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**Information technology — Coding-  
independent code points —**

**Part 4:  
Usage of video signal type code points**

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## Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)) or the IEC list of patent declarations received (see <http://patents.iec.ch>).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information* in collaboration with ITU-T. The technically identical text is published as ITU-T Series H Supplement 19 (10/2019).

This second edition cancels and replaces the first edition (ISO/IEC TR 23091-4:2019), which has been technically revised.

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

- Tables are added to describe the carriage of these combinations in baseband transmission formats.
- For high dynamic range and wide colour gamut usage, an additional combination describing usage of the  $IC_T C_p$  colour representation of Rec. ITU-R BT.2100 and content mastering with a mastering display having 4000 cd/m<sup>2</sup> peak brightness is described.
- Two new informative annexes are added. Annex A describes commonly used video property combinations that are not specified in industry standards. Annex B indicates the relevance of the system identifier tags in consumer distribution specifications.
- Additional general refinements are also included to improve readability and clarity and improve the use of terminology.

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

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](http://www.iso.org/members.html).

## 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 could 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) may be performed.

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# 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 and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <http://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 that spans the full range of values that could 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 that does not span the full range of values that could be expressed with that bit depth

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* (standards.iteh.ai)

**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 <sub>T</sub> C <sub>P</sub>	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
NGG	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

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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 bit-streams)
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,  $Y'_{CB}C'_R$ , 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, the non-linear, approximately perceptual uniform Y' might not be representing true luminance, regardless of the transfer function.

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## 5 Overview

ISO/IEC TR 23091-4:2020

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 could 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 the 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) may be performed.

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 could 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 may 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 may 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 may be repeated in the next successive domain.

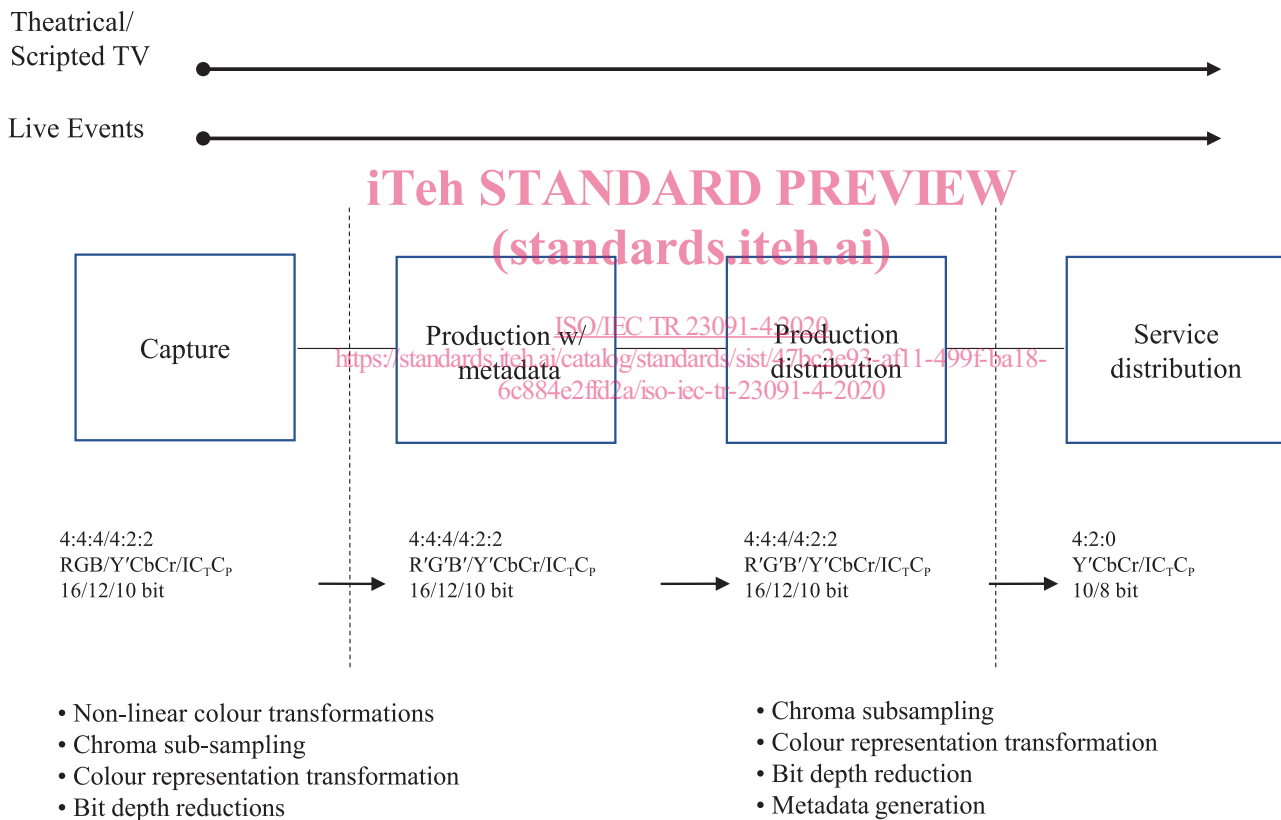


Figure 1 — Video workflows through different carriage domains

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 may 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