**3GPP TSG SA WG4#109-e meeting *S4-200765***

**20th May – 3rd June 2020 revision of AHVIC-247**

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| *CR-Form-v12.0* |
| **Pseudo CHANGE REQUEST** |
|  |
|  | **26.955** | **CR** | **<CR#>** | **rev** | **2** | **Current version:** | **0.1.0** |  |
|  |
| *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 | **X** | Radio Access Network |  | Core Network | **X** |

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|  |
| ***Title:***  | Online Gaming and Screen Content Scenario |
|  |  |
| ***Source to WG:*** | Qualcomm Incorporated, Fraunhofer, Xiaomi (Sony, Orange, Tencent, Samsung) |
| ***Source to TSG:*** | SA4 |
|  |  |
| ***Work item code:*** | FS\_5GVideo |  | ***Date:*** | 2020-05-18 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-17 |
|  | *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:*** | Game and screen content is considered an important applicaton |
|  |  |
| ***Summary of change:*** | This introduces this new scenario |
|  |  |
| ***Consequences if not approved:*** | This scenario would be missing |
|  |  |
| ***Clauses affected:*** | 2, 4.X, 6.Y |
|  |  |
|  | **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:*** | **Discussion**: * Mary-Luc: Very informative. Want to get feedback from our team
	+ Thomas: I am very interested to get this information, but just add information to make sure that we add the correct numbers
* Richard: This picked my interest, that for low latency streaming you may use RTP
	+ Thomas: RTP may be confusing
* Michelle: You mention the screen content tools of HEVC. Do you want to compare?
	+ Thomas: No comparison envisaged
	+ Michelle: Do you want HEVC SCC tools?
	+ Thomas: I have no idea right now, group decision
	+ Kiho: Use AVC and HEVC, not using Screen Content Profile
	+ Gilles: Agree on commercial deployment aspect, but is in scope of Telepresence so we may do it
	+ Thomas: Not per se excluding it, but not commit to do it.

**Decision**:* + Content is agreeable, expect additional input and more supporters. Update expected for the next meeting.

**AHVIC-247** is **agreed** |

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

# 2 References

Add at the end

[X] 3GPP TS26.223, "Telepresence using the IP Multimedia Subsystem (IMS); Media handling and interaction"

[N] "NVIDIA VIDEO CODEC SDK", https://developer.nvidia.com/nvidia-video-codec-sdk

[A] Microsoft Online Documentation, "Real-time media calls and meetings with Microsoft Teams", <https://docs.microsoft.com/en-us/microsoftteams/platform/bots/calls-and-meetings/real-time-media-concepts>

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

## 4.X Screen Content Coding

3GPP TS26.223 [X] specifies a client for the IMS-based telepresence service supporting conversational speech, video and text transported over RTP. Telepresence is defined as a conference with interactive audio-visual communications experience between remote locations, where the users enjoy a strong sense of realism and presence between all participants (i.e. as if they are in same location) by optimizing a variety of attributes such as audio and video quality, eye contact, body language, spatial audio, coordinated environments and natural image size.

For video, beyond the regular capabilities, telepresence UEs are recommended to support:

- H.265 (HEVC) Screen-Extended Main, Main Tier, Level 4.1

- H.265 (HEVC) Screen-Extended Main 4:4:4, Main Tier, Level 4.1

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

## 6.Y Scenario Y: Online Gaming and Screen Content Scenario

### 6.Y.1 Motivation

This scenario mostly motivates cases for which content goes beyond videographic content, an in particular includes computer generated imagery (CGI). Several application spaces are obvious and serve as motivation and reference, in particular gaming, 3D content and telepresence including screen and slide sharing.

According to the 2020 Mobile Internet Phenomena Report from Sandvine [9] gaming is continuing to grow on mobile network. The improved performance of 4G and the coming promise of 5G will continue to drive at least casual gamers to mobile networks.

Online gaming was discussed and introduced in detail in TR 26.928 [X]. At least the following use cases are in context of Online gaminig.

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| --- | --- | --- | --- | --- | --- |
| 5 | Untethered Immersive Online Gaming | VR | 6DoF | Streaming, Interactive, Split | XR5G-V3XR5G-V4 with gaming controller |
| 6 | Immersive Game Spectator Mode | VR | 6DoF | Streaming, Split | XR5G-P1XR5G-V3XR5G-V4 |

For raster-based split rendering, according to TR 26.928, clause 4.4, rasterized 3D scenes available in frame buffers are provided by the XR engine and need to be encoded, distributed, and decoded. According to clause 4.2.1, relevant formats for frame buffers are 2k by 2k per eye, potentially even higher. Frame rates are expected to be at least 60fps, potentially higher up to 90 fps. The formats of frame buffers are regular texture video signals that are then directly rendered. As the processing is graphics centric, formats beyond commonly used 4:2:0 signals and YUV signals may be considered. It is known from experiments that with H.264/AVC the bitrates are in the order of 50 Mbps per eye buffer. It is expected that this can be reduced to lower bitrates with improved compression tools as for example available for H.265/HEVC. For use case 5 from above and split rendering, encoding is required to be done in low-latency based on the considerations in TR 26.928. For the spectator mode, higher latency may be acceptable.

As an example, a comprehensive set of API including high-performance tools, samples and documentation for hardware accelerated video encode and decode on Windows and Linux for NVIDIA™ Video Codec SDK is available [N]. For example, in a game recording and streaming scenario like streaming to Twitch.tv using Open Broadcaster Software (OBS), encoding being completely offloaded to NVENC makes the graphics engine bandwidth fully available for game rendering. As of May 2020, the following formats are supported for hardware-based encoding as documented on the high-end Turing encoding:

- H.264 (AVCHD) YUV 4:2:0, YUV 4:4:4, and Lossless, all 8 bit, Max Resolution 4096 x 4096;

- H.265 (HEVC) YUV 4:2:0, YUV 4:4:4, and Lossless, all 10 bit, Max Resolution 8192 x 8192;

For telepresence and screen-sharing applications, some information related to video is collected in the following:

* MS Teams™ [B] as of end of 2019.
	+ There are several formats supported for video. Two key properties of a video format are its frame size and color format. Supported frame sizes include 640x360 ("360p"), 1280x720 ("720p"), and 1920x1080 ("1080p"). Supported color formats include NV12 (12 bits per pixel) and RGB24 (24 bits per pixel).
	+ A "720p" video frame contains 921,600 pixels (1280 times 720). In the RGB24 color format, each pixel is represented as 3 bytes (24-bits) comprised of one byte each of red, green, and blue color components. Therefore, a single 720p RGB24 video frame requires 2,764,800 bytes of data (921,600 pixels times 3 bytes/pixel). At a frame rate of 30fps, sending 720p RGB24 video frames means processing approximately 80 MB/s of content (which is substantially compressed by the H.264 video codec before network transmission).
* Other tools are for further study.

In typical cloud gaming environments, the game server produces rasterized frames at a fixed resolution, framerate and color bit depth which are negotiated with the player client. Negotiation takes into account game capabilities, player choices and eventually bandwidth contraints.

Typical characteristics of rasterized frames produced by the game engine are:

* Resolution of 720p, 1080p or 4K
* Framerate of 30fps, 60fps or 120 fps
* Typical color bit depth of 8bits (RGB frames) but higher bit depth may be offered for HDR compatible games

Rasterized frames are directly passed to a video encoder (typically H.264 but H.265 may be used in a few environments) and content is live encoded to fit target quality. As an example, the following quality categorization may be done:

* High Quality: 4k at 60/120fps with an average throughput of 60/100 Mbps
* Main Quality: 1080p at 60/120fps with an average throughput of 30/40 Mbps
* Low Quality: 720p/1080p at 30fps with an average throughput of 10/12 Mbps

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

3GPP until now has very restricted set of services, but based on the considerations in clause 6.Y.1, the following encoding benchmark capabilities are considered for decoding:

- H.264 (AVCHD) YUV 4:2:0, YUV 4:4:4, 8 bit, Max Resolution 1920x1080 and 4096 x 2048

- H.265 (HEVC) YUV 4:2:0, YUV 4:4:4, 10 bit, Max Resolutions 4096 x 2048, 8192 x 4096

The considered scenario is low-latency streaming, possibly using UDP/IP based distribution. Important aspects that are expected to be considered when evaluating a codec in the context of this:

- Quality and Coding Efficiency:

- The ability to compress computer-generated content.

- The ability compress YUV 4:2:0 and 4:4:4 content

- Considered settings for encoding:

- Low-latency settings

- No specific error resilience mechanisms

- Encoding in this scenario is typically done as

- Real-time encoding

- Cloud-based encoding

### 6.Y.3 Source Format Properties

Table 6.Y-1 provides an overview of the different source signal properties for Online Gaming and Screen Content Sharing. This information is used to select proper test sequences.

Table 6.Y-1 Screen Content and Online Gaming source properties

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| --- | --- | --- |
| Source format properties | Screen Content | Online Gaming |
| Spatial resolution | 1920 x 1080 | 2048 x 1024, 4096 x 2048, 8192 x 4096 |
| Chroma format | Y’CbCr | Y’CbCr |
| Chroma subsampling | 4:2:0, 4:4:4 | 4:2:0, 4:4:4 |
| Picture aspec ratio | 16:9 | 2:1, 16:9 |
| Frame rates | 25, 30, 50, 60 Hz | 30, 60, 90, 120 Hz |
| Bit depth | 8, 10 | 8, 10 |
| Colour space formats | BT.709, BT.2020 | BT.2020 |
| Transfer characteristics | BT.709, BT.2100 (HDR) | BT.2100 (HDR) |

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

Table 6.Y-2 provides an overview of encoding and decoding constraints Online Gaming and Screen Content scenario using AVC and HEVC codecs. This will support the definition of detailed test conditions.

Table 6.X-2 Encoding and Decoding Configurations for Online Gaming and Screen Content

|  |  |  |
| --- | --- | --- |
| Encoding and Decoding Constraints | AVC  | HEVC |
| Relevant Codec and Codec Profile/Levels according to TS26.116 and TS26.511. | H.264/AVC Main Profile Level 4.0 [X] | H.265/HEVC Main-10 Profile Level 4.1, Level 5.1, Level 6.1 |
| RAP period | 1 second, no intra | 1 second, no intra |
| Bit rate parameters (CBR, VBR, CAE, HRD parameters) | Fixed QP | Fixed QP |
| Latency requirements and specific encoding settings | Low-latency requirements, no backward-compatible prediction | Low-latency requirements, no backward-compatible prediction |
| Encoding complexity context  | real-time encoding | real-time encoding. |
| Required decoding capabilities | H.264/AVC Main Profile Level 4.0 [X] | H.265/HEVC Main-10 Profile Level 4.2, 5.2, 6.2 [8] |

### 6.Y.5 Performance Metrics

tbd

### 6.Y.6 Interoperability Considerations

tbd

### 6.Y.7 Test Sequences

tbd

### 6.Y.8 Detailed Test Conditions

tbd

### 6.Y.9 External Performance Data

tbd

### 6.Y.10 Additional Information

tbd