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| *Title:* | **Initial text for the specification of profiles, tiers, and levels in 3D-HEVC** | | |
| *Status:* | Input Document | | |
| *Purpose:* | Proposal | | |
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# Abstract

Initial text for the specification of profiles, tiers and levels in 3D-HEVC is provided, which can be further discussed and refined at the meeting.

The second version of this document (v2) has been revised according to the decisions of the joint meeting of JCT-3V and the parent bodies and the technical adjustments discussed in the JCT-3V meeting.

# Introduction

The current 3D-HEVC Draft 9 does not include text defining profiles, tiers and levels. To fill this gap an initial specification is provided in this document, which can be the basis for further discussion. The profile specification is based on the Multiview Main profile and has been modified to cover 3D-HEVC related aspects.

# Proposed specification of profiles, tiers and levels

Differences to the Multiview Main profile are indicated in red. Comments on the changed items are highlighted yellow.

* 1. **Profiles, tiers, and levels**
     1. **Profiles**
        1. **~~Multiview~~ 3D Main profile**

For a layer in an output operation point associated with an OLS in a bitstream, the layer being conforming to the ~~Multiview~~ 3D Main profile, the following applies:

– Let olsIdx be the OLS index of the OLS.

– The sub-bitstream subBitstream is derived as follows:

– If OlsIdxToLsIdx[ olsIdx ] is less than or equal to vps\_num\_layer\_sets\_minus1, subBitstream is derived by invoking the sub-bitstream extraction process as specified in clause F.10.1 with the following inputs: the bitstream, tIdTarget equal to OpTid of the output operation point, and layerIdListTarget containing the nuh\_layer\_id value layerId of the layer and all the reference layers of the layer.

– Otherwise, subBitstream is derived by invoking the sub-bitstream extraction process as specified in clause F.10.3 with tIdTarget equal to OpTid of the output operation point and with layerIdListTarget containing the nuh\_layer\_id value of the layer and all the reference layers of the layer.

– The base layer sub-bitstream baseBitstream is derived as follows:

– If VCL NAL units with nuh\_layer\_id equal to 0 are included in subBitstream, baseBitstream is derived by invoking the sub-bitstream extraction process as specified in clause F.10.1 with the subBitstream, tIdTarget equal to OpTid of the output operation point, and layerIdListTarget containing only one nuh\_layer\_id value that is equal to 0 as inputs.

– Otherwise, baseBitstream is derived by invoking the independent non-base layer rewriting process as specified in clause F.10.2 with subBitstream, tIdTarget equal to OpTid of the output operation point, and layerIdListTarget containing only the smallest nuh\_layer\_id value of the VCL NAL units of subBitstream as inputs.

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 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 a layer with nuh\_layer\_id equal to i and VpsDepthFlag[ i ] equal to 0 in subBitstream shall have chroma\_format\_idc equal to 1 only.
* All active SPSs for a layer with nuh\_layer\_id equal to i and VpsDepthFlag[ i ] equal to 1 in subBitstream shall have chroma\_format\_idc equal to 0 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 0, 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 AuxId[ i ] derived according to any active VPS is greater than to 0 for the layer with nuh\_layer\_id equal to i in subBitstream, iv\_mv\_pred\_flag[ i ], iv\_mv\_scaling\_flag[ i ], log2\_sub\_pb\_size\_minus3[ i ], iv\_res\_pred\_flag[ i ], depth\_refinement\_flag[ i ], view\_synthesis\_pred\_flag[ i ], depth\_based\_blk\_part\_flag[ i ], mpi\_flag[ i ], log2\_mpi\_sub\_pb\_size\_minus3[ i ], dmm\_cpred\_tex\_flag[ i ], intra\_sdc\_dmm\_wfull\_flag[ i ], lim\_qt\_pred\_flag[ i ], and inter\_sdc\_flag[ i ] shall be equal to 0.
* When VpsDepthFlag[ i ] derived according to any active VPS is greater than to 0 for the layer with nuh\_layer\_id equal to i in subBitstream, AuxId[ i ] shall be equal to 0.
* ~~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.~~

[Remark: Above constraint was introduced to always output both layers for the stereo case. Since applications for 3D-HEVC might require output of only one view, even when two views are provided in an OLS this constraint can be removed.]

* 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.~~

[Remark: Above constraint was introduced to restrict vertical components of motion vectors in the stereo case, for 3D-HEVC it might be removed.]

* When ViewOrderIdx[ i ] or VpsDepthFlag[ 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 ] or VpsDepthFlag[ 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.

[Remark: For 3D-HEVC the two constraints above are extended to depth maps.]

* 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 dependent layers and is derived as specified in F.7.4.3.1, shall be less than or equal to 4.

[Remark: We might consider increasing the above number of allowed direct and indirect reference layers for 3D-HEVC.]

* All active SPSs for layers in subBitstream shall have sps\_range\_extension\_flag equal to 0 only and sps\_extension\_6bits equal to 0 only.
* All active PPSs for layers in subBitstream shall have pps\_range\_extension\_flag equal to 0 only and pps\_extension\_6bits equal to 0 only.
* 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.
* 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 clauses 9.3.4.3.3 and 9.3.4.3.4 when parsing coding\_tree\_unit( ) data for any coding tree unit shall be less than or equal to 5 \* RawCtuBits / 3.
* general\_level\_idc and sub\_layer\_level\_idc[ i ] for all values of i in active SPSs for any layer in subBitstream shall not be equal to 255 (which indicates level 8.5).
* The level constraints specified for the ~~Multiview~~ 3D Main profile in clause ~~G.11.2~~I.11.2 shall be fulfilled.
* ~~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.~~
* 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 VpsDepthFlag[ i ] is equal to VpsDepthFlag[ j ], AuxId[ i ] is equal to AuxId[ j ] and i is greater than j.

[Remark: Following constraint would require depth of a view to be signalled after texture, hence T0 T1 T2 D0 D1 D2, would be possible. This requires further consideration.

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* For any active VPS, LayerIdxInVps[ i ] shall be equal LayerIdxInVps[ j ] + 1 for any values of i and j among layerIdListTarget that was used to derive subBitstream such that ViewOrderIdx[ i ] is equal to ViewOrderIdx[ j ], AuxId[ i ] is equal to AuxId[ j ], VpsDepthFlag[ i ] is equal to 1, and VpsDepthFlag[ j ] is equal to 0.

[Remark: Above requirement would require depth of a view to be signalled immediately after texture, hence only T0 D0 T1 D1 T2 D2, would be possible.]

In the remainder of this clause and clause I.11.2.1~~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~~ 3D 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~~ 8 or general\_profile\_compatibility\_flag[ ~~6~~8 ] 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~~ 8 or sub\_layer\_profile\_compatibility\_flag[ OpTid ][ ~~6~~8 ] 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.
  + 1. **Tiers and levels**

The specification in sub-clause G.11.2 and its sub-clauses apply, with the following modifications:

* "Multiview Main profile" is replaced by "3D Main profile"
  + 1. **Decoder capabilities**

When a decoder conforms to any profile specified in Annex ~~G~~I, it shall also have the INBLD capability specified in clause F.11.1.

Clause F.11.2 specifies requirements for a decoder conforming to any profile specified in Annex ~~G~~I.

# Patent rights declaration(s)

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