**3GPP TSG SA WG4#115-e meeting S4-211018**

**18th– 27th August 2021 revision of S4aV210744**

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| *CR-Form-v12.0* |
| **DRAFT CHANGE REQUEST** |
|  |
|  | **26**.**116** | **CR** | draft | **rev** | **2** | **Current version:** | **16.3.1** |  |
|  |
| *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 |  | Radio Access Network |  | Core Network |  |

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| --- |
|  |
| ***Title:***  | **HEVC 8K Operation Point** |
|  |  |
| ***Source to WG:*** | Qualcomm Incorporated, Tencent |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** | 8K\_TV\_5G |  | ***Date:*** | 26/07/2021 |
|  |  |  |  |  |
| ***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 canbe 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  |
|  |  |
| ***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:- In addition to the luminance resolutions already included in TS 26.116 for UHD services, the specification is expected to support 16:9 aspect ratio and luminance resolution up to 7680x4320 pixels, including 5120 x 2880 pixels.- The specification is expected to 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.- The specifications is expected to 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. |
|  |  |
| ***Consequences if not approved:*** | Work Item objectives not complete |
|  |  |
| ***Clauses affected:*** | 1, 2, 4.2, 4.3, 4.5.9 (new), 5.1.3, 5.5.4, 5.6.4, 5.7.4, 5.8.4, 5.9.4, 5.10.4, 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:*** | **This revision addresses the following comments****Discussion** during telco on August 3, 2021* Issues while presenting
	+ Title in 4.5.9
	+ 23091-2 or 3
* Fabrice: Up to now we only we have three operation points, why one now?
	+ Thomas: Three reasons
		- For UHD this was introduced gradually and addressed different market realities
		- Nowadays this is not the case we understand, all receivers support all three
		- We also do the same in MPEG CMAF
* Gilles: What about the Editor’s Note?
	+ Thomas: suggest to add some more details with reference to LS and also to check 5.4.3 and how it relates to CMAF.
* Alexis & Fabrice:
	+ Non-constant luminance needs to be added in 4.5.9.5 and in 5
	+ Shall for chroma\_loc? Add note
	+ Thomas: ok - thanks
 |

**===== 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.

**===== 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 23000-19:2020/DAMD2:2021: " 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 | TransferCharacteristics |
| 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] PQBT.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 =====**

### 4.5.9 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.

- 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 bits 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 =====**

### 5.1.3 Adaptation Set Constraints

For a video Adaptation Set, the following constraints apply:

- The @codecs parameter shall be present on Adaptation Set level and shall signal the maximum required capability to decode any Representation in the Adaptation Set. The @codecs parameter should be signalled on the representation level if different from the one on Adaptation Set level.

- The @profiles parameter may be present to signal the constraints for the Adaptation Set.

- The attributes @maxWidth and @maxHeight shall be present. They are expected be used to signal the original source content format. This means that they may exceed the actual largest size of any coded Representation in one Adaptation Set. More details for each Operation Point are provided.

- The @width and @height shall be signalled for each Representation (possibly defaulted on Adaptation Set level) and shall match the values of the maximum width and height in the Sample Description box of the contained Representation.

- The Chroma Format may be signalled. If signalled:

- An Essential or Supplemental 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.

- The signalling shall be on Adaptation Set level.

- The Color Primaries and Transfer Function shall be signalled unless ITU-R BT.709 is used. If signalled:

- An Essential or Supplemental Descriptor shall be used to signal the value by setting the @schemeIdURI attribute to urn:mpeg:mpegB:cicp:ColourPrimaries and urn:mpeg:mpegB:cicp:TransferCharacteristics 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.

- The signalling shall be on Adaptation Set level only, i.e. the value shall not be different for different Representations in one Adaptation Set.

- The maximum frame rate may be signalled on Adaptation Set using the @maxFrameRate attribute.

- The @frameRate shall be signalled for each Representation (possibly defaulted on Adaptation Set level). In one Adaptation Set, only frame rates shall be present from one of the following subsets:

- 24 Hz with proposed signalling @frameRate="24"

- 25 Hz, 50 Hz with proposed signalling @frameRate="25" or @frameRate="50",

- 30 Hz, 60 Hz with proposed signalling @frameRate="30" or @frameRate="60",

- 24/1.001 Hz with proposed signalling @frameRate="24000/1001",

- 30/1.001 Hz, 60/1.001 Hz with proposed signalling @frameRate="30000/1001" or @frameRate="60000/1001".

- Random Access Points shall be signalled by @startsWithSAP set to 1, 2 or 3.

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

### 5.5.4 Adaptation Set Constraints

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

- @maxWidth and @maxHeight shall be set to one of the following pairs: (1920, 1080), (1280, 720).

- The @codecs parameter shall be set to hev1.2.4.L123.B0 or hvc1.2.4.L123.B0,

- @width and @height for Representations shall be set to one of the following pairs: (1920, 1080), (1600, 900), (1280, 720), (960, 540), (854, 480), (640, 360), or (426, 240).

- If ITU-R BT.2020 is used, then the Colour Primaries, Transfer Characteristics and Matrix Coefficients shall be signalled as defined in clause 5.1.3.

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

If the SEI messages for HLG Signaling as defined in clause 4.5.3.8 is present in the bitstream, then a Supplemental Descriptor should be present with the @schemeIdUri attribute set to urn:mpeg:mpegB:cicp:TransferCharacteristics as defined ISO/IEC 23091-2 [10] and the @value attribute according the "Transfer characteristics" Table of ISO/IEC 23091-2 [10] is set to 18.

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

### 5.6.4 Adaptation Set Constraint

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

- @maxWidth and @maxHeight shall be set to one of the following pairs: (3840, 2160), (1920, 1080), (1280, 720).

- The @codecs parameter shall be set to hev1.2.4.L153.B0 or hvc1.2.4.L153.B0.

- @width and @height for Representations shall be set to one of the following pairs: (3840, 2160), (3200, 1800), (2560, 1440), (1920, 1080), (1600, 900), (1280, 720), (960, 540), (854, 480), (640, 360), or (426, 240). @width and @height shall not be greater than @MaxWidth and @MaxHeight respectively.

- @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 as defined in clause 5.1.3.

If the SEI messages for HLG Signaling as defined in clause 4.5.3.8 is present in the bitstream, then a Supplemental Descriptor should be present with the @schemeIdUri attribute set to urn:mpeg:mpegB:cicp:TransferCharacteristics as defined ISO/IEC 23091-2 [10] and the @value attribute according the "Transfer characteristics" Table of ISO/IEC 23091-2 [10] is set to 18.

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

### 5.7.4 Adaptation Set Constraint

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

- @maxWidth and @maxHeight shall be set to one of the following pairs: (1920, 1080), (1280, 720).

- The @codecs parameter shall be set to one of the values defined in Table 5.7.4-1, depending on the operating mode as defined in clause 4.5.5.9, except that the level indication may indicate a lower level to which all the applicable Bitstreams conform.

Table 5.7.4-1: Codecs parameters for different HD HDR Operating modes

|  |  |  |
| --- | --- | --- |
| Operation Modes name | Codecs Parameter for hvc1 | Codecs Parameter for hev1 |
| HEVC/H.265 HDR 720p HD30  | hvc1.2.4.L83.B0 | hev1.2.4.L83.B0 |
| HEVC/H.265 HDR 720p HD60  | hvc1.2.4.L93.B0 | hev1.2.4.L93.B0 |
| HEVC/H.265 HDR Full HD30  | hvc1.2.4.L113.B0 | hev1.2.4.L113.B0 |
| HEVC/H.265 HDR Full HD60  | hvc1.2.4.L123.B0 | hev1.2.4.L123.B0 |

- @width and @height for Representations shall be set to one of the following pairs: (1920, 1080), (1600, 900), (1280, 720), (960, 540), (854, 480), (640, 360), or (426, 240). @width and @height shall not be greater than @MaxWidth and @MaxHeight respectively.

- @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 as defined in clause 5.1.3. In particular, the Essential Descriptors shall be present to signal BT.2020 and BT.2100 PQ 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 16.

- 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 =====**

### 5.8.4 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 3840 and @maxHeight shall be set to 2160.

- The @codecs parameter shall be set to one of the values defined in Table 5.2, depending on the operating mode as defined in clause 4.5.6.9,

Table 5.2: Codecs parameters for different UHD HDR Operating modes

|  |  |  |
| --- | --- | --- |
| Operation Modes name | Codecs Parameter for hvc1 | Codecs Parameter for hev1 |
| HEVC/H.265 HDR UHD30  | hvc1.2.4.L143.B0 | hev1.2.4.L143.B0 |
| HEVC/H.265 HDR UHD60  | hvc1.2.4.L153.B0 | hev1.2.4.L153.B0 |

- @width and @height for Representations shall be set to one of the following pairs: (3840, 2160), (3200, 1800), (2560, 1440), (1920, 1080), (1600, 900), (1280, 720), (960, 540), (854, 480), (640, 360), or (426, 240).

- @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 as defined in clause 5.1.3. In particular, the Essential Descriptors shall be present to signal BT.2020 and BT.2100 PQ 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 16.

- 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 =====**

### 5.9.4 Adaptation Set Constraint

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

- @maxWidth and @maxHeight shall be set to one of the following pairs: (1920, 1080), (1280, 720).

- The @codecs parameter shall be set to one of the values defined in Table 5.9.4-1, depending on the operating mode as defined in clause 4.5.7.8, except that the level indication may indicate a lower level to which all the applicable Bitstreams conform.

Table 5.9.4-1: Codecs parameters for different HD HDR Operating modes

|  |  |  |
| --- | --- | --- |
| Operation Modes name | Codecs Parameter for hvc1 | Codecs Parameter for hev1 |
| HEVC/H.265 HDR HLG 720p HD30  | hvc1.2.4.L83.B0 | hev1.2.4.L83.B0 |
| HEVC/H.265 HDR HLG 720p HD60  | hvc1.2.4.L93.B0 | hev1.2.4.L93.B0 |
| HEVC/H.265 HDR HLG Full HD30  | hvc1.2.4.L113.B0 | hev1.2.4.L113.B0 |
| HEVC/H.265 HDR HLG Full HD60  | hvc1.2.4.L123.B0 | hev1.2.4.L123.B0 |

- @width and @height for Representations shall be set to one of the following pairs: (1920, 1080), (1600, 900), (1280, 720), (960, 540), (854, 480), (640, 360), or (426, 240). @width and @height shall not be greater than @MaxWidth and @MaxHeight respectively.

- @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 HLG as defined in clause 5.1.3. In particular, the Essential Descriptors shall be present to signal BT.2020 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 the “Matrix coefficients” Table of 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.

- set to either 18 or 14. If 14 is signalled for HLG\_HDR, a Supplementary Descriptor with the same attributes shall be used to signal the value 18, and the @profiles parameter shall not include "urn:3GPP:video:op:h265-Full-HD", but should include "urn:3GPP:video:op:h265-Full-HD-HDR-HLG".

- The Essential Descriptors, and if applicable the Supplementary Descriptors, 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.

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

### 5.10.4 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 3840 and @maxHeight shall be set to 2160.

- The @codecs parameter shall be set to one of the values defined in Table 5.10.4-1, depending on the operating mode as defined in clause 4.5.6.9,

Table 5.10.4-1: Codecs parameters for different UHD HDR HLG Operating modes

|  |  |  |
| --- | --- | --- |
| Operation Modes name | Codecs Parameter for hvc1 | Codecs Parameter for hev1 |
| HEVC/H.265 HDR HLG UHD30  | hvc1.2.4.L143.B0 | hev1.2.4.L143.B0 |
| HEVC/H.265 HDR HLG UHD60  | hvc1.2.4.L153.B0 | hev1.2.4.L153.B0 |

- @width and @height for Representations shall be set to one of the following pairs: (3840, 2160), (3200, 1800), (2560, 1440), (1920, 1080), (1600, 900), (1280, 720), (960, 540), (854, 480), (640, 360), or (426, 240).

- @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 HLG as defined in clause 5.1.3. In particular, the Essential Descriptors shall be present to signal BT.2020 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 the “Matrix coefficients” Table of 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.

- set to either 18 or 14. If 14 is signalled for HLG\_HDR, a Supplementary Descriptor with the same attributes shall be used to signal the value 18, and the @profiles parameter shall not include "urn:3GPP:video:op:h265-UHD", but should include "urn:3GPP:video:op:h265-UHD-HDR-HLG".

- The Essential Descriptors, and if applicable the Supplementary Descriptors, 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.

**===== 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 5.1.2 shall apply. In addition, the conditions in 5.8.3 shall apply.

### 5.11.3 File Format Signalling

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.

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.

Editor’s Note: Detailed comparison with the work in DVB and MPEG CMAF [13] is still needed. In particular, a comparison between the CMAF constraints and the constraints in clause 5.4.3 needs to be done and an active statement should be provided on how CMAF format and 3GPP format compare. An incoming LS from MPEG is expected on this matter.

### 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 Stockhammertsto@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 Stockhammertsto@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 Stockhammertsto@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 Stockhammertsto@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 Stockhammertsto@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 Stockhammertsto@qti.qualcomm.com | none |
| urn:3GPP:video:op:h265-UHD-HDR | DASH profile identifier for H.265/HEVC UHD HDROperation Point | TS 26.116, clause 5.8.1  | Thomas Stockhammertsto@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 Stockhammertsto@qti.qualcomm.com | none |
| urn:3GPP:video:op:h265-UHD-HDR-HLG | DASH profile identifier for H.265/HEVC UHD HDR HLGOperation Point | TS 26.116, clause 5.10.1  | Thomas Stockhammertsto@qti.qualcomm.com | none |
| urn:3GPP:video:op:h265-8K-UHD | DASH profile identifier for H.265/HEVC 8K UHDOperation Point | TS 26.116, clause 5.11.1  | Thomas Stockhammertsto@qti.qualcomm.com | none |