**3GPP TSG SA WG4#115-e meeting S4-211019**

**18th–27th August 2021**

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| *CR-Form-v12.0* | | | | | | | | |
| **DRAFT CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **26**.**955** | **CR** | draft | **rev** | **2** | **Current version:** | **17.0.0** |  |
|  | | | | | | | | |
| *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:*** | **8K TV Scenario** | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Qualcomm Incorporated | | | | | | | | | |
| ***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 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 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Provides a new scenario for TR26.955 to document characterization of 8K TV. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Work Item objectives not complete | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 4.2, 6.X (new), Annex C.X (new) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | | Thomas  Xavier has prepared the sequence for 3GPP. He is on vacation, back on 16/7. He will be your poc for 8K.  Regards  **Thierry Fautier** Vice President, Video Strategy  Meanwhile, I got some potential 8K sequences from Harmonic for 8K TV 5G work item in 3GPP.  I have downloaded the sequences and converted to yuv.  I created a 1080p version you can look at. The conversion was somehow wrongly done by FFMPEG, so apologies. But it should give you an idea.   * <https://dash-large-files.akamaized.net/WAVE/3GPP/5GVideo/Others/RiverPlate_HDR10_8K_5994_HEVC-70Mbps_AAC-LC-320Kbps_extract2_35s_1080p_avc.mp4> * <https://dash-large-files.akamaized.net/WAVE/3GPP/5GVideo/Others/RiverPlate_HDR10_8K_5994_HEVC-70Mbps_AAC-LC-320Kbps_extract3_35s_1080p_avc.mp4> * <https://dash-large-files.akamaized.net/WAVE/3GPP/5GVideo/Others/RiverPlate_HDR10_8K_5994_HEVC-75Mbps_AAC-LC-320Kbps_extract1_35s_1080p_avc.mp4>   The raw sequences should only be accessible to 3GPP members and there is a proposed attached that would have to executed between Harmonic and 3GPP.  We will update the SA4 community on the progress on the CLA and the management of accessing the tools | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

**===== 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".

…

[X] 8K Association Resources, <https://8kassociation.com/resources/>

[Y] Thierry Fautier, "New codecs,”, DASH-IF Workshop on Media Streaming and 5G, December 2019, accessible https://dashif.org/docs/workshop-2019/04-thierry%20fautier%20-%20Harmonic%20Codec%20Comparison%205G%20Media%20Workshop\_Final%20v3.pdf

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

## 4.2 TV Video Profiles

The TV Video Profiles in TS 26.116 [3] address coded representations of TV distribution signals up to UHD-1 phase 2. Table 4.2-1 provides an overview of the TV relevant formats considered in the context of 3GPP TV Video Profiles.

In the context of TV Video Profiles, the following aspect are defined:

- **Bitstream**: A media bitstream that conforms to a video encoding format and certain Operation Point.

- **Operation Point**: A collection of discrete combinations of different content formats including spatial and temporal resolutions, colour mapping, transfer functions, etc. and the encoding format.

- **Receiver**: A receiver that can decode and render any bitstream that is conforming to a certain Operation Point.

Table 4.2-1: TV over 3GPP services Video Profile Operation Points (TS 26.116 [3])

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | BT.709 |
| H.265/HEVC 720p HD | 1280 × 720 | 16:9 | Progressive | 30 | Y'CbCr | 4:2:0 | 8 | BT.709 | BT.709 |
| H.264/AVC Full HD | 1920 × 1080 | 16:9 | Progressive | 60 | Y'CbCr | 4:2:0 | 8 | BT.709 | BT.709 |
| H.265/HEVC Full HD | 1920 × 1080 | 16:9 | Progressive | 60 | Y'CbCr | 4:2:0 | 8; 10 | BT.709; BT.2020 | BT.709; BT.2020 |
| H.265/HEVC UHD | 3840 × 2160 | 16:9 | Progressive | 60 | Y'CbCr | 4:2:0 | 10 | BT.2020 | BT.2020 |
| H.265/HEVC Full HD HDR | 1920 x 1080 | 16:9 | Progressive | 60 | Y'CbCr | 4:2:0 | 10 | BT.2020 | BT.2100 PQ |
| H.265/HEVC UHD HDR | 3840 x 2160 | 16:9 | Progressive | 60 | Y'CbCr | 4:2:0 | 10 | BT.2020 | BT.2100 PQ |
| H.265/HEVC Full HD HDR HLG | 1920 x 1080 | 16:9 | Progressive | 60 | Y'CbCr | 4:2:0 | 10 | BT.2020 | BT.2100 HLG |
| H.265/HEVC UHD HDR HLG | 3840 x 2160 | 16:9 | Progressive | 60 | Y'CbCr | 4:2:0 | 10 | BT.2020 | BT.2100 HLG |
| H.265/HEVC 8K UHD | 7680 x 4320 | 16:9 | Progressive | 60 | Y'CbCr | 4:2:0 | 10 | BT.2020 | BT.2020  BT.2100 PQ BT.2100 HLG |

Each one of the Operation Points is associated with a video coding specification and a particular Profile, Level, and Tier (for HEVC). The combination of a specific profile, level, and tier indicate the maximum decoding capabilities, such as chroma format, resolution, frame rate, and bit depth, that can be supported by a decoder conforming to such combination of parameters. An operation point is also associated with additional bitstream constraints defined in TS 26.116 [3], clause 4. Table 4.2-2 summarizes the video coding specification profile, tier, and level associated with each operation point.

Table 4.2-2: Operation point video codec Profile/Tier/Level

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Operation Point name | Video Codec | Profile | Tier | Level |
| H.264/AVC 720p HD | AVC | High | - | 3.1 |
| H.265/HEVC 720p HD | HEVC | Main | Main | 3.1 |
| H.264/AVC Full HD | AVC | High | - | 4.2 |
| H.265/HEVC Full HD | HEVC | Main 10 | Main | 4.1 |
| H.265/HEVC UHD | HEVC | Main 10 | Main | 5.1 |
| H.265/HEVC Full HD HDR | HEVC | Main 10 | Main | 4.1 |
| H.265/HEVC UHD HDR | HEVC | Main 10 | Main | 5.1 |
| H.265/HEVC Full HD HDR HLG | HEVC | Main 10 | Main | 4.1 |
| H.265/HEVC UHD HDR HLG | HEVC | Main 10 | Main | 5.1 |
| H.265/HEVC 8K UHD | HEVC | Main 10 | Main | 6.1 |

For TV Video profiles, interoperability with ISO BMFF based systems and the DASH Streaming is of most relevance. Hence, for a codec to be used in the context of TV Video Profiles, the following is defined in terms of interoperability:

1. The receiver requirements on elementary stream level
2. The encapsulation of an elementary stream into an ISO Base Media File Format track
3. The provisioning of the media as part of the DASH Adaptation Set to support seamless switching
4. All MPD-level signalling for the codec to support capability discovery

For details, refer to TS 26.116 [3], clause 4 and clause 5.

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

## 6.X Scenario 2: 8K-TV

### 6.X.1 Motivation

Since the initial development and last update of TV Video Profiles defined in 3GPP TS 26.116, TV and mobile device capabilities have improved and nowadays they support higher decoding capabilities. In particular, new TV sets and 5G mobile devices entering the market since 2020 support up to 8K video decoding as well as 8K display capabilities.

8K is recently trialed and introduced in several services. In addition, other ecosystem support is happening, such as 8K encoders are announced, 8K TV sets are shipped and content is produced in 8K. Some good information, background and motivation is for example collected by the 8K Association [X] . Furthermore, it evident that distribution of 8K TV content is feasible with 5G. As an example, it was shown that with HEVC around 40 MBit/s on sports content can be achieved [Y]. Most of the existing services are build on H.265/HEVC.

### 6.X.2 Description of the Anticipated Application

In the context of 3GPP services, 5G Media Streaming [13] as well as the TV Video Profiles [3] are specifications addressing this 8K-TV scenario. Both, 5G Media Streaming [13] and TV Video Profiles [3] build on CMAF-based Segment formats and DASH distribution. From 3GPP TS 26.116, the following operation point may be considered in scope of the 8K-TV Streaming Scenario (pending availability of appropriate test content):

- H.265/HEVC 8K, see 3GPP TS 26.116 [3] clause 4.5.9.

Important aspects that are expected to be considered when evaluating a codec in the context of this 8K-TV scenario are similar to those of 4K-TV as defined in clause 6.3.2.

### 6.X.3 Source Format Properties

Table 6.X.3-1 provides an overview of the different source signal properties for 4K-TV. This information is used to select proper test sequences.

Table 6.X.3-1 8K-TV source format properties

|  |  |
| --- | --- |
| Source format properties | 4K-TV |
| Spatial resolution | 7680 × 4320 |
| Chroma format | Y’CbCr |
| Chroma subsampling | 4:2:0 |
| Picture aspec ratio | 16:9 |
| Frame rates | 24; 50; 60; 24/1.001; 60/1.001; [100; 120] Hz |
| Bit depth | 10 |
| Colour space formats | BT.2020 [15] |
| Transfer characteristics | BT.2020 [15], BT.2100 [16] (PQ & HLG) |
| Range | Standard range |

### 6.X.4 Encoding and Decoding Constraints

Table 6.X.4-1 provides an overview of encoding and decoding constraints for 8K-TV category using codec HEVC. This will support the definition of detailed test conditions.

Table 6.X.4-1 Encoding and Decoding Configurations for 8K-TV with HEVC codec

|  |  |
| --- | --- |
| Encoding and Decoding Constraints | H.265/HEVC 4K-TV |
| Relevant Codec and Codec Profile/Levels according to TS26.116 and TS26.511. | H.265/HEVC Main 10 Profile  Level 6.1 [8] |
| RAP period | Unconstrained, 1 sec |
| Bit rate parameters (CBR, VBR, CAE, HRD parameters) | QP = [tbd]  VBR |
| Latency requirements and specific encoding settings | No latency requirements beyond RAP so picture reordering allowed |
| Encoding complexity context | real-time encoding, cloud-based encoding, offline encoding, etc. |
| Required decoding capabilities | H.265/HEVC Main 10 Profile  Level 6.1 [8], and support for BT.2020 and BT.2100 |

### 6.X.5 Performance Metrics

Performance is assessed using BD-Rate computation, with PSNR, SSIM and VMAF metrics as objective quality criterion. Regarding complexity considerations, encoding/decoding runtime is provided.

### 6.X.6 Interoperability Considerations

In order to use a codec in the context of 5G Media Streaming services in 3GPP TS 26.511 [13] and for TV Video profiles in 3GPP TS 26.116 [3], the same considerations for interoperability as for FullHD according to clause 6.2.6 apply.

For additional details, please refer to 3GPP TS 26.116 [3] and 3GPP TS 26.511 [13].

### 6.X.7 Reference Sequences

Table 6.X.7-1 provides the selected reference sequences for this scenario for SDR and Table 6.X.7-2 provides the selected reference sequences for this scenario for HDR. Keys are defined to refer to the sequences in the context of the scenario. The sequences are named and a reference to the details of the sequence is provided. Annex C.X describes in detail the selection process conducted to build the test sequences considered for this scenario, the outcome of this process is reported in the table below.

Table 6.X.7-1 SDR Reference Sequences for 8K-TV scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Key | Name | Reference | Resolution | Frame rate | Colour Gamut | Number of Frames | Scene Cut |
| S6-R1 |  |  | 7680 × 4320 |  |  |  |  |
| S6-R2 |  |  | 7680 × 4320 |  |  |  |  |
| S6-R3 |  |  | 7680 × 4320 |  |  |  |  |
| S6-R4 |  |  | 7680 × 4320 |  |  |  |  |
| S6-R5 |  |  | 7680 × 4320 |  |  |  |  |
| S6-R6 |  |  | 7680 × 4320 |  |  |  |  |
| S6-R7 |  |  | 7680 × 4320 |  |  |  |  |
| S6-R8 |  |  | 7680 × 4320 |  |  |  |  |

Table 6.X.7-2 HDR Reference Sequences for 8K-TV scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Key | Name | Reference | Resolution | Frame rate | Colour Gamut | Number of Frames | Scene Cut |
| S6-R11 |  |  | 7680 × 4320 |  |  |  |  |
| S6-R12 |  |  | 7680 × 4320 |  |  |  |  |
| S6-R13 |  |  | 7680 × 4320 |  |  |  |  |
| S6-R14 |  |  | 7680 × 4320 |  |  |  |  |
| S6-R15 |  |  | 7680 × 4320 |  |  |  |  |
| S6-R16 |  |  | 7680 × 4320 |  |  |  |  |
| S6-R17 |  |  | 7680 × 4320 |  |  |  |  |

### 6.X.8 Anchor Definition

#### 6.X.8.1 Overview

This clause provides details on how to generate the anchors for the 8K-TV scenario.

No H.264/AVC Anchors are defined.

H.265/HEVC Anchors are defined in clause 6.X.8.3.

#### 6.X.8.2 H.264/AVC Anchors

No H.264/AVC Anchors are defined for this scenario.

#### 6.X.8.3 H.265/HEVC Anchors

##### 6.X.8.3.1 Overview

Table 6.X.8.3.1-1 provides an overview of the H.265/HEVC anchor tuples. Keys are identified to refer to the anchors in the context of the scenario.

The details are also provided here: https://dash-large-files.akamaized.net/WAVE/3GPP/5GVideo/Bitstreams/Scenario-6-8K/265/anchors.csv.

Table 6.X.8.3.1-1 Anchor Tuple generation with H.265/HEVC for 4K-TV Scenario

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Key | Clause | Reference Sequence | Reference Encoder | Configuration | Variations | Anchor Key |
| S6-A01-265 | 6.X.8.3.3 | S2-R1 | HM16.23 | S6-HM-01 | QP: [22,27,32,37] | S6-A1-265-<QP> |
| S6-A02-265 | 6.X.8.3.3 | S2-R2 | HM16.23 | S6-HM-01 | QP: [22,27,32,37] | S6-A2-265-<QP> |
| S6-A03-265 | 6.X.8.3.3 | S2-R3 | HM16.23 | S6-HM-01 | QP: [22,27,32,37] | S6-A3-265-<QP> |
| S6-A04-265 | 6.X.8.3.3 | S2-R4 | HM16.23 | S6-HM-01 | QP: [22,27,32,37] | S6-A4-265-<QP> |
| S6-A05-265 | 6.X.8.3.3 | S2-R5 | HM16.23 | S6-HM-01 | QP: [22,27,32,37] | S6-A5-265-<QP> |
| S6-A06-265 | 6.X.8.3.3 | S2-R6 | HM16.23 | S6-HM-01 | QP: [22,27,32,37] | S6-A6-265-<QP> |
| S6-A07-265 | 6.X.8.3.3 | S2-R7 | HM16.23 | S6-HM-01 | QP: [22,27,32,37] | S6-A7-265-<QP> |
| S6-A08-265 | 6.X.8.3.3 | S2-R8 | HM16.23 | S6-HM-01 | QP: [22,27,32,37] | S6-A8-265-<QP> |
| S6-A11-265 | 6.X.8.3.4 | S2-R11 | HM16.23 | S6-HM-02 | QP: [22,27,32,37] | S6-A11-265-<QP> |
| S6-A12-265 | 6.X.8.3.4 | S2-R12 | HM16.23 | S6-HM-02 | QP: [22,27,32,37] | S6-A12-265-<QP> |
| S6-A13-265 | 6.X.8.3.4 | S2-R13 | HM16.23 | S6-HM-02 | QP: [22,27,32,37] | S6-A13-265-<QP> |
| S6-A14-265 | 6.X.8.3.4 | S2-R14 | HM16.23 | S6-HM-02 | QP: [22,27,32,37] | S6-A14-265-<QP> |
| S6-A15-265 | 6.X.8.3.4 | S2-R15 | HM16.23 | S6-HM-02 | QP: [22,27,32,37] | S6-A15-265-<QP> |
| S6-A16-265 | 6.X.8.3.4 | S2-R16 | HM16.23 | S6-HM-02 | QP: [22,27,32,37] | S6-A16-265-<QP> |
| S6-A17-265 | 6.X.8.3.4 | S2-R17 | HM16.23 | S6-HM-02 | QP: [22,27,32,37] | S6-A17-265-<QP> |

##### 6.X.8.3.2 Common Parameters and Settings

To generate the anchor bitstreams, HM16.23 is used:

- HM16.23 https://hevc.hhi.fraunhofer.de/svn/svn\_HEVCSoftware/tags/HM-16.23/

The common parameters are as follows:

* Profile: main10 (Main 10 Profile)
* DecodingRefreshType: 1 (CRA)
* SearchRange: 384
* InternalBitDepth: 10 (codec operating bit-depth where all sequences (including 8 bit sequences) are coded with an internal bitdeph of 10 in accordance with [44] and metrics are calculated in 10 bits).
* SEIMasteringDisplayColourVolumeSEI is not added. If it would be added, then the metadata in the json file may be used.

The following parameters need to be adapted for each sequence as follows using the JSON parameters of the reference sequence:

- IntraPeriod: Intra Period aligned with GOPSize such that approximately 1 second is achieved, i.e.

- "frameRate": 23.98 or 24.0 or 25 or 30 => IntraPeriod set to 32,

- "frameRate": 50.0 or 59.94 or 60 => IntraPeriod set to 64.

The following parameters are variables and triggered through updates of the config-file.

* QP: [22,27,32,37].

In cases where the anchor uses temporal filtering and the codec being tested does not, additional results may be included for information to show the comparison with temporal filtering turned off for the anchor. Alternatively, an external document, which details the improvement due to temporal filtering for the anchor, may be referenced.

##### 6.X.8.3.3 S2-HM-01: SDR Settings

The common parameters as defined in 6.X.8.3.2 apply.

In addition, the following parameters apply:

In addition, the following parameters apply:

* VuiParametersPresent: 1 (VUI present)
* ColourPrimaries: 9
* TransferCharacteristics: 14
* MatrixCoefficients: 9
* ChromaLocInfoPresent: 1
* ChromaSampleLocTypeTopField: 2
* ChromaSampleLocTypeBottomField: 2
* SEIDecodedPictureHash: 0 (md5 checksum absent)

The settings are defined in the attached configuration file s6-hm-01.cfg.

##### 6.X.8.3.4 S2-HM-02: HDR PQ Settings

The common parameters as defined in 6.X.8.3.2 apply.

In addition, the following parameters apply:

* VuiParametersPresent: 1 (VUI present)
* ColourPrimaries: 9
* TransferCharacteristics: 16
* MatrixCoefficients: 9
* ChromaLocInfoPresent: 1
* ChromaSampleLocTypeTopField: 2
* ChromaSampleLocTypeBottomField: 2
* SEIDecodedPictureHash: 0 (md5 checksum absent)

The settings are defined in the attached configuration file s6-hm-02.cfg.

### 6.X.9 Anchor Results

tbd

### 6.X.10 Additional Information and Performance Data

Tbd (with references).

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

# C.X 8K-TV Sequences

Editor’s Note:

Meanwhile, I got some potential 8K sequences from Harmonic for 8K TV 5G work item in 3GPP

I have downloaded the sequences and converted to yuv.  I created a 1080p version you can look at. The conversion was somehow wrongly done by FFMPEG, so apologies. But it should give you an idea.

<https://dash-large-files.akamaized.net/WAVE/3GPP/5GVideo/Others/RiverPlate_HDR10_8K_5994_HEVC-70Mbps_AAC-LC-320Kbps_extract2_35s_1080p_avc.mp4>

<https://dash-large-files.akamaized.net/WAVE/3GPP/5GVideo/Others/RiverPlate_HDR10_8K_5994_HEVC-70Mbps_AAC-LC-320Kbps_extract3_35s_1080p_avc.mp4>

<https://dash-large-files.akamaized.net/WAVE/3GPP/5GVideo/Others/RiverPlate_HDR10_8K_5994_HEVC-75Mbps_AAC-LC-320Kbps_extract1_35s_1080p_avc.mp4>

The raw sequences should only be accessible to 3GPP members and there is a proposed attached that would have to executed between Harmonic and 3GPP.

We will update the SA4 community on the progress on the CLA and the management of accessing the tools

## C.X.1 SDR Category

tbd

## C.X.2 HDR Category

tbd