**3GPP TSG SA WG4#127 S4-240081**

**Sophia-Antipolis, France, 29th Jan- 2nd Feb 2024**

**Source: China Mobile Com. Corporation, Qualcomm Incorporated, ZTE, Xiaomi, Fraunhofer HHI, China Unicom, Huawei**

**Title: New SID on 3D Video in 5G Services**

**Document for: Approval**

**Agenda Item: 9.12**

3GPP™ Work Item Description

Information on Work Items can be found at <http://www.3gpp.org/Work-Items>
See also the [3GPP Working Procedures](http://www.3gpp.org/specifications-groups/working-procedures), article 39 and the TSG Working Methods in [3GPP TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm)

Title: Feasibility Study on 3D Video in 5G Services

Acronym: FS\_3DV

Unique identifier: XXXXXX

Potential target Release: Rel-19

# 1 Impacts

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Affects: | UICC apps | ME | AN | CN | Others (specify) |
| Yes |  | X |  | X |  |
| No | X |  | X |  | X |
| Don't know |  |  |  |  |  |

# 2 Classification of the Work Item and linked work items

## 2.1 Primary classification

### This work item is a …

|  |  |
| --- | --- |
| X | Study  |
|  | Normative – Stage 1 |
|  | Normative – Stage 2 |
|  | Normative – Stage 3 |
|  | Normative – Other\* |

**\* Other = e.g. testing**

## 2.2 Parent Work Item

For a brand-new topic, use “N/A” in the table below. Otherwise indicate the parent Work Item.

|  |
| --- |
| Parent Work / Study Items  |
| Acronym | Working Group | Unique ID | Title (as in 3GPP Work Plan) |
|  |  |  |  |

### 2.3 Other related Work Items and dependencies

|  |
| --- |
| Other related Work /Study Items (if any) |
| Unique ID | Title | Nature of relationship |
| 520036 | Study on Mobile 3D Video Coding | May reference for stereoscopic 3D video services.  |
| 960046 | Real-time Transport Protocol Configurations | May reference RTP-based solution for transporting 3D video content  |
| 950014 | Immersive Real-time Communication for WebRTC | May reference transport protocols and payload formats for the distribution of 3D content. |
| 870011 | Feasibility Study on 5G Video Codec Characteristics | May reference video codecs for different 3D content and defined scenarios for work flows. |
| 1000017 | Evaluation of new HEVC coding tools | May reference HEVC profile. |
| 810006 | Study on eXtended Reality (XR) in 5G | May reference 3D video content in XR services. |
| 880011 | Study on 5G Glass-type AR/MR Devices | May reference AR/MR devices and associated 3D video format. |

**Dependency on non-3GPP (draft) specification:**

# 3 Justification

Due to the commercialization of 3D capture devices (e.g., ToF cameras, phones equipped with depth sensors, spatial cameras, see for example here: <https://www.techradar.com/computing/virtual-reality-augmented-reality/i-tried-the-iphone-15s-new-spatial-video-feature-and-it-will-be-the-vision-pros-killer-app>) and 3D displays (e.g., VR HMDs, AR Glasses, MR HMDs, glasses-free autostereoscopic displays, and multiscopic displays), significant progress has been made in 3D Video-related services. Integrating 3D video into end-to-end 3GPP services, e.g. messaging or real-time communication, can produce more detailed and continuous visual information, thereby creating a more life-like and immersive experience.

Despite hardware advancements, the diversity in 3D video formats and coding techniques are still hampering the widespread success of 3D video in 5G services. These include stereoscopic 3D frames (e.g., side-by-side, checkerboard, or top-and-bottom), representation techniques like Multi-view, Multi-view plus Depth, Point Clouds, RGBD, Dynamic Mesh, and implicit Neural Representation, existing 3GPP codecs e.g., MV-HEVC, and also emerging codecs e.g., 3D-HEVC, MIV, V-PCC. For spatial/3D video transmission, it is essential to determine an appropriate spatial/3D video format and codec, considering constraints imposed by each delivery channel, including bit rate and compatibility requirements. Therefore, the standardization of spatial/3D video format and compression methods is crucial to ensure interoperability across different equipment and applications.

Spatial/3D video may require the processing, transmission, and storage of massive data through the 3GPP network, thereby will significantly challenge the network bandwidth as well as the computational capability of terminal points. In the case of single-viewpoint spatial/3D, data consumption is expected to double, while light-field technologies needs to accommodate up to multiple viewpoints to ensure an optimal user experience (the more viewpoints obtained, the closer the presented content is to the actual object). For example, supporting tens of simultaneous views in 3D video may require over 10 times the bandwidth of 2D video when encoded with existing 3GPP codecs such as H.264/AVC or H.265/HEVC. Thus, exploring network solutions and optimizing bandwidth is needed for delivering real-time 3D video across a broad viewing range without compromising the 3D perceptual experience. Moreover, 3D-related features like multi-viewpoints generation, rendering, view interpolations (views and sources) and real-time 2D-to-3D conversion require computing capabilities which may be hard to support by certain types of UE. Investigating the feasibility of implementing these features, either fully or partially, at the network level is also essential to minimize computing latency or improve energy efficiency. In addition, the implementation constraints of encoding, decoding and rendering on typical UE form factors including smartphones, HMDs and glasses need to be considered.

In Release 11, the Mobile 3D stereoscopic video has been investigated in FS\_M3DVC, TR 26.905. It targets the support of stereoscopic 3D video coding solutions, enhance the integration of selected video coding technologies into existing service components and functionalities, and address the potential network capacity and QoS requirements for stereoscopic 3D video services.

However, there are some open issues that worth to be further investigated, for example:

* TR 26.905 primarily addresses the DASH-based streaming solution, it falls short of meeting the demands of 3D RTC. Real-time transport protocols like RTP and RTCP, or emerging QUIC-based content distribution protocols such as Media over QUIC, could potentially offer viable solutions.
* In TR 26.905, stereoscopic 3D frames were addressed as the primary format for 3D video content. However, this approach typically result in reduction in resolution (half of the respective original resolution) or double the frame rate of the original video, and it does not support viewpoint adjustment or additional viewpoint generation in the receiver-side. Therefore, other potential 3D video content formats should also be studied to address these limitations.
* 3GPP services extension to support 3D-related features, involves 2D-to-3D conversion, conversational services and specific mobile 3D video adaptations to the bitrate variation.
* Communication and networking solutions need to be investigated for satisfying the delay and data rate requirements of 3D real-time transmission.

In Release 16 to 18, in TR 26.918 and TR 26.928, 3D video formats have been investigated for AR and VR services. It targets the support of immersive formats for 3DoF+ and 6DOF. However, the focus was on split rendering and low capability AR devices. These formats may need to be considered in a) for AR and VR separately, b) for various targeted services and device types, c) for uplink and downlink, d) in non-split rendering frameworks e) possibly in other scenario such as split rendering, messaging, etc.

* However, additional information and supporting transport protocols for these formats needs to be considered.

Currently, in Release-18 3GPP SA WG 4 is working on the Evaluation of new HEVC coding tools (FS\_HEVC Profiles, TR 26.966), with the anticipation of offering HEVC-based solutions for the delivery of 3D video content. However, AVC or other codec solutions may also serve the requirements of 3D Video-related services.

# 4 Objective

The study item has the following objectives:

1. Identify and document established and emerging capturing (including cameras for spatial video capturing) and contribution, as well as display technologies (smartphones, VR HMDs, AR glasses, autostereoscopic and multiscopic displays), along with associated formats, to support market-relevant spatial/3D video within the next years.

NOTE 1: The work is expected to build upon and extend the findings documented in TR 26.928, TR 26.998 and TS 26.119.

NOTE 2: Acquisition is not limited to typical 3GPP XR UEs (e.g., smartphones, glasses)

2. Establish and document a set of 3D/spatial video end-to-end reference scenarios and workflows to support 3GPP network related delivery, including real-time communication, streaming services, split rendering, 2D-to-3D conversion, and messaging for devices leveraging the generation and display technologies. This includes identifying and defining relevant 3D video formats (multiview, point cloud mesh) in the context of above workflows, and representation technologies to support delivery of these formats within 3GPP networks.

2 Alignment with the generalized media delivery architecture defined in TS 26.501/506 is expected, primarily addressing reference points M2 and M4.

NOTE 3: Prioritize 3D video formats that are the most relevant to 3GPP services.

3. Prioritize the workflows and the associated formats based on market relevance for further evaluation.

NOTE 4: The workflow priority will be determined as the first step following the agreement on the specification skeleton and scope.

4. Define concrete evaluation scenarios (test conditions, KPIs, Metrics, test sequences, agreed reference signals) based on the above prioritized reference workflows, and evaluate the feasibility and performance of existing 3GPP codecs as well as potentially new codec solutions to support the work flows.

NOTE 5: Reuse existing performance results from MPEG or other standard organizations, if they fit in the evaluation framework defined in 3GPP. If there are no suitable existing performance results, communicate with MPEG to ask for potential further evaluation on selected topics.

5. Based on the findings in steps 1, 2, 3, and 4 document (i) interoperability requirements, (ii) traffic characteristics and (iii) potential QoS optimizations or requirements, to support the above work flows and evaluate the feasibility of new formats with different services, considering the implementation constraints and performance indicators such as encoding, decoding, and rendering complexity, network resource consumption, bandwidth utilization, and interoperability considerations.

NOTE 6: Network service, and end-device implementation constraints and complexity are expected to be considered when evaluating existing video profiles from 3GPP or other standards for their commercial feasibility in supporting 3D services over 5G/5G-A.

6. Based on the findings in steps 1, 2, 3, 4 and 5, identify potential gaps or deficiencies of existing 3GPP codecs, and offer recommendations to potentially extend 3GPP video specifications and capabilities.

7. Identify potential areas for normative work as the next phase and communicate with other 3GPP WGs regarding relevant aspects related to the study to the extent needed.

# 5 Expected Output and Time scale

|  |
| --- |
| New specifications {One line per specification. Create/delete lines as needed} |
| Type  | TS/TR number | Title | For info at TSG#  | For approval at TSG# | Rapporteur |
| *TR* | *26.9XX* | *Evaluation and Characteriztion of Beyond 2D Video Formats and Codecs* | *SA#106* | *SA#107* |  |

|  |
| --- |
| Impacted existing TS/TR {One line per specification. Create/delete lines as needed} |
| TS/TR No. | Description of change  | Target completion plenary# | Remarks |
|  |  |  |  |

# 6 Work item Rapporteur(s)

*Jiayi Xu, xujiayi@chinamobile.com*

# 7 Work item leadership

SA4

# 8 Aspects that involve other WGs

# 9 Supporting Individual Members

|  |
| --- |
| Supporting IM name |
| China Mobile Com. Corporation |
| Qualcomm Incorporated |
| ZTE |
| Xiaomi |
| Fraunhofer HHI |
| China Unicom |
| Huawei |
|  |
|  |
|  |