|  |
| --- |
| **INTERNATIONAL ORGANIZATION FOR STANDARDIZATION ORGANISATION INTERNATIONALE DE NORMALISATION ISO/IEC JTC 1/SC 29/WG 5 MPEG JOINT VIDEO CODING TEAM WITH ITU-T SG 16** |
| **ISO/IEC JTC 1 / SC 29 / WG 5 N 143** |
| **Online, 13–22 July 2022** |
| |  |  | | --- | --- | | **Title:** | **Preliminary working draft of HEVC multiview profiles supporting extended bit depth** | | **Source:** | **Convenor (Jens-Rainer Ohm)** | | **Type:** | **Project** | | **Subtype:** | **Draft** | | **Status:** | **Approved** | | **Date:** | **2022-10-19** | | **Expected Action:** | **Info** | | **Action due date:** | **N/A** | | **No. of pages** | **12** (without this cover page) | | **Email of convenor:** | **ohm @ ient . rwth-aachen . de** | | **Committee URL:** | **https://sd.iso.org/documents/ui/#!/browse/iso/iso-iec-jtc-1/iso-iec-jtc-1-sc-29/iso-iec-jtc-1-sc-29-wg-5** | |

|  |  |
| --- | --- |
| **Joint Video Experts Team (JVET)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29**  27th Meeting, by teleconference, 13–22 July 2022 | Document: JVET-AA1011 |

|  |  |  |  |
| --- | --- | --- | --- |
| *Title:* | **HEVC multiview profiles supporting extended bit depth (Draft 1)** | | |
| *Status:* | Output document approved by JVET | | |
| *Purpose:* | Draft text | | |
| *Author(s) or Contact(s):* | Alexis Tourapis Walt Husak | Tel: Email: | [atourapis@apple.com](mailto:atourapis@apple.com) wjh@dolby.com |
| *Source:* | Editors | | |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Abstract

This document contains the draft text for changes to the High Efficiency Video Coding (HEVC) standard (ITU‑T H.265 | ISO/IEC 23008-2), for the addition of new multiview profiles supporting extended bitdetph.

Draft 1 incorporated items:

* Addition of new multiview profiles supporting extended bitdetph (JVET-AA0239)

**Changes to the specification text** *(additions are yellow-highlighted, removals are highlighted as strikethroughs in red font)*:

*Replace Table F.3, with the following:*

Table F.3 — Specification of CompatibleProfileList

|  |  |
| --- | --- |
| **Profile to which  the decoder conforms** | **Profiles that the decoder shall support CompatibleProfileList** |
| Scalable Main | Scalable Main, Main, Main Still Picture |
| Scalable Main 10 | Scalable Main 10, Main, Main Still Picture, Main 10, Scalable Main |
| Scalable Monochrome | The compatible format range extensions profiles of the Monochrome profile, and the compatible scalable format range extensions profiles of the Scalable Monochrome profile |
| Scalable Monochrome 12 | The compatible format range extensions profiles of the Monochrome 12 profile, and the compatible scalable format range extensions profiles of the Scalable Monochrome 12 profile |
| Scalable Monochrome 16 | The compatible format range extensions profiles of the Monochrome 16 profile, and the compatible scalable format range extensions profiles of the Scalable Monochrome 16 profile |
| Scalable Main 4:4:4 | Scalable Main, Main, Main Still Picture, the compatible format range extensions profiles of the Main 4:4:4 profile, and the compatible scalable format range extensions profiles of the Scalable Main 4:4:4 profile |
| Multiview Main | Multiview Main, Main, Main Still Picture |
| Multiview Main 10 | Multiview Main 10, Main, Main Still Picture, Main 10, Multiview Main |
| Multiview Monochrome | The compatible format range extensions profiles of the Monochrome profile, and the compatible multiview format range extensions profiles of the Multiview Monochrome profile |
| Multiview Monochrome 12 | The compatible format range extensions profiles of the Monochrome 10 profile, and the compatible multiview format range extensions profiles of the Multiview Monochrome 10 profile |
| 3D Main | 3D Main, Multiview Main, Main, Main Still Picture |

*In subclause G.11.1.1, make the following changes:*

G.11.1.1 Multiview Main and Multiview Main 10 profiles

For a layer in an output operation point associated with an OLS in a bitstream, the layer being conforming to the Multiview Main and Multiview Main 10 profile, the following applies:

— Let olsIdx be the OLS index of the OLS, the sub-bitstream subBitstream and the base layer sub-bitstream baseBitstream are derived as specified in F.11.3.

When vps\_base\_layer\_internal\_flag is equal to 1, the base layer sub-bitstream baseBitstream shall obey the following constraints:

— When the layer conforms to the Multiview Main profile, the base layer sub-bitstream baseBitstream shall be indicated to conform to the Main profile.

— When the layer conforms to the Multiview Main 10 profile, the base layer sub-bitstream baseBitstream shall be indicated to conform to the Main 10 or the Main profile.

The sub-bitstream subBitstream shall obey the following constraints:

— All active VPSs shall have vps\_num\_rep\_formats\_minus1 in the range of 0 to 15, inclusive.

— All active SPSs for layers in subBitstream shall have chroma\_format\_idc equal to 1 only.

— All active SPSs for layers in subBitstream shall have transform\_skip\_rotation\_enabled\_flag, transform\_skip\_context\_enabled\_flag, implicit\_rdpcm\_enabled\_flag, explicit\_rdpcm\_enabled\_flag, extended\_precision\_processing\_flag, intra\_smoothing\_disabled\_flag, high\_precision\_offsets\_enabled\_flag, persistent\_rice\_adaptation\_enabled\_flag, and cabac\_bypass\_alignment\_enabled\_flag, when present, equal to 0 only.

— CtbLog2SizeY derived from all active SPSs for layers in subBitstream shall be in the range of 4 to 6, inclusive.

— All active PPSs for layers in subBitstream shall have log2\_max\_transform\_skip\_block\_size\_minus2 and chroma\_qp\_offset\_list\_enabled\_flag, when present, equal to 0 only.

— ScalabilityId[ j ][ smIdx ] derived according to any active VPS shall be equal to 0 for any smIdx value not equal to 1 or 3 and for any value of j such that layer\_id\_in\_nuh[ j ] is among layerIdListTarget that was used to derive subBitstream.

— When NumLayersInIdList[ OlsIdxToLsIdx[ olsIdx ] ] is equal to 2, output\_layer\_flag[ olsIdx ][ j ] derived according to any active VPS shall be equal to 1 for j in the range of 0 to 1, inclusive, for subBitstream.

— All active VPSs shall have alt\_output\_layer\_flag[ olsIdx ] equal to 0 only.

— When ViewOrderIdx[ i ] derived according to any active VPS is equal to 1 for the layer with nuh\_layer\_id equal to i in subBitstream, inter\_view\_mv\_vert\_constraint\_flag shall be equal to 1 in the sps\_multilayer\_extension( ) syntax structure in each active SPS for that layer.

— When ViewOrderIdx[ i ] derived according to any active VPS is greater than to 0 for the layer with nuh\_layer\_id equal to i in subBitstream, num\_ref\_loc\_offsets shall be equal to 0 in each active PPS for that layer.

— When ViewOrderIdx[ i ] derived according to any active VPS is greater than 0 for the layer with nuh\_layer\_id equal to i in subBitstream, the values of pic\_width\_in\_luma\_samples and pic\_height\_in\_luma\_samples in each active SPS for that layer shall be equal to the values of pic\_width\_in\_luma\_samples and pic\_height\_in\_luma\_samples, respectively, in each active SPS for all reference layers of that layer.

— For a layer with nuh\_layer\_id iNuhLId equal to any value included in layerIdListTarget that was used to derive subBitstream, the value of NumRefLayers[ iNuhLId ], which specifies the total number of direct and indirect reference layers and is derived as specified in F.7.4.3.1, shall be less than or equal to 4.

— All active SPSs for layers in subBitstream shall have sps\_range\_extension\_flag and sps\_scc\_extension\_flag equal to 0 only.

— All active PPSs for layers in subBitstream shall have pps\_range\_extension\_flag and pps\_scc\_extension\_flag equal to 0 only.

— When an active PPS for any layer in subBitstream has tiles\_enabled\_flag equal to 1, it shall have entropy\_coding\_sync\_enabled\_flag equal to 0.

— When an active PPS for any layer in subBitstream has tiles\_enabled\_flag equal to 1, ColumnWidthInLumaSamples[ i ] shall be greater than or equal to 256 for all values of i in the range of 0 to num\_tile\_columns\_minus1, inclusive, and RowHeightInLumaSamples[ j ] shall be greater than or equal to 64 for all values of j in the range of 0 to num\_tile\_rows\_minus1, inclusive.

— The number of times read\_bits( 1 ) is called in 9.3.4.3.3 and 9.3.4.3.4 when parsing coding\_tree\_unit( ) data for any CTU shall be less than or equal to 5 \* RawCtuBits / 3.

— For any active VPS, ViewOrderIdx[ i ] shall be greater than ViewOrderIdx[ j ] for any values of i and j among layerIdListTarget that was used to derive subBitstream such that AuxId[ i ] is equal to AuxId[ j ] and i is greater than j.

When the layer conforms to the Multiview Main profile, the sub-bitstream subBitstream shall obey the following constraints:

— All active SPSs for layers in subBitstream shall have bit\_depth\_luma\_minus8 equal to 0 only.

— All active SPSs for layers in subBitstream shall have bit\_depth\_chroma\_minus8 equal to 0 only.

— All active PPSs for layers in subBitstream shall have colour\_mapping\_enabled\_flag equal to 0 only.

— The tier and level constraints specified for the Multiview Main profile in G.11.2 shall be fulfilled.

When the layer conforms to the Multiview Main 10 profile, the sub-bitstream subBitstream shall obey the following constraints:

— All active SPSs for layers in subBitstream shall have bit\_depth\_luma\_minus8 in the range of 0 to 2, inclusive.

— All active SPSs for layers in subBitstream shall have bit\_depth\_chroma\_minus8 in the range of 0 to 2, inclusive..

— The tier and level constraints specified for the Multiview Main 10 profile in G.11.2 shall be fulfilled.

In the remainder of this subclause and G.11.2.1, all syntax elements in the profile\_tier\_level( ) syntax structure refer to those in the profile\_tier\_level( ) syntax structure associated with the layer.

Conformance of a layer in an output operation point associated with an OLS in a bitstream to the Multiview Main profile is indicated as follows:

— If OpTid of the output operation point is equal to vps\_max\_sub\_layer\_minus1, the conformance is indicated by general\_profile\_idc being equal to 6 or general\_profile\_compatibility\_flag[ 6 ] being equal to 1, and general\_max\_12bit\_constraint\_flag being equal to 1, general\_max\_10bit\_constraint\_flag being equal to 1, general\_max\_8bit\_constraint\_flag being equal to 1, general\_max\_422chroma\_constraint\_flag being equal to 1, general\_max\_420chroma\_constraint\_flag being equal to 1, general\_max\_monochrome\_constraint\_flag being equal to 0, general\_intra\_constraint\_flag being equal to 0, and general\_one\_picture\_only\_constraint\_flag being equal to 0, and general\_lower\_bit\_rate\_constraint\_flag being equal to 1.

— Otherwise (OpTid of the output operation point is less than vps\_max\_sub\_layer\_minus1), the conformance is indicated by sub\_layer\_profile\_idc[ OpTid ] being equal to 6 or sub\_layer\_profile\_compatibility\_flag[ OpTid ][ 6 ] being equal to 1, and sub\_layer\_max\_12bit\_constraint\_flag[ OpTid ] being equal to 1, sub\_layer\_max\_10bit\_constraint\_flag[ OpTid ] being equal to 1, sub\_layer\_max\_8bit\_constraint\_flag[ OpTid ] being equal to 1, sub\_layer\_max\_422chroma\_constraint\_flag[ OpTid ] being equal to 1, sub\_layer\_max\_420chroma\_constraint\_flag[ OpTid ] being equal to 1, sub\_layer\_max\_monochrome\_constraint\_flag[ OpTid ] being equal to 0, sub\_layer\_intra\_constraint\_flag[ OpTid ] being equal to 0, and sub\_layer\_one\_picture\_only\_constraint\_flag[ OpTid ] being equal to 0, and sub\_layer\_lower\_bit\_rate\_constraint\_flag[ OpTid ] being equal to 1.

Conformance of a layer in an output operation point associated with an OLS in a bitstream to the Multiview Main 10 profile is indicated as follows:

— If OpTid of the output operation point is equal to vps\_max\_sub\_layer\_minus1, the conformance is indicated by general\_profile\_idc being equal to 6 or general\_profile\_compatibility\_flag[ 6 ] being equal to 1, and general\_max\_12bit\_constraint\_flag being equal to 1, general\_max\_10bit\_constraint\_flag being equal to 1, general\_max\_8bit\_constraint\_flag being equal to 0, general\_max\_422chroma\_constraint\_flag being equal to 1, general\_max\_420chroma\_constraint\_flag being equal to 1, general\_max\_monochrome\_constraint\_flag being equal to 0, general\_intra\_constraint\_flag being equal to 0, and general\_one\_picture\_only\_constraint\_flag being equal to 0, and general\_lower\_bit\_rate\_constraint\_flag being equal to 1.

— Otherwise (OpTid of the output operation point is less than vps\_max\_sub\_layer\_minus1), the conformance is indicated by sub\_layer\_profile\_idc[ OpTid ] being equal to 6 or sub\_layer\_profile\_compatibility\_flag[ OpTid ][ 6 ] being equal to 1, and sub\_layer\_max\_12bit\_constraint\_flag[ OpTid ] being equal to 1, sub\_layer\_max\_10bit\_constraint\_flag[ OpTid ] being equal to 1, sub\_layer\_max\_8bit\_constraint\_flag[ OpTid ] being equal to 0, sub\_layer\_max\_422chroma\_constraint\_flag[ OpTid ] being equal to 1, sub\_layer\_max\_420chroma\_constraint\_flag[ OpTid ] being equal to 1, sub\_layer\_max\_monochrome\_constraint\_flag[ OpTid ] being equal to 0, sub\_layer\_intra\_constraint\_flag[ OpTid ] being equal to 0, and sub\_layer\_one\_picture\_only\_constraint\_flag[ OpTid ] being equal to 0, and sub\_layer\_lower\_bit\_rate\_constraint\_flag[ OpTid ] being equal to 1.

*Add a new subclause G.11.1.2,as follows:*

G.11.1.2 Multiview format range extensions profiles

The following profiles, collectively referred to as the multiview format range extensions profiles, are specified in this subclause:

— the Multiview Monochrome and Multiview Monochrome 10 profiles.

For a layer in an output operation point associated with an OLS in a bitstream, the layer being conforming to the Multiview Monochrome and Multiview Monochrome 10 profile, the following applies:

— Let olsIdx be the OLS index of the OLS, the sub-bitstream subBitstream and the base layer sub-bitstream baseBitstream are derived as specified in F.11.3.

When vps\_base\_layer\_internal\_flag is equal to 1, the base layer sub-bitstream baseBitstream shall obey the following constraints:

— The base layer sub-bitstream baseBitstream shall be indicated to conform to the Main profile, the Main 10 profile or a format range extensions profile.

The sub-bitstream subBitstream shall obey the following constraints:

— All active VPSs shall have vps\_num\_rep\_formats\_minus1 in the range of 0 to 15, inclusive.

— All active SPSs for layers in subBitstream shall have chroma\_format\_idc equal to 1 only.

— All active SPSs for the layers in subBitstream shall have separate\_colour\_plane\_flag, cabac\_bypass\_alignment\_enabled\_flag, when present, equal to 0 only.

— CtbLog2SizeY derived from all active SPSs for layers in subBitstream shall be in the range of 4 to 6, inclusive.

— ScalabilityId[ j ][ smIdx ] derived according to any active VPS shall be equal to 0 for any smIdx value not equal to 1 or 3 and for any value of j such that layer\_id\_in\_nuh[ j ] is among layerIdListTarget that was used to derive subBitstream.

— The constraints specified in Table H.3, in which entries marked with “–“ indicate that the table entry does not impose a profile-specific constraint on the corresponding syntax element, shall apply for all active SPSs and PPSs for layers in subBitstream.

NOTE For some syntax elements with table entries marked with “–“, a constraint may be imposed indirectly – e.g. by semantics constraints that are imposed elsewhere in this document when other specified constraints are fulfilled.

— All active SPSs for layers in subBitstream shall have the same value of chroma\_format\_idc.

— All active SPSs for layers in subBitstream shall have sps\_scc\_extension\_flag equal to 0 only.

— All active PPSs for layers in subBitstream shall have pps\_scc\_extension\_flag equal to 0 only.

— When an active PPS for any layer in subBitstream has tiles\_enabled\_flag equal to 1, it shall have entropy\_coding\_sync\_enabled\_flag equal to 0.

— When an active PPS for any layer in subBitstream has tiles\_enabled\_flag equal to 1, ColumnWidthInLumaSamples[ i ] shall be greater than or equal to 256 for all values of i in the range of 0 to num\_tile\_columns\_minus1, inclusive, and RowHeightInLumaSamples[ j ] shall be greater than or equal to 64 for all values of j in the range of 0 to num\_tile\_rows\_minus1, inclusive.

— The number of times read\_bits( 1 ) is called in 9.3.4.3.3 and 9.3.4.3.4 when parsing coding\_tree\_unit( ) data for any CTU shall be less than or equal to 5 \* RawCtuBits / 3.

— For any active VPS, DependencyId[ i ] shall be greater than DependencyId[ j ] for any values of i and j among layerIdListTarget that was used to derive subBitstream such that AuxId[ i ] is equal to AuxId[ j ] and i is greater than j.

— The tier and level constraints specified for the Multiview Monochrome and Multiview Monochrome profiles in G.11.2, as applicable, shall be fulfilled.

Table G.3 — Allowed values for syntax elements in the multiview format range extensions profiles

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Profile for which constraint is specified** | **chroma\_format\_idc** | **bit\_depth\_luma\_minus8 and bit\_depth\_chroma\_minus8** | **transform\_skip\_rotation\_enabled\_flag, transform\_skip\_context\_enabled\_flag, implicit\_rdpcm\_enabled\_flag, explicit\_rdpcm\_enabled\_flag, intra\_smoothing\_disabled\_flag, persistent\_rice\_adaptation\_enabled\_flag, and log2\_max\_transform\_skip\_block\_size\_minus2** | **extended\_precision\_processing\_flag** | **chroma\_qp\_offset\_list\_enabled\_flag** |
| Multiview Monochrome | 0 | 0 | 0 | 0 | 0 |
| Multiview Monochrome 10 | 0 | 0..2 | 0 | 0 | 0 |

In the remainder of this subclause and H.11.2.1, all syntax elements in the profile\_tier\_level( ) syntax structure refer to those in the profile\_tier\_level( ) syntax structure associated with the layer.

Conformance of a layer in an output operation point associated with an OLS in a bitstream for the scalable format range exensions profiles is indicated as follows:

— If OpTid of the output operation point is equal to vps\_max\_sub\_layer\_minus1, the conformance is indicated by general\_profile\_idc being equal to 10 or general\_profile\_compatibility\_flag[ 10 ] being equal to 1, with the additional indications specified in Table H.4 for the general constraint flags.

— Otherwise (OpTid of the output operation point is less than vps\_max\_sub\_layer\_minus1), the conformance is indicated by sub\_layer\_profile\_idc[ OpTid ] being equal to 10 or sub\_layer\_profile\_compatibility\_flag[ OpTid ][ 10 ] being equal to 1, with the additional indications specified in Table H.4 for the flags associated with the index OpTid.

All other combinations of general\_max\_14bit\_constraint\_flag, general\_max\_12bit\_constraint\_flag, general\_max\_10bit\_constraint\_flag, general\_max\_8bit\_constraint\_flag, general\_max\_422chroma\_constraint\_flag, general\_max\_420chroma\_constraint\_flag, general\_max\_monochrome\_constraint\_flag, general\_intra\_constraint\_flag, general\_one\_picture\_only\_constraint\_flag, and general\_lower\_bit\_rate\_constraint\_flag with general\_profile\_idc equal to 10 or general\_profile\_compatibility\_flag[ 10 ] equal to 1 are reserved for future use by ITU-T | ISO/IEC. All other combinations of sub\_layer\_max\_14bit\_constraint\_flag[ OpTid ], sub\_layer\_max\_12bit\_constraint\_flag[ OpTid ], sub\_layer\_max\_10bit\_constraint\_flag[ OpTid ], sub\_layer\_max\_8bit\_constraint\_flag[ OpTid ], sub\_layer\_max\_422chroma\_constraint\_flag[ OpTid ], sub\_layer\_max\_420chroma\_constraint\_flag[ OpTid ], sub\_layer\_max\_monochrome\_constraint\_flag[ OpTid ], sub\_layer\_intra\_constraint\_flag[ OpTid ], sub\_layer\_one\_picture\_only\_constraint\_flag[ OpTid ], and sub\_layer\_lower\_bit\_rate\_constraint\_flag[ OpTid ] with sub\_layer\_profile\_idc[ OpTid ] equal to 10 or sub\_layer\_profile\_compatibility\_flag[ OpTid ][ 10 ] equal to 1 are reserved for future use by ITU-T | ISO/IEC. Such combinations shall not be present in bitstreams conforming to this document. However, decoders conforming to the scalable format range extensions profiles shall allow other combinations as specified below in this clause to occur in the bitstream.

Table H.4 — Bitstream indications for conformance to scalable range extensions profiles

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Profile for which the bitstream indicates conformance** | **general\_max\_14bit\_constraint\_flag or sub\_layer\_max\_14bit\_constraint\_‌flag[ OpTid ]** | **general\_max\_12bit\_constraint\_flag or sub\_layer\_max\_12bit\_constraint\_‌flag[ OpTid ]** | **general\_max\_10bit\_constraint\_flag or sub\_layer\_max\_10bit\_constraint\_‌flag[ OpTid ]** | **general\_max\_8bit\_constraint\_flag or sub\_layer\_max\_8bit\_constraint\_‌flag[ OpTid ]** | **general\_max\_422chroma\_constraint\_flag or sub\_layer\_max\_422chroma\_constraint\_‌flag[ OpTid ]** | **general\_max\_420chroma\_constraint\_flag or sub\_layer\_max\_420chroma\_constraint\_‌flag[ OpTid ]** | **general\_max\_monochrome\_constraint\_flag or sub\_layer\_max\_monochrome\_constraint\_‌flag[ OpTid ]** | **general\_intra\_constraint\_flag or sub\_layer\_intra\_constraint\_‌flag[ OpTid ]** | **general\_one\_picture\_only\_constraint\_flag or sub\_layer\_one\_picture\_only\_constraint\_‌flag[ OpTid ]** | **general\_lower\_bit\_rate\_constraint\_flag or sub\_layer\_lower\_bit\_rate\_constraint\_‌flag[ OpTid ]** |
| Multiview Monochrome | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| Multiview Monochrome 10 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 |

*Modify subclause G.11.2.1,as follows:*

G.11.2.1 General tier and level limits

For purposes of comparison of tier capabilities, the tier with general\_tier\_flag or sub\_layer\_tier\_flag[ i ] equal to 0 is considered to be a lower tier than the tier with general\_tier\_flag or sub\_layer\_tier\_flag[ i ] equal to 1.

For purposes of comparison of level capabilities, a particular level of a specific tier is considered to be a lower level than some other level of the same tier when the value of the general\_level\_idc or sub\_layer\_level\_idc[ i ] of the particular level is less than that of the other level.

The following is specified for expressing the constraints in this subclause and H.11.2.2:

— For the Multiview Main profile, the value of each of the variables CpbVclFactor, CpbNalFactor, FormatCapabilityFactor, and MinCrScaleFactor is the same as that specified in Table A.10 for the Main profile. For the Multiview Main 10 profile, the value of each of these variables is the same as that specified in Table A.10 for the Main 10 profile.

— For the Multiview Monochrome profile, the value of each of the variables CpbVclFactor, CpbNalFactor, FormatCapabilityFactor, and MinCrScaleFactor is the same as that specified in Table A.10 for the Monochrome profile.

— For the Multiview Monochrome 10 profile, the value of each of the variables CpbVclFactor, CpbNalFactor, FormatCapabilityFactor, and MinCrScaleFactor is the same as that specified in Table A.10 for the Monochrome 10 profile.

— Let access unit n be the n-th access unit in decoding order, with the first access unit being access unit 0 (i.e. the 0-th access unit).

— Let the variable fR be set as follows:

— If the bitstream or sub-layer representation is indicated to conform to the Main tier or is indicated to conform to a level that is lower than level 7.0, fR is set equal to 1 ÷ 300.

— Otherwise, fR is set equal to 1 ÷ 960.

— Let the variable olsIdx be the index of the OLS.

— For each layer with nuh\_layer\_id equal to currLayerId, let the variable layerSizeInSamplesY be derived as follows:

layerSizeInSamplesY = pic\_width\_vps\_in\_luma\_samples \* pic\_height\_vps\_in\_luma\_samples (H‑121)

where pic\_width\_vps\_in\_luma\_samples and pic\_height\_vps\_in\_luma\_samples are found in the vps\_rep\_format\_idx[ LayerIdxInVps[ currLayerId ] ]-th rep\_format( ) syntax structure in the VPS.

When the specified level is not level 8.5, each layer with nuh\_layer\_id equal to currLayerId conforming to a profile at a specified tier and level shall obey the following constraints for each bitstream conformance test as specified in F.13, where “access unit” is used to denote the picture unit in the layer and the CPB is understood to be the BPB:

a) The value of layerSizeInSamplesY shall be less than or equal to MaxLumaPs, where MaxLumaPs is specified in Table A.8 for the tier and level of the layer.

b) The value of pic\_width\_vps\_in\_luma\_samples of the vps\_rep\_format\_idx[ LayerIdxInVps[ currLayerId ] ]-th rep\_format( ) syntax structure in the VPS shall be less than or equal to Sqrt( MaxLumaPs \* 8 ).

c) The value of pic\_height\_vps\_in\_luma\_samples of the vps\_rep\_format\_idx[ LayerIdxInVps[ currLayerId ] ]-th rep\_format( ) syntax structure in the VPS shall be less than or equal to Sqrt( MaxLumaPs \* 8 ).

d) The value of max\_vps\_dec\_pic\_buffering\_minus1[ olsIdx ][ LayerIdxInVps[ currLayerId ] ][ HighestTid ] shall be less than or equal to MaxDpbSize as derived by Formula (A‑2), with PicSizeInSamplesY being replaced with layerSizeInSamplesY, for the tier and level of the layer.

e) For level 5 and higher levels, the value of CtbSizeY for the layer shall be equal to 32 or 64.

f) The value of NumPicTotalCurr for each picture in the layer shall be less than or equal to 8.

g) When decoding each coded picture in the layer, the value of num\_tile\_columns\_minus1 shall be less than MaxTileCols and num\_tile\_rows\_minus1 shall be less than MaxTileRows, where MaxTileCols and MaxTileRows are specified in Table A.8 for the tier and level of the layer.

h) For the VCL HRD parameters of the layer, CpbSize[ i ] shall be less than or equal to CpbVclFactor \* MaxCPB for at least one of the delivery schedules identified by bsp\_sched\_idx[ olsIdx ][ 0 ][ HighestTid ][ combIdx ][ LayerIdxInVps[ currLayerId ] ] for combIdx ranging from 0 to num\_bsp\_schedules\_minus1[ olsIdx ][ 0 ][ HighestTid ], inclusive, where CpbSize[ i ] is specified in F.13.1 and MaxCPB is specified in Table A.8 for the tier and level of the layer in units of CpbVclFactor bits.

i) For the NAL HRD parameters of the layer, CpbSize[ i ] shall be less than or equal to CpbNalFactor \* MaxCPB for at least one of the delivery schedules identified by bsp\_sched\_idx[ olsIdx ][ 0 ][ HighestTid ][ combIdx ][ LayerIdxInVps[ currLayerId ] ] for combIdx ranging from 0 to num\_bsp\_schedules\_minus1[ olsIdx ][ 0 ][ HighestTid ], inclusive, where CpbSize[ i ] is specified in F.13.1 and MaxCPB is specified in Table A.8 for the tier and level of the layer in units of CpbNalFactor bits.

j) For each coded picture, the value of BinCountsInNalUnits shall be less than or equal to ( 32 ÷ 3 ) \* NumBytesInVclNalUnits + ( RawMinCuBits \* PicSizeInMinCbsY ) ÷ 32.

Table A.8 specifies the limits for each level of each tier for levels other than level 8.5.

NOTE Since there are no limits specified by Table A.8 for level 8.5, it is not possible in general for a practical decoder to be assured of being able to decode all bitstreams that conform to this level. The purpose of the definition of level 8.5 is to provide a suitable label for bitstreams that can exceed the limits of all other specified levels. When the bitstream is indicated to conform to level 8.5, a decoder is expected to examine the characteristics of the bitstream during its operation in order to determine whether it is capable of decoding the bitstream.

A tier and level to which a layer in an output operation point associated with an OLS in a bitstream conforms are indicated by the syntax elements general\_tier\_flag and general\_level\_idc if OpTid of the output layer set is equal to vps\_max\_sub\_layer\_minus1, and by the syntax elements sub\_layer\_tier\_flag[ OpTid ] and sub\_layer\_level\_idc[ OpTid ] otherwise, as follows:

— If the specified level is not level 8.5, general\_tier\_flag or sub\_layer\_tier\_flag[ OpTid ] equal to 0 indicates conformance to the Main tier, and general\_tier\_flag or sub\_layer\_tier\_flag[ OpTid ] equal to 1 indicates conformance to the High tier, according to the tier constraints specified in Table A.8, and general\_tier\_flag and sub\_layer\_tier\_flag[ OpTid ] shall be equal to 0 for levels below level 4 (corresponding to the entries in Table A.8 marked with "-"). Otherwise (the specified level is level 8.5), it is a requirement of bitstream conformance that general\_tier\_flag and sub\_layer\_tier\_flag[ OpTid ] shall be equal to 1 and the value 0 for general\_tier\_flag and sub\_layer\_tier\_flag[ OpTid ] is reserved for future use by ITU-T | ISO/IEC, and decoders shall ignore the value of general\_tier\_flag and sub\_layer\_tier\_flag[ OpTid ].

— general\_level\_idc and sub\_layer\_level\_idc[ OpTid ] shall be set equal to a value of 30 times the level number specified in Table A.8.

*Modify subclause G.11.2.2,as follows:*

**G.11.2.2 Profile-specific tier and level limits for the Multiview Main, Multiview Main 10, and multiview format range extensions profiles**

The following is specified for expressing the constraints in this subclause:

— The variable HbrFactor is set equal to 1.

— The variable BrVclFactor is set equal to CpbVclFactor \* HbrFactor.

— The variable BrNalFactor is set equal to CpbNalFactor \* HbrFactor.

— The variable MinCr is set equal to MinCrBase \* MinCrScaleFactor ÷ HbrFactor, where MinCrBase is specified in Table A.9.

When the specified level is not level 8.5, each layer conforming to the Multiview Main, Multiview Main 10 profiles, or the multiview format range extensions profiles at a specified tier and level shall obey the following constraints for each conformance test as specified in F.13, where "access unit" is used to denote the picture unit in the layer, and the CPB is understood to be the BPB:

a) The nominal removal time of access unit n (with n greater than 0) from the CPB, as specified in F.13.2.3, shall satisfy the constraint that AuNominalRemovalTime[ n ] − AuCpbRemovalTime[ n − 1 ] is greater than or equal to Max( layerSizeInSamplesY ÷ MaxLumaSr, fR ), where layerSizeInSamplesY is the value of layerSizeInSamplesY for access unit n − 1 and MaxLumaSr is the value specified in Table A.9 that applies to access unit n − 1 for the tier and level of the layer.

b) The difference between consecutive output times of pictures in different access units, as specified in F.13.3.3, shall satisfy the constraint that DpbOutputInterval[ n ] is greater than or equal to Max( layerSizeInSamplesY ÷ MaxLumaSr, fR ), where layerSizeInSamplesY is the value of layerSizeInSamplesY of access unit n and MaxLumaSr is the value specified in Table A.9 for access unit n for the tier and level of the layer, provided that access unit n is an access unit that has a picture that is output and is not the last of such access units.

c) The removal time of access unit 0 shall satisfy the constraint that the number of coded slice segments in access unit 0 is less than or equal to Min( Max( 1, MaxSliceSegmentsPerPicture \* MaxLumaSr / MaxLumaPs \* ( AuCpbRemovalTime[ 0 ] − AuNominalRemovalTime[ 0 ] ) + MaxSliceSegmentsPerPicture \* layerSizeInSamplesY / MaxLumaPs ), MaxSliceSegmentsPerPicture ), for the value of layerSizeInSamplesY of access unit 0, where MaxSliceSegmentsPerPicture, MaxLumaPs, and MaxLumaSr are the values specified in Table A.8 and Table A.9 for the tier and level of the layer.

d) The difference between consecutive CPB removal times of access units n and n − 1 (with n greater than 0) shall satisfy the constraint that the number of slice segments in access unit n is less than or equal to Min( ( Max( 1, MaxSliceSegmentsPerPicture \* MaxLumaSr / MaxLumaPs \* ( AuCpbRemovalTime[ n ] − AuCpbRemovalTime[ n − 1 ] ) ), MaxSliceSegmentsPerPicture ), where MaxSliceSegmentsPerPicture, MaxLumaPs, and MaxLumaSr are the values specified in Table A.8 and Table A.9 that apply to access unit n for the tier and level of the layer.

e) For the VCL HRD parameters for the layer, BitRate[ i ] shall be less than or equal to BrVclFactor \* MaxBR for at least one of the delivery schedules identified by bsp\_sched\_idx[ olsIdx ][ 0 ][ HighestTid ][ combIdx ][ LayerIdxInVps[ currLayerId ] ] for combIdx ranging from 0 to num\_bsp\_schedules\_minus1[ olsIdx ][ 0 ][ HighestTid ], inclusive, where BitRate[ i ] is specified in F.13.1 and MaxBR is specified in Table A.9 in units of BrVclFactor bits/s for the tier and level of the layer.

f) For the NAL HRD parameters for the layer, BitRate[ i ] shall be less than or equal to BrNalFactor \* MaxBR for at least one of the delivery schedules identified by bsp\_sched\_idx[ olsIdx ][ 0 ][ HighestTid ][ combIdx ][ LayerIdxInVps[ currLayerId ] ] for combIdx ranging from 0 to num\_bsp\_schedules\_minus1[ olsIdx ][ 0 ][ HighestTid ], inclusive, where BitRate[ i ] is specified in F.13.1 and MaxBR is specified in Table A.9 in units of BrNalFactor bits/s for the tier and level of the layer.

g) The sum of the NumBytesInNalUnit variables for access unit 0 shall be less than or equal to FormatCapabilityFactor \* ( Max( layerSizeInSamplesY, fR \* MaxLumaSr ) + MaxLumaSr \* ( AuCpbRemovalTime[ 0 ] − AuNominalRemovalTime[ 0 ] ) ) ÷ MinCr for the value of layerSizeInSamplesY of access unit 0, where MaxLumaSr is specified in Table A.9, and both MaxLumaSr and FormatCapabilityFactor are the values that apply to access unit 0 for the tier and level of the layer.

h) The sum of the NumBytesInNalUnit variables for access unit n (with n greater than 0) shall be less than or equal to FormatCapabilityFactor \* MaxLumaSr \* ( AuCpbRemovalTime[ n ] − AuCpbRemovalTime[ n − 1 ] ) ÷ MinCr, where MaxLumaSr is specified in Table A.9, and both MaxLumaSr and FormatCapabilityFactor are the values that apply to access unit n for the tier and level of the layer.

i) The removal time of access unit 0 shall satisfy the constraint that the number of tiles in coded pictures in access unit 0 is less than or equal to Min( Max( 1, MaxTileCols \* MaxTileRows \* 120 \* ( AuCpbRemovalTime[ 0 ] − AuNominalRemovalTime[ 0 ] ) + MaxTileCols \* MaxTileRows \* PicSizeInSamplesY / MaxLumaPs ), MaxTileCols \* MaxTileRows ), for the value of layerSizeInSamplesY of access unit 0, where MaxTileCols and MaxTileRows are the values specified in Table A.8 that apply to access unit 0 for the tier and level of the layer.

j) The difference between consecutive CPB removal times of access units n and n − 1 (with n greater than 0) shall satisfy the constraint that the number of tiles in coded pictures in access unit n is less than or equal to Min( Max( 1, MaxTileCols \* MaxTileRows \* 120 \* ( AuCpbRemovalTime[ n ] − AuCpbRemovalTime[ n − 1 ] ) ), MaxTileCols \* MaxTileRows ), where MaxTileCols and MaxTileRows are the values specified in Table A.8 that apply to access unit n for the tier and level of the layer.

\_\_\_\_\_\_\_\_\_\_\_\_