
**Information technology – General
video coding —**

**Part 2:
Low complexity enhancement video
coding**

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*Technologies de l'information – Codage vidéo général —
Partie 2: Codage vidéo d'amélioration de faible complexité*
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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 or www.iec.ch/members_experts/refdocs).

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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. In the IEC, see www.iec.ch/understanding-standards.

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*.

A list of all parts in the ISO/IEC 23094 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.

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Information technology – General video coding —

Part 2: Low complexity enhancement video coding

1 Scope

This document specifies low complexity enhancement video coding.

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.

ISO/IEC 11578:1996, *Information technology — Open systems interconnection — Remote procedure call (RPC)*

ITU-T H.273 | ISO/IEC 23091-2:2019, *Information technology — Coding-independent code points — Part 2: Video*

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

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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 <https://www.electropedia.org/>

3.1

access unit

AU

set of *NAL units* (3.35) that are associated with a particular output time, are consecutive in *decoding order* (3.20), and contain exactly one *coded picture* (3.9)

3.2

bitstream

sequence of bits, in the form of a *NAL unit stream* (3.36) or a *byte stream* (3.6), that forms the representation of *coded pictures* (3.9), and associated data forming one or more coded video sequences (CVSS)

3.3

block

MxN (M-column by N-row) array of samples, or an MxN array of *transform coefficients* (3.57)

3.4

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

**3.5
byte-aligned**

position in a *bitstream* (3.2) in which the position is an integer multiple of 8 bits from the position of the first bit in the *bitstream*

Note 1 to entry: A bit, *byte* (3.4) or *syntax element* (3.53) is said to be *byte-aligned* when the position at which it appears in a *bitstream* (3.2) is *byte-aligned*.

**3.6
byte stream**

encapsulation of a *NAL unit stream* (3.36) containing *start code prefixes* (3.51) and *NAL units* (3.35)

**3.7
chroma**

sample array or single sample is 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 the implication of the use of linear light transfer characteristics that is often associated with the term chrominance.

**3.8
chunk**

entropy coded portion of data containing the quantized *transform coefficient* (3.57) belonging to a coefficient group

**3.9
coded picture**

coded representation (3.10) of a *picture* (3.40) containing all *TUs* (3.58) of the *picture*

**3.10
coded representation**

data element as represented in its coded form

**3.11
coded video sequence**

CVS
coded sequence of *access units* (3.1)

**3.12
coding block**

$M \times N$ *block* (3.3) of samples for some values of M and N

**3.13
coding unit**

CU
32 x 32 *block* (3.3) of samples resulting from the parsing of the entropy encoded *transform coefficients* (3.57) in the *decoding process* (3.22)

**3.14
coefficient group**

CG
syntactical structure containing coded data related to a specific set of *transform coefficients* (3.57)

**3.15
component**

array or single sample from one of the three arrays (*luma* (3.34) and two *chroma* (3.7)) that compose a *picture* (3.40) 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

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3.16**data block**

syntax structure (3.54) containing *bytes* (3.4) corresponding to a type of data

3.17**decoded base picture**

decoded picture (3.18) derived by decoding a *coded picture* (3.9) with a *base decoder* (3.20)

3.18**decoded picture**

picture (3.40) derived by decoding a *coded picture* (3.9), and which is either a *decoded frame* (3.29) or a *decoded field* (3.28)

3.19**decoded picture buffer****DPB**

buffer holding *decoded pictures* (3.18) for reference or output reordering

3.20**decoder**

embodiment of a *decoding process* (3.22)

3.21**decoding order**

order in which *syntax elements* (3.53) are processed by the *decoding process* (3.22)

3.22**decoding process**

process specified that reads a *bitstream* (3.2) and derives *decoded pictures* (3.18) from it

3.23**emulation prevention byte**

byte (3.4) equal to 0x03 that may be present within a *NAL unit* (3.35), the presence of which ensures that no sequence of consecutive *byte-aligned* (3.5) *bytes* in the *NAL unit* contains a *start code prefix* (3.51)

3.24**encoder**

embodiment of an *encoding process* (3.25)

3.25**encoding process**

process that produces a *bitstream* (3.2) conforming to this document

3.26**enhancement layer**

layer (3.32) within the *bitstream* (3.2) pertaining to the *residual planes* (3.47)

3.27**enhancement sub-layer**

layer (3.32) of the *enhancement layer* (3.26)

3.28**field**

assembly of alternate rows of a *frame* (3.29)

3.29**frame**

array of *luma* (3.34) samples in monochrome format or array of *luma* samples and two corresponding arrays of *chroma* (3.7) samples in 4:2:0, 4:2:2, and 4:4:4 colour format, and which consists of two *fields* (3.28): a top field and a bottom field

3.30
instantaneous decoding refresh picture
IDR picture

picture (3.40) for which a *NAL unit* (3.35) contains a global configuration data block and does not refer to any other *picture* for operation of the *decoding process* (3.22) of this *picture* and for which no subsequent *pictures* in *decoding order* (3.21) refer to any *picture* that precedes it in *decoding order*

Note 1 to entry: An *IDR picture* shall occur at least when an *IDR picture* for the base *decoder* (3.20) occurs. The *IDR picture* for a base *decoder* is not specified in this document.

3.31
inverse transform

part of the *decoding process* (3.22) by which a set of *transform coefficients* (3.57) is converted into *residuals* (3.46)

3.32
layer

one of a set of syntactical structures in a non-branching hierarchical relationship

3.33
level

defined set of constraints on the values that may be taken by the *syntax elements* (3.53) and variables of this document

Note 1 to entry: The same set of *levels* is defined for all *profiles* (3.41), with most aspects of the definition of each *level* being in common across different *profiles*. Individual implementations may, within specified constraints, support a different *level* for each supported *profile*.

3.34
luma

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

Note 1 to entry: The term *luma* is used rather than the term *luminance* in order to avoid the implication of 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.

3.35
network abstraction layer unit
NAL unit

syntax structure (3.54) containing an indication of the type of data to follow and *bytes* (3.4) containing that data in the form of an *RBSP* (3.42) interspersed as necessary with *emulation prevention bytes* (3.23)

3.36
network abstraction layer unit stream
NAL unit stream

sequence of *NAL units* (3.35)

3.37
output order

order in which the *decoded pictures* (3.18) are output from the *decoded picture buffer* (3.19) (for the *decoded pictures* that are to be output from the *decoded picture buffer*)

3.38
partitioning

division of a set into subsets such that each element of the set is in exactly one of the subsets

3.39
plane

collection of data related to plane Y (*luma* (3.34)) or C (*chroma* (3.7))

3.40**picture**

field (3.28) or *frame* (3.29)

3.41**profile**

specified subset of the syntax of this document

3.42**raw byte sequence payload****RBSP**

syntax structure (3.54) containing an integer number of *bytes* (3.4) that is encapsulated in a *NAL unit* (3.35) and which is either empty or has the form of a *string of data bits* (3.52) containing *syntax elements* (3.53) followed by an *RBSP stop bit* (3.43) and followed by zero or more subsequent bits equal to 0

3.43**raw byte sequence payload stop bit****RBSP stop bit**

bit equal to 1 present within an *RBSP* (3.42) after a *string of data bits* (3.52)

Note 1 to entry: The location of the end of the *string of data bits* within an *RBSP* can be identified by searching from the end of the *RBSP* for the *RBSP stop bit*, which is the last non-zero bit in the *RBSP*.

3.44**reserved**

value of a particular *syntax element* (3.53) for future use by ISO/IEC and not to be used in *bitstreams* (3.2) conforming to this document, but could be used in *bitstreams* conforming to future revised editions of this document

3.45**reserved_zeros**

value of a particular *syntax element* (3.53) for future use by ISO/IEC and not to be used in *bitstreams* (3.2) conforming to this document, but could be used in *bitstreams* conforming to future revised editions of this document

Note 1 to entry: In this document, the value of any *reserved_zeros* bit is zero.

3.46**residual**

difference between a prediction of a sample or data element and a reference of that same sample or data element

3.47**residual plane**

collection of *residuals* (3.46)

3.48**run length encoding****RLE**

method for encoding a sequence of values in which consecutive occurrences of the same value are represented as a single value together with its number of occurrences

3.49**sample aspect ratio**

the ratio between the intended horizontal distance between the columns and the intended vertical distance between the rows of the *luma* (3.34) sample array in a *picture* (3.40), which is specified for assisting the display process (not specified in this Specification) and expressed as h:v, where h is the horizontal width and v is the vertical height, in arbitrary units of spatial distance

3.50

source

video material or some of its attributes before encoding

3.51

start code prefix

unique sequence of three *bytes* (3.4) equal to 0 x 000001 embedded in the *byte stream* (3.6) as a prefix to each *NAL unit* (3.35)

Note 1 to entry: The location of a *start code prefix* can be used by a *decoder* (3.20) to identify the beginning of a new *NAL unit* and the end of a previous *NAL unit*. Emulation of *start code prefixes* is prevented within *NAL units* by the inclusion of *emulation prevention bytes* (3.23).

3.52

string of data bits

SODB

sequence of some number of bits representing *syntax elements* (3.53) present within a *raw byte sequence payload* (3.42) prior to the *raw byte sequence payload stop bit* (3.43), and within which 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

3.53

syntax element

element of data represented in the *bitstream* (3.2)

3.54

syntax structure

zero or more *syntax elements* (3.53) present together in the *bitstream* (3.2) in a specified order

3.55

tile

rectangular region of *TUs* (3.58) within a particular *picture* (3.40)

3.56

transform

part of the *decoding process* (3.22) by which a *block* (3.3) of *transform coefficients* (3.57) is converted to a *block* of spatial-domain values

3.57

transform coefficient

scalar quantity, considered to be in a transformed domain, that is associated with a particular index in an *inverse transform* (3.31) part of the *decoding process* (3.22)

3.58

transform unit

TU

$M \times N$ *block* (3.3) of samples resulting from a *transform* (3.56) in the *decoding process* (3.22)

3.59

unspecified

value of a particular *syntax element* (3.53) with no specified meaning in this document and that will not have a specified meaning in any future revised editions of this document

3.60

video coding layer NAL unit

VCL NAL unit

NAL units (3.35) that have reserved values of *NalUnitType* that are classified as VCL NAL units in this document

4 Abbreviated terms

CLVS	coded layer-wise video sequence
CPB	coded picture buffer
CPBB	coded picture buffer of the base
CPBL	coded picture buffer LCEVC
CVS	coded video sequence
DPBB	decoded picture buffer of the base
DUT	decoder under test
HBD	hypothetical base decoder
HDM	hypothetical demuxer
HRD	hypothetical reference decoder
HSS	hypothetical stream scheduler
I	intra
LCEVC	low complexity enhancement video coding
LSB	least significant bit
MSB	most significant bit
SEI	supplemental enhancement information
VUI	video usability information

5 Conventions

5.1 General

NOTE The mathematical operators used in this document are similar to those used in the C programming language. However, the results of integer division and arithmetic shift operations are defined more precisely, and additional operations are defined, such as exponentiation and real-valued division. Numbering and counting conventions generally begin from 0, e.g., “the first” is equivalent to the 0-th, “the second” is equivalent to the 1-th, etc.

5.2 Arithmetic operators

+	addition
–	subtraction (as a two-argument operator) or negation (as a unary prefix operator)
*	multiplication, including matrix multiplication
	exponentiation; specifies x to the power of y
x^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.
÷	division in mathematical equations where no truncation or rounding is intended
	division in mathematical equations where no truncation or rounding is intended
$\sum_{i=x}^y f(i)$	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.

5.3 Logical operators

x && y	Boolean logical “and” of x and y
x y	Boolean logical “or” of x and y
!	Boolean logical “not”
x ? y : z	if x is TRUE or not equal to 0, evaluates to the value of y; otherwise, evaluates to the value of z

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5.4 Relational operators

>	greater than	ISO/IEC 23094-2:2021
>=	greater than or equal to	https://standards.iteh.ai/catalog/standards/sist/fc7e4034-3dba-4218-a6d9-589b268d889a/iso-iec-23094-2-2021
<	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.

5.5 Bit-wise operators

&	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 non-negative integer values of y. Bits shifted into the most significant bits (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 non-negative integer values of y. Bits shifted into the least significant bits (LSBs) as a result of the left shift have a value equal to 0.

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5.6 Assignment operators (standards.iteh.ai)

=	assignment operator ISO/IEC 23094-2:2021
++	increment, i.e., x++ is equivalent to x = x + 1; when used in an array index, evaluates to the value of the variable prior to the increment operation
--	decrement, i.e., x-- is equivalent to x = x - 1; when used in an array index, evaluates to the value of the variable prior to the decrement operation
+=	increment by amount specified, i.e., x += 3 is equivalent to x = x + 3, and x += (-3) is equivalent to x = x + (-3)
-=	decrement by amount specified, i.e., x -= 3 is equivalent to x = x - 3, and x -= (-3) is equivalent to x = x - (-3)

5.7 Range notation

x = y...z	x takes on integer values starting from y to z, inclusive, with x, y, and z being integer numbers and z being greater than y
x = y to z	x takes on integer values starting from y to z, inclusive, with x, y, and z being integer numbers and z being greater than y

5.8 Mathematical functions

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

$$\text{Ceil}(x) \text{ smallest integer greater than or equal to } x \quad (2)$$