**3GPP TSG- Meeting #**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  |  | **CR** |  | **rev** |  | **Current version:** |  |  |
|  | | | | | | | | |
| *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:*** | [FS\_HEVC\_Profiles] Evaluation of Solution #4.1 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Nokia | | | | | | | | | |
| ***Source to TSG:*** | S4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | FS\_HEVC\_Profiles | | | | |  | ***Date:*** | | | 29/01/2024 |
|  |  | | | |  | |  | | |  |
| ***Category:*** |  |  | | | | | ***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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | This pCR provides performance evaluation coming for performance evaluation of Solution #4.1 in FS\_HEVC\_Profiles. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Changes in clauses 6.8.3.1 and 6.8.3.2 documenting performance assessment and associated references in 2 | | | | | | | | |
| ***tr*** | |  | | | | | | | | |
| ***Consequences if not approved:*** | | No performance documented. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 6.8.3.1, 6.3.8.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | N/A | | | | | | | | |

**===== CHANGE #1 =====**

# 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] ISO/IEC 14496-10:2022: "Information technology — Coding of audio-visual objects — Part 10: Advanced video coding"

[3] ISO/IEC 23008-2:2015: "Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 2: High efficiency video coding"

[3] 3GPP TR 26.905: "Mobile stereoscopic 3D video".

[4] 3GPP TS 26.247: "Transparent end-to-end Packet-switched Streaming Service (PSS); Progressive Download and Dynamic Adaptive Streaming over HTTP (3GP-DASH)".

[5] 3GPP TS 26.244: "Transparent end-to-end packet switched streaming service (PSS); 3GPP file format (3GP)".

[6] 3GPP TS 26.214: "IP Multimedia Subsystem (IMS); Multimedia Telephony; Media handling and interaction".

[7] 3GPP TS 26.218: "Virtual Reality (VR) profiles for streaming applications"

[8] 3GPP TS 26.347: "Multimedia Broadcast/Multicast Service (MBMS); Protocols and codecs"

[9] Vetro, Anthony. "Frame compatible formats for 3D video distribution." In 2010 IEEE International Conference on Image Processing, pp. 2405-2408. IEEE, 2010.

[10] Hannuksela, Miska M., Ye Yan, Xuehui Huang, and Houqiang Li. "Overview of the multiview high efficiency video coding (MV-HEVC) standard." In 2015 IEEE International Conference on Image Processing (ICIP), pp. 2154-2158. IEEE, 2015.

[11] ISO/IEC JTC1/SC29/WG11 MPEG2011 M22746, "AVC/MVC anchor coding for MFC", November 2011, Geneva, Switzerland.

[12] ISO/IEC JTC1/SC29/WG11 N16050, "MV-HEVC Verification Test Report", San Diego, US, Feb. 2016.

[13] ISO/IEC 14496-15:2022, "Information technology — Coding of audio-visual objects — Part 15: Carriage of network abstraction layer (NAL) unit structured video in the ISO base media file format"

[14] "HTTP Live Streaming (HLS) authoring specification for Apple devices," <https://developer.apple.com/documentation/http-live-streaming/hls-authoring-specification-for-apple-devices>

[15] "ISO Base Media File Format and Apple HEVC Stereo Video Format additions," Version 0.9 (Beta) June 21, 2023

[16] "Apple HEVC Stereo Video," Interoperability Profile Version 0.9 (Beta) June 21, 2023

[17] Delbracio, Mauricio, Damien Kelly, Michael S. Brown, and Peyman Milanfar. "Mobile computational photography: A tour." Annual Review of Vision Science 7 (2021): 571-604.

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[20] Joint Video Team (JVT) of ISO/IEC MPEG & ITU-T VCEG JVT-I018, "Color format downconversion for test sequence generation," 2003.

[21] Joint Video Team (JVT) of ISO/IEC MPEG & ITU-T VCEG JVT-I019, "Color format upconversion for video display," 2003.

[22] ISO/IEC 23008-12:2022: "Information technology - MPEG systems technologies - Part 12: Image File Format".

[23] ISO/IEC 14496-12:2022: "Information technology — Coding of audio-visual objects — Part 12: ISO base media file format".

[24] "Using HEIF or HEVC media on Apple devices," https://support.apple.com/en-us/HT207022

[25] "HEIF Imaging," <https://source.android.com/docs/core/camera/heif>

[26] ITU-T Recommendation T.81: "Information technology; Digital compression and coding of continuous-tone still images: Requirements and guidelines".

[27] 3GPP TR 26.948: "Study on video enhancements in 3GPP multimedia services"

[28] HTTP Live Streaming (HLS) Authoring Specification for Apple Devices, <https://developer.apple.com/documentation/http_live_streaming/http_live_streaming_hls_authoring_specification_for_apple_devices>

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[31] ISO/IEC JTC1/SC29/WG11 N16268, "Supplemental SHVC verification test report", June 2016, Geneva, CH.

[32] 3GPP TR 26.955: "Video codec characteristics for 5G-based services and applications"

[33] ISO/IEC 23000-19:2020, "Information technology — Multimedia application format (MPEG-A) — Part 19: Common media application format (CMAF) for segmented media"

[34] ISO/IEC JTC1/SC29/WG03 N01026, "Preliminary WD of ISO/IEC 23000-19 AMD New Structural CMAF Brand Profile", October 2023, Hannover, Germany.

[35] ITU-R/Study Group 6/Document 6/33-E Draft New Recommendation ITU-R BT. "[EVP]: Subjective assessment of video quality using expert viewing protocol (EVP)", 4 February 2016, Geneva.

[36] ISO/IEC JTC1/SC29/WG03 N01033, "Technology under consideration on CMAF", October 2023, Hannover, Germany.

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[41] K. Wegner and O. Stankiewicz, ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11, Document JCT3V-B0151, “3D-HEVC with reduced resolution of depth”, Oct. 2012.

**===== CHANGE #2 =====**

#### 6.8.3.1 Assessment/discussion of hardware impact

This potential solution requires the device to decode the auxiliary channels and forward them to the XR runtime. This task is expected to be straightforward and light in terms of processing. As documented in [37], the carriage of auxiliary pictures does not impact the decoding of the primary layers for which the complexity remains unchanged. The decoding of the added auxiliary channels can be done by reusing single-layer HEVC decoding instances. A demuxer software update on top of an existing 4:2:0 decoder is expected to be sufficient to enable the feature with minimal complexity and power consumption overhead.

**===== CHANGE #2 =====**

In this scenario, additional data is carried, through auxiliary pictures. As multiple solutions are possible, the performance should be evaluated as follows:

* For stereoscopic content:
  + A 2-views MV-HEVC bitstream with up to two auxiliary pictures for depth and alpha channels.
  + A 3D-HEVC+depth bitstream with one auxiliary channel for alpha channel.
* For regular 2D content:
  + A 2D MV-HEVC bitstream with up to two auxiliary pictures for depth and alpha channels.

As the coding of the auxiliary pictures themselves would not change between those configurations, it is needed to identify what would be the impact on distribution when adding those auxiliary pictures to a regular 2D or stereo HEVC encoded bitstream to enable pose correction optimization. The performance of alpha channel coding with HEVC is supported in the industry, at distribution friendly data rate [38], and is then not subject to particular concerns in terms of performance.

Regarding the depth channel coding, the 5:1 fixed ratio has been established as typically a good value to be used when it comes to static bitrate allocation between texture and depths [39] for older codecs. However, the solution #4.1 focuses on HEVC, for which the topic was addressed during MV-HEVC standard development. From [40], it is estimated that the ratio between texture and rate can be lowered to reach an overhead in the range of 8%, which can be further reduced when adjusting the depth resolution [41]. Thus, it is assessed that the coding and distribution of depth channel can be done at a reasonable and acceptable additional data rate.

**===== END OF CHANGES =====**