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Information technology — MPEG systems technologies —

Part 8: Coding-independent code points

Technologies de l'information — Technologies des systèmes MPEG —

Partie 8: Points de code indépendants du codage

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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. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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).

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).

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This second edition cancels and replaces the first edition (ISO/IEC 23001-8:2013), which has been technically revised.

It also incorporates the Amendment ISO/IEC 23001-8:2013/Amd 1:2015 and the Technical Corrigendum ISO/IEC 23001-8:2013/Cor 1:2015.

ISO/IEC 23001 consists of the following parts, under the general title *Information technology — MPEG systems technologies*:

— *Part 1: Binary MPEG format for XML*

— *Part 2: Fragment request units*

— *Part 3: XML IPMP messages*

— *Part 4: Codec configuration representation*

— *Part 5: Bitstream Syntax Description Language (BSDL)*

— *Part 7: Common encryption in ISO base media file format files*

— *Part 8: Coding-independent code points*

— *Part 9: Common encryption of MPEG-2 transport streams*

— *Part 10: Carriage of timed metadata metrics of media in ISO base media file format*

— *Part 11: Energy-efficient media consumption (green metadata)*

Information technology — MPEG systems technologies —

Part 8:
Coding-independent code points

1 Scope

This part of ISO/IEC 23001 defines various code points and fields that establish properties of a video or audio stream that are independent of the compression encoding and bit rate. These properties may describe the appropriate interpretation of decoded video or audio data or may, similarly, describe the characteristics of such signals before the signal is compressed by an encoder that is suitable for compressing such an input signal.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11664-1, *Colorimetry — Part 1: CIE standard colorimetric observers*

Rec. ITU-R BS.1770, *Algorithms to measure audio programme loudness and true-peak audio level*

Rec. ITU-R BS.1771-1, *Requirements for loudness and true-peak indicating meters*

EBU R 128, *Loudness normalization and permitted maximum level of audio signals*

EBU Tech 3341, *Loudness Metering: EBU mode metering to supplement loudness normalization in accordance with EBU R128*

EBU Tech 3342, *Loudness Range: A measure to supplement loudness normalisation in accordance with EBU R 128*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
channel
Ch.
conceptual representation of an audio signal for coding or transmission as it may be used within the digital signal processing chain of an audio codec

Note 1 to entry: A channel may correspond directly to one specific loudspeaker or it may carry an audio signal that is meant to be further processed and played back on more than one loudspeaker by some means not further specified here.

3.1.2
DRC
dynamic range compressor process that modifies the amplitude of an audio signal

3.1.3
K-weighted
frequency weighting by means of a two-stage filter, as defined in Rec. ITU-R BS.1770

3.1.4
LKFS
loudness, K-weighted, relative to nominal full scale, as defined in Rec. ITU-R BS.1770

3.1.5
loudspeaker
LS
physical loudspeaker with a given geometric position relative to the listener and, if applicable, a label or name

Note 1 to entry: Even though the loudspeaker names used in this part of ISO/IEC 23001 each describe one discrete loudspeaker position, some loudspeaker signals may, in practice, be rendered on a loudspeaker array consisting of multiple loudspeakers which are all driven with the same audio signal, for example, in a theatrical setting.

3.1.6
loudspeaker index
association of a loudspeaker geometric position to a given index

3.1.7
loudspeaker layout
set of loudspeakers with a specific constellation of geometric positions meant for authoring or playback of audio content

3.1.8
loudspeaker layout index
association of a loudspeaker layout to a given index

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

LSB least-significant bit

MSB most-significant bit

4 Conventions

NOTE The mathematical operators used in this part of ISO/IEC 23001 are similar to those used in the C programming language. However, integer division and arithmetic shift operations are specifically defined. Numbering and counting conventions generally begin from 0.

4.1 Arithmetic operators

The following arithmetic operators are defined as follows:

+ Addition.

– Subtraction (as a two-argument operator) or negation (as a unary prefix operator).

* Multiplication, including matrix multiplication.

x^y Exponentiation. Specifies x to the power of y. In other contexts, such notation is used for superscripting not intended for interpretation as exponentiation.

/ Integer division with truncation of the result toward zero. For example, 7 / 4 and (−7) / (−4) are truncated to 1 and (−7) / 4 and 7 / (−4) are truncated to −1.

÷ Used to denote division in mathematical equations where no truncation or rounding is intended.

$\frac{x}{y}$ Used to denote division in mathematical equations where no truncation or rounding is intended.

$\sum_{i=x}^{y} f(i)$ The summation of f(i) with i taking all integer values from x up to and including y.

x % y Modulus. Remainder of x divided by y, defined only for integers x and y with x >= 0 and y > 0.

4.2 Relational operators

The following relational operators are defined as follows:

> greater than

>= greater than or equal to

< less than

<= less than or equal to

== equal to

!= not equal to

When a relational operator is applied to a syntax element or variable that has been assigned the value “na” (not applicable), the value “na” is treated as a distinct value for the syntax element or variable. The value “na” is considered not to be equal to any other value.

4.3 Bit-wise operators

The following bit-wise operators are defined as follows:

& Bit-wise “and”. When operating on integer arguments, operates on a two’s complement representation of the integer value. When operating on a binary argument that contains fewer bits than another argument, the shorter argument is extended by adding more significant bits equal to 0.

| Bit-wise “or”. When operating on integer arguments, operates on a two’s complement representation of the integer value. When operating on a binary argument that contains fewer bits than another argument, the shorter argument is extended by adding more significant bits equal to 0.

^ Bit-wise “exclusive or”. When operating on integer arguments, operates on a two’s complement representation of the integer value. When operating on a binary argument that contains fewer bits than another argument, the shorter argument is extended by adding more significant bits equal to 0.

x >> y Arithmetic right shift of a two's complement integer representation of x by y binary digits. This function is defined only for positive integer values of y. Bits shifted into the MSBs as a result of the right shift have a value equal to the MSB of x prior to the shift operation.

x << y Arithmetic left shift of a two's complement integer representation of x by y binary digits. This function is defined only for positive integer values of y. Bits shifted into the LSBs as a result of the left shift have a value equal to 0.

4.4 Mathematical functions

The following mathematical functions are defined as follows:

$$Abs(x) = \begin{cases} x & ; \quad x >= 0 \\ -x & ; \quad x < 0 \end{cases} \tag{1}$$

$$Clip1_Y(x) = Clip3(0, (1 << BitDepth_Y) - 1, x), \tag{2}$$

where $BitDepth_Y$ is the representation bit depth of the corresponding luma colour component signal.

$$Clip1_C(x) = Clip3(0, (1 << BitDepth_C) - 1, x), \tag{3}$$

where $BitDepth_C$ is the representation bit depth of the corresponding chroma colour component signal C. In general, $BitDepth_C$ may be distinct for different chroma colour components signals C, e.g. for C corresponding to Cb or Cr.

$$Clip3(x,y,z) = \begin{cases} x & ; \quad z < x \\ y & ; \quad z > y \\ z & ; \quad \text{otherwise} \end{cases} \tag{4}$$

Floor(x) the largest integer less than or equal to x. (5)

Log10(x) returns the base-10 logarithm of x. (6)

Round(x) = Sign(x) * Floor(Abs(x) + 0.5). (7)

$$Sign(x) = \begin{cases} 1 & ; \quad x >= 0 \\ -1 & ; \quad x < 0 \end{cases} \tag{8}$$

$$Sqrt(x) = \sqrt{x} \tag{9}$$

5 Introduction

5.1 General

This Clause identifies the code points defined in this part of ISO/IEC 23001, as listed in Table 1 with cross-references to the subclause in which each is specified.

Table 1 — List of code point definitions

Name	Abstract	Subclause
ColourPrimaries	Video colour primaries	7.1
TransferCharacteristics	Video colour transfer characteristics	7.2
MatrixCoefficients and **VideoFullRangeFlag**	Video matrix colour coefficients	7.3
VideoFramePackingType and **QuincunxSamplingFlag**	Video frame packing	7.4
PackedContentInterpretationType	Interpretation of packed video frames	7.5
SampleAspectRatio, SarWidth, SarHeight	Sample aspect ratio of video	7.6
OutputChannelPosition	Audio channel assignment	8.1
ChannelConfiguration	Audio channel configuration	8.2
LoudspeakerGeometry	Audio loudspeaker geometry	8.3
LoudspeakerElevation	Audio loudspeaker elevation	8.3
LoudspeakerAzimuth	Audio loudspeaker azimuth	8.3
ProgramLoudness	Audio program loudness level	8.4
AnchorLoudness	Audio anchor content loudness level	8.5
LoudnessRange	Range of loudness	8.6
LoudnessRangeTop	Top value of loudness range	8.7
MomentaryLoudnessMax	Maximum Loudness (400 ms window)	8.8
ShortTermLoudnessMax	Maximum Loudness (3 s window)	8.9
ShortTermLoudness	Loudness (3 s window)	8.10
SamplePeakLevel	Level of sample peak magnitude	8.11
TruePeakLevel	Level of true peak	8.11
DrcCharacteristic	Index of DRC characteristic	8.12

5.2 Background

In a number of specifications, there is a need to identify some characteristics of media that are logically independent of the compression format (for example, aspects that relate to the sourcing or presentation or the role of the media component). These media characteristics have typically been documented by fields that take an encoded value or item selected from an enumerated list, herein called code points.

These code points are typically defined in the specification of compression formats to document these characteristics of the media. In past practices, the definition of these fields has been copied from standard to standard, sometimes with new values being added in later standards (and sometimes with later amendments specified to add new entries to existing standards).

This past practice has raised a number of issues, including the following:

a) A lack of a formal way to avoid conflicting assignments being made in different standards.

b) Having additional values defined in later specifications that may be practically used with older compression formats, but without clear formal applicability of these new values to older standards.

c) Any update or correction of code point semantics can incur significant effort to update all standards in which the code point is specified, instead of enabling a single central specification to apply across different referencing specifications.

d) The choice of reference for other specifications (such as container or delivery formats) not being obvious; wherein a formal reference to a compression format standard appears to favour that one

format over others, and also appears to preclude definitions defined in other compression format specifications.

e) Burdensome maintenance needs to ensure that a reference to material defined in a compression format specification is maintained appropriately over different revisions of the referenced format specification, as the content of a compression format specification may change over time and is ordinarily not intended as a point of reference for defining such code points.

This part of ISO/IEC 23001 provides a central definition of such code points to address these issues.

5.3 Applicability

The usage of this part of ISO/IEC 23001 is illustrated in Figure 1. This part of ISO/IEC 23001 can be used to provide universal descriptions to assist interpretation of signals following decoding or to describe the properties of the signals before they are encoded.

This part of ISO/IEC 23001 provides code points for coding-independent description of multimedia signal characteristics.

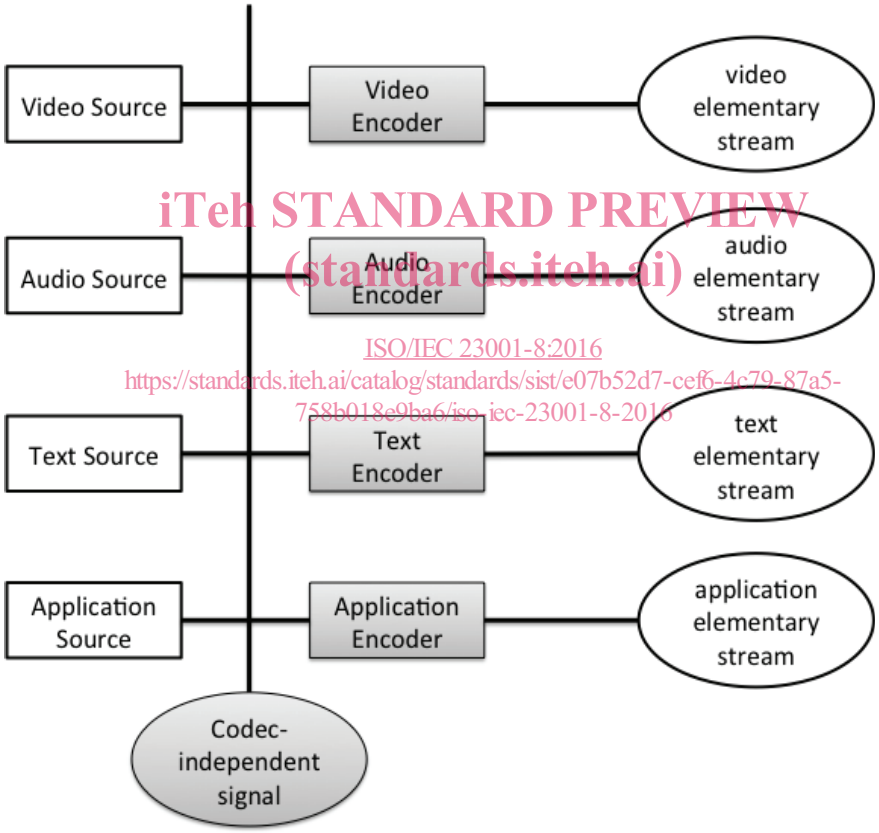

Figure 1 — Scope of this part of ISO/IEC 23001

6 Principles for definition and referencing of code points

6.1 Code point encoding and defaults

The code points defined herein may be specified as a value or a label of an enumerated list. The definition of their encoding and representation (e.g. as a binary number) is the responsibility of the specification using the code point, as is the identification of any applicable default value not specified herein. It is also possible for external specifications to use a mapping to values defined here, if they wish to preserve identical semantics but different code point assignments.

Guidance is given for each code point as to a suitable type (e.g. unsigned integer) and a suitable value range (e.g. 0 to 63) for assistance in writing derived specifications. In some instances, default flag values are provided that are suggested to be inferred for code point parameters with associated flags that may not be explicitly signalled or specified in derived specifications.

6.2 Externally defined values

If the external specification permits values not defined by this part of ISO/IEC 23001 to be identified in the same field that carries values defined by this part of ISO/IEC 23001, then that other specification should identify how values defined herein can be distinguished from values not defined herein.

6.3 Reference format

References to code points in this part of ISO/IEC 23001 should use only the code point name (i.e. a "Name" from Table 1) and specification title, and not use section numbers or any other "fragile" reference such as a table number. Example: "**ChocolateDensity** as defined in ISO/IEC 23001-8 *Coding-independent code points*".

6.4 URN Format

The Uniform Resource Names (URN) prefix

`urn:mpeg:mpegB:cicp:`

is defined by this part of ISO/IEC 23001 to form URN labels for the names in Table 1, when followed by a name from that table. Systems may use these URNs to identify values defined herein.

EXAMPLE `urn:mpeg:mpegB:cicp:ColourPrimaries`

7 Video code points

7.1 Colour primaries

Type: Unsigned integer, enumeration

Range: 0 – 255

ColourPrimaries indicates the chromaticity coordinates of the source colour primaries as specified in Table 2 in terms of the CIE 1931 definition of x and y as specified by ISO 11664-1.

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

Table 2 — Interpretation of colour primaries (ColourPrimaries) value

Value	Colour primaries			Informative remarks
0	Reserved			For future use by ISO/IEC
1	primary	x	y	Rec. ITU-R BT.709-5
	green	0.300	0.600	Rec. ITU-R BT.1361 conventional colour gamut system and extended colour gamut system (historical)
	blue	0.150	0.060	
	red	0.640	0.330	IEC 61966-2-1 sRGB or sYCC
	white D65	0.312 7	0.329 0	IEC 61966-2-4
				Society of Motion Picture and Television Engineers RP 177 (1993) Annex B
2	Unspecified			Image characteristics are unknown or are determined by the application.
3	Reserved			For future use by ISO/IEC

Table 2 *(continued)*

Value	Colour primaries			Informative remarks
4	primary	x	y	Rec. ITU-R BT.470-6 System M (historical)
	green	0.21	0.71	United States National Television System Committee 1953 Recommendation for transmission standards for colour television
	blue	0.14	0.08	
	red	0.67	0.33	United States Federal Communications Commission Title 47 Code of Federal Regulations (2003) 73.682 (a) (20)
	white C	0.310	0.316	
5	primary	x	y	Rec. ITU-R BT.470-6 System B, G (historical)
	green	0.29	0.60	Rec. ITU-R BT.601-6 625
	blue	0.15	0.06	Rec. ITU-R BT.1358 625 (historical)
	red	0.64	0.33	Rec. ITU-R BT.1700 625 PAL and 625 SECAM
	white D65	0.312 7	0.329 0	
6	primary	x	y	Rec. ITU-R BT.601-6 525
	green	0.310	0.595	Rec. ITU-R BT.1358 525 (historical)
	blue	0.155	0.070	Rec. ITU-R BT.1700 NTSC
	red	0.630	0.340	Society of Motion Picture and Television Engineers 170M (2004)
	white D65	0.312 7	0.329 0	(functionally the same as the value 7)
7	primary	x	y	Society of Motion Picture and Television Engineers 240M (1999)
	green	0.310	0.595	(functionally the same as the value 6)
	blue	0.155	0.070	
	red	0.630	0.340	
	white D65	0.312 7	0.329 0	
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
	green	0.170	0.797	
	blue	0.131	0.046	
	red	0.708	0.292	
	white D65	0.312 7	0.329 0	
10	primary	x	y	Society of Motion Picture and Television Engineers ST 428-1
	green (Y)	0.0	1.0	(CIE 1931 XYZ as in ISO 11664-1)
	blue (Z)	0.0	0.0	
	red (X)	1.0	0.0	
	centre white	1 ÷ 3	1 ÷ 3	

Table 2 *(continued)*

Value	Colour primaries			Informative remarks
11	primary	x	y	Society of Motion Picture and Television Engineers 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	Society of Motion Picture and Television Engineers EG 432-1 (2010)
	green	0.265	0.690	
	blue	0.150	0.060	
	red	0.680	0.320	
	white D65	0.312 7	0.329 0	
13–21	Reserved			For future use by ISO/IEC
22	primary	x	y	EBU Tech. 3213-E (1975)
	green	0.295	0.605	
	blue	0.155	0.077	
	red	0.630	0.340	
	white D65	0.312 7	0.329 0	
23–255	Reserved			For future use by ISO/IEC

7.2 Transfer characteristics

Type: Unsigned integer, enumeration

Range: 0 – 255

TransferCharacteristics indicates the opto-electronic transfer characteristic of the source picture, as specified in Table 3, as a function of a linear optical intensity input L_c with a nominal real-valued range of 0 to 1. For interpretation of entries in Table 3 that are expressed in terms of multiple curve segments parameterized by the variable α over a region bounded by the variable β or by the variables β and γ, the values of α and β are defined to be the positive constants necessary for the curve segments that meet at the value β to have continuity of both value and slope at the value β. The value of γ, when applicable, is defined to be the positive constant necessary for the associated curve segments to meet at the value γ. For example, for TransferCharacteristics equal to 1, 6, 14, or 15, α has the value 1 + 5.5 * β = 1.099 296 826 809 442... and β has the value 0.018 053 968 510 807....

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

Table 3 — Interpretation of transfer characteristics (TransferCharacteristics) value

Value	Transfer characteristics		Informative remarks
0	Reserved		For future use by ISO/IEC
1	$V = \alpha * L_c^{0.45} - (\alpha - 1)$	for $1 >= L_c >= \beta$	Rec. ITU-R BT.709-5
	$V = 4.500 * L_c$	for $\beta > L_c >= 0$	Rec. ITU-R BT.1361 conventional colour gamut system (historical) (functionally the same as the values 6, 14 and 15; the value 1 is preferred)
2	Unspecified		Image characteristics are unknown or are determined by the application.