

INTERNATIONAL  
STANDARD

ISO/IEC  
14496-10

Sixth edition  
2010-12-15

---

---

## Information technology — Coding of audio-visual objects

### Part 10: Advanced Video Coding

*Technologies de l'information — Codage des objets audiovisuels*

iTeh STANDARD PREVIEW  
(standards.iteh.ai)

[ISO/IEC 14496-10:2010](#)

<https://standards.iteh.ai/catalog/standards/sist/143ad43b-53c4-47a2-b5ea-9c39153ba14a/iso-iec-14496-10-2010>

---

---

---

Reference number  
ISO/IEC 14496-10:2010(E)



© ISO/IEC 2010

**PDF disclaimer**

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO/IEC 14496-10:2010](#)

<https://standards.iteh.ai/catalog/standards/sist/143ad43b-53c4-47a2-b5ea-9c39153ba14a/iso-iec-14496-10-2010>



### COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2010

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

## Contents

	Page
<b>0 Introduction .....</b>	<b>xvi</b>
0.1 Prologue .....	xvi
0.2 Purpose .....	xvi
0.3 Applications .....	xvi
0.4 Publication and versions of this Specification .....	xvi
0.5 Profiles and levels .....	xvii
0.6 Overview of the design characteristics .....	xviii
0.6.1 Predictive coding .....	xviii
0.6.2 Coding of progressive and interlaced video .....	xix
0.6.3 Picture partitioning into macroblocks and smaller partitions .....	xix
0.6.4 Spatial redundancy reduction .....	xix
0.7 How to read this Specification .....	xix
<b>1 Scope.....</b>	<b>1</b>
<b>2 Normative references .....</b>	<b>1</b>
<b>3 Definitions .....</b>	<b>1</b>
<b>4 Abbreviations .....</b>	<b>9</b>
<b>5 Conventions .....</b>	<b>10</b>
5.1 Arithmetic operators .....	10
5.2 Logical operators .....	11
5.3 Relational operators .....	11
5.4 Bit-wise operators .....	11
5.5 Assignment operators .....	11
5.6 Range notation .....	12
5.7 Mathematical functions .....	12
5.8 Order of operation precedence .....	13
5.9 Variables, syntax elements, and tables .....	14
5.10 Text description of logical operations .....	14
5.11 Processes .....	15
<b>6 Source, coded, decoded and output data formats, scanning processes, and neighbouring relationships .....</b>	<b>16</b>
6.1 Bitstream formats .....	16
6.2 Source, decoded, and output picture formats .....	16
6.3 Spatial subdivision of pictures and slices .....	21
6.4 Inverse scanning processes and derivation processes for neighbours .....	22
6.4.1 Inverse macroblock scanning process .....	22
6.4.2 Inverse macroblock partition and sub-macroblock partition scanning process .....	23
6.4.3 Inverse 4x4 luma block scanning process .....	25
6.4.4 Inverse 4x4 Cb or Cr block scanning process for ChromaArrayType equal to 3 .....	25
6.4.5 Inverse 8x8 luma block scanning process .....	25
6.4.6 Inverse 8x8 Cb or Cr block scanning process for ChromaArrayType equal to 3 .....	26
6.4.7 Derivation process of the availability for macroblock addresses .....	26
6.4.8 Derivation process for neighbouring macroblock addresses and their availability .....	26
6.4.9 Derivation process for neighbouring macroblock addresses and their availability in MBAFF frames .....	27
6.4.10 Derivation processes for neighbouring macroblocks, blocks, and partitions .....	28
6.4.11 Derivation process for neighbouring locations .....	33
6.4.12 Derivation processes for block and partition indices .....	36
<b>7 Syntax and semantics .....</b>	<b>37</b>
7.1 Method of specifying syntax in tabular form .....	37
7.2 Specification of syntax functions, categories, and descriptors .....	38
7.3 Syntax in tabular form .....	40
7.3.1 NAL unit syntax .....	40
7.3.2 Raw byte sequence payloads and RBSP trailing bits syntax .....	40

7.3.3	Slice header syntax .....	49
7.3.4	Slice data syntax .....	54
7.3.5	Macroblock layer syntax .....	55
7.4	Semantics .....	62
7.4.1	NAL unit semantics .....	62
7.4.2	Raw byte sequence payloads and RBSP trailing bits semantics .....	71
7.4.3	Slice header semantics .....	85
7.4.4	Slice data semantics .....	97
7.4.5	Macroblock layer semantics .....	97
<b>8</b>	<b>Decoding process.....</b>	<b>110</b>
8.1	NAL unit decoding process .....	111
8.2	Slice decoding process.....	112
8.2.1	Decoding process for picture order count .....	112
8.2.2	Decoding process for macroblock to slice group map .....	116
8.2.3	Decoding process for slice data partitions .....	120
8.2.4	Decoding process for reference picture lists construction.....	120
8.2.5	Decoded reference picture marking process .....	127
8.3	Intra prediction process.....	132
8.3.1	Intra_4x4 prediction process for luma samples.....	132
8.3.2	Intra_8x8 prediction process for luma samples.....	139
8.3.3	Intra_16x16 prediction process for luma samples .....	147
8.3.4	Intra prediction process for chroma samples.....	149
8.3.5	Sample construction process for I_PCM macroblocks .....	154
8.4	Inter prediction process.....	154
8.4.1	Derivation process for motion vector components and reference indices.....	157
8.4.2	Decoding process for Inter prediction samples .....	169
8.4.3	Derivation process for prediction weights .....	179
8.5	Transform coefficient decoding process and picture construction process prior to deblocking filter process.....	181
8.5.1	Specification of transform decoding process for 4x4 luma residual blocks .....	182
8.5.2	Specification of transform decoding process for luma samples of Intra_16x16 macroblock prediction mode .....	182
8.5.3	Specification of transform decoding process for 8x8 luma residual blocks .....	183
8.5.4	Specification of transform decoding process for chroma samples .....	184
8.5.5	Specification of transform decoding process for chroma samples with ChromaArrayType equal to 3 .....	186
8.5.6	Inverse scanning process for 4x4 transform coefficients and scaling lists .....	186
8.5.7	Inverse scanning process for 8x8 transform coefficients and scaling lists .....	187
8.5.8	Derivation process for chroma quantisation parameters .....	189
8.5.9	Derivation process for scaling functions .....	189
8.5.10	Scaling and transformation process for DC transform coefficients for Intra_16x16 macroblock type .....	191
8.5.11	Scaling and transformation process for chroma DC transform coefficients .....	191
8.5.12	Scaling and transformation process for residual 4x4 blocks .....	193
8.5.13	Scaling and transformation process for residual 8x8 blocks .....	196
8.5.14	Picture construction process prior to deblocking filter process .....	200
8.5.15	Intra residual transform-bypass decoding process .....	201
8.6	Decoding process for P macroblocks in SP slices or SI macroblocks .....	202
8.6.1	SP decoding process for non-switching pictures .....	202
8.6.2	SP and SI slice decoding process for switching pictures .....	205
8.7	Deblocking filter process .....	207
8.7.1	Filtering process for block edges .....	211
8.7.2	Filtering process for a set of samples across a horizontal or vertical block edge.....	213
<b>9</b>	<b>Parsing process .....</b>	<b>219</b>
9.1	Parsing process for Exp-Golomb codes .....	219
9.1.1	Mapping process for signed Exp-Golomb codes .....	221
9.1.2	Mapping process for coded block pattern .....	221
9.2	CAVLC parsing process for transform coefficient levels .....	224
9.2.1	Parsing process for total number of transform coefficient levels and trailing ones .....	225
9.2.2	Parsing process for level information .....	229
9.2.3	Parsing process for run information .....	230
9.2.4	Combining level and run information .....	234

9.3	CABAC parsing process for slice data .....	234
9.3.1	Initialisation process .....	236
9.3.2	Binarization process .....	260
9.3.3	Decoding process flow .....	269
9.3.4	Arithmetic encoding process (informative) .....	291
<b>Annex A</b>	<b>Profiles and levels.....</b>	<b>299</b>
A.1	Requirements on video decoder capability.....	299
A.2	Profiles .....	299
A.2.1	Baseline profile.....	299
A.2.2	Main profile .....	300
A.2.3	Extended profile .....	300
A.2.4	High profile .....	301
A.2.5	High 10 profile .....	301
A.2.6	High 4:2:2 profile .....	302
A.2.7	High 4:4:4 Predictive profile .....	302
A.2.8	High 10 Intra profile.....	303
A.2.9	High 4:2:2 Intra profile.....	303
A.2.10	High 4:4:4 Intra profile.....	304
A.2.11	CAVLC 4:4:4 Intra profile .....	304
A.3	Levels .....	305
A.3.1	Level limits common to the Baseline, Constrained Baseline, Main, and Extended profiles .....	305
A.3.2	Level limits common to the High, High 10, High 4:2:2, High 4:4:4 Predictive, High 10 Intra, High 4:2:2 Intra, High 4:4:4 Intra, and CAVLC 4:4:4 Intra profiles.....	307
A.3.3	Profile-specific level limits.....	309
A.3.4	Effect of level limits on frame rate (informative).....	314
A.3.5	Effect of level limits on maximum DPB size in units of frames (informative) .....	317
<b>Annex B</b>	<b>Byte stream format.....</b>	<b>319</b>
B.1	Byte stream NAL unit syntax and semantics .....	319
B.1.1	Byte stream NAL unit syntax .....	319
B.1.2	Byte stream NAL unit semantics .....	319
B.2	Byte stream NAL unit decoding process .....	320
B.3	Decoder byte-alignment recovery (informative) .....	320
<b>Annex C</b>	<b>Hypothetical reference decoder .....</b>	<b>322</b>
C.1	Operation of coded picture buffer (CPB) .....	326
C.1.1	Timing of bitstream arrival .....	326
C.1.2	Timing of coded picture removal .....	327
C.2	Operation of the decoded picture buffer (DPB) .....	328
C.2.1	Decoding of gaps in frame_num and storage of "non-existing" frames .....	328
C.2.2	Picture decoding and output .....	329
C.2.3	Removal of pictures from the DPB before possible insertion of the current picture .....	329
C.2.4	Current decoded picture marking and storage .....	330
C.3	Bitstream conformance .....	331
C.4	Decoder conformance .....	332
C.4.1	Operation of the output order DPB .....	333
C.4.2	Decoding of gaps in frame_num and storage of "non-existing" pictures .....	333
C.4.3	Picture decoding .....	334
C.4.4	Removal of pictures from the DPB before possible insertion of the current picture .....	334
C.4.5	Current decoded picture marking and storage .....	335
<b>Annex D</b>	<b>Supplemental enhancement information .....</b>	<b>338</b>
D.1	SEI payload syntax .....	339
D.1.1	Buffering period SEI message syntax .....	341
D.1.2	Picture timing SEI message syntax .....	342
D.1.3	Pan-scan rectangle SEI message syntax .....	343
D.1.4	Filler payload SEI message syntax .....	343
D.1.5	User data registered by ITU-T Rec. T.35 SEI message syntax .....	343
D.1.6	User data unregistered SEI message syntax .....	344
D.1.7	Recovery point SEI message syntax .....	344
D.1.8	Decoded reference picture marking repetition SEI message syntax .....	344
D.1.9	Spare picture SEI message syntax .....	345

D.1.10	Scene information SEI message syntax .....	345
D.1.11	Sub-sequence information SEI message syntax.....	346
D.1.12	Sub-sequence layer characteristics SEI message syntax.....	346
D.1.13	Sub-sequence characteristics SEI message syntax.....	347
D.1.14	Full-frame freeze SEI message syntax .....	347
D.1.15	Full-frame freeze release SEI message syntax .....	347
D.1.16	Full-frame snapshot SEI message syntax.....	347
D.1.17	Progressive refinement segment start SEI message syntax.....	348
D.1.18	Progressive refinement segment end SEI message syntax.....	348
D.1.19	Motion-constrained slice group set SEI message syntax .....	348
D.1.20	Film grain characteristics SEI message syntax .....	349
D.1.21	Deblocking filter display preference SEI message syntax .....	349
D.1.22	Stereo video information SEI message syntax.....	350
D.1.23	Post-filter hint SEI message syntax.....	350
D.1.24	Tone mapping information SEI message syntax .....	351
D.1.25	Frame packing arrangement SEI message syntax .....	352
D.1.26	Reserved SEI message syntax.....	352
D.2	SEI payload semantics .....	352
D.2.1	Buffering period SEI message semantics.....	352
D.2.2	Picture timing SEI message semantics.....	353
D.2.3	Pan-scan rectangle SEI message semantics .....	358
D.2.4	Filler payload SEI message semantics .....	359
D.2.5	User data registered by ITU-T Rec. T.35 SEI message semantics.....	359
D.2.6	User data unregistered SEI message semantics.....	360
D.2.7	Recovery point SEI message semantics .....	360
D.2.8	Decoded reference picture marking repetition SEI message semantics.....	362
D.2.9	Spare picture SEI message semantics .....	362
D.2.10	Scene information SEI message semantics.....	364
D.2.11	Sub-sequence information SEI message semantics .....	366
D.2.12	Sub-sequence layer characteristics SEI message semantics.....	367
D.2.13	Sub-sequence characteristics SEI message semantics.....	368
D.2.14	Full-frame freeze SEI message semantics.....	370
D.2.15	Full-frame freeze release SEI message semantics.....	370
D.2.16	Full-frame snapshot SEI message semantics .....	370
D.2.17	Progressive refinement segment start SEI message semantics.....	370
D.2.18	Progressive refinement segment end SEI message semantics.....	371
D.2.19	Motion-constrained slice group set SEI message semantics .....	371
D.2.20	Film grain characteristics SEI message semantics .....	372
D.2.21	Deblocking filter display preference SEI message semantics .....	378
D.2.22	Stereo video information SEI message semantics.....	380
D.2.23	Post-filter hint SEI message semantics .....	380
D.2.24	Tone mapping information SEI message semantics .....	381
D.2.25	Frame packing arrangement SEI message semantics .....	383
D.2.26	Reserved SEI message semantics .....	391
Annex E	Video usability information.....	392
E.1	VUI syntax.....	393
E.1.1	VUI parameters syntax .....	393
E.1.2	HRD parameters syntax .....	394
E.2	VUI semantics .....	394
E.2.1	VUI parameters semantics .....	394
E.2.2	HRD parameters semantics .....	407
Annex F	Patent Rights .....	409
Annex G	Scalable video coding .....	411
G.1	Scope .....	411
G.2	Normative references .....	411
G.3	Definitions .....	411
G.4	Abbreviations.....	415
G.5	Conventions .....	415

G.6	Source, coded, decoded and output data formats, scanning processes, neighbouring and reference layer relationships .....	415
G.6.1	Derivation process for reference layer macroblocks .....	415
G.6.2	Derivation process for reference layer partitions.....	418
G.6.3	Derivation process for reference layer sample locations in resampling .....	419
G.6.4	SVC derivation process for macroblock and sub-macroblock partition indices.....	421
G.7	Syntax and semantics .....	421
G.7.1	Method of specifying syntax in tabular form .....	421
G.7.2	Specification of syntax functions, categories, and descriptors .....	421
G.7.3	Syntax in tabular form.....	421
G.7.4	Semantics .....	433
G.7.4.1	NAL unit semantics.....	434
G.8	SVC decoding process.....	466
G.8.1	SVC initialisation and decoding processes .....	468
G.8.2	SVC reference picture lists construction and decoded reference picture marking process .....	487
G.8.3	SVC intra decoding processes .....	498
G.8.4	SVC Inter prediction process.....	508
G.8.5	SVC transform coefficient decoding and sample array construction processes .....	521
G.8.6	Resampling processes for prediction data, intra samples, and residual samples .....	538
G.8.7	SVC deblocking filter processes.....	568
G.8.8	Specification of bitstream subsets .....	580
G.9	Parsing process .....	581
G.9.1	Alternative parsing process for coded block pattern .....	582
G.9.2	Alternative CAVLC parsing process for transform coefficient levels.....	583
G.9.3	Alternative CABAC parsing process for slice data in scalable extension .....	587
G.10	Profiles and levels.....	590
G.10.1	Profiles .....	590
G.10.2	Levels .....	593
G.11	Byte stream format .....	598
G.12	Hypothetical reference decoder .....	598
G.13	Supplemental enhancement information ISO/IEC 14496-10:2010 .....	598
G.13.1	SEI payload ISO/IEC 14496-10:2010 .....	599
G.13.2	SEI payload semantics ISO/IEC 14496-10:2010 .....	605
G.14	Video usability information.....	633
G.14.1	SVC VUI parameters extension syntax .....	634
G.14.2	SVC VUI parameters extension semantics .....	634
<b>Annex H Multiview video coding.....</b>		<b>637</b>
H.1	Scope .....	637
H.2	Normative references .....	637
H.3	Definitions.....	637
H.4	Abbreviations .....	639
H.5	Conventions.....	639
H.6	Source, coded, decoded and output data formats, scanning processes, and neighbouring relationships .....	639
H.7	Syntax and semantics .....	639
H.7.1	Method of specifying syntax in tabular form .....	639
H.7.2	Specification of syntax functions, categories, and descriptors .....	640
H.7.3	Syntax in tabular form.....	640
H.7.4	Semantics .....	644
H.8	MVC decoding process .....	657
H.8.1	MVC decoding process for picture order count .....	658
H.8.2	MVC decoding process for reference picture lists construction.....	658
H.8.3	MVC decoded reference picture marking process.....	663
H.8.4	MVC inter prediction and inter-view prediction process .....	663
H.8.5	Specification of bitstream subsets .....	663
H.9	Parsing process .....	667
H.10	Profiles and levels .....	667
H.10.1	Profiles .....	667
H.10.2	Levels .....	669
H.11	Byte stream format .....	672
H.12	MVC hypothetical reference decoder.....	672

H.13	MVC SEI messages .....	672
H.13.1	SEI message syntax.....	672
H.13.2	SEI message semantics .....	678
H.14	Video usability information .....	690
H.14.1	MVC VUI parameters extension syntax .....	691
H.14.2	MVC VUI parameters extension semantics .....	691

## LIST OF FIGURES

Figure 6-1 – Nominal vertical and horizontal locations of 4:2:0 luma and chroma samples in a frame.....	18
Figure 6-2 – Nominal vertical and horizontal sampling locations of 4:2:0 samples in top and bottom fields.....	19
Figure 6-3 – Nominal vertical and horizontal locations of 4:2:2 luma and chroma samples in a frame.....	19
Figure 6-4 – Nominal vertical and horizontal sampling locations of 4:2:2 samples top and bottom fields.....	20
Figure 6-5 – Nominal vertical and horizontal locations of 4:4:4 luma and chroma samples in a frame.....	20
Figure 6-6 – Nominal vertical and horizontal sampling locations of 4:4:4 samples top and bottom fields.....	21
Figure 6-7 – A picture with 11 by 9 macroblocks that is partitioned into two slices.....	22
Figure 6-8 – Partitioning of the decoded frame into macroblock pairs .....	22
Figure 6-9 – Macroblock partitions, sub-macroblock partitions, macroblock partition scans, and sub-macroblock partition scans .....	24
<b>iTeh STANDARD REVIEW (standards.iteh.ai)</b>	
Figure 6-10 – Scan for 4x4 luma blocks.....	25
Figure 6-11 – Scan for 8x8 luma blocks.....	25
Figure 6-12 – Neighbouring macroblocks for a given macroblock .....	26
Figure 6-13 – Neighbouring macroblocks for a given macroblock in ISO/IEC 14496-10:2010 frames.....	27
<a href="https://standards.iteh.ai/catalog/standards/sist/143ad43b-53c4-47a2-b5ea-9391958a1fa/iso_iec_14496-10-2010">https://standards.iteh.ai/catalog/standards/sist/143ad43b-53c4-47a2-b5ea-9391958a1fa/iso_iec_14496-10-2010</a>	
Figure 6-14 – Determination of the neighbouring macroblock, blocks, and partitions (informative) .....	28
Figure 7-1 – Structure of an access unit not containing any NAL units with nal_unit_type equal to 0, 7, 8, or in the range of 12 to 18, inclusive, or in the range of 20 to 31, inclusive.....	69
Figure 8-1 – Intra_4x4 prediction mode directions (informative) .....	134
Figure 8-2 – Example for temporal direct-mode motion vector inference (informative) .....	166
Figure 8-3 – Directional segmentation prediction (informative) .....	167
Figure 8-4 – Integer samples (shaded blocks with upper-case letters) and fractional sample positions (un-shaded blocks with lower-case letters) for quarter sample luma interpolation .....	174
Figure 8-5 – Fractional sample position dependent variables in chroma interpolation and surrounding integer position samples A, B, C, and D .....	176
Figure 8-6 – Assignment of the indices of dcY to luma4x4BlkIdx .....	183
Figure 8-7 – Assignment of the indices of dcC to chroma4x4BlkIdx: (a) ChromaArrayType equal to 1, (b) ChromaArrayType equal to 2 .....	185
Figure 8-8 – 4x4 block scans. (a) Zig-zag scan. (b) Field scan (informative) .....	187
Figure 8-9 – 8x8 block scans. (a) 8x8 zig-zag scan. (b) 8x8 field scan (informative) .....	188
Figure 8-10 – Boundaries in a macroblock to be filtered .....	208
Figure 8-11 – Convention for describing samples across a 4x4 block horizontal or vertical boundary .....	212
Figure 9-1 – Illustration of CABAC parsing process for a syntax element SE (informative) .....	236
Figure 9-2 – Overview of the arithmetic decoding process for a single bin (informative) .....	285

Figure 9-3 – Flowchart for decoding a decision.....	286
Figure 9-4 – Flowchart of renormalization .....	289
Figure 9-5 – Flowchart of bypass decoding process .....	290
Figure 9-6 – Flowchart of decoding a decision before termination .....	291
Figure 9-7 – Flowchart for encoding a decision.....	293
Figure 9-8 – Flowchart of renormalization in the encoder.....	294
Figure 9-9 – Flowchart of PutBit(B).....	295
Figure 9-10 – Flowchart of encoding bypass .....	296
Figure 9-11 – Flowchart of encoding a decision before termination .....	297
Figure 9-12 – Flowchart of flushing at termination .....	297
Figure C-1 – Structure of byte streams and NAL unit streams for HRD conformance checks.....	323
Figure C-2 – HRD buffer model .....	325
Figure D-1 – Rearrangement and upconversion of checkerboard interleaving (frame_packing_arrangement_type equal to 0).....	389
Figure D-2 – Rearrangement and upconversion of column interleaving (frame_packing_arrangement_type equal to 1 with quincunx_sampling_flag equal to 0).....	389
Figure D-3 – Rearrangement and upconversion of row interleaving (frame_packing_arrangement_type equal to 2 with quincunx_sampling_flag equal to 0).....	390
Figure D-4 – Rearrangement and upconversion of side-by-side packing arrangement (frame_packing_arrangement_type equal to 3 with quincunx_sampling_flag equal to 0).....	390
Figure D-5 – Rearrangement and upconversion of top-bottom packing arrangement (frame_packing_arrangement_type equal to 4 with quincunx_sampling_flag equal to 0).....	391
Figure D-6 – Rearrangement and upconversion of side-by-side packing arrangement with quincunx sampling (frame_packing_arrangement_type equal to 3 with quincunx_sampling_flag equal to 1).....	391
Figure D-7 – Rearrangement of a temporal interleaving frame arrangement (frame_packing_arrangement_type equal to 5) .....	392
Figure E-1 – Location of chroma samples for top and bottom fields for chroma_format_idc equal to 1 (4:2:0 chroma format) as a function of chroma_sample_loc_type_top_field and chroma_sample_loc_type_bottom_field .....	404

## LIST OF TABLES

Table 5-1 – Operation precedence from highest (at top of table) to lowest (at bottom of table) .....	13
Table 6-1 – SubWidthC, and SubHeightC values derived from chroma_format_idc and separate_colour_plane_flag .....	17
Table 6-2 – Specification of input and output assignments for subclauses 6.4.10.1 to 6.4.10.7 .....	28
Table 6-3 – Specification of mbAddrN.....	33
Table 6-4 – Specification of mbAddrN and yM.....	35
Table 7-1 – NAL unit type codes, syntax element categories, and NAL unit type classes .....	63
Table 7-2 – Assignment of mnemonic names to scaling list indices and specification of fall-back rule .....	74
Table 7-3 – Specification of default scaling lists Default_4x4_Intra and Default_4x4_Inter .....	74
Table 7-4 – Specification of default scaling lists Default_8x8_Intra and Default_8x8_Inter .....	75
Table 7-5 – Meaning of primary_pic_type .....	83
Table 7-6 – Name association to slice_type .....	86

Table 7-7 – modification_of_pic_nums_idc operations for modification of reference picture lists .....	92
Table 7-8 – Interpretation of adaptive_ref_pic_marking_mode_flag .....	94
Table 7-9 – Memory management control operation (memory_management_control_operation) values .....	95
Table 7-10 – Allowed collective macroblock types for slice_type .....	98
Table 7-11 – Macroblock types for I slices .....	99
Table 7-12 – Macroblock type with value 0 for SI slices .....	100
Table 7-13 – Macroblock type values 0 to 4 for P and SP slices .....	101
Table 7-14 – Macroblock type values 0 to 22 for B slices .....	102
Table 7-15 – Specification of CodedBlockPatternChroma values .....	104
Table 7-16 – Relationship between intra_chroma_pred_mode and spatial prediction modes .....	105
Table 7-17 – Sub-macroblock types in P macroblocks .....	106
Table 7-18 – Sub-macroblock types in B macroblocks .....	107
Table 8-1 – Refined slice group map type .....	117
Table 8-2 – Specification of Intra4x4PredMode[ luma4x4BlkIdx ] and associated names .....	133
Table 8-3 – Specification of Intra8x8PredMode[ luma8x8BlkIdx ] and associated names .....	140
Table 8-4 – Specification of Intra16x16PredMode and associated names .....	147
Table 8-5 – Specification of Intra chroma prediction modes and associated names .....	150
Table 8-6 – Specification of the variable colPic .....	159
Table 8-7 – Specification of PicCodingStruct( X ) .....	159
Table 8-8 – Specification of mbAddrCol, yM, and vertMvScale .....	161
Table 8-9 – Assignment of prediction utilization flags .....	163
Table 8-10 – Derivation of the vertical component of the chroma vector in field coding mode .....	169
Table 8-11 – Differential full-sample luma locations .....	175
Table 8-12 – Assignment of the luma prediction sample predPartLX <sub>L</sub> [ x <sub>L</sub> , y <sub>L</sub> ] .....	176
Table 8-13 – Specification of mapping of idx to c <sub>ij</sub> for zig-zag and field scan .....	187
Table 8-14 – Specification of mapping of idx to c <sub>ij</sub> for 8x8 zig-zag and 8x8 field scan .....	188
Table 8-15 – Specification of QP <sub>C</sub> as a function of qP <sub>I</sub> .....	189
Table 8-16 – Derivation of offset dependent threshold variables α' and β' from indexA and indexB .....	216
Table 8-17 – Value of variable t' <sub>C0</sub> as a function of indexA and bS .....	217
Table 9-1 – Bit strings with "prefix" and "suffix" bits and assignment to codeNum ranges (informative) .....	220
Table 9-2 – Exp-Golomb bit strings and codeNum in explicit form and used as ue(v) (informative) .....	220
Table 9-3 – Assignment of syntax element to codeNum for signed Exp-Golomb coded syntax elements se(v) .....	221
Table 9-4 – Assignment of codeNum to values of coded_block_pattern for macroblock prediction modes .....	221
Table 9-5 – coeff_token mapping to TotalCoeff( coeff_token ) and TrailingOnes( coeff_token ) .....	227
Table 9-6 – Codeword table for level_prefix (informative) .....	230
Table 9-7 – total_zeros tables for 4x4 blocks with tzVlcIndex 1 to 7 .....	232
Table 9-8 – total_zeros tables for 4x4 blocks with tzVlcIndex 8 to 15 .....	232
Table 9-9 – total_zeros tables for chroma DC 2x2 and 2x4 blocks .....	233

Table 9-10 – Tables for run_before.....	234
Table 9-11 – Association of ctxIdx and syntax elements for each slice type in the initialisation process .....	237
Table 9-12 – Values of variables m and n for ctxIdx from 0 to 10 .....	238
Table 9-13 – Values of variables m and n for ctxIdx from 11 to 23 .....	239
Table 9-14 – Values of variables m and n for ctxIdx from 24 to 39 .....	239
Table 9-15 – Values of variables m and n for ctxIdx from 40 to 53 .....	239
Table 9-16 – Values of variables m and n for ctxIdx from 54 to 59, and 399 to 401.....	240
Table 9-17 – Values of variables m and n for ctxIdx from 60 to 69 .....	240
Table 9-18 – Values of variables m and n for ctxIdx from 70 to 104 .....	241
Table 9-19 – Values of variables m and n for ctxIdx from 105 to 165 .....	242
Table 9-20 – Values of variables m and n for ctxIdx from 166 to 226 .....	243
Table 9-21 – Values of variables m and n for ctxIdx from 227 to 275 .....	244
Table 9-22 – Values of variables m and n for ctxIdx from 277 to 337 .....	245
Table 9-23 – Values of variables m and n for ctxIdx from 338 to 398 .....	246
Table 9-24 – Values of variables m and n for ctxIdx from 402 to 459 .....	247
Table 9-25 – Values of variables m and n for ctxIdx from 460 to 483 .....	248
Table 9-26 – Values of variables m and n for ctxIdx from 484 to 571 .....	249
Table 9-27 – Values of variables m and n for ctxIdx from 572 to 659 .....	251
Table 9-28 – Values of variables m and n for ctxIdx from 660 to 717 .....	253
Table 9-29 – Values of variables m and n for ctxIdx from 718 to 775 .....	254
Table 9-30 – Values of variables m and n for ctxIdx from 776 to 863 .....	255
Table 9-31 – Values of variables m and n for ctxIdx from 864 to 951 .....	257
Table 9-32 – Values of variables m and n for ctxIdx from 952 to 1011 .....	259
Table 9-33 – Values of variables m and n for ctxIdx from 1012 to 1023 .....	260
Table 9-34 – Syntax elements and associated types of binarization, maxBinIdxCtx, and ctxIdxOffset .....	262
Table 9-35 – Bin string of the unary binarization (informative) .....	265
Table 9-36 – Binarization for macroblock types in I slices.....	267
Table 9-37 – Binarization for macroblock types in P, SP, and B slices .....	268
Table 9-38 – Binarization for sub-macroblock types in P, SP, and B slices .....	269
Table 9-39 – Assignment of ctxIdxInc to binIdx for all ctxIdxOffset values except those related to the syntax elements coded_block_flag, significant_coeff_flag, last_significant_coeff_flag, and coeff_abs_level_minus1 .....	271
Table 9-40 – Assignment of ctxIdxBlockCatOffset to ctxBlockCat for syntax elements coded_block_flag, significant_coeff_flag, last_significant_coeff_flag, and coeff_abs_level_minus1 .....	272
Table 9-41 – Specification of ctxIdxInc for specific values of ctxIdxOffset and binIdx .....	281
Table 9-42 – Specification of ctxBlockCat for the different blocks.....	282
Table 9-43 – Mapping of scanning position to ctxIdxInc for ctxBlockCat == 5, 9, or 13 .....	283
Table 9-44 – Specification of rangeTabLPS depending on pStateIdx and qCodIRangeIdx .....	287
Table 9-45 – State transition table .....	288
Table A-1 – Level limits .....	308

Table A-2 – Specification of cpbBrVclFactor and cpbBrNalFactor.....	311
Table A-3 – Baseline and Constrained Baseline profile level limits .....	312
Table A-4 – Main, High, High 10, High 4:2:2, High 4:4:4 Predictive, High 10 Intra, High 4:2:2 Intra, High 4:4:4 Intra, and CAVLC 4:4:4 Intra profile level limits .....	313
Table A-5 – Extended profile level limits .....	314
Table A-6 – Maximum frame rates (frames per second) for some example frame sizes.....	315
Table A-7 – Maximum DPB size (frames) for some example frame sizes.....	318
Table D-1 – Interpretation of pic_struct .....	356
Table D-2 – Mapping of ct_type to source picture scan.....	357
Table D-3 – Definition of counting_type values .....	358
Table D-4 – scene_transition_type values .....	366
Table D-5 – model_id values.....	374
Table D-6 – blending_mode_id values .....	375
Table D-7 – filter_hint_type values .....	382
Table D-8 – Definition of frame_packing_arrangement_type.....	385
Table D-9 – Definition of content_interpretation_type .....	386
Table E-1 – Meaning of sample aspect ratio indicator.....	396
Table E-2 – Meaning of video_format .....	397
Table E-3 – Colour primaries .....	398
Table E-4 – Transfer characteristics .....	399
Table E-5 – Matrix coefficients.....	402
Table E-6 – Divisor for computation of $\Delta t_{fi,dpb}(n)$ .....	405
Table F-1 – Organisations providing patent rights licensing notices.....	410
Table G-1 – Name association to slice_type for NAL units with nal_unit_type equal to 20.....	452
Table G-2 – Interpretation of adaptive_ref_base_pic_marking_mode_flag .....	462
Table G-3 – Memory management base control operation (memory_management_base_control_operation) values .....	462
Table G-4 – Allowed collective macroblock types for slice_type .....	466
Table G-5 – Inferred macroblock type I_BL for EI slices.....	466
Table G-6 – Scale values cS for transform coefficient level scaling .....	531
Table G-7 – Macroblock type predictors mbTypeILPred.....	549
Table G-8 – Sub-macroblock type predictors subMbTypeILPred[ mbPartIdx ] .....	549
Table G-9 – 16-phase luma interpolation filter for resampling in Intra_Base prediction.....	559
Table G-10 – Mapping of ( nX, nY ) to coeffTokenIdx and vice versa.....	586
Table G-11 – Association of ctxIdx and syntax elements for each slice type in the initialisation process.....	590
Table G-12 – Values of variables m and n for ctxIdx from 1024 to 1026 .....	590
Table G-13 – Values of variables m and n for ctxIdx from 1027 to 1030 .....	590
Table G-14 – Syntax elements and associated types of binarization, maxBinIdxCtx, and ctxIdxOffset.....	591
Table G-15 – Assignment of ctxIdxInc to binIdx for the ctxIdxOffset values related to the syntax elements base_mode_flag and residual_prediction_flag .....	591

Table G-16 – Scalable Baseline profile level limits .....	600
Table G-17 – Specification of cpbBrVclFactor and cpbBrNalFactor .....	600
Table H-1 – modification_of_pic_nums_idc operations for modification of reference picture lists.....	658
Table H-2 – Association between camera parameter variables and syntax elements. ....	690

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO/IEC 14496-10:2010](#)  
<https://standards.iteh.ai/catalog/standards/sist/143ad43b-53c4-47a2-b5ea-9c39153ba14a/iso-iec-14496-10-2010>

## 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

ISO/IEC 14496-10 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.

This part of ISO/IEC 14496 is technically aligned with ITU-T Rec. H.264 but is not published as identical text.

**THE STANDARD PREVIEW**  
**(standards.iteh.ai)**

This sixth edition cancels and replaces the fifth edition (ISO/IEC 14496-10:2009) which has been technically revised.

ISO/IEC 14496 consists of the following parts, ~~ISO/IEC 14496-10:2010~~ under the general title *Information technology — Coding of audio-visual objects*:

<https://standards.iteh.ai/catalog/standards/sist/143ad43b-53c4-47a2-b5ea-9c39153ba14a/iso-iec-14496-10-2010>

- *Part 1: Systems*
- *Part 2: Visual*
- *Part 3: Audio*
- *Part 4: Conformance testing*
- *Part 5: Reference software*
- *Part 6: Delivery Multimedia Integration Framework (DMIF)*
- *Part 7: Optimized reference software for coding of audio-visual objects* [Technical Report]
- *Part 8: Carriage of ISO/IEC 14496 contents over IP networks*
- *Part 9: Reference hardware description* [Technical Report]
- *Part 10: Advanced Video Coding*
- *Part 11: Scene description and application engine*
- *Part 12: ISO base media file format*

- Part 13: Intellectual Property Management and Protection (IPMP) extensions
- Part 14: MP4 file format
- Part 15: Advanced Video Coding (AVC) file format
- Part 16: Animation Framework eXtension (AFX)
- Part 17: Streaming text format
- Part 18: Font compression and streaming
- Part 19: Synthesized texture stream
- Part 20: Lightweight Application Scene Representation (LASeR) and Simple Aggregation Format (SAF)
- Part 21: MPEG-J Graphics Framework eXtensions (GFX)
- Part 22: Open Font Format
- Part 23: Symbolic Music Representation
- Part 24: Audio and systems interaction
- Part 25: 3D Graphics Compression Model  
**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**
- Part 26: Audio conformance
- Part 27: 3D Graphics conformance ISO/IEC 14496-10:2010  
<https://standards.iteh.ai/catalog/standards/sist/143ad43b-53c4-47a2-b5ea-9c39153ba14a/iso-iec-14496-10-2010>