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Part 10: Advanced Video Coding

AMENDMENT 1: Additional profiles and supplemental enhancement information (SEI) messages

Technologies de l'information — Codage des objets audiovisuels —
Partie 10: Codage visuel avancé

AMENDEMENT 1: Profils additionnels et messages d'informations d'amélioration supplémentaires (SEI)

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Foreword

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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.

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Amendment 1 to ISO/IEC 14496-10:2012 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

Information technology — Coding of audio-visual objects —

Part 10:
Advanced Video Coding

AMENDMENT 1: Additional profiles and supplemental enhancement information (SEI) messages

At the end of 0.4, replace the following:

ITU-T Rec. H.264 | ISO/IEC 14496-10 version 15 (the current Specification) refers to the integrated version 14 text with miscellaneous corrections and clarifications as specified in a fifth technical corrigendum.

with:

ITU-T Rec. H.264 | ISO/IEC 14496-10 version 15 refers to the integrated version 14 text with miscellaneous corrections and clarifications as specified in a fifth technical corrigendum.

ITU-T Rec. H.264 | ISO/IEC 14496-10 version 16 refers to the integrated version 15 text after its amendment to define three new profiles intended primarily for communication applications (the Constrained High, Scalable Constrained Baseline, and Scalable Constrained High profiles).

ITU-T Rec. H.264 | ISO/IEC 14496-10 version 17 (the current Specification) refers to the integrated version 15 text after its amendment to define additional supplemental enhancement information (SEI) message data, including the multiview view position SEI message, the display orientation SEI message, and two additional frame packing arrangement type indication values for the frame packing arrangement SEI message (the 2D and tiled arrangement type indication values).

In 7.4.2.1.1, replace the following:

constraint_set5_flag is specified as follows:

- If profile_idc is equal to 118, constraint_set5_flag equal to 1 indicates that the coded video sequence obeys all constraints specified in subclause H.10.1.2 and constraint_set5_flag equal to 0 indicates that the coded video sequence may or may not obey all constraints specified in subclause H.10.1.2.
- Otherwise (profile_idc is not equal to 118), the value of 1 for constraint_set5_flag is reserved for future use by ITU-T | ISO/IEC. constraint_set5_flag shall be equal to 0 when profile_idc is not equal to 118 in bitstreams conforming to this Recommendation | International Standard. Decoders shall ignore the value of constraint_set5_flag when profile_idc is not equal to 118.

with:

constraint_set5_flag is specified as follows:

- If profile_idc is equal to 77, 88, or 100, constraint_set5_flag equal to 1 indicates that B slice types are not present in the coded video sequence. constraint_set5_flag equal to 0 indicates that B slice types may or may not be present in the coded video sequence.

- Otherwise, if profile_idc is equal to 118, constraint_set5_flag equal to 1 indicates that the coded video sequence obeys all constraints specified in subclause H.10.1.2 and constraint_set5_flag equal to 0 indicates that the coded video sequence may or may not obey all constraints specified in subclause H.10.1.2.
- Otherwise (profile_idc is not equal to 77, 88, 100, or 118), the value of 1 for constraint_set5_flag is reserved for future use by ITU-T | ISO/IEC. constraint_set5_flag shall be equal to 0 when profile_idc is not equal to 118 in bitstreams conforming to this Recommendation | International Standard. Decoders shall ignore the value of constraint_set5_flag when profile_idc is not equal to 118.

In 8.7, replace the following:

A conditional filtering process is specified in this subclause that is an integral part of the decoding process which shall be applied by decoders conforming to the Baseline, Constrained Baseline, Main, Extended, High, Progressive High, High 10, High 4:2:2, and High 4:4:4 Predictive profiles. For decoders conforming to the High 10 Intra, High 4:2:2 Intra, High 4:4:4 Intra, and CAVLC 4:4:4 Intra profiles, the filtering process specified in this subclause, or one similar to it, should be applied but is not required.

with:

A conditional filtering process is specified in this subclause that is an integral part of the decoding process which shall be applied by decoders conforming to the Baseline, Constrained Baseline, Main, Extended, High, Progressive High, Constrained High, High 10, High 4:2:2, and High 4:4:4 Predictive profiles. For decoders conforming to the High 10 Intra, High 4:2:2 Intra, High 4:4:4 Intra, and CAVLC 4:4:4 Intra profiles, the filtering process specified in this subclause, or one similar to it, should be applied but is not required.

Add A.2.4.2 "Constrained High profile" as follows:

A.2.4.2 Constrained High profile

Bitstreams conforming to the Constrained High profile shall obey all constraints specified in subclause A.2.4.1 for the Progressive High profile, and shall additionally obey the constraint that B slice types shall not be present.

Conformance of a bitstream to the Constrained High profile is indicated by profile_idc being equal to 100 with both constraint_set4_flag and constraint_set5_flag being equal to 1.

Decoders conforming to the Constrained High profile at a specific level shall be capable of decoding all bitstreams in which one or more of the following conditions are true:

- (profile_idc is equal to 66 or constraint_set0_flag is equal to 1), constraint_set1_flag is equal to 1, and the combination of level_idc and constraint_set3_flag represents a level less than or equal to the specified level.
- profile_idc is equal to 77, constraint_set0_flag is equal to 1, and the combination of level_idc and constraint_set3_flag represents a level less than or equal to the specified level.
- profile_idc is equal to 77, constraint_set4_flag is equal to 1, constraint_set5_flag is equal to 1, and level_idc represents a level less than or equal to the specified level.
- profile_idc is equal to 88, constraint_set1_flag is equal to 1, constraint_set4_flag is equal to 1, constraint_set5_flag is equal to 1, and the combination of level_idc and constraint_set3_flag represents a level less than or equal to the specified level.
- profile_idc is equal to 100, constraint_set4_flag is equal to 1, constraint_set5_flag is equal to 1, and level_idc represents a level less than or equal to the specified level.

Replace the heading of A.3.2 with the following:

A.3.2 Level limits common to the High, Progressive High, Constrained 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

In A.3.2, replace the following:

Bitstreams conforming to the High, Progressive 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, or CAVLC 4:4:4 Intra profiles at a specified level shall obey the following constraints:

with:

Bitstreams conforming to the High, Progressive High, Constrained 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, or CAVLC 4:4:4 Intra profiles at a specified level shall obey the following constraints:

Also in A.3.2, replace the following:

Table A-1 specifies the limits for each level. A definition of all levels identified in the "Level number" column of Table A-1 is specified for the High, Progressive 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. Each entry in Table A-1 indicates, for the level corresponding to the row of the table, the absence or value of a limit that is imposed by the variable corresponding to the column of the table, as follows:

with:

Table A-1 specifies the limits for each level. A definition of all levels identified in the "Level number" column of Table A-1 is specified for the High, Progressive High, Constrained 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. Each entry in Table A-1 indicates, for the level corresponding to the row of the table, the absence or value of a limit that is imposed by the variable corresponding to the column of the table, as follows:

Replace A.3.3 and its Table A-2 with the following:

A.3.3 Profile-specific level limits

a) In bitstreams conforming to the Main, High, Progressive High, Constrained 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, or CAVLC 4:4:4 Intra profiles, the removal time of access unit 0 shall satisfy the constraint that the number of slices in picture 0 is less than or equal to (Max(PicSizeInMbs, fR * MaxMBPS) + MaxMBPS * (t_r(0) − $t_{r,n}$(0))) ÷ SliceRate, where MaxMBPS and SliceRate are the values specified in Tables A-1 and A-4, respectively, that apply to picture 0 and PicSizeInMbs is the number of macroblocks in picture 0.

b) In bitstreams conforming to the Main, High, Progressive High, Constrained 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, or CAVLC 4:4:4 Intra profiles, the difference between consecutive removal times of access units n and n − 1 with n > 0 shall satisfy the constraint that the number of slices in picture n is less than or equal to MaxMBPS * (t_r(n) − t_r(n − 1)) ÷ SliceRate, where MaxMBPS and SliceRate are the values specified in Tables A-1 and A-4, respectively, that apply to picture n.

c) In bitstreams conforming to the Main, High, Progressive High, High 10, High 4:2:2, High 4:4:4 Predictive profiles, sequence parameter sets shall have direct_8x8_inference_flag equal to 1 for the levels specified in Table A-4.

NOTE 1 – direct_8x8_inference_flag is not relevant to the Baseline, Constrained Baseline, Constrained High, High 10 Intra, High 4:2:2 Intra, High 4:4:4 Intra, and CAVLC 4:4:4 Intra profiles as these profiles do not allow B slice types, and direct_8x8_inference_flag is equal to 1 for all levels of the Extended profile.

d) In bitstreams conforming to the 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, CAVLC 4:4:4 Intra, or Extended profiles, sequence parameter sets shall have frame_mbs_only_flag equal to 1 for the levels specified in Table A-4 for the 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, or CAVLC 4:4:4 Intra profiles and in Table A-5 for the Extended profile.

NOTE 2 – frame_mbs_only_flag is equal to 1 for all levels of the Baseline, Constrained Baseline, Constrained High, and Progressive High profiles (specified in clauses A.2.1, A.2.1.1, and A.2.4.1, respectively).

e) In bitstreams conforming to the Main, High, Progressive High, High 10, High 4:2:2, High 4:4:4 Predictive, or Extended profiles, the value of sub_mb_type[mbPartIdx] with mbPartIdx = 0..3 in B macroblocks with mb_type equal to B_8x8 shall not be equal to B_Bi_8x4, B_Bi_4x8, or B_Bi_4x4 for the levels in which MinLumaBiPredSize is shown as 8x8 in Table A-4 for the Main, High, Progressive High, High 10, High 4:2:2, High 4:4:4 Predictive profiles and in Table A-5 for the Extended profile.

f) In bitstreams conforming to the Baseline, Constrained Baseline, or Extended profiles, ($xInt_{max} - xInt_{min} + 6$) * ($yInt_{max} - yInt_{min} + 6$) <= MaxSubMbRectSize in macroblocks coded with mb_type equal to P_8x8, P_8x8ref0 or B_8x8 for all invocations of the process specified in clause 8.4.2.2.1 used to generate the predicted luma sample array for a single reference picture list (reference picture list 0 or reference picture list 1) for each 8x8 sub-macroblock with the macroblock partition index mbPartIdx, where NumSubMbPart(sub_mb_type[mbPartIdx]) > 1, where MaxSubMbRectSize is specified in Table A-3 for the Baseline and Constrained Baseline profiles and in Table A-5 for the Extended profile and the following apply:

- $xInt_{min}$ is the minimum value of $xInt_L$ among all luma sample predictions for the sub-macroblock
- $xInt_{max}$ is the maximum value of $xInt_L$ among all luma sample predictions for the sub-macroblock
- $yInt_{min}$ is the minimum value of $yInt_L$ among all luma sample predictions for the sub-macroblock
- $yInt_{max}$ is the maximum value of $yInt_L$ among all luma sample predictions for the sub-macroblock

g) In bitstreams conforming to the High, Progressive High, Constrained 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, or CAVLC 4:4:4 Intra profiles, for the VCL HRD parameters, BitRate[SchedSelIdx] <= cpbBrVclFactor * MaxBR and CpbSize[SchedSelIdx] <= cpbBrVclFactor * MaxCPB for at least one value of SchedSelIdx, where cpbBrVclFactor is specified in Table A-2 and BitRate[SchedSelIdx] and CpbSize[SchedSelIdx] are given as follows:

- If vcl_hrd_parameters_present_flag is equal to 1, BitRate[SchedSelIdx] and CpbSize[SchedSelIdx] are given by Equations E-37 and E-38, respectively, using the syntax elements of the hrd_parameters( ) syntax structure that immediately follows vcl_hrd_parameters_present_flag.
- Otherwise (vcl_hrd_parameters_present_flag is equal to 0), BitRate[SchedSelIdx] and CpbSize[SchedSelIdx] are inferred as specified in clause E.2.2 for VCL HRD parameters.

MaxBR and MaxCPB are specified in Table A-1 in units of cpbBrVclFactor bits/s and cpbBrVclFactor bits, respectively. The bitstream shall satisfy these conditions for at least one value of SchedSelIdx in the range 0 to cpb_cnt_minus1, inclusive.

h) In bitstreams conforming to the High, Progressive High, Constrained 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, or CAVLC 4:4:4 Intra profiles, for the NAL HRD parameters, BitRate[SchedSelIdx] <= cpbBrNalFactor * MaxBR and CpbSize[SchedSelIdx] <= cpbBrNalFactor * MaxCPB for at least one value of SchedSelIdx, where cpbBrNalFactor is specified in Table A-2 and BitRate[SchedSelIdx] and CpbSize[SchedSelIdx] are given as follows:

- If nal_hrd_parameters_present_flag is equal to 1, BitRate[SchedSelIdx] and CpbSize[SchedSelIdx] are given by Equations E-37 and E-38, respectively, using the syntax elements of the hrd_parameters( ) syntax structure that immediately follows nal_hrd_parameters_present_flag.
- Otherwise (nal_hrd_parameters_present_flag is equal to 0), BitRate[SchedSelIdx] and CpbSize[SchedSelIdx] are inferred as specified in clause E.2.2 for NAL HRD parameters.

MaxBR and MaxCPB are specified in Table A-1 in units of cpbBrNalFactor bits/s and cpbBrNalFactor bits, respectively. The bitstream shall satisfy these conditions for at least one value of SchedSelIdx in the range 0 to cpb_cnt_minus1, inclusive.

i) In bitstreams conforming to the High, Progressive High, or Constrained High profiles, the sum of the NumBytesInNALunit variables for access unit 0 is less than or equal to 384 * (Max(PicSizeInMbs, fR * MaxMBPS) + MaxMBPS * ($t_r(0) - t_{r,n}(0)$)) ÷ MinCR, where MaxMBPS and MinCR are the values specified in Table A-1 that apply to picture 0 and PicSizeInMbs is the number of macroblocks in picture 0.

NOTE 3 – Such a limit involving MinCR is not imposed for bitstream conformance to the 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.

j) In bitstreams conforming to the High, Progressive High, or Constrained High profiles, the sum of the NumBytesInNALunit variables for access unit n with n > 0 is less than or equal to 384 * MaxMBPS * (t_r(n) − t_r(n − 1)) ÷ MinCR, where MaxMBPS and MinCR are the values specified in Table A-1 that apply to picture n.

NOTE 4 – Such a limit involving MinCR is not imposed for bitstream conformance to the 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.

k) In bitstreams conforming to the High 10, High 4:2:2, High 4:4:4 Predictive, High 10 Intra, High 4:2:2 Intra, High 4:4:4 Intra, or CAVLC 4:4:4 Intra profiles, when PicSizeInMbs is greater than 1620, the number of macroblocks in any coded slice shall not exceed MaxFS / 4, where MaxFS is specified in Table A-1.

Table A-2 – Specification of cpbBrVclFactor and cpbBrNalFactor

Profile	cpbBrVclFactor	cpbBrNalFactor
High **Progressive High** **Constrained High**	1 250	1 500
High 10 **High 10 Intra**	3 000	3 600
High 4:2:2 **High 4:2:2 Intra**	4 000	4 800
High 4:4:4 Predictive **High 4:4:4 Intra** **CAVLC 4:4:4 Intra**	4 000	4 800

Replace A.3.3.2 and its Table A-4 with the following:

A.3.3.2 Level limits of the Main, High, Progressive High, Constrained 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

Table A-4 specifies limits for each level that are specific to bitstreams conforming to the Main, High, Progressive High, Constrained 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, or CAVLC 4:4:4 Intra profiles. Each entry in Table A-4 indicates, for the level corresponding to the row of the table, the absence or value of a limit that is imposed by the variable corresponding to the column of the table, as follows:

– If the table entry is marked as "-", no limit is imposed by the value of the variable as a requirement of bitstream conformance to the profile at the specified level.

– Otherwise, the table entry specifies the value of the variable for the associated limit that is imposed as a requirement of bitstream conformance to the profile at the specified level.

NOTE – The constraints for MinLumaBiPredSize and direct_8x8_inference_flag are not relevant to the Constrained High, High 10 Intra, High 4:2:2 Intra, High 4:4:4 Intra, and CAVLC 4:4:4 Intra profiles, as these profiles do not support B slices.

Table A-4 – Main, High, Progressive High, Constrained 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

Level_number	SliceRate	MinLumaBiPredSize	direct_8x8_inference_flag	frame_mbs_only_flag
1	-	-	-	1
1b	-	-	-	1
1.1	-	-	-	1
1.2	-	-	-	1
1.3	-	-	-	1
2	-	-	-	1
2.1	-	-	-	-
2.2	-	-	-	-
3	22	-	1	-
3.1	60	8x8	1	-
3.2	60	8x8	1	-
4	60	8x8	1	-
4.1	24	8x8	1	-
4.2	24	8x8	1	1
5	24	8x8	1	1
5.1	24	8x8	1	1
5.2	24	8x8	1	1

In D.1, replace the following rows of the table:

else if(payloadType == 45)		
frame_packing_arrangement(payloadSize)	5	
else		
reserved_sei_message(payloadSize)	5	

with the following:

else if(payloadType == 45)		
frame_packing_arrangement(payloadSize)	5	
else if(payloadType == 46)		
multiview_view_position(payloadSize) /* specified in Annex H */	5	
else if(payloadType == 47)		
display_orientation(payloadSize)	5	
else		
reserved_sei_message(payloadSize)	5	

Add D.1.26 "Display orientation SEI message syntax" as follows;

D.1.26 Display orientation SEI message syntax

display_orientation(payloadSize) {	**Descriptor**
display_orientation_cancel_flag	u(1)
if (!display_orientation_cancel_flag) {	
hor_flip	u(1)
ver_flip	u(1)
anticlockwise_rotation	u(16)
display_orientation_repetition_period	ue(v)
display_orientation_extension_flag	u(1)
}	
}	

Renumber the heading of D.1.26 to D.1.27 as follows:

D.1.27 Reserved SEI message syntax

In D.2.25, replace Table D-8 and the following text:

Table D-8 – Definition of frame_packing_arrangement_type

Value	Interpretation
0	Each component plane of the decoded frames contains a "checkerboard" based interleaving of corresponding planes of two constituent frames as illustrated in Figure D-1.
1	Each component plane of the decoded frames contains a column based interleaving of corresponding planes of two constituent frames as illustrated in Figure D-2 and Figure D-3.
2	Each component plane of the decoded frames contains a row based interleaving of corresponding planes of two constituent frames as illustrated in Figure D-4 and Figure D-5.
3	Each component plane of the decoded frames contains a side-by-side packing arrangement of corresponding planes of two constituent frames as illustrated in Figure D-6, Figure D-7, and Figure D-10.
4	Each component plane of the decoded frames contains a top-bottom packing arrangement of corresponding planes of two constituent frames as illustrated in Figure D-8 and Figure D-9.
5	The component planes of the decoded frames in output order form a temporal interleaving of alternating first and second constituent frames as illustrated in Figure D-11.

NOTE 1 – Figure D-1 to Figure D-10 provide typical examples of rearrangement and upconversion processing for various packing arrangement schemes. Actual characteristics of the constituent frames are signalled in detail by the subsequent syntax elements of the frame packing arrangement SEI message. In Figure D-1 to Figure D-10, an upconversion processing is performed on each constituent frame to produce frames having the same resolution as that of the decoded frame. An example of the upsampling method to be applied to a quincunx sampled frame as shown in Figure D-1 or Figure D-10 is to fill in missing positions with an average of the available spatially neighbouring samples (the average of the values of the available samples above, below, to the left and to the right of each sample to be generated). The actual upconversion process to be performed, if any, is outside the scope of this Specification.

NOTE 2 – The sample aspect ratio (SAR) indicated in the VUI parameters should indicate the output picture shape for the packed decoded frame output by a decoder that does not interpret the frame packing arrangement SEI message. In the examples shown in Figure D-1 to Figure D-10, the SAR produced in each upconverted colour plane would be the same as the SAR indicated in the