TECHNICAL REPORT

ISO/IEC TR 23091-4

Third edition

Information technology — Coding-independent code points —

Part 4: Usage of video signal type code points

PROOF/ÉPREUVE

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information* in collaboration with ITU-T (as ITU-T Series H Supplement 19 (04/2021)).

This third edition cancels and replaces the second edition (ISO/IEC 23091-4:2020), which has been technically revised.

The main changes compared to the previous edition are as follows:

— clarity and terminology is improved;

— an error in the value of the registration identifier for the MasteringDisplayMinimumLuminance parameter of SMPTE ST 2067-21 for the BT709x100n05 tag combination is corrected.

A list of all parts in the ISO/IEC 23091 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

This document discusses video signal property description code points and their combinations that are widely used in production and video content workflows. Video properties and values are usually expressed in "metadata" that can exist across production and distribution workflows. Knowledge of these properties and their combinations has value as content is processed in the end-to-end production-to-distribution workflow chain.

The combinations of all possible expressible video properties as code point values can hypothetically result in hundreds or thousands of permutations; but many of those combinations are rarely or never used in practice. For example, it is highly unlikely that perceptual quantization (PQ) transfer characteristics function specified in Rec. ITU-R BT.2100 would be combined with the colour primaries specified in Rec. ITU-R BT.601. Only a small subset of the possible combinations is used in practice.

This document is written to provide information to help the producers of various content processing tools to avoid processing mistakes that can cause video quality degradation due to having incorrect assumptions made about video property combinations. There are only a few limited sets of video property combinations that are widely used in present-day video production and distribution equipment chains. This document describes these limited sets of combinations that are currently widely used and describes how the associated signal type metadata is carried to aid in the automation of content workflows across various domains of capture, production, and distribution. Lastly, this document aims to help its readers, especially toolset developers, to repurpose tools to work properly across several domains (e.g. capture, production, production distribution, and service distribution) where similar video conversion functions (e.g. chroma subsampling or colour space conversions) can be performed.

Information technology — Coding-independent code points —

Part 4:
Usage of video signal type code points

1 Scope

This document describes common industry representation practices for the usage of video signal type code points, as these properties are conveyed across video content production and distribution carriage systems.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Rec. ITU-T H.264 | ISO/IEC 14496-10, *Information technology — Coding of audio-visual objects — Part 10: Advanced video coding*

Rec. ITU-T H.265 | ISO/IEC 23008-2, *Information technology — High efficiency coding and media delivery in heterogeneous environments — High efficiency video coding*

Rec. ITU-T H.273 | ISO/IEC 23091-2, *Information technology — Coding-independent code points — Part 2: Video*

3 Terms and definitions

For the purposes of this document, the terms and definitions in Rec. ITU-T H.265 | ISO/IEC 23008-2, Rec. ITU-T H.264 | ISO/IEC 14496-10 and Rec. ITU-T H.273 | ISO/IEC 23091-2 and the following apply.

ISO ad IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org

3.1
3G-SDI
serial digital interface with a transport capacity of 2.970 Gbit/s and 2.970/1.001 Gbit/s for transporting uncompressed digital video signals

3.2
6G-SDI
serial digital interface with a transport capacity of 5.94 Gbit/s and 5.94/1.001 Gbit/s for transporting uncompressed digital video signals

3.3
10G-SDI
serial digital interface with a transport capacity of 10.692 Gbit/s for transporting uncompressed digital video signals

3.4
12G-SDI
serial digital interface with a transport capacity of 11.88 Gbit/s and 11.88/1.001 Gbit/s for transporting uncompressed digital video signals

3.5
colour coding characteristics
combination of colour gamut, colour primaries, dynamic range, transfer function, colour representation, video range, and chroma sample location

3.6
colour volume
space of all colours and intensities that a device or signal can reproduce or convey

3.7
creative intent
desired vision of the content creator (e.g. a director, cinematographer, videographer, editor or colourist) who adjusts and approves the appearance of rendered content in the production process

3.8
dual-link SDI
two parallel serial digital interfaces for transporting uncompressed video signals

3.9
electro-optical transfer function
EOTF
function to map a non-linear video signal to display linear light

3.10
full range
range in a fixed-point (integer) representation such that the active video range spans the full range of values that can be expressed with that bit depth

3.11
HD-SDI
serial digital interface for transporting uncompressed digital HD video signals

3.12
inverse electro-optical transfer function
inverse EOTF
function that is the inverse of an *EOTF* (3.9)

3.13
inverse opto-electrical transfer function
inverse OETF
function that is the inverse of an *OETF* (3.15)

3.14
narrow range
range in a fixed-point (integer) representation such that the active video range does not span the full range of values that can be expressed with that bit depth, although the remaining range can potentially be used for undershoot or overshoot processing artefacts and sync

Note 1 to entry: Narrow range is, in some applications, referred to by synonyms such as: “limited range”, “video range”, “legal range”, “SMPTE range” or “standard range”.

3.15
opto-electrical transfer function
OETF
function to map relative scene linear light to a non-linear video signal

3.16
opto-optical transfer function
OOTF
function to map relative scene linear light to display linear light

3.17
quad-link SDI
four parallel serial digital interfaces for transporting uncompressed video signals

3.18
random access point access unit
RAPAU
access unit in a video bitstream containing an intra-coded picture with the property that all pictures following the intra-coded picture in output order can be correctly decoded without using any information preceding it in the bitstream

3.19
SDI
serial digital interface for transporting uncompressed video signals

3.20
SD-SDI
signal digital interface for transporting uncompressed digital SD video signals

3.21
transfer function
function among any of the following: *EOTF* (3.9), *inverse EOTF* (3.12), *OETF* (3.15), inverse *OETF* (3.13), *OOTF* (3.16), or inverse OOTF

3.22
U-SDI
multilink (up to 24 links) serial digital interface with a transport capacity of 10.692 Gbit/s per link for transporting uncompressed digital video signals

4 Abbreviated terms

2K informally used to refer to an HD resolution (1920 × 1080 for television or 2048 × 1080 for film)

4K informally used to refer a UHD resolution (3840 × 2160 for television or 4096 × 2160 for film)

8K informally used to refer to a UHD resolution (7680 × 4320 or 8192 × 4320)

AVC advanced video coding (Rec. ITU-T H.264 | ISO/IEC 14496-10)

CICP coding-independent code points (Rec. ITU-T H.273 | ISO/IEC 23091-2)

EOTF electro-optical transfer function

GBR green, blue and red component colour system in linear light domain; same as RGB, although emphasizing that the green component is handled as the primary colour component by some technical elements of the video coding technology

NOTE The colour representation does not indicate the media component order in a coded representation. For example, GBR represents the same component colour system as RGB.

G′B′R′ green, blue and red component colour system in a non-linear domain associated with a transfer function which maps the linear light domain to a more perceptually uniform domain; same as R′G′B′, although emphasizing that the green component is handled as the primary colour component by some technical elements of the video coding technology

NOTE The colour representation does not indicate the media component order in a coded representation. For example, G′B′R′ represents the same component colour system as R′G′B′.

HD high definition

HDR high dynamic range

HEVC high efficiency video coding (Rec. ITU-T H.265 | ISO/IEC 23008-2)

HLG hybrid log-gamma (as defined in Rec. ITU-R BT.2100)

HVS human visual system

IC_TC_P constant intensity signal format (as defined in Rec. ITU-R BT.2100)

LCD liquid crystal display

LED light-emitting diode

LUT look-up table

MDCV mastering display colour volume

MXF material exchange format (as defined in SMPTE ST 377-1)

N/A not applicable

N/R not required

NCG narrow colour gamut (typically as per Rec. ITU-R BT.709)

NCL non-constant luminance

OETF opto-electrical transfer function

OOTF opto-optical transfer function

OLED organic light-emitting diode

PQ perceptual quantizer (as defined in Rec. ITU-R BT.2100)

QP quantization parameter

RAPAU random access point access unit

RGB red, green and blue component colour system in linear light domain

NOTE The colour representation does not indicate the media component order in a coded representation. For example, RGB represents the same component colour system as GBR.

R′G′B′ red, green and blue component colour system in a non-linear domain associated with a transfer function which maps the linear light domain to a more perceptually uniform domain

NOTE The colour representation does not indicate the media component order in a coded representation. For example, R′G′B′ represents the same component colour system as G′B′R′.

SD standard definition

SDR standard dynamic range

SEI supplemental enhancement information

UHD ultra-high definition

UL universal label (as defined in SMPTE ST 377-1)

VUI video usability information (a sequence-level syntax structure in HEVC and AVC bitstreams)

WCG wide colour gamut (a gamut substantially wider than the gamut conveyed by Rec. ITU-R BT.709, e.g. as per Rec. ITU-R BT.2020 or Rec. ITU-R BT.2100)

XYZ CIE 1931 colour space (wherein Y corresponds to the luminance signal)

Y′CbCr luma (Y′), chroma blue (Cb) and chroma red (Cr) colour representation defined by a matrix transformation relationship to an R′G′B′ colour system

NOTE A Y′CbCr representation is commonly used for video/image distribution as a way of encoding RGB information. Such a representation is also commonly expressed as YCbCr, $Y'C_BC_R$, or $Y'C'_BC'_R$, and can also be known as YUV in some documents. The relationship between Y′CbCr and R′G′B′ considered in this document is defined by matrix coefficients specified in Rec. ITU-R BT.601, Rec. ITU-R BT.709, Rec. ITU-R BT.2020 or Rec. ITU-R BT.2100. Unlike the CIE-Y component in the linear-light XYZ representation, it is possible that the non-linear, approximately perceptual uniform Y′ will not represent true luminance, regardless of the transfer function.

5 Overview

This document discusses video signal property description code points and their combinations that are widely used in production and video content workflows. Video properties and values are usually expressed in "metadata" that can exist across production and distribution workflows. Knowledge of these properties and their combinations has value as content is processed in the end-to-end production-to-distribution workflow chain.

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The coding-independent code points (CICP) specification for video (Rec. ITU-T H.273 | ISO/IEC 23091-2) defines code points and fields that identify properties of video signals. These code points are defined independently from how these properties are carried in a coded video-layer bitstream such as an HEVC or AVC bitstream, which can differ depending on bitstream format. The compressed representation is sometimes considered to be a temporary, compacted state for distribution or delivery of the video signal, while the reconstructed video signal output from a video decoder can be interpreted as having the same meaning as a video signal immediately prior to compression in the encoder.

Subclauses 7.2 and 7.3 define system identifier tags for combinations of the described commonly used values of such video signal property combinations that apply across signal domains. In addition, these subclauses also identify how the video property values are carried in the signal processing workflow. Subclause 7.3 defines system identifier tags for commonly used values for mastering display colour

volume descriptions. Annex A defines system identifier tags used for additional combinations that are not specified as industry standards. Annex B defines system identifier tags that are used in some existing consumer distribution formats.

6 Workflow domains

Figure 1 illustrates workflow domains (capture, production, production distribution, and service distribution) in which video content can exist, be edited, or be converted. Typical content workflows across these domains are either theatrical/scripted (episodic) TV or live events. There are many similar video processing functions that can be performed in each domain and often these functions can be repeated in the next successive domain.

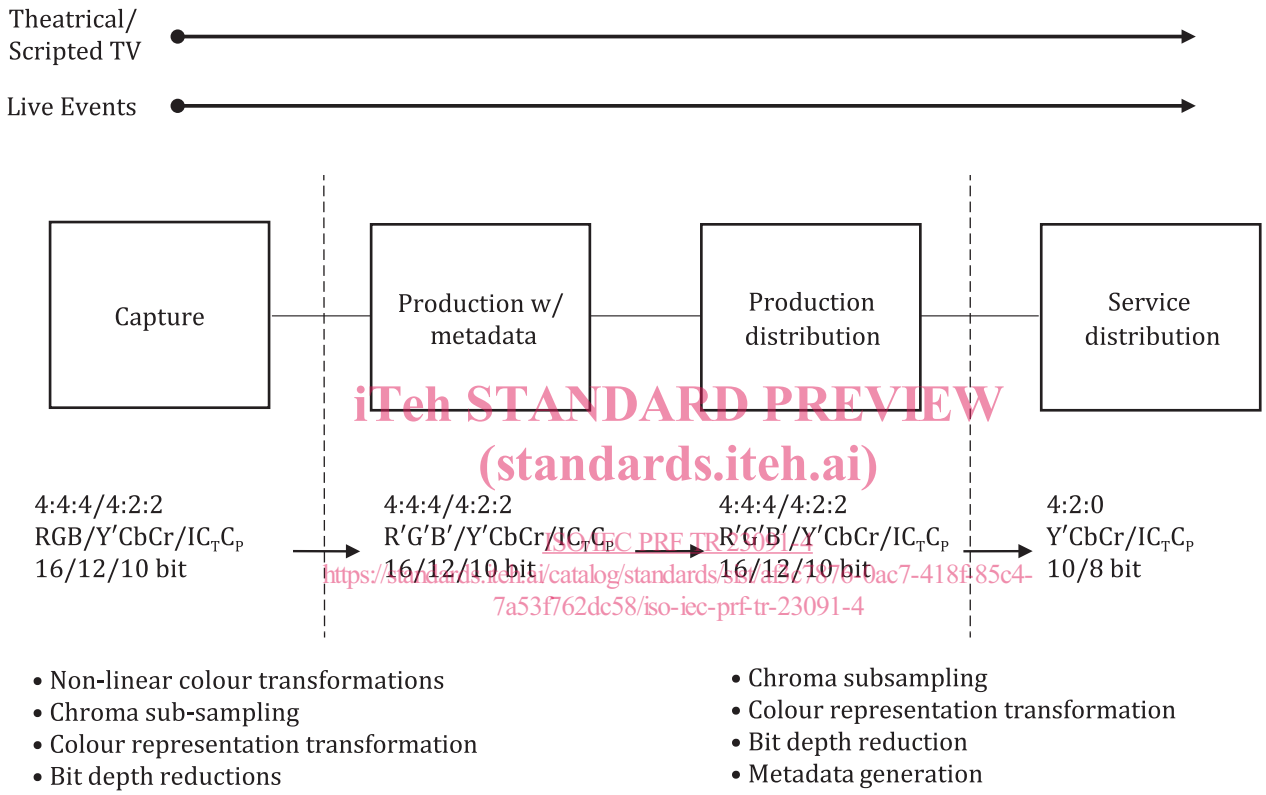

Figure 1 — Video workflows through different carriage domains

In the capture domain, content is created through sensors on cameras converting optical signals into a digital format. Content is retained at its highest informational format, although some conversions can be performed to reduce transport bandwidth demands.

In the interface to the production domain, content undergoes further processing transformations such as non-linear transformations, chroma subsampling (e.g. 4:4:4 to 4:2:2), colour representation changes (e.g. RGB to Y′CbCr NCL) and bit depth reduction (e.g. 16 bits per sample to 10 bits per sample). For theatrical/scripted TV workflows entering in the production domain, content can be augmented with computer-generated imagery sources, overlaid with graphics, and colour graded using a mastering display. For live event workflows, there is always a real-time constraint, which limits content processing to real-time operations. After the colour grading, both static and dynamic metadata can be generated that are to be attached to the content workflow. However, for live events, it is possible that the generation of highly customized metadata will not be practical and the metadata will need to be generated further downstream by automated content analysis approaches.

In the production distribution domain, some additional processing is done to the content to further reduce transport bandwidth demands. This can include some sample-wise processing transformations

