcast contribution SDR | BT.709 YCC | 10-bit 4:2:2 (AVC High422 Profile) | typically, this is how we provide live content to our business partners |

# Workflow domains

[Existing Figure for Discussion purposes]

Capture

Production w/ metadata

Service

distribution

Production

distribution

Theatrical/

Scripted TV

Live Events

* Non-linear colour transformations
* Chroma sub-sampling
* Colour representation transformation
* Bit depth reductions
* Chroma sub-sampling
* Colour representation transformation
* Bit depth reduction
* Metadata generation

4:4:4/4:2:2

RGB/Y′CbCr

16/12/10 bit

4:4:4/4:2:2

R′G′B′/Y′CbCr

16/12/10 bit

4:4:4/4:2:2

R′G′B′/Y′CbCr

16/12/10 bit

4:2:0

Y′CbCr

10/8 bit

**Figure 1 – Video workflows through different carriage domains**

[ED/YS] Need to add Camera log information in a combined section or its own section?

[ED/YS] Q1- At the capture level should we try to identify the widely used camera outputs combinations? 1) 2) 4 different types of camera logs R’G’B’ or YCbCr w/ 4:2:2 or 4:2:0 and either 12 or 10 bit. This is the describes the signal outputs that need to be converted ( e.g. LUT for PQ or HLG/ RGB or R’G’B’ to Y’CbCr)

[ED/YS] Q2: Is every other operation in the workflow just a degradation of the signal information through a conversion.

[ED/YS] Table for Baseband resolution to type of interface. E.g. UHD resolution baseband transmission could use quad3G or 12G. Accommodates camera that only may have 1 type of connections. This may come in as a separate contribution.

# Common video signal type combinations

## General

## Colorimetry and colour range descriptions

### General

### Colour properties

### Common descriptions and carriage – standard dynamic range video with narrow colour gamut

**Table 4 – SDR NCG common colour volume descriptions**

|  | **System Identifier** | **BT709\_YCC** | **BT709\_RGB** | | **FR709\_RGB** | | **BT601\_525** | **BT601\_625** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Colour properties** | Colour primaries | BT.709 | BT.709 | | BT.709 | | BT.601 | BT.601 |
| Transfer characteristics | BT.709 | BT.709 | | BT.709 | | BT.709 | BT.709 |
| Colour representation | Y′CbCr | R′G′B′ | | R′G′B′ | | Y′CbCr | Y′CbCr |
| **Other** | Full/narrow range | Narrow | Narrow | | Full | | Narrow | Narrow |
| 4:2:0 chroma sample location alignment | Interstitial | Interstitial | | Interstitial | | Interstitial | Interstitial |
| **CICP parameters --ISO/IEC 23008** | ColourPrimaries | 1 | 1 | | 1 | | 6 | 5 |
| TransferCharacteristics | 1 | 1 | | 1 | | 6 | 6 |
| MatrixCoefficients | 1 | 0 | | 0 | | 6 | 5 |
| VideoFullRangeFlag | 0 | 0 | | 1 | | 0 | 0 |
| **SMPTE MXF parameters --ST 2067-21:2019** | Colour primaries | 06.0E.2B.34.04.01.01.06.04.01.01.01.03.03.00.00 | | | | | 06.0E.2B.34.04.01.01.06.04.01.01.01.03.01.00.00 | 06.0E.2B.34.04.01.01.06.04.01.01.01.03.02.00.00 |
| Transfer characteristic | 06.0E.2B.34.04.01.01.01.04.01.01.01.01.02.00.00 | | | | | | |
| Coding equations | 06.0E.2B.34.04.01.01.01.04.01.01.01.02.02.00.00 | | N/R | | N/R | 06.0E.2B.34.04.01.01.01.04.01.01.01.02.01.00.00 | |
| Full/narrow level range  indicated in black reference level, white reference level, colour range | Inferred | | | | | | |
| 4:2:0 chroma sample location alignment | Inferred (ChromaLocType = 0) | | | | | | |

### Common descriptions and carriage – standard dynamic range video with wide colour gamut

**Table 5 – SDR WCG common colour volume descriptions**

|  | **System Identifier** | **BT2020\_YCC\_NCL** | **BT2020\_RGB** | **FR2020\_RGB** |
| --- | --- | --- | --- | --- |
| **Colour properties** | Colour primaries | BT.2020 | BT.2020 | BT.2020 |
| Transfer characteristics | BT.2020 | BT.2020 | BT.2020 |
| Colour representation | Y′CbCr | R′G′B′ | R′G′B′ |
| **Other** | Full/narrow range | Narrow | Narrow | Full |
| 4:2:0 chroma sample location alignment | Co-sited | Co-sited | Co-sited |
| **CICP parameters --ISO/IEC 23008** | ColourPrimaries | 9 | 9 | 9 |
| TransferCharacteristics | 14 | 14 | 14 |
| MatrixCoefficients | 9 | 0 | 0 |
| VideoFullRangeFlag | 0 | 0 | 1 |
| **SMPTE MXF parameters --ST 2067-21:2019** | Colour primaries | 06.0E.2B.34.04.01.01.0D.04.01.01.01.03.04.00.0 | | |
| Transfer characteristic | 06.0E.2B.34.04.01.01.0E.04.01.01.01.01.09.00.00 | | |
| Coding equations | 06.0E.2B.34.04.01.01.0D.04.01.01.01.02.06.00.00 | N/R | N/R |
| Full/narrow level range  indicated in black reference level, white reference level, colour range | Inferred | | |
| 4:2:0 chroma sample location alignment | Inferred (ChromaLocType = 2) | | |

### Common descriptions and carriage – high dynamic range video with wide colour gamut

**Table 6 – HDR WCG common colour volume descriptions**

|  | **System Identifier** | **BT2100\_PQ\_YCC** | **BT2100\_HLG\_YCC** | **BT2100\_PQ\_RGB** | **BT2100\_HLG\_RGB** |
| --- | --- | --- | --- | --- | --- |
| **Colour properties** | Colour primaries | BT.2020 / BT.2100 | BT.2020 / BT.2100 | BT.2020 / BT.2100 | BT.2020 / BT.2100 |
| Transfer characteristics | BT.2100 PQ | BT.2100 HLG | BT.2100 PQ | BT.2100 HLG |
| Colour representation | Y′CbCr | Y′CbCr | R′G′B′ | R′G′B′ |
| **Other** | Full/narrow range | Narrow | Narrow | Narrow | Narrow |
| 4:2:0 chroma sample location alignment | Co-sited | Co-sited | Co-sited | Co-sited |
| **CICP parameters --ISO/IEC 23008** | ColourPrimaries | 9 | 9 | 9 | 9 |
| TransferCharacteristics | 16 | 18 | 16 | 18 |
| MatrixCoefficients | 9 | 9 | 0 | 0 |
| VideoFullRangeFlag | 0 | 0 | 0 | 0 |
| **SMPTE MXF parameters --ST 2067-21:2019** | Colour primaries | 06.0E.2B.34.04.01.01.0D.04.01.01.01.03.04.00.00 | | | |
| Transfer characteristic | 06.0E.2B.34.04.01.01.0D.04.01.01.01.01.0A.00.00 | 06.0E.2B.34.04.01.01.0D.04.01.01.01.01.0B.00.00 | 06.0E.2B.34.04.01.01.0D.04.01.01.01.01.0A.00.00 | 06.0E.2B.34.04.01.01.0D.04.01.01.01.01.0B.00.00 |
| Coding equations | 06.0E.2B.34.04.01.01.0D.04.01.01.01.02.06.00.00 | | N/R | N/R |
| Full/narrow level range  indicated in black reference level, white reference level, colour range | Inferred | | | |
| 4:2:0 chroma sample location alignment | Inferred (ChromaLocType = 2) | | | |

## Mastering display colour volume descriptions

### Mastering display colour volume properties

### Common descriptions and carriage – mastering display colour volume descriptions

**Table 7 – Mastering display colour volume descriptions**

|  | **System identifier** | | **BT709x100n05** | **P3D65x1000n0005** | **BT2100x107n0005** |
| --- | --- | --- | --- | --- | --- |
| **Mastering display properties defined according to SMPTE ST 2086** | Colour primaries (x,y) | | {0.6400, 0.3300}  {0.3000, 0.6000}  {0.1500, 0.0600} | {0.6800, 0.3200}  {0.2650, 0.6900}  {0.1500, 0.0600} | {0.7080, 0.2920}  {0.1700, 0.7970}  {0.1310, 0.0460} |
| White point chromaticity (x,y) | | {0.3127, 0.3290} (D65) | | |
| Maximum luminance [cd/m2] | | 100 | 1000 | 1000 |
| Minimum luminance [cd/m2] | | 0.05 for LCD/LED | 0.0005 for OLED | 0.0005 for OLED |
| **HEVC or AVC MDCV SEI message** | Display\_primaries\_x[0]/y[0] | | {32000, 16500} | {35400, 14600} | {34000, 16000} |
| Display\_primaries\_x[1]/y[1] | | {15000, 30000} | {8500, 39850} | {13250, 34500} |
| Display\_primaries\_x[2]/y[2] | | {7500, 3000} | {6550, 2300} | {7500, 3000} |
| White\_point\_x/y | | {15635, 16450} | | |
| Max/min\_display\_mastering\_luminance | | {1000000, 500} | {10000000, 5} | {10000000, 5} |
| **SMPTE MXF parameters --ST 2067-21:2019** | MasteringDisplayPrimaries | Registration identifier | 060e2b34.0101010e.04200401.01010000 | | |
| Coded decimal | {32000, 16500} {15000, 30000} {7500, 3000} | {35400, 14600} {8500, 39850} {6550, 2300} | {34000, 16000} {13250, 34500} {7500, 3000} |
| MasteringDisplayWhitePoint  Chromaticity | Registration identifier | 060e2b34.0101010e.04200401.01020000 | | |
| Coded decimal | {15635, 16450} | | |
| MasteringDisplayMaximum  Luminance | Registration identifier | 060e2b34.0101010e.04200401.01030000 | | |
| Coded decimal | 1000000 | 10000000 | 10000000 |
| MasteringDisplayMinimum  Luminance | Registration identifier | 060e2b34.0101010e.04200401.01030000 | | |
| Coded decimal | 500 | 5 | 5 |

## Widely used video/image characteristics in workflow domains

Several video properties can be associated as video/image characteristics. These types of video properties can be converted as it moves through each domain (capture, production distribution, service distribution) in the workflow. For distribution domains, bit depth, colour sampling structure, colour form, and compression format can be discovered through the format profile definition and bitstream syntax. The remainder of video properties in this description is not carried in any wrapper but can be identified through the system identifier tags which may be sent as out of stream information

### Video/image characteristics for capture domain

In the capture domain content originates from camera capture from one or multiple cameras. The process in this domain are often in real-time and can include some real-time production processes (e.g. adding graphics, colour grading, static/dynamic LUTs for things like transfer curves changes (HLG to PQ), full/narrow range scalability conversion). A real-time delivery through all the domains in the workflow to the viewer is generally a live event workflow. If production or service distribution is non realtime, this may become a part of a theatrical or scripted type of workflow. In the capture domain, content needs to be kept at a high information rate so it is stored/transmitted generally as editable images in a lossless or uncompressed format.

AVC Class 100, or 100 Mb/s, is an example of a **common** lossy compression level used for professional 709 capture. Corresponding uncompressed bit rate for 709 is about 3 Gb/s.

Table 6- Widely Used Video/Image Workflow Characteristics in the Capture Domain

|  |  |
| --- | --- |
| SDR/NCG | |
| Colour sampling structure | 4:4:4 [Y’CbCr, R’G’B’], 4:2:2 [Y’CbCr] |
| Frame structure | Interlaced, progressive |
| Bit depth | 10, 8 |
| Compression type | Lossless, uncompressed |
| Compression dimension | None |
| Compression format | None |
| File Wrappers | None, MXF |
| Wireline Frame Digital Interface | SDI, HD-SDI, ST.2022 (IP/Mux), ST.2110 (IP/UnMux) |

|  |  |
| --- | --- |
| HDR/WCG, SDR/WCG | |
| Colour sampling structure | 4:4:4 [R’G’B’], 4:2:2 [Y’CbCr], 4:4:4 [Y’CbCr] |
| Frame structure | Progressive |
| Bit depth | 16, 12, 10 |
| Compression type | Lossless, uncompressed |
| Compression dimension | None |
| Compression format | None |
| File Wrappers | None, MXF |
| Wireline Frame Digital Interface | HD-SDI, ST.2022-6 (IP/Mux), ST.2110-20 (IP/UnMux) |

### Video/image characteristics for production domain

In the production domain, the video/image content can be mixed with other sources such as CGI content. It can also undergo colour space, sampling structure, and bit-depth conversions as well as alterations of the content through colour grading processes to provide an intended “look” to the content to the viewer. Content conversions may lose come of the information from the capture domain, but the content is still of a high quality, and editable. Content is more in an uncompressed or lightly compressed format.

Table 7- Widely Used Video/Image Workflow Characteristics in the Production Domain

|  |  |
| --- | --- |
| SDR/NCG | |
| Colour sampling structure | 4:4:4 [Y’CbCr, R’G’B’], 4:2:2 [Y’CbCr] |
| Frame structure | Interlaced, progressive |
| Bit depth | 10, 8 |
| Compression type | uncompressed, Lossless, compressed |
| Compression dimension | None |
| Compression format | None |
| File Wrappers | None, MXF, |
| Wireline Frame Digital Interface | SDI, HD-SDI, ST.2022-6 (IP/Mux), ST.2110-10 (IP/UnMux), Others |

|  |  |
| --- | --- |
| HDR/WCG, SDR/WCG | |
| Colour sampling structure | 4:4:4 [R’G’B’], 4:2:2 [Y’CbCr] |
| Frame structure | Progressive |
| Bit depth | 12, 10 |
| Compression type | Lossless, uncompressed |
| Compression dimension | None, spatial |
| Compression format | None, J2K |
| File Wrappers | None, MXF, |
| Wireline Frame Digital Interface | HD-SDI, ST 2022-6 (IP/Mux), ST.2110-20 (IP/UnMux), Others |

### Video/Image Characteristics for Production Distribution Domain

In the production distribution domain, is intended for distribution of content to other facilities or to act as a mezzanine or contribution feed (e.g. IMF, HEVC, J2K, AVC) to a service provider. Content is usually lightly compressed in a spatial dimension or both a spatial/temporal dimension.

Table 8- Widely Used Video/Image Workflow Characteristics in the Production Distribution Domain

|  |  |
| --- | --- |
| SDR/NCG | |
| Colour sampling structure | 4:2:2 [YCbCr], 4:2:0 [YCbCr] |
| Frame structure | Interlaced, progressive |
| Bit depth | 10, 8 |
| Compression type | Lossless, uncompressed |
| Compression dimension | None |
| Compression format | None, J2K, HEVC, AVC, MPEG-2 |
| File Wrappers | MXF, MPEG2-TS, ISOBMFF |
| Wireline Frame Digital Interface | SDI, HD-SDI, ST.2022-6 (IP/MUX), ST 2110-20 (IP/UnMux), others |

|  |  |
| --- | --- |
| HDR/WCG, SDR/WCG | |
| Colour sampling structure | 4:2:2 [Y’CbCr], 4:2:2 [Y’CbCr] |
| Frame structure | Progressive |
| Bit depth | 16, 12, 10 |
| Compression type | Lossless, uncompressed |
| Compression dimension | None, spatial, spatial/temporal |
| Compression format | None, J2K, HEVC, AVC, MPEG-2 |
| File Wrappers | MXF, MPEG2-TS, ISOBMFF |
| Wireline Frame Digital Interface | SDI, HD-SDI, ST.2022 (IP/MUX), ST.2110-20 (IP/UnMux) , others |

### Video/image characteristics for service distribution domain

In the service distribution domain, the remaining conversion stage of the content is intended to be the final format that is consumed by the viewer’s player device. Video content may be reduced by further subsampling, bit depth, and traditional distribution video codec techniques.

Table 9- Widely Used Video/Image Workflow Characteristics in the Service Distribution Domain

|  |  |
| --- | --- |
| SDR/NCG | |
| Colour sampling structure | 4:2:0 [Y’CbCr] |
| Frame structure | Interlaced, progressive |
| Bit depth | 10, 8 |
| Compression type | Lossless, uncompressed |
| Compression dimension | None |
| Compression format | HEVC, AVC, MPEG-2, Others |
| File Wrappers | MPEG2-TS, ISOBMFF |
| Wireline Frame Digital Interface |  |

|  |  |
| --- | --- |
| HDR/WCG, SDR/WCG | |
| Colour sampling structure | 4:2:0 [Y’CbCr] |
| Frame structure | Progressive |
| Bit depth | 10 |
| Compression type | Lossless, uncompressed |
| Compression dimension | Spatial, spatial/temporal |
| Compression format | HEVC, AVC, others |
| File Wrappers | MPEG2-TS, ISOBMFF |
| Wireline Frame Digital Interface |  |

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