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| **ITU – Telecommunications Standardization Sector**STUDY GROUP 16 Question 6**Video Coding Experts Group (VCEG)**53rd Meeting: 20–26 February 2016, San Diego, US | Document VCEG-BA09 |

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| Question: | Q.6/SG16 (VCEG) |
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| Title: | A Progressive High 10 profile in ITU-T Rec. H.264/MPEG-4 AVC |
| Purpose: | Profile Proposal (no new technology) |

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**Abstract**

Contribution m37478 [1] initially requested the addition of several new profiles in the ITU-T Rec. H.264/ MPEG-4 AVC standard [2][3]. By the end of the 113th MPEG meeting, several organizations agreed that at least a Progressive High 10 profile would be highly desirable [4]. Therefore, in this contribution we request that this profile is added in this specification.

# Introduction

Slower than anticipated adoption of the HEVC [5][6] standard in consumer devices, for a variety of reasons, has resulted in a considerable delay in deployment of certain, higher end services, impacting growth and revenue of several companies. Support of 4:2:0 10 bit formats in particular, is considered essential for a variety of applications, ranging from broadcast and over-the-top distribution of both standard and high dynamic range as well as wide colour gamut content. On the other hand, support of interlace formats is also considered undesirable or unnecessary within the same context.

Therefore, given the considerable maturity, wide-spread adoption, and deployment of the Rec. H.264/MPEG-4 AVC [2][3] standard, we believe that such specific capability profiles would be able to provide to manufacturers and services alike a potential alternative to HEVC. This could thus enable and effectively accelerate the deployment of such new video services.

Given strong support from various organizations and industries, we would like to request the creation of a new 4:2:0 10 bit, progressive only, profile in the Rec. H.264/MPEG-4 AVC.

# Suggested Text Modifications

The following text additions and modifications are suggested in the text:

8.7 Deblocking filter process

A conditional filtering process is specified in this clause 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, Progressive 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 clause, or one similar to it, should be applied but is not required.

A.2.5.1 Progressive High 10 profile

Bitstreams conforming to the Progressive High 10 profile shall obey all constraints specified in clause A.2.5 for the High 10 profile, and shall additionally obey the constraint that sequence parameter sets shall have frame\_mbs\_only\_flag equal to 1.

Conformance of a bitstream to the Progressive High 10 profile is indicated by profile\_idc being equal to 110 with constraint\_set4\_flag being equal to 1.

Decoders conforming to the Progressive High 10 profile at a specific level shall be capable of decoding all bitstreams in which one or more of the following conditions is 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, 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 88, constraint\_set1\_flag is equal to 1, constraint\_set4\_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 or 110, constraint\_set4\_flag is equal to 1, and level\_idc represents a level less than or equal to the specified level.

A.3.2 Level limits common to the High, Progressive High, Constrained High, High 10, Progressive 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

Bitstreams conforming to the High, Progressive High, Constrained High, High 10, Progressive 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:

…

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, Progressive 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:

A.3.3 Profile-specific level limits

1. In bitstreams conforming to the Main, High, Progressive High, Constrained High, High 10, Progressive 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 \* ( tr( 0 ) − tr,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.
2. In bitstreams conforming to the Main, High, Progressive High, Constrained High, High 10, Progressive 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 \* ( tr( n ) − tr( n − 1 ) ) ÷ SliceRate, where MaxMBPS and SliceRate are the values specified in Tables A‑1 and A‑4, respectively, that apply to picture n.
3. In bitstreams conforming to the Main, High, Progressive High, High 10, Progressive 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.

1. 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, Progressive High, Progressive High 10, and Constrained High profiles (specified in clauses ‎A.2.1, ‎A.2.1.1, ‎A.2.4.1, and ‎A.2.4.2, respectively).

1. In bitstreams conforming to the Main, High, Progressive High, High 10, Progressive 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, Progressive High 10, High 4:2:2, High 4:4:4 Predictive profiles and in Table A‑5 for the Extended profile.
2. In bitstreams conforming to the Baseline, Constrained Baseline, or Extended profiles, ( xIntmax − xIntmin + 6 ) \* ( yIntmax − yIntmin + 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

– xIntmin is the minimum value of xIntL among all luma sample predictions for the sub-macroblock

– xIntmax is the maximum value of xIntL among all luma sample predictions for the sub-macroblock

– yIntmin is the minimum value of yIntL among all luma sample predictions for the sub-macroblock

– yIntmax is the maximum value of yIntL among all luma sample predictions for the sub-macroblock

1. In bitstreams conforming to the High, Progressive High, Constrained High, High 10, Progressive 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-46 and E-47, 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.

1. In bitstreams conforming to the High, Progressive High, Constrained High, High 10, Progressive 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-46 and E-47, 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.

1. 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 \* ( tr( 0 ) − tr,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, Progressive 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.

1. 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 \* ( tr( n ) − tr( 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, Progressive 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.

1. In bitstreams conforming to the High 10, Progressive 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** |
| **HighProgressive HighConstrained High** | 1 250 | 1 500 |
| **High 10****Progressive 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 |

A3.3.2 Level limits of the Main, High, Progressive High, Constrained High, High 10, Progressive 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, Progressive 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, Progressive 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 |

# References

1. A.M. Tourapis, D. Singer, K. Kolarov, “Request for new ISO/IEC 14496-10/MPEG-4 part 10/AVC profiles”, MPEG document M37069, Geneva, SW, Oct. 2015
2. ITU-T H.264, “Advanced video coding for generic audiovisual services”
3. ISO/IEC 14496-10:2014, “Information technology -- Coding of audio-visual objects -- Part 10: Advanced Video Coding”
4. A. Dueñas, A. Norkin, G. Martin-Cocher, D. Hoang, J. Ridge, J. Sampedro, L. Winger, P. Haskell, A. Wells, J. Helman, A.M. Tourapis, “Support for the request for new ISO/IEC 14496-10/MPEG-4 part 10/AVC profiles”, MPEG document M37478, Geneva, SW, Oct. 2015
5. ITU-T H.265, “High efficiency video coding“
6. ISO/IEC 23008:2014, “Information technology -- High efficiency coding and media delivery in heterogeneous environments -- Part 2: High efficiency video coding, Second Edition”

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