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Information technology — MPEG video technologies —

Part 7: Versatile supplemental enhancement information messages for coded video bitstreams

Technologies de l'information — Technologies vidéo MPEG —

Partie 7: Messages d'améliorations complémentaires polyvalents pour les flux binaires vidéo codés

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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 information*, in collaboration with ITU-T. The technically identical text is published as Recommendation ITU-T H.274 (08/2020).

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Introduction

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Information technology — MPEG video technologies —

Part 7:
Versatile supplemental enhancement information messages for coded video bitstreams

1 Scope

This document specifies the syntax and semantics of video usability information (VUI) parameters and supplemental enhancement information (SEI) messages. The VUI parameters and SEI messages defined in this document are designed to be conveyed within coded video bitstreams in a manner specified in a video coding specification or to be conveyed by other means determined by the specifications for systems that make use of such coded video bitstreams. This document is particularly intended for use with coded video bitstreams as specified by Rec. ITU-T H.266 | ISO/IEC 23090-3, although it can also be used with other types of coded video bitstreams.

VUI parameters and SEI messages can assist in processes related to decoding, display or other purposes. However, unless otherwise specified in a referencing specification, the interpretation and use of the VUI parameters and SEI messages specified in this document is not a required functionality of a video decoder or receiving video system. Although semantics are specified for the VUI parameters and SEI messages, decoders and receiving video systems can simply ignore the content of the VUI parameters and SEI messages or can use them in a manner that somewhat differs from what is specified in this document.

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2 Normative references

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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.

Recommendation ITU-T H.273 | ISO/IEC 23091-2,*Coding-independent code points for video signal type identification*

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

ISO/IEC 11578:1996, *Information technology — Open Systems Interconnection — Remote Procedure Call (RPC)*

Recommendation ITU-T T.35:2000, *Procedure for the allocation of ITU-T defined codes for non standard facilities*

IETF RFC 1321, *The MD5 Message-Digest Algorithm*

3 Terms and definitions

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

ISO and 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/

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3.1
AU
access unit
set of *PUs* that belong to different *layers* and contain *coded pictures* associated with the same *output time*

3.2
APS
adaptation parameter set
syntax structure containing *syntax elements* that apply to zero or more *slices* as determined by zero or more *syntax elements* found in *slice headers*

3.3
associated IRAP picture
previous *IRAP picture* (when present) in *decoding order*, for a particular picture, in the same *layer* as the particular *picture*

3.4
azimuth circle
circle on a sphere connecting all points with the same azimuth value

Note 1 to entry: An azimuth circle is always a *great circle* like a longitude line on the earth.

3.5
byte
sequence of 8 bits, within which, when written or read as a sequence of bit values, the left-most and right-most bits represent the most and least significant bits, respectively, and the bits are written or read from left to right

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3.6
chroma
sample array or single sample representing one of the two colour difference signals related to the primary colours, represented by the symbols Cb and Cr

Note 1 to entry: The term chroma is used rather than the term chrominance in order to avoid implying the use of linear light transfer characteristics that is often associated with the term chrominance.

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3.7
CLVS
coded layer video sequence
sequence of *PUs* of the same layer that consists, in *decoding order*, of a *CLVSS PU*, followed by zero or more *PUs* that are not *CLVSS PUs*, including all subsequent *PUs* up to but not including any subsequent *PU* that is a *CLVSS PU*

3.8
CLVSS PU
PU in which the *coded picture* is a *CLVSS picture*

3.9
CLVSS
coded layer video sequence start
coded picture that starts a new CLVS as specified in a video coding specification

Note 1 to entry: In Rec. ITU-T H.266 | ISO/IEC 23090-3, a CLVSS picture is an *IRAP picture* with NoIncorrectPicOutputFlag equal to 1 or a gradual decoding refresh picture with NoIncorrectPicOutputFlag equal to 1. In Rec. ITU-T H.265 | ISO/IEC 23008-2, a CLVSS picture is an *IRAP picture* with NoRaslOutputFlag equal to 1.

3.10
coded picture
coded representation of a *picture* containing all *CTUs* of the *picture*

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3.11
coded slice NAL unit
NAL unit that contains a coded *slice*

3.12
coded video bitstream
sequence of bits that forms the representation of a sequence of *AUs* forming one or more *CVSs*

3.13
CVS
coded video sequence
sequence of *AUs* that consists, in *decoding order*, of a *CVSS AU*, followed by zero or more *AUs* that are not *CVSS AUs*, including all subsequent *AUs* up to but not including any subsequent *AU* that is a *CVSS AU*

3.14
CVSS AU
AU that has a PU for each *layer* present in the *CVS* and the *coded picture* in each *PU* is a *CLVSS picture*

3.15
component
array or single sample from one of the three arrays (*luma* and two *chroma*) that compose a *picture* in 4:2:0, 4:2:2, or 4:4:4 colour format or the array or a single sample of the array that compose a *picture* in monochrome format

3.16
constituent picture
part of a spatially *frame*-packed stereoscopic *picture* that corresponds to one view, or a *picture* itself when *frame* packing is not in use or the temporal interleaving *frame* packing arrangement is in use

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3.17
cropped decoded picture
result of cropping a *decoded picture* based on the conformance cropping window for the corresponding *coded picture*

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3.18
decoded picture
decoded picture is derived by decoding a *coded picture*

3.19
decoder
embodiment of a *decoding process*

3.20
decoding order
order in which *syntax elements* are conveyed in the *coded video bitstream* and are processed by a *decoding process*

3.21
decoding process
process that reads a *coded video bitstream* and derives *decoded pictures* from it

3.22
elevation circle
circle on a sphere connecting all points with the same elevation value

Note 1 to entry: An elevation circle is similar to a lattitude line on the earth. Except when the elevation value is zero, an elevation circle is not a *great circle* like a longitude circle on the earth.

3.23
encoder
embodiment of an *encoding process*

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3.24
encoding process
process that produces a *coded video bitstream*

3.25
field
assembly of alternative rows of samples of a *frame*

3.26
flag
variable or single-bit *syntax element* that can take one of the two possible values: 0 and 1

3.27
frame
composition of a top *field* and a bottom *field*, where sample rows 0, 2, 4, … originate from the top *field* and sample rows 1, 3, 5, … originate from the bottom *field*

3.28
global coordinate axes
coordinate axes associated with *omnidirectional video* that are associated with an externally referenceable position and orientation

Note 1 to entry: The global coordinate axes could correspond to the position and orientation of a device or rig used for omnidirectional audio/video acquisition as well as the position of an observer's head in the three-dimensional space of the *omnidirectional video* rendering environment.

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3.29
great circle
intersection of a sphere and a plane that passes through the centre point of the sphere

Note 1 to entry: A great circle is also known as an orthodrome or Riemannian circle.

3.30
inter prediction
aspect of the *decoding process* for a *coded picture* that makes use of data derived from the *decoding process* of one or more previously decoded *reference pictures*

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3.31
IRAP picture
coded picture starting from which all *pictures* in the same *layer* in both *decoding order* and *output order* can be decoded without first decoding any *picture* in the same *layer* earlier in *decoding order* in the *coded video bitstream*

3.32
layer
set of *VCL NAL units* that all have a particular value of layer identifier and the associated non-VCL NAL units, wherein the layer identifier is a variable for which the value is specified by a video coding specification

Note 1 to entry: In the contexts of Rec. ITU-T H.266 | ISO/IEC 23090-3 and Rec. ITU-T H.265 | ISO/IEC 23008-2, the layer identifier is the value of the nuh_layer_id syntax element in the NAL unit header.

3.33
leading picture
picture that is in the same *layer* as the *associated IRAP picture* and precedes the *associated IRAP picture* in *output order*

3.34
local coordinate axes
coordinate axes having a specified rotation relationship relative to the *global coordinate axes*

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3.35
luma
sample array or single sample representing the monochrome signal related to the primary colours, represented by the symbol or subscript Y or L

Note 1 to entry: The term luma is used rather than the term luminance in order to avoid implying the use of linear light transfer characteristics that is often associated with the term luminance. The symbol L is sometimes used instead of the symbol Y to avoid confusion with the symbol y as used for vertical location.

3.36
NAL unit
syntax structure containing an indication of the type of data that follows and *bytes* containing that data in a manner that enables the extraction of a string of data bits from the syntax structure

3.37
non-VCL NAL unit
NAL unit that is not a *VCL NAL unit*

3.38
omnidirectional video
video content in a format that enables rendering according to the user's viewing orientation, e.g., if viewed using a head-mounted device, or according to a user's desired *viewport*, reflecting a potentially rotated viewing position

3.39
output order
order in which the *decoded pictures* are output from the *decoder* (for the *decoded pictures* that are to be output from the *decoder*)

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3.40
output time
time when a *decoded picture* is to be output from the *decoder* (for the *decoded pictures* that are to be output from the *decoder*)

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3.41
packed region
region in a *region-wise packed picture* that is mapped to a *projected region* according to a *region-wise packing*

3.42
picture
array of *luma* samples in monochrome format or an array of *luma* samples and two corresponding arrays of *chroma* samples in 4:2:0, 4:2:2, and 4:4:4 colour format

Note 1 to entry: A picture could be either a frame or a field. However, in one CLVS, either all pictures are frames or all pictures are fields.

3.43
PPS
picture parameter set
A *syntax structure* containing *syntax elements* that apply to zero or more entire *coded pictures* as determined by a *syntax element* that is the same for all *slices* of a picture and found in the picture header or *slice headers* of each *picture*

3.44
PU
picture unit
set of *NAL units* that contain all *VCL NAL units* of a *coded picture* and their associated non-VCL NAL units

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3.45
projected picture
picture that uses a *projection* format for *omnidirectional video*

3.46
projected region
region in a *projected picture* that is mapped to a *packed region* according to a *region-wise packing*

3.47
projection
specified correspondence between the colour samples of a *projected picture* and azimuth and elevation positions on a sphere

3.48
random access
act of starting the decoding process for a *coded video bitstream* at a point other than the beginning of the bitstream

3.49
RASL picture
leading picture that cannot be correctly decoded when the decoding process starts from the *associated IRAP picture*

3.50
reference picture
picture that contains samples that could be used for *inter prediction* in the decoding process of subsequent pictures in decoding order

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3.51
reference picture list
list of *reference pictures* that is used for *inter prediction* of a *slice*

3.52
region-wise packed picture
decoded picture that contains one or more *packed regions*

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Note 1 to entry: A region-wise packed picture could contain a *region-wise packing* of a *projected picture*.

3.53
region-wise packing
transformation, resizing, and relocation of *packed regions* of a *region-wise packed picture* to remap the *packed regions* to *projected regions* of a *projected picture*

3.54
sample aspect ratio
indicated width-to-height aspect ratio of the luma samples of the associated *decoded pictures*

3.55
slice
region of a *picture* that can be decoded separately from other regions of the same *coded picture* (although in some cases the *decoding process* for the *picture* might use *inter prediction* that makes reference to other previously decoded *reference pictures*)

3.56
source
term used to describe the video material or some of its attributes before encoding

3.57
sphere coordinates
azimuth and elevation angles identifying a location of a point on a sphere

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3.58
sphere region
region on a sphere, specified either by four *great circles* or by two *azimuth circles* and two *elevation circles*, or such a region on a rotated sphere after applying yaw, pitch, and roll rotations

3.59
STSA picture
coded picture that enables up-switching, at the *coded picture*, to the *temporal sublayer* containing the *coded picture*, from the immediately lower *temporal sublayer* of the same *layer* when the *coded picture* does not belong to the lowest *temporal sublayer*

Note 1 to entry: An STSA picture does not use pictures in the same layer and with the same temporal sublayer identifier as the STSA picture for inter prediction reference. Pictures following an STSA picture in decoding order in the same layer and with the same temporal sublayer identifier as the STSA picture do not use pictures prior to the STSA picture in decoding order in the same layer and with the same temporal sublayer identifier as the STSA picture for inter prediction reference. STSA pictures in an independent layer (i.e., a layer that does not depend on other layers in its decoding) always have a temporal sublayer identifier greater than 0.

3.60
syntax element
element of data represented in a *syntax structure*

3.61
syntax structure
zero or more *syntax elements* that are present together in a specified order in a string of data bits, where the left-most bit is considered to be the first and most significant bit, and the right-most bit is considered to be the last and least significant bit

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3.62
SEI message
syntax structure that provides a particular type of information that assists in processes related to decoding, display or other purposes but is not needed by the *decoding process* in order to determine the values of the samples in *decoded pictures*

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3.63
temporal sublayer
subset of a temporal scalable *bitstream*, consisting of *VCL NAL units* with a particular value of *temporal sublayer identifier* and the associated *non-VCL NAL units*

3.64
temporal sublayer identifier
number greater than or equal to 0 defined by a variable for which the value is specified by a video coding specification such that pictures of all *temporal sublayers* have a specified temporal output order relative to each other and pictures with a lower temporal sublayer identifier can be decoded without reference to pictures with a higher temporal sublayer identifier

3.65
tilt angle
angle indicating the amount of tilt of a *sphere region*, measured as the amount of rotation of a *sphere region* along the axis originating from the sphere origin passing through the centre point of the *sphere region*, where the angle value increases clockwise when looking from the origin towards the positive end of the axis

3.66
trailing picture
coded picture that is associated with an *IRAP picture* and follows the *IRAP* picture in both decoding order and output order

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3.67
VCL NAL unit
collective term for *coded slice NAL units* and the subset of other *NAL units* that have *reserved* values of *NAL unit* type identifiers that are classified as VCL NAL units in a referencing specification

3.68
VUI parameters
syntax structure that identifies properties of interpretation of decoded pictures for display purposes, particularly including colour representation information

3.69
viewport
region of *omnidirectional video* content suitable for display and viewing by the user

4 Abbreviated terms

AU	access unit
APS	adaptation parameter set
CRC	cyclic redundancy check
CLVS	coded layer video sequence
CLVSS	coded layer video sequence start
CVS	coded video sequence
DRAP	dependent random access point
FIR	finite impulse response
IRAP	intra random access point
NAL	network abstraction layer
PPS	picture parameter set
PU	picture unit
RASL	random access skipped leading
RWP	region-wise packing
SAR	sample aspect ratio
SARI	sample aspect ratio information
SEI	supplemental enhancement information
STSA	step-wise temporal sublayer access
VCL	video coding layer
VUI	video usability information

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