**3GPP TSG SA WG4#117e S4-220213**

**E-meeting, 14th – 23rd February 2022**

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **26**.**116** | **CR** | **0018** | **rev** | **-** | **Current version:** | **16.5.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network | **X** |

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| ***Title:*** | **8K HEVC Operation Point and CMAF Alignment** | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Qualcomm Incorporated, Tencent | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | 8K\_TV\_5G | | | | |  | ***Date:*** | | | 22/02/2022 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | |  |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) Rel-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | See work item description | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | - Define new 8K TV operation point(s) for TV Video profiles with conforming bitstream requirement based on H.265/HEVC Main-10 Profile Main Tier Profile with the following constraints:  - support 16:9 aspect ratio and luminance resolution up to 7680x4320 pixels, including 5120 x 2880 pixels in addition to the luminance resolutions already included in TS 26.116 for UHD services,  - enable an 8K operation point that is within the profile level constraints of H.265/HEVC Main-10 Profile, Main Tier and Level 6.1 decoding capabilities,  - support conformance points with 10-bit BT.2020 non-constant luminance colorimetry with SDR, HDR PQ and HDR HLG.  - Define the relevant ISO BMFF encapsulation, CMAF media profile and DASH signaling for the new 8K TV operation point.  - Alignment with CMAF encapsulation and media profiles. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Work Item objectives not complete  Common content generation for 3GPP and CMAF significantly more complex. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 1, 2, 4.2, 4.3, 4.4.1.4, 4.5.1.3, 4.5.1.4, 4.5.1.5, 4.5.2.2, 4.5.9 (new), 5.1.2, 5.1.3, 5.11 (new), A.1 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  |  | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  |  | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  |  | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

**===== CHANGE =====**

# 1 Scope

The present document specifies requirements and guidelines on video source formats (frame rate, resolution, aspect ratio, colorimetry, bit depth…) and encoding parameters (codec format, random access point period, SEI messages…) for different types of TV services, including linear TV, catch-up TV or on-demand services. A limited set of Operation Points (e.g. SDTV, HDTV, UHD, 8K UHD, …) are defined to provide confidence to content providers/broadcasters on the quality of experience offered by 3GPP services when used for TV-like distribution. Operation Points define format and encoding restrictions but may also be viewed as compatibility points for UEs.

In particular, the Operation Points defined in the present document may serve as the primary tested configurations for TV centric video distribution. The Operation Points are defined based on the analysis and findings in the technical report TR 26.949 [2].

In addition, in the context of DASH operations, not only the main distribution formats are defined, but also a subset of spatial and temporal resolutions. In order to minimize testing for seamless switching experience, suitable lower resolutions of distribution formats are defined. Furthermore, to compensate congestion situations, a minimum service quality is defined in order to provide service continuity.

The specification is aligned with the Common Media Application Format (CMAF) as defined in ISO/IEC 23000-19 [13] to a large extent. Differences and further restrictions compared to CMAF baseline formats as well as media profiles are highlighted.

**===== CHANGE =====**

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TR 26.949: "Video formats for 3GPP services".

[3] Recommendation ITU-R BT.709-6 (06/2015): "Parameter values for the HDTV standards for production and international programme exchange".

[4] Recommendation ITU-R BT.2020-2 (10/2015): "Parameter values for ultra-high definition television systems for production and international programme exchange".

[5] Recommendation ITU-T H.264 (04/2017): "Advanced video coding for generic audiovisual services" | ISO/IEC 14496-10:2014: "Information technology – Coding of audio-visual objects – Part 10: Advanced Video Coding".

[6] Recommendation ITU-T H.265 (11/2019): "High efficiency video coding" | ISO/IEC 23008-2:2020: "High Efficiency Coding and Media Delivery in Heterogeneous Environments – Part 2: High Efficiency Video Coding".

[7] 3GPP TS 26.244: "Transparent end-to-end packet switched streaming service (PSS); 3GPP file format (3GP)".

[8] 3GPP TS 26.247: "Transparent end-to-end Packet-switched Streaming Service (PSS); Progressive Download and Dynamic Adaptive Streaming over HTTP (3GP-DASH)".

[9] ISO/IEC 14496-15: 2019: "Information technology - Coding of audio-visual objects - Part 15: Carriage of network abstraction layer (NAL) unit structured video in ISO base media file format".

[10] ISO/IEC 23091-2:2019, "Information technology — Coding-independent code points — Part 2: Video".

[11] Recommendation ITU‑R BT.2100-2 (07/2018): "Image parameter values for high dynamic range television for use in production and international programme exchange".

[12] 3GPP TS 26.511: "5G Media Streaming (5GMS); Profiles, codecs and formats".

[13] ISO/IEC 23000-19:2021: " Information technology — Multimedia application format (MPEG-A) — Part 19: Common media application format (CMAF) for segmented media".

**===== CHANGE =====**

## 4.2 General requirements on video profile Operation Points

The following requirements apply to video profile Operation Points:

- 16:9 picture aspect ratio shall be used. 3GPP UEs with display aspect ratio different from 16:9 and supporting the TV services over 3GPP are, by default, assumed to display the video in letter-box or pillarbox modes, depending on the screen size and orientation.

- Y'CbCr (non-constant luminance) as the Chroma Format should be used.

- 4:2:0 chroma sub-sampling shall be used.

- The following spatial resolutions should be used for:

- Operation Points (for video intended to be viewed in full-screen mode): 7680 × 4320, 5120 × 2880, 3840 × 2160, 1920 × 1080 and 1280 × 720.

- Distribution formats: 7680 × 4320, 5120 × 2880, 3840 × 2160, 3200 × 1800, 2560 × 1440, 1920 × 1080, 1600 × 900, 1280 × 720, 960 × 540, 854 × 480, 640 × 360, 426 × 240.

NOTE 1: Distribution formats within an Operation Point do not exceed the native resolution of the Operation Point, but they may be subsampled in order to optimize distribution or adapt to the viewing conditions.

- The following frame rates should be used depending on the Operation Point: 24; 25; 30; 50 and 60Hz. The following fractional frame rates may be used: 24/1.001, 30/1.001, 60/1.001 (Hz). Frame rates are not associated to any particular spatial resolution.

- The following colour space formats may be used depending on the Operation Point: ITU-R BT.709 [3] and ITU-R BT.2020 [4]. If no signal is provided for the colour space, BT.709 [3] should be assumed as default colour space. Receiving devices should support BT.2020 [4] signaling and provide an appropriate mapping of the signal to the supported colour space of the device. Colour spaces are not associated to any particular spatial resolution.

- The following transfer characteristics may be used depending on the Operation Point: ITU-R BT.709 [3] and ITU-R BT.2020 [4] non-constant luminance transfer characteristics or the electro-optical transfer function as defined in Recommendation ITU‑R BT.2100 [11], either for the Perceptual Quantization (PQ) system, or for the Hybrid Log Gamma (HLG) system.

NOTE 2: Although ITU-R BT.2020 is originally only recommended for 2160p/4320p resolution, this 3GPP specification recommends that BT.2020 be supported irrespective of the resolution to keep the colour space consistent across resolutions.

- The Random Access Point period shall be less than or equal to 5 seconds, should be less than or equal to 2 seconds and may be less than or equal to 0.5 second for H.264/AVC [5] and 1 second for H.265/HEVC [6] for specific service requirements such as fast channel change or fast access to the bitstream.

- Bit depth: Either 8 or 10 bits shall be used depending on the Operation Point.

Table 4.2-1 provides an overview of the Operation Points defined in the present document.

Table 4.2-1: TV over 3GPP services Video Profile Operation Points

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operation Point name | Resolution format | Picture aspect ratio | Scan | Max. frame rate | | Chroma format | Chroma sub-sampling | Bit depth | Colour space format | Transfer  Characteristics |
| H.264/AVC 720p HD | 1280 × 720 | 16:9 | Progressive | 30 | Y'CbCr | | 4:2:0 | 8 | BT.709 [3] | BT.709 [3] |
| H.265/HEVC 720p HD | 1280 × 720 | 16:9 | Progressive | 30 | Y'CbCr | | 4:2:0 | 8 | BT.709 [3] | BT.709 [3] |
| H.264/AVC Full HD | 1920 × 1080 | 16:9 | Progressive | 60 | Y'CbCr | | 4:2:0 | 8 | BT.709 [3] | BT.709 [3] |
| H.265/HEVC Full HD | 1920 × 1080 | 16:9 | Progressive | 60 | Y'CbCr | | 4:2:0 | 8; 10 | BT.709 [3]; BT.2020 [4] | BT.709 [3]; BT.2020 [4] |
| H.265/HEVC UHD | 3840 × 2160 | 16:9 | Progressive | 60 | Y'CbCr | | 4:2:0 | 10 | BT.2020 [4] | BT.2020 [4] |
| H.265/HEVC Full HD HDR | 1920 x 1080 | 16:9 | Progressive | 60 | Y'CbCr | | 4:2:0 | 10 | BT.2020 [4] | BT.2100 [11] PQ |
| H.265/HEVC UHD HDR | 3840 x 2160 | 16:9 | Progressive | 60 | Y'CbCr | | 4:2:0 | 10 | BT.2020 [4] | BT.2100 [11] PQ |
| H.265/HEVC Full HD HDR HLG | 1920 x 1080 | 16:9 | Progressive | 60 | Y'CbCr | | 4:2:0 | 10 | BT.2020 [4] | BT.2100 [11] HLG |
| H.265/HEVC UHD HDR HLG | 3840 x 2160 | 16:9 | Progressive | 60 | Y'CbCr | | 4:2:0 | 10 | BT.2020 [4] | BT.2100 [11] HLG |
| H.265/HEVC 8K UHD | 7680 x 4320 | 16:9 | Progressive | 60 | Y'CbCr | | 4:2:0 | 10 | BT.2020 [4] | BT.2020 [4]  BT.2100 [11] PQ  BT.2100 [11] HLG |

Operation Points are defined including the video codec format.

**===== CHANGE =====**

## 4.3 General Video codec requirements

The following video codecs and associated Profiles and Levels should be used:

- H.264/AVC Progressive High Profile Level 3.1 [5] for 720p HD services

- H.264/AVC Progressive High Profile Level 4.2 [5] for Full HD services

- H.265/HEVC Main Profile Main Tier Level 3.1 [6] for 720p HD services

- H.265/HEVC Main-10 Profile Main Tier Level 4.1 [6] for Full HD services

- H.265/HEVC Main-10 Profile Main Tier Profile Level 5.1 [6] for UHD services

- H.265/HEVC Main-10 Profile Main Tier Profile Level 4.1 [6] for Full HD HDR services

- H.265/HEVC Main-10 Profile Main Tier Profile Level 5.1 [6] for UHD HDR services

- H.265/HEVC Main-10 Profile Main Tier Profile Level 6.1 [6] for 8K UHD services

The Table 4.3-1 presents the mapping of the operation points with the codec type, profile and level.

Table 4.3-1: Video codec parameters

|  |  |  |
| --- | --- | --- |
| Operation Point name | Resolution Format | Codec type, profile and level |
| H.264/AVC 720p HD | 1280 × 720 | AVC/H.264 Progressive High Profile Level 3.1 |
| HEVC/H.265 720p HD | 1280 × 720 | HEVC/H.265 Main Profile Main Tier Level 3.1 |
| H.264/AVC Full HD | 1920 × 1080 | AVC/H.264 Progressive High Profile Level 4.2 |
| HEVC/H.265 Full HD | 1920 × 1080 | HEVC/H.265 Main-10 Profile Main Tier Level 4.1 |
| HEVC/H.265 UHD | 3840 × 2160 | HEVC/H.265 Main-10 Profile Main Tier Level 5.1 |
| HEVC/H.265 Full HD HDR | 1920 x 1080 | HEVC/H.265 Main-10 Profile Main Tier Level 4.1 |
| HEVC/H.265 UHD HDR | 3840 x 2160 | HEVC/H.265 Main-10 Profile Main Tier Level 5.1 |
| HEVC/H.265 Full HD HDR HLG | 1920 x 1080 | HEVC/H.265 Main-10 Profile Main Tier Level 4.1 |
| HEVC/H.265 UHD HDR HLG | 3840 x 2160 | HEVC/H.265 Main-10 Profile Main Tier Level 5.1 |
| HEVC/H.265 8K UHD | 7680 x 4320 | HEVC/H.265 Main-10 Profile Main Tier Level 6.1 |

**===== CHANGE =====**

#### 4.4.1.4 Video usability information

The aspect ratio information shall be present, i.e.

- The aspect\_ratio\_present\_flag value shall be set to 1.

- The aspect\_ratio\_idc value shall be set to 1 indicating a square pixel format.

NOTE: CMAF [13] permits other pixel format than square pixels, but this is not the case in this specification.

The colour parameter information shall be present, i.e.

- video\_signal\_type\_present\_flag value and colour\_description\_present\_flag value shall be set to 1.

- The values of colour\_primaries, transfer\_characteristics and matrix\_coefficients are defined in clause 4.4.2.4 for H.264/AVC 720p HD and in clause 4.4.3.4 for H.264/AVC Full HD Operation Points.

The timing information may be present.

- If the timing information is present, i.e. the value of timing\_info\_present\_flag is set to 1, then the values of num\_units\_in\_tick and time\_scale shall be set according to the frame rates allowed in clause 4.4.2.5 for H.264/AVC 720p HD and in clause 4.4.3.5 for H.264/AVC Full HD Operation Points. The timing information present in the video Bitstream should be consistent with the timing information signalled at the system level.

NOTE: In 3GPP PSS and MBMS User services, the Receiver observes the timing at the system level, and ignores the timing information in the video Bitstream.

- The frame rate shall not change between two RAPs. fixed\_frame\_rate\_flag value shall be set to 1.

There are no requirements on output timing conformance for H.264/AVC decoding (Annex C of [5]). The Hypothetical Reference Decoder (HRD) parameters, if present, should be ignored by the Receiver.

**===== CHANGE =====**

#### 4.5.1.3 Video parameter set

H.265/HEVC Receivers should ignore the content of all Video Parameter Sets (VPS) NAL units as defined in Recommendation ITU-T H.265 / ISO/IEC 23008-2 [6].

NOTE 1: The content of VPS may be used in future Operation Points.

NOTE 2: CMAF requires that each HEVC video media sample in the CMAF track references the VPS in the CMAF header sample entry and that a VPS does not change within CMAF tracks or between CMAF tracks in a CMAF switching set.

**===== CHANGE =====**

#### 4.5.1.4 Sequence parameter set

The following restrictions apply to the active Sequence Parameter Set (SPS):

- The Video Usability Information (VUI) shall be present in the active Sequence Parameter Set. The vui\_parameters\_present\_flag shall be set to 1 and the constraints defined in clause 4.5.1.5 for the VUI shall apply.

- The chroma sub-sampling shall be 4:2:0, chroma\_format\_idc value shall be set to 1.

NOTE: CMAF implicitly requires this as this is a requirements from the HEVC media profiles.

- The source video format shall be progressive, i.e.

- The general\_progressive\_source\_flag shall be set to 1,

- The general\_interlaced\_source\_flag shall be set to 0,

- The general\_frame\_only\_constraint\_flag shall be set to 1.

- Only 2D contents are required to be supported, i.e.

- The general\_non\_packed\_constraint\_flag shall be set to 1.

NOTE: CMAF requires in H.4.2.6.1 SPS fields that the general\_non\_packed\_constraint\_flag is set to 0. However, this bug will be fixed in the next edition.

Receivers conforming to any of the H.265/HEVC Operation Points shall only support Bitstreams with the restrictions on the SPS defined above.

**===== CHANGE =====**

#### 4.5.1.5 Video usability information

The aspect ratio information shall be present, i.e.

- The aspect\_ratio\_info\_present\_flag value shall be set to 1.

- The aspect\_ratio\_idc value shall be set to 1 indicating a square pixel format.

The colour parameter information shall be present, i.e.

- video\_signal\_type\_present\_flag value and colour\_description\_present\_flag value shall be set to 1.

NOTE: CMAF does not require setting the above flags.

- The values of colour\_primaries, transfer\_characteristics and matrix\_coeffs are defined individually for each operation point.

Only video range signals shall be used, i.e.

- The video\_full\_range\_flag shall be set to 0.

No overscan signnalling shall be present, i.e.

* the overscan\_info\_present\_flag shall be set to 0

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. The timing information present in the video Bitstream should be consistent with the timing information signalled at the system level.

- The frame rate shall not change between two RAPs. fixed\_frame\_rate\_flag value, if present, shall be set to 1.

NOTE 1: In 3GPP PSS and MBMS User services, the Receiver observes the timing at the system level, and ignores the timing information in the video Bitstream.

NOTE 2: CMAF does recommend to not change the frame rate within an entire CMAF track.

There are no requirements on output timing conformance for H.265/HEVC decoding (Annex C of [6]). The Hypothetical Reference Decoder (HRD) parameters, if present, should be ignored by the Receiver.

**===== CHANGE =====**

#### 4.5.2.2 Profile, tier and level

A Bitstream conforming to the H.265/HEVC 720p HD Operation Point shall comply with the following restrictions:

- The general\_profile\_idc shall be set to 1 indicating the Main profile.

- The general\_tier\_flag shall be set to 0 indicating the Main tier.

- The value of level\_idc shall not be greater than 93 (corresponding to the Level 3.1) and should indicate the lowest level to which the Bitstream conforms.

NOTE: CMAF explicitly requires that the above parameters do not change throughout an HEVC elementary stream. The above statement includes this requirement implicitly.

**===== CHANGE =====**

### 5.1.2 File Format Signalling

Representations used in the context of the specification shall conform to the 3GP File Format [7] and the 3GP-DASH Segment format [8] with the following further requirements:

- The '3gtv' ISO brand shall be set as a compatible\_brand in the File Type Box ('ftyp').

- The value of the duration field in the Movie Header Box ('mvhd') shall be set to a value of '0'

- The Track Header Box ('tkhd') shall obey the following constraints:

- The value of the duration field shall be set to '0'.

- The width and height fields for a visual track shall specify the track's visual presentation size as fixed-point 16.16 values expressed in on a uniformly sampled grid (commonly called square pixels)

- The Media Header Box ('mdhd') shall obey the following constraints:

- The value of the duration field shall be set to '0'.

- The Video Media Header ('vmhd') shall obey the following constraints:

- The value of the version field shall be set to '0'.

- The value of the graphicsmode field shall be set to '0'.

- The value of the opcolor field shall be set to {'0', '0', '0'}.

- The Sample Description Box ('stsd') shall obey the following constraints:

- A visual sample entry shall be used.

- The box shall include a NAL Structured Video Parameter Set.

- the maximum width and height values shall correspond to the maximum cropped horizontal and vertical sample counts indicated in any Sequence Parameter Set in the track.

- It shall contain a Decoder Configuration Record which signals the Profile, Level, and other parameters in the video track.

- The entry\_count field of the Sample-to-Chunk Box ('stsc') shall be set to '0'.

- Both the sample\_size and sample\_count fields of the Sample Size Box ('stsz') box shall be set to zero ('0'). The sample\_count field of the Sample Size Box ('stz2') box shall be set to zero ('0'). The actual sample size information can be found in the Track Fragment Run Box ('trun') for the track.

Note: This is because the Movie Box ('moov') contains no media samples.

- The entry\_count field of the Chunk Offset Box ('stco') shall be set to '0'.

- Movie Fragment Header Boxes ('mfhd') shall contain sequence\_number values that are sequentially numbered starting with the number 1 and incrementing by +1, sequenced by movie fragment storage and presentation order.

- Any Segment Index Box ('sidx'), if present, shall obey the additional constraints:

- the timescale field shall have the same value as the timescale field in the Media Header Box ('mdhd') within the same track; and

- the reference\_ID field shall be set to the track\_ID of the ISO Media track as defined in the Track Header Box ('tkhd').

- For AVCSampleEntry ('avc3') and HEVCSampleEntry ('hev1') NAL Structured Video tracks, the 'first\_sample\_flags' shall signal the picture type of the first sample in each movie fragment as specified below.

- sample\_is\_non\_sync\_sample=0: If the first sample is a sync sample.

- sample\_is\_non\_sync\_sample=1: If the first sample is not a sync sample.

- sample\_depends\_on=2: If the first sample is an I frame.

- The Colour Information Box ('colr') should be present. If present, it shall signal the colour\_primaries, transfer\_characteristics and matrix\_coeffs applicable to all the bitstreams associated with this sample entry.

- The sample timing shall obey the frame rate requirements for each Operation Point.

In addition, to conform to a video CMAF track according to ISO/IEC 23000-19 [13], at least the following applies:

- The field matrix needs to be set to their default values as defined in ISO/IEC 14496-12, except to indicate video orientation

- The Sync Sample Box ('stss') needs to have an entry\_count of zero if present

- If Segment Index Boxes ('sidx') exists

- the timescale field needs to have the same value as the timescale field in the Media Header Box ('mdhd') within the same track; and

- the reference\_ID field needs to be set to the track\_ID of the ISO Media track as defined in the Track Header Box ('tkhd').

Beyond the CMAF track constraints, the 3GPP profile requires the following

- The value of the duration field in the Movie Header Box ('mvhd') is set to a value of '0'.

- The value of the duration field in the Media Header Box ('mdhd') is set to '0'.

- A NAL Structured Video Parameter Set needs to be present in the Sample Description Box ('stsd').

- Movie Fragment Header Boxes ('mfhd') need to contain sequence\_number values that are sequentially numbered starting with the number 1 and incrementing by +1, sequenced by movie fragment storage and presentation order.

- If Segment Index Boxes ('sidx') exist, each subsegment referenced in the SegmentIndexBox needs to be a single CMAF fragment contained in the CMAF track file.

**===== CHANGE =====**

### 4.5.9 H.265/HEVC 8K UHD Operation Point

#### 4.5.9.1 Introduction

An 8K UHD H.265/HEVC Operation Point is introduced that includes three options for the transfer characterics: SDR, HDR PQ and HDR HLG. It is considered that receivers that support 10-bit decoding are all capable of handling any of the three transfer characteristics.

The general requirements and recommendations for Bitstreams and Receivers for H.265/HEVC Operation Points in clause 4.5.1 as well as the additional restrictions documented in this clause 4.5.9 shall apply for the **H.265/HEVC 8K** **UHD** Operation Point.

#### 4.5.9.2 Profile, tier and level

A Bitstream conforming to the H.265/HEVC 8K UHD Operation Point shall comply with the following restrictions:

- The general\_profile\_idc shall be set to 2 indicating the Main-10 profile.

- The general\_tier\_flag shall be set to 0 indicating the Main tier.

- The value of level\_idc shall not be greater than 183 (corresponding to the Level 6.1) and should indicate the lowest level to which the Bitstream conforms.

#### 4.5.9.3 Bit depth

A Bitstream conforming to the H.265/HEVC 8K UHD Operation Point shall be encoded with 10 bits precision, i.e. the fields shall be set as follows

- bit\_depth\_luma\_minus8 = 2

- bit\_depth\_chroma\_minus8 = bit\_depth\_luma\_minus8

Receivers conforming to the H.265/HEVC 8K UHD Operation Point shall support 10 bit precision.

#### 4.5.9.4 Spatial resolution

The spatial resolution of the distribution format shall be one of the following:

- 7680 × 4320,

- 5120 × 2880,

- 3840 × 2160,

- 3200 × 1800,

- 2560 × 1440,

- 1920 × 1080,

- 1600 × 900,

- 1280 × 720,

- 960 × 540,

- 854 × 480.

#### 4.5.9.5 Colour information and HDR transfer characteristics

A Bitstream conforming to the H.265/HEVC 8K UHD Operation Point shall comply with the following restrictions in the VUI:

- colour\_primaries shall be set to the value 9,

- transfer\_characteristics shall be set to one of the following values

- 14 for SDR,

- 16 for HDR PQ,

- 18 for HDR HLG,

- matrix\_coeffs shall be set to the value 9,

- the chroma\_loc\_info\_present\_flag shall be equal to 1, and if set the chroma\_sample\_loc\_type\_top\_field and chroma\_sample\_loc\_type\_bottom\_field shall both be equal to 2.

For transfer\_characteristics set to 16, it implies that Recommendation BT.2020 [4] colorimetry in non-constant luminance and Perceptual Quantization (PQ) electro-optical transfer function (EOTF) as defined in Recommendation ITU-R BT.2100 [11] are in use.

For transfer\_characteristics set to 18, it implies that Recommendation BT.2020 [4] colorimetry in non-constant luminance and Hybrid Log Gamma (HLG) opto-electronic transfer function (OETF) as defined in Recommendation ITU-R BT.2100 [11] are in use.

#### 4.5.9.6 Frame rates

A Bitstream conforming to the H.265/HEVC 8K UHD Operation Point shall have one of the following frame rates: 24; 25; 30; 50; 60; 24/1.001; 30/1.001; 60/1.001 Hz.

The frame rate may be indicated in the VUI by setting vui\_time\_scale and vui\_num\_units\_in\_tick.

#### 4.5.9.7 SEI messages for metadata signalling

If HDR PQ is in use, then the same requirements and recommendations on SEI messages as defined in clause 4.5.6.7 apply.

#### 4.5.9.8 Receiver compatibility

Receivers conforming to the **H.265/HEVC 8K UHD** Operation Point shall support decoding and processing

* H.265/HEVC 720p HD,
* H.265/HEVC Full HD,
* H.265/HEVC UHD,
* H.265/HEVC Full HD HDR,
* H.265/HEVC UHD HDR,
* HEVC/H.265 Full HD HDR HLG,
* H.265/HEVC UHD HDR HLG, and
* H.265/HEVC 8K UHD Bitstreams.

Receivers conforming to the **H.265/HEVC 8K** **UHD** Operation Point should support processing the optional SEI messages defined in clause 4.5.9.7.

**===== CHANGE =====**

## 5.11 H.265/HEVC 8K UHD Operation Point

### 5.11.1 Operation Point Identifier

If all Representations in an Adaptation Set conform to the elementary stream constraints for the **H.265/HEVC 8K** **UHD** Operation Point as defined in clause 4.9.6 and the Adaptation Set conforms to the MPD signalling according to clause 5.11.2 and 5.11.4, and the Representations conform to the file format constraints in clause 5.8.3, then the @profiles parameter in the Adaptation Set may signal conformance to this Operation Point by using "urn:3GPP:video:op:h265-8K-UHD".

### 5.11.2 MPD Signalling

The requirements as defined in clause 5.1.1 shall apply. In addition, the conditions in 5.11.4 shall apply.

### 5.11.3 File Format Constraints

For Representations conforming to the **H.265/HEVC 8K UHD** Operation Point the following requirements apply.

The requirements as defined in clause 5.4.3 shall apply. The video track shall be encoded using the requirements and recommendations for H.265/HEVC 8K UHD Operation Point as defined in clause 4.9.6.

In addition, the Representation shall conform to an MPEG CMAF Track that conforms to the ‘c8k0' media profile as defined ISO/IEC 23000-19 [13].

If sample entry hvc1 is in use, then any possibly present Mastering display colour volume SEI message or any possibly present Content light level information SEI message shall be provided in the decoder configuration record and shall be constant for the entire file.

### 5.11.4 Adaptation Set Constraint

The requirements as defined in clause 5.1.3 shall apply. In addition, the following shall apply:

- @maxWidth shall be set to 7680 and @maxHeight shall be set to 4320.

- The @codecs parameter shall be set to either hvc1.2.4.L183.B0 or hev1.2.4.L183.B0.

- @width and @height for Representations shall be set to one of the following pairs: (7680, 4320), (5120, 2880), (3840, 2160), (3200, 1800), (2560, 1440), (1920, 1080), (1600, 900), (1280, 720), (960, 540), or (854, 480).

- @frameRate shall be set to one of the following values: "24", "25", "30", "50", "60", "24000/1001", "30000/1001" or "60000/1001".

- The Colour Primaries, Transfer Characteristics and Matrix Coefficients shall be signalled to indicate ITU-R BT.2020, and BT.2100 PQ and BT.2100 HLG as defined in clause 5.1.3. In particular, the Essential Descriptors shall be present to signal BT.2020, and BT.2100 PQ and BT.2100 HLG as follows:

- an Essential Descriptor shall be used to signal the value by setting the @schemeIdUri attribute to urn:mpeg:mpegB:cicp:MatrixCoefficients as defined ISO/IEC 23091-2 [10] and the @value attribute according to ISO/IEC 23091-2 [10]. The values shall match the values set in the VUI, i.e. the value is set to 9.

- Essential Descriptors shall be used to signal the value by setting the @schemeIdUri attribute to urn:mpeg:mpegB:cicp:ColourPrimaries and urn:mpeg:mpegB:cicp:TransferCharacteristics, respectively, as defined ISO/IEC 23091-2 [10] and the @value attribute according to the "Colour primaries" Table and the "Transfer characteristics" Table of ISO/IEC 23091-2 [10], respectively. The values shall match the values set in the VUI, i.e.

- urn:mpeg:mpegB:cicp:ColourPrimaries with value set to 9.

- urn:mpeg:mpegB:cicp:TransferCharacteristics with value set to

- 14 if SDR is in use,

- 16 if HDR PQ is in use, or

- 18 if HDR HLG is in use.

- The Essential Descriptors, and if applicable the Supplementary Descriptor, shall be on Adaptation Set level only, i.e all Representations in one Adaptation Set are required to have the same Matrix Coefficients, Color Primaries and Transfer Function.

- If any Representation contains a mastering display colour volume SEI message or a content light level information SEI message, the same SEI message shall be present in all Representations in the Adaptation Set.

- For hvc1 this implies that the SEI messages shall be provided in the decoder configuration record of every Representation.

- For hev1, if any of such SEI message is carried inband within a segment/subsegment of any Representation of the Adaptation Set, it shall be carried with the first picture of that segment/subsegment in decode order in all Representations of this Adaptation Set.

**===== CHANGE =====**

# A.1 3GPP Registered URIs

The clause documents the registered URIs in this specification following the process in <http://www.3gpp.org/specifications-groups/34-uniform-resource-name-urn-list>

Table A-1 lists all registered URN values as well as

- a brief description of its functionality;

- a reference to the specification or other publicly available document (if any) containing the definition;

- the name and email address of the person making the application; and

- any supplementary information considered necessary to support the application.

Table A-1: 3GPP Registered URNs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| URN | Description | Reference | Contact | Remarks |
| urn:3GPP:video:op:h264-720p-HD | DASH profile identifier for H.264/AVC 720p HD Operation Point | TS 26.116, clause 5.2.1 | Thomas Stockhammer  tsto@qti.qualcomm.com | none |
| urn:3GPP:video:op:h264-Full-HD | DASH profile identifier for H.264/AVC Full HD Operation Point | TS 26.116, clause 5.3.1 | Thomas Stockhammer  tsto@qti.qualcomm.com | none |
| urn:3GPP:video:op:h265-720p-HD | DASH profile identifier for H.265/HEVC 720p HD Operation Point | TS 26.116, clause 5.4.1 | Thomas Stockhammer  tsto@qti.qualcomm.com | none |
| urn:3GPP:video:op:h265-Full-HD | DASH profile identifier for H.265/HEVC Full HD Operation Point | TS 26.116, clause 5.5.1 | Thomas Stockhammer  tsto@qti.qualcomm.com | none |
| urn:3GPP:video:op:h265-UHD | DASH profile identifier for H.265/HEVC UHD  Operation Point | TS 26.116, clause 5.6.1 | Thomas Stockhammer  tsto@qti.qualcomm.com | none |
| urn:3GPP:video:op:h265-Full-HD-HDR | DASH profile identifier for H.265/HEVC Full HD HDR Operation Point | TS 26.116, clause 5.7.1 | Thomas Stockhammer  tsto@qti.qualcomm.com | none |
| urn:3GPP:video:op:h265-UHD-HDR | DASH profile identifier for H.265/HEVC UHD HDR Operation Point | TS 26.116, clause 5.8.1 | Thomas Stockhammer  tsto@qti.qualcomm.com | none |
| urn:3GPP:video:op:h265-Full-HD-HDR-HLG | DASH profile identifier for H.265/HEVC Full HD HDR HLG Operation Point | TS 26.116, clause 5.9.1 | Thomas Stockhammer  tsto@qti.qualcomm.com | none |
| urn:3GPP:video:op:h265-UHD-HDR-HLG | DASH profile identifier for H.265/HEVC UHD HDR HLG Operation Point | TS 26.116, clause 5.10.1 | Thomas Stockhammer  tsto@qti.qualcomm.com | none |
| urn:3GPP:video:op:h265-8K-UHD | DASH profile identifier for H.265/HEVC 8K UHD Operation Point | TS 26.116, clause 5.11.1 | Thomas Stockhammer  tsto@qti.qualcomm.com | none |