**3GPP TSG-SA WG4 Meeting #133-eS4-251409r01**

**Online, 18 – 25 July 2025**

**Source: Xiaomi**

**Title: [VOPS] Update on bitstream validation software**

**Agenda item: 9.5**

**Document for: DISCUSSION**

# 1. Introduction

This contribution provides an update on the development of a bitstream validation software.

To this, this document collects the normative statements as defined in TS 26.265 1.2.0 as well as the status of implementation.

The current effort is to implement the constraints for one video operation point which is the 3GPP MV-HEVC Stereo Operation Point and implement the dependent building blocks in terms of representation format, bitstream constraints and decoding capabilities.

After that, more operation points can be developed, if time permits, within the VOPS Work Item timeline.

As reminder, the bitstream validation software is hosted on the 3GPP forge at this location: <https://forge.3gpp.org/rep/sa4/vops/bitstream-validator>

# 2. Progress of normative statements coverage

## 2.1 Overview

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| --- | --- | --- |
| **Category** | **Name** | **Implementation** |
| 3GPP Video Representation Formats | High-Definition | none |
| 3GPP Video Representation Formats | High Dynamic Range | none |
| 3GPP Video Representation Formats | Stereoscopic format | none |
| Common Bitstream Constraints | AVC motion-vector constraints | none |
| Common Bitstream Constraints | AVC rate constraints | none |
| Common Bitstream Constraints | HEVC progressive constraints | done |
| Common Bitstream Constraints | HEVC VUI constraints | none |
| Common Bitstream Constraints | HEVC frame-packing constraints | none |
| Decoding Capabilities | AVC-FullHD-Dec | none |
| Decoding Capabilities | AVC-UHD-Dec | none |
| Decoding Capabilities | AVC-8K-Dec | none |
| Decoding Capabilities | HEVC-HD-Dec | none |
| Decoding Capabilities | HEVC-FullHD-Dec | none |
| Decoding Capabilities | HEVC-8K-Dec | none |
| Decoding Capabilities | MV-HEVC-Dual-layers-UHD420-Dec | work-in-progress |
| Decoding Capabilities | HEVC-Frame-Packed-Stereo-Dec | none |
| Video Operation Points | 3GPP AVC HD Operation Point | none |
| Video Operation Points | 3GPP HEVC HD Operation Point | none |
| Video Operation Points | 3GPP HEVC HDR Operation Point | none |
| Video Operation Points | 3GPP HEVC UHD Operation Point | none |
| Video Operation Points | 3GPP HEVC Stereo Operation Point | none |
| Video Operation Points | 3GPP MV-HEVC Stereo Operation Point | work-in-progress |

## 2.2 3GPP Video Representation Formats

### 2.2.1 High-Definition

|  |  |  |
| --- | --- | --- |
| **Clause** | **Statement** | **Implementation** |
| 4.4.3.2 High-Definition | (Picture aspect ratio)  16:9 should be used as it is the only format defined in ITU-R BT-709-6 [bt709] | none |
| 4.4.3.2 High-Definition | (Spatial Resolution width x height)  1920 × 1080 should be used as it is the only format defined in ITU-R BT-709-6 [bt709]. | none |
| 4.4.3.2 High-Definition | (Scan Type)  The source scan type of the pictures as defined in clause 7.3 of Rec. ITU-T H.273 shall be progressive. | none |
| 4.4.3.2 High-Definition | (Chroma format indicator)  The chroma format indicator shall be 4:2:0. | none |
| 4.4.3.2 High-Definition | (Bit depth)  The values shall be either 8 or 10 bit. | none |
| 4.4.3.2 High-Definition | (Bit depth)  The bit depth shall be the same for all samples. | none |
| 4.4.3.2 High-Definition | (Colour primaries)  Only the value 1, as defined in clause 8.2 of Rec. ITU-T H.273, is permitted. | none |
| 4.4.3.2 High-Definition | (Transfer Characteristics)  Only the value 1, as defined in clause 8.2 of Rec. ITU-T H.273 is permitted. | none |
| 4.4.3.2 High-Definition | (Matrix Coefficients)  Only the value 1, as defined in clause 8.2 of Rec. ITU-T H.273, is permitted. | none |
| 4.4.3.2 High-Definition | (Frame rates)  The permitted values are 60, 60/1.001, 50, 30, 30/1.001, 25, 24, 24/1.001 fps. | none |
| 4.4.3.2 High-Definition | (Frame packing)  No frame packing shall be applied. | none |
| 4.4.3.2 High-Definition | (Projection)  No projection shall be used. | none |
| 4.4.3.2 High-Definition | (Sample aspect ratio)  The pixel aspect ratio shall be 1 (square pixel), i.e. only the value 1 as defined in clause 7.3 of Rec. ITU-T H.273 is permitted. | none |
| 4.4.3.2 High-Definition | (Chroma sample location type)  The location of the chroma samples relative to the luma samples for progressive frames as defined in Rec. ITU-T H.273, clause 8.7, shall be set to 0 (chroma samples are horizontally co-sited with and vertically centered between the first luma sample at the top-left corner and the first two luma samples at the top-left corner, respectively). | none |
| 4.4.3.2 High-Definition | (Range)  The restricted video range shall be used. | none |

### 2.2.2 High Dynamic Range

|  |  |  |
| --- | --- | --- |
| **Clause** | **Statement** | **Implementation** |
| 4.4.3.3 High Dynamic Range | (Picture aspect ratio)  16:9 should be used as it is the only format defined in ITU-R BT-2100-2 [bt2100]. | none |
| 4.4.3.3 High Dynamic Range | (Spatial Resolution width x height)  7680 × 4320, 3840 × 2160, 1920 × 1080 are the only formats supported in ITU-R BT-2100-2 [bt2100] and should therefore be used. | none |
| 4.4.3.3 High Dynamic Range | (Scan Type)  the source scan type of the pictures as defined in clause 7.3 of Rec. ITU-T H.273 is progressive | none |
| 4.4.3.3 High Dynamic Range | (Chroma format indicator)  The chroma format indicator shall be 4:2:0. | none |
| 4.4.3.3 High Dynamic Range | (Bit depth)  The permitted value shall be 10 bit. | none |
| 4.4.3.3 High Dynamic Range | (Colour primaries)  Only the value 9 as defined in clause 8.2 of Rec. ITU-T H.273 is permitted. | none |
| 4.4.3.3 High Dynamic Range | (Transfer Characteristics)  Only the values 14 (for SDR with WCG), 16 (for PQ) and 18 (for HLG) as defined in clause 8.2 of Rec. ITU-T H.273 are permitted. | none |
| 4.4.3.3 High Dynamic Range | (Matrix Coefficients)  Only the value 9 as defined in clause 8.2 of Rec. ITU-T H.273 is permitted. | none |
| 4.4.3.3 High Dynamic Range | (Frame rates)  The permitted values are 120, 120/1.001,100, 60, 60/1.001, 50, 30, 30/1.001, 25, 24, 24/1.001 fps. | none |
| 4.4.3.3 High Dynamic Range | (Frame packing)  No frame packing shall be applied. | none |
| 4.4.3.3 High Dynamic Range | (Projection)  No projection shall be used. | none |
| 4.4.3.3 High Dynamic Range | (Sample aspect ratio)  The pixel aspect ratio is 1 (square pixel), i.e. only the value 1 as defined in clause 7.3 of Rec. ITU-T H.273 is permitted. | none |
| 4.4.3.3 High Dynamic Range | (Chroma sample location type)  the location of chroma samples relative to the luma samples for progressive frames as defined in Rec. ITU-T H.273, clause 8.7 shall be set to 2 (chroma samples are co-sited with the luma samples at the top-left corner). | none |
| 4.4.3.3 High Dynamic Range | (Range)  The restricted video range shall be used. | none |

### 2.2.3 Stereoscopic format

|  |  |  |
| --- | --- | --- |
| **Clause** | **Statement** | **Implementation** |
| 4.4.3.4 Stereoscopic format | (Picture aspect ratio)  Shall be set to 16:9, 1:1. | none |
| 4.4.3.4 Stereoscopic format | (Spatial Resolution width x height)  Should be set to 3840 × 2160, 1920 × 1080, 2048 × 2048, 1024 × 1024. | none |
| 4.4.3.4 Stereoscopic format | (Scan Type)  The source scan type of the pictures as defined in clause 7.3 of Rec. ITU-T H.273 shall be progressive | none |
| 4.4.3.4 Stereoscopic format | (Chroma format indicator)  The chroma format indicator shall be 4:2:0. | none |
| 4.4.3.4 Stereoscopic format | (Bit depth)  The permitted values are 8 or 10 bit. 8 bit is only permitted for SDR. | none |
| 4.4.3.4 Stereoscopic format | (Colour primaries)  (Transfer Characteristics)  (Matrix Coefficients)  Only the following value combinations are permitted: (1, 1, 1), (9, 14, 9), (9, 16, 9), and (9, 18, 9) for SDR HD, SDR UHD, HDR PQ, and HDR HLG, respectively. | none |
| 4.4.3.4 Stereoscopic format | (Frame rates)  The permitted values are 60, 60/1.001, 48, 48/1.001, 50, 30, 30/1.001, 25, 24, 24/1.001 fps. | none |
| 4.4.3.4 Stereoscopic format | (Frame packing)  The permitted values are no frame packing, side-by-side, top-and-bottom. | none |
| 4.4.3.4 Stereoscopic format | (Projection)  No projection shall be used. | none |
| 4.4.3.4 Stereoscopic format | (Sample aspect ratio)  The pixel aspect ratio shall be 1 (square pixel), i.e. only the value 1 as defined in clause 7.3 of Rec. ITU-T H.273 is permitted. | none |
| 4.4.3.4 Stereoscopic format | (Chroma sample location type)  For SDR HD, the location of chroma samples relative to the luma samples for progressive frames as defined in Rec. ITU-T H.273, clause 8.7 shall be set to 0.  For SDR UHD, HDR PQ, and HDR HLG, the location of chroma samples relative to the luma samples for progressive frames as defined in Rec. ITU-T H.273, clause 8.7, shall be set to 2. | none |
| 4.4.3.4 Stereoscopic format | (Range)  The restricted video range shall be used. | none |

## 2.3 Common Bitstream Constraints

### 2.3.1 AVC Bitstreams

|  |  |  |  |
| --- | --- | --- | --- |
| **Clause** | **Constraint name** | **Statement** | **Implementation** |
| 4.5.2 AVC Bitstreams | *motion-vector constraints* | the bitstream does neither include horizontal motion vector component values that exceed the range from −2048 to 2047, inclusive, [...] in units of ¼ luma sample displacement. | none |
| 4.5.2 AVC Bitstreams | *motion-vector constraints* | the bitstream does neither include [...], nor does have vertical motion vector component values that exceed the range from −512 to 511, inclusive, in units of ¼ luma sample displacement. | none |
| 4.5.2 AVC Bitstreams | *rate constraints* | the maximum VCL Bit Rate is constrained to be 120 Mbps with cpbBrVclFactor and cpbBrNalFactor being fixed to be 1250 and 1500, respectively; | none |
| 4.5.2 AVC Bitstreams | *rate constraints* | the bitstream does not contain more than 16 slices per picture. | none |

### 2.3.2 HEVC Bitstreams

|  |  |  |  |
| --- | --- | --- | --- |
| **Clause** | **Constraint name** | **Statement** | **Implementation** |
| 4.5.3 HEVC Bitstreams | *progressive constraints* | (the active Sequence Parameter Set (SPS))  general\_progressive\_source\_flag shall be set to 1 | done |
| 4.5.3 HEVC Bitstreams | *progressive constraints* | (the active Sequence Parameter Set (SPS))  general interlaced\_source\_flag shall  be set to 0, | done |
| 4.5.3 HEVC Bitstreams | *progressive constraints* | (the active Sequence Parameter Set (SPS))  general\_non\_packed\_constraint\_flag shall be set to 1, and | done |
| 4.5.3 HEVC Bitstreams | *progressive constraints* | (the active Sequence Parameter Set (SPS))  general\_frame\_only\_constraint\_flag shall be set to 1. | done |
| 4.5.3 HEVC Bitstreams | *VUI constraints* | Video Parameter Sets (VPS) NAL units as defined in Recommendation ITU-T H.265 / ISO/IEC 23008-2 [h265] may be present, but the Bitstream shall be valid if the Receiver ignores the VPS. | none |
| 4.5.3 HEVC Bitstreams | *VUI constraints* | The Video Usability Information (VUI) is present in the active Sequence Parameter Set, i.e. the vui\_parameters\_present\_flag shall be set to 1. | none |
| 4.5.3 HEVC Bitstreams | *VUI constraints* | (In the VUI)  the aspect ratio information is present, i.e. the aspect\_ratio\_info\_present\_flag value shall be set to 1, | none |
| 4.5.3 HEVC Bitstreams | *VUI constraints* | (In the VUI)  the colour parameter information is present, i.e. video\_signal\_type\_present\_flag value shall be set to 1 and the colour\_description\_present\_flag value shall be set to 1. | none |
| 4.5.3 HEVC Bitstreams | *VUI constraints* | (In the VUI)  only video range signals are used, i.e. the video\_full\_range\_flag shall be set to 0 | none |
| 4.5.3 HEVC Bitstreams | *VUI constraints* | (In the VUI)  no overscan signalling is present, i.e. the overscan\_info\_present\_flag shall be set to 0 | none |
| 4.5.3 HEVC Bitstreams | *VUI constraints* | (In the VUI)  the chroma location shall be signalled, i.e. chroma\_loc\_info\_present\_flag shall be set to 1 | none |
| 4.5.3 HEVC Bitstreams | *VUI constraints* | (In the VUI)  the timing information may be present. If the timing information is present, i.e. the value of vui\_timing\_info\_present\_flag is set to 1, then the values of vui\_num\_units\_in\_tick and vui\_time\_scale shall be set according to the frame rates allowed for each operation point. | none |
| 4.5.3 HEVC Bitstreams | *VUI constraints* | (In the VUI)  The frame rate shall not change between two RAPs. fixed\_frame\_rate\_flag value, if present, shall be set to 1 | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | (the active Sequence Parameter Set (SPS))  general\_progressive\_source\_flag shall be set to 1, | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | (the active Sequence Parameter Set (SPS))  general interlaced\_source\_flag shall be set to 0, | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | (the active Sequence Parameter Set (SPS))  general\_non\_packed\_constraint\_flag | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | (the active Sequence Parameter Set (SPS))  general\_frame\_only\_constraint\_flag shall be set to 1. | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | The frame packing arrangement SEI message shall be present | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | (frame packing arrangement SEI message)  The value of frame\_packing\_arrangement\_type shall be set to either the value of 3 for the side-by-side packing arrangement, or the value of 4 for the top-bottom/over-under packing arrangement. | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | (frame packing arrangement SEI message)  The value of quincunx\_sampling\_flag shall be set to 0 | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | (frame packing arrangement SEI message)  The value of content\_interpretation\_type shall be set to either 1 or 2 | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | (frame packing arrangement SEI message)  The value of spatial\_flipping\_flag shall be set to 0 | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | (frame packing arrangement SEI message)  The value of frame0\_flipped\_flag shall be set to 0 | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | (frame packing arrangement SEI message)  The value of field\_views\_flag shall be set to 0. | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | (frame packing arrangement SEI message)  The value of current\_frame\_is\_frame0\_flag shall be set to 0 | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | (frame packing arrangement SEI message)  The values of frame0\_grid\_position\_x, frame0\_grid\_position\_y, frame1\_grid\_position\_x, and frame1\_grid\_position\_y, shall remain the same throughout the bitstream | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | (frame packing arrangement SEI message)  The value of upsampled\_aspect\_ratio\_flag shall be set to 0, indicating the presence of full resolution frame packed video and the aspect\_ratio\_idc shall be set to 1. | none |
| 4.5.3 HEVC Bitstreams | *frame-packing constraints* | All parameters shall remain the same for the entire bitstream | none |

## 2.4 Decoding Capabilities

### 2.4.1 AVC-FullHD-Dec

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| --- | --- | --- |
| **Clause** | **Statement** | **Implementation** |
| 5.3.1 AVC Decoding Capabilities | the capability to decode AVC/ITU-T H.264 Progressive High Profile Level 4.0 [h264] bitstreams. | none |

### 2.4.2 AVC-UHD-Dec

|  |  |  |
| --- | --- | --- |
| **Clause** | **Statement** | **Implementation** |
| 5.3.1 AVC Decoding Capabilities | the capability to decode AVC/ITU-T H.264 Progressive High Profile Level 5.1 [h264] bitstreams [...] | none |
| 5.3.1 AVC Decoding Capabilities | [...] with *rate constraints* as defined in clause 4.5.2 | none |

### 2.4.3 AVC-8K-Dec

|  |  |  |
| --- | --- | --- |
| **Clause** | **Statement** | **Implementation** |
| 5.3.1 AVC Decoding Capabilities | the capability to decode AVC/ITU-T H.264 Progressive High Profile Level 6.1 [h264] bitstreams [...] | none |
| 5.3.1 AVC Decoding Capabilities | [...] with *motion-vector* constraints and *rate constraints* as defined in clause 4.5.2 | none |

### 2.4.4 HEVC-HD-Dec

|  |  |  |
| --- | --- | --- |
| **Clause** | **Statement** | **Implementation** |
| 5.3.2 HEVC Decoding Capabilities | the capability to decode a bitstream containing a single sub-bitstream conforming to HEVC/ITU-T H.265 Main Profile, Main Tier, Level 3.1 [h265] with *progressive* constraints as defined in clause 4.5.3, | none |
| 5.3.2 HEVC Decoding Capabilities | **Or**  the capability to decode a bitstream containing multiple layers where the base layer sub-bitstream conforms to HEVC/ITU-T H.265 Main Profile, Main Tier, Level 3.1 [h265] with *progressive* constraints as defined in clause 4.5.3. | none |

### 2.4.5 HEVC-FullHD-Dec

|  |  |  |
| --- | --- | --- |
| **Clause** | **Statement** | **Implementation** |
| 5.3.2 HEVC Decoding Capabilities | the capability to decode a bitstream containing a single sub-bitstream conforming to HEVC/ITU-T H.265 Main 10 Profile, Main Tier, Level 4.1 [h265] with *progressive* constraints as defined in clause 4.5.3, | none |
| 5.3.2 HEVC Decoding Capabilities | **Or**  the capability to decode a bitstream containing multiple layers where the base layer sub-bitstream conforms to HEVC/ITU-T H.265 Main 10 Profile, Main Tier, Level 4.1 [h265] with *progressive* constraints as defined in clause 4.5.3. | none |

### 2.4.6 HEVC-8K-Dec

|  |  |  |
| --- | --- | --- |
| **Clause** | **Statement** | **Implementation** |
| 5.3.2 HEVC Decoding Capabilities | the capability to decode bitstreams conforming to HEVC/ITU-T H.265 Main10 Profile, Main Tier, Level 6.1 [h265] bitstreams [...] | none |
| 5.3.2 HEVC Decoding Capabilities | [...] with *progressive* and *VUI* constraints as defined in clause 4.5.3 | none |
| 5.3.2 HEVC Decoding Capabilities | the bitstream does not exceed the maximum luma picture size in samples of 33,554,432, | none |
| 5.3.2 HEVC Decoding Capabilities | the maximum VCL Bit Rate is constrained to be 80 Mbps with CpbVclFactor and CpbNalFactor being fixed to be 1000 and 1100, respectively. | none |

### 2.4.7 MV-HEVC-Dual-layers-UHD420-Dec

|  |  |  |
| --- | --- | --- |
| **Clause** | **Statement** | **Implementation** |
| 5.3.2 HEVC Decoding Capabilities | the capability to decode bitstreams with an HEVC/ITU-T H.265 Main 10 Profile base layer (nuh\_layer\_id=0), [...] | none |
| 5.3.2 HEVC Decoding Capabilities | [...] with *progressive* [...] | done |
| 5.3.2 HEVC Decoding Capabilities | [...] and *VUI* constraints as defined in clause 4.5.3 | none |
| 5.3.2 HEVC Decoding Capabilities | and a single enhancement layer (nuh\_layer\_id!=0) that is tagged either:  - as an HEVC/ITU-T H.265 Multiview Main 10 layer, or  - as an HEVC/ITU-T H.265 Multiview Extended 10 layer [h265]. | none |
| 5.3.2 HEVC Decoding Capabilities | where each layer conforms to Main Tier, Level 5.1 and where UE should be capable of supporting single layer decoding of HEVC/ITU-T H.265 Main 10 Profile bitstreams at Main Tier, Level 5.2. | none |
| 5.3.2 HEVC Decoding Capabilities | [...] and where UE should be capable of supporting single layer decoding of HEVC/ITU-T H.265 Main 10 Profile bitstreams at Main Tier, Level 5.2. | none |

### 2.4.8 HEVC-Frame-Packed-Stereo-Dec

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| --- | --- | --- |
| **Clause** | **Statement** | **Implementation** |
| 5.3.2 HEVC Decoding Capabilities | the capability to decode a bitstream conforming to HEVC/ITU-T H.265 Main 10 Profile, Main Tier, Level 6.0 [h265] bitstreams with *frame-packing* and *VUI* *constraints* as defined in clause 4.5.3 [...] | none |
| 5.3.2 HEVC Decoding Capabilities | [...] with *frame-packing* and *VUI* *constraints* as defined in clause 4.5.3 | none |

## 2.5 Video Operation Points

### 2.5.1 3GPP AVC HD Operation Point

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| **Clause** | **Statement** | **Implementation** |
| 6.2.2 3GPP AVC HD Operation Point | the Bitstream shall conform to AVC/ITU-T H.264 High Progressive Profile, Level 4.0 [h264] bitstreams [...] | none |
| 6.2.2 3GPP AVC HD Operation Point | [...] with *rate* constraints as defined in clause 4.5.2. | none |
| 6.2.2 3GPP AVC HD Operation Point | the Representation Format included in the Bitstream shall conform to the 3GPP-HD Representation format as defined in clause 4.4.3.2. | none |
| 6.2.2 3GPP AVC HD Operation Point | the Bitstream shall be decodable by a decoder with **AVC-FullHD-Dec** decoding capabilities. | none |

### 2.5.2 3GPP HEVC HD Operation Point

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| **Clause** | **Statement** | **Implementation** |
| 6.3.2 3GPP HEVC HD Operation Point | the Bitstream shall conform to HEVC/ITU-T H.265 Main 10 Profile, Main Tier, Level 4.1 [h265] bitstreams [...] | none |
| 6.3.2 3GPP HEVC HD Operation Point | [...] with *progressive* and *VUI* constraints as defined in clause 4.5.3 | none |
| 6.3.2 3GPP HEVC HD Operation Point | the Representation Format included in the Bitstream shall conform to the 3GPP-HD Representation format as defined in clause 4.4.3.2. | none |
| 6.3.2 3GPP HEVC HD Operation Point | the Bitstream shall be decodable by a decoder with **HEVC-FullHD-Dec** decoding capabilities. | none |
| 6.3.2 3GPP HEVC HD Operation Point | The chroma sub-sampling shall be 4:2:0 and the value of chroma\_format\_idc shall be set to 1. | none |
| 6.3.2 3GPP HEVC HD Operation Point | The aspect\_ratio\_idc value shall be set to 1, indicating a square pixel format. | none |
| 6.3.2 3GPP HEVC HD Operation Point | In the VUI, the values of colour\_primaries, transfer\_characteristics and matrix\_coeffs each shall be set to 1. | none |
| 6.3.2 3GPP HEVC HD Operation Point | The value of chroma\_sample\_loc\_type\_top\_field shall be set to 0. | none |
| 6.3.2 3GPP HEVC HD Operation Point | The timing information may be present. | none |
| 6.3.2 3GPP HEVC HD Operation Point | (timing infromation)  If the timing information is present, i.e. the value of vui\_timing\_info\_present\_flag is set to 1, then the values of vui\_num\_units\_in\_tick and vui\_time\_scale shall be set according to the frame rates allowed for each operation point. The timing information present in the video Bitstream should be consistent with the timing information signalled at the system level. | none |
| 6.3.2 3GPP HEVC HD Operation Point | (timing infromation)  The frame rate shall not change between two RAPs. fixed\_pic\_rate\_general\_flag value, if present, shall be set to 1. | none |

### 2.5.3 3GPP HEVC HDR Operation Point

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| **Clause** | **Statement** | **Implementation** |
| 6.3.3 3GPP HEVC HDR Operation Point | the Bitstream shall conform to HEVC/ITU-T H.265 Main 10 Profile, Main Tier, Level 4.1 [h265] bitstreams [...] | none |
| 6.3.3 3GPP HEVC HDR Operation Point | [...] with *progressive* and *VUI* constraints as defined in clause 4.5.3 | none |
| 6.3.3 3GPP HEVC HDR Operation Point | the Representation Format included in the Bitstream shall conform to the 3GPP HDR Representation format as defined in clause 4.4.3.3. | none |
| 6.3.3 3GPP HEVC HDR Operation Point | the Bitstream shall be decodable by a decoder with **HEVC-FullHD-Dec** decoding capabilities as defined in clause 5.3.2. | none |
| 6.3.3 3GPP HEVC HDR Operation Point | The chroma sub-sampling shall be 4:2:0 and the value of chroma\_format\_idc shall be set to 1. | none |
| 6.3.3 3GPP HEVC HDR Operation Point | The aspect\_ratio\_idc value shall be set to 1, indicating a square pixel format. | none |
| 6.3.3 3GPP HEVC HDR Operation Point | In the VUI, the values of colour\_primaries and matrix\_coeffs each shall be set to 9, [...] | none |
| 6.3.3 3GPP HEVC HDR Operation Point | [...] and the value of transfer\_characteristics shall be set to one of the following values: 14 (for SDR with WCG), 16 (for PQ) and 18 (for HLG). | none |
| 6.3.3 3GPP HEVC HDR Operation Point | The value of the chroma\_sample\_loc\_type\_top\_field shall be set to 2. | none |
| 6.3.3 3GPP HEVC HDR Operation Point | The timing information may be present. | none |
| 6.3.3 3GPP HEVC HDR Operation Point | (timing information)  If the timing information is present, i.e. the value of vui\_timing\_info\_present\_flag is set to 1, then the values of vui\_num\_units\_in\_tick and vui\_time\_scale shall be set according to the frame rates allowed for each operation point. The timing information present in the video Bitstream should be consistent with the timing information signalled at the system level. | none |
| 6.3.3 3GPP HEVC HDR Operation Point | (timing information)  The frame rate shall not change between two RAPs. fixed\_pic\_rate\_general\_flag value, if present, shall be set to 1. | none |

### 2.5.4 3GPP HEVC UHD Operation Point

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| **Clause** | **Statement** | **Implementation** |
| 6.3.4 3GPP HEVC UHD | the Bitstream shall conform to HEVC/ITU-T H.265 Main 10 Profile, Main Tier, Level 5.1 [h265] bitstreams [...] | none |
| 6.3.4 3GPP HEVC UHD | [...] with *progressive* and *VUI* constraints as defined in clause 4.5.3. | none |
| 6.3.4 3GPP HEVC UHD | the Representation Format included in the Bitstream shall conform to the 3GPP HDR Representation format as defined in clause 4.4.3.3. | none |
| 6.3.4 3GPP HEVC UHD | the Bitstream shall be decodable by a decoder with **HEVC-UHD-Dec** decoding capabilities as defined in clause 5.3.2. | none |
| 6.3.4 3GPP HEVC UHD | The chroma sub-sampling shall be 4:2:0 and the value of chroma\_format\_idc shall be set to 1. | none |
| 6.3.4 3GPP HEVC UHD | The aspect\_ratio\_idc value shall be set to 1, indicating a square pixel format. | none |
| 6.3.4 3GPP HEVC UHD | In the VUI, the values of colour\_primaries and matrix\_coeffs each shall be set to 9, [...] | none |
| 6.3.4 3GPP HEVC UHD | [...] and the value of transfer\_characteristics shall be set to one of the following values: 14 (for SDR with WCG), 16 (for PQ) and 18 (for HLG). | none |
| 6.3.4 3GPP HEVC UHD | The value of the chroma\_sample\_loc\_type\_top\_field shall be set to 2. | none |
| 6.3.4 3GPP HEVC UHD | The timing information may be present. | none |
| 6.3.4 3GPP HEVC UHD | (timing information)  If the timing information is present, i.e. the value of vui\_timing\_info\_present\_flag is set to 1, then the values of vui\_num\_units\_in\_tick and vui\_time\_scale shall be set according to the frame rates allowed for each operation point. The timing information present in the video Bitstream should be consistent with the timing information signalled at the system level. | none |
| 6.3.4 3GPP HEVC UHD | (timing information)  The frame rate shall not change between two RAPs. fixed\_pic\_rate\_general\_flag value, if present, shall be set to 1. | none |

### 2.5.5 3GPP HEVC Stereo Operation Point

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| **Clause** | **Statement** | **Implementation** |
| 6.3.5 3GPP HEVC Stereo | the Bitstream shall conform to HEVC/ITU-T H.265 Main 10 Profile, Main Tier, Level 5.2 [h265] bitstreams [...] | none |
| 6.3.5 3GPP HEVC Stereo | [...] with *frame-packing constraints* as defined in clause 4.5.3. | none |
| 6.3.5 3GPP HEVC Stereo | the Representation Format included in the Bitstream shall conform to the 3GPP Stereoscopic format as defined in clause 4.4.3.4. | none |
| 6.3.5 3GPP HEVC Stereo | the Bitstream shall be decodable by a decoder with **HEVC-Stereo-Dec** decoding capabilities as defined in clause 5.3.2. | none |
| 6.3.5 3GPP HEVC Stereo | The chroma sub-sampling shall be 4:2:0 and the value of chroma\_format\_idc shall be set to 1. | none |
| 6.3.5 3GPP HEVC Stereo | The aspect\_ratio\_idc value shall be set to 1, indicating a square pixel format. | none |
| 6.3.5 3GPP HEVC Stereo | In the VUI, either  - the values of colour\_primaries, transfer\_characteristics and matrix\_coeffs each shall be set to 1.  - The value of chroma\_sample\_loc\_type\_top\_field shall be set to 0.  - or  - the values of colour\_primaries and matrix\_coeffs each shall be set to 9, and the value of transfer\_characteristics shall be set to one of the following values: 14 (for SDR with WCG), 16 (for PQ) and 18 (for HLG).  - The value of the chroma\_sample\_loc\_type\_top\_field shall be set to 2. | none |
| 6.3.5 3GPP HEVC Stereo | The timing information may be present. | none |
| 6.3.5 3GPP HEVC Stereo | (timing information)  If the timing information is present, i.e. the value of vui\_timing\_info\_present\_flag is set to 1, then the values of vui\_num\_units\_in\_tick and vui\_time\_scale shall be set according to the frame rates allowed for each operation point. The timing information present in the video Bitstream should be consistent with the timing information signalled at the system level. | none |
| 6.3.5 3GPP HEVC Stereo | (timing information)  The frame rate shall not change between two RAPs. fixed\_pic\_rate\_general\_flag value, if present, shall be set to 1. | none |

### 2.5.6 3GPP MV-HEVC Stereo Operation Point

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| **Clause** | **Statement** | **Implementation** |
| 6.3.6 3GPP MV-HEVC Stereo | the Representation Format included in the Bitstream shall conform to the 3GPP Stereoscopic format as defined in clause 4.4.3.4. | none |
| 6.3.6 3GPP MV-HEVC Stereo | The bitstream shall conform to the constraints specified in the **MV-HEVC-UHD** decoding capabilities as defined in clause 5.3.2. | work-in-progress |
| 6.3.6 3GPP MV-HEVC Stereo | the Bitstream shall be decodable by a decoder with **HEVC-UHD-Dec** decoding capabilities as defined in clause 5.3.2. | none |
| 6.3.6 3GPP MV-HEVC Stereo | the Bitstream shall be decodable by a decoder with **MV-HEVC-UHD** decoding capabilities as defined in clause 5.3.2. | none |
| 6.3.6 3GPP MV-HEVC Stereo | The chroma sub-sampling shall be 4:2:0 and the value of chroma\_format\_idc shall be set to 1. | done |
| 6.3.6 3GPP MV-HEVC Stereo | AuxId[ lId ] shall be equal to 0 in the VPS extension for the sub-bitstream with nuh\_layer\_id != 0. | none |
| 6.3.6 3GPP MV-HEVC Stereo | The aspect\_ratio\_idc value shall be set to 1, indicating a square pixel format. | done |
| 6.3.6 3GPP MV-HEVC Stereo | In the VUI, either  - the **values** of colour\_primaries, transfer\_characteristics and matrix\_coeffs each shall be set to 1.  - The value of chroma\_sample\_loc\_type\_top\_field shall be set to 0.  - or  - the values of colour\_primaries and matrix\_coeffs each shall be set to 9, and the value of transfer\_characteristics shall be set to one of the following values: 14 (for SDR with WCG), 16 (for PQ) and 18 (for HLG).  - The value of the chroma\_sample\_loc\_type\_top\_field shall be set to 2. | none |
| 6.3.6 3GPP MV-HEVC Stereo | The timing information may be present. | none |
| 6.3.6 3GPP MV-HEVC Stereo | (timing information)  If the timing information is present, i.e. the value of vui\_timing\_info\_present\_flag is set to 1, then the values of vui\_num\_units\_in\_tick and vui\_time\_scale shall be set according to the frame rates allowed for each operation point. The timing information present in the video Bitstream should be consistent with the timing information signalled at the system level. | none |
| 6.3.6 3GPP MV-HEVC Stereo | (timing information)  The frame rate shall not change between two RAPs. fixed\_pic\_rate\_general\_flag value, if present, shall be set to 1. | none |

# Conclusion

We propose to include this progress status in the next revision of the VOPS Permanent Document on the conformance.