**3GPP TSG SA WG4#127 S4-240504**

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

**Source: China Mobile Com. Corporation, Qualcomm Incorporated, ZTE, Xiaomi, Fraunhofer HHI, China Unicom, Huawei, Nokia Corporation, Philips, InterDigital Europe, Samsung Electronics Co. Ltd**

**Title: Draft SID on Beyond 2D Video**

**Document for: Agreement**

**Agenda Item: 6.2**

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 Beyond 2D Video

Acronym: FS\_Beyond2D

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 beyond 2D video content  |
| 950014 | Immersive Real-time Communication for WebRTC | May reference transport protocols and payload formats for the distribution of beyond 2D video content. |
| 870011 | Feasibility Study on 5G Video Codec Characteristics | May reference video codecs for different beyond 2D video 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 beyond 2D video content in XR services. |
| 880011 | Study on 5G Glass-type AR/MR Devices | May reference AR/MR devices and associated beyond 2D video format. |

# 3 Justification

Due to the commercialization of capture systems (e.g., ToF cameras, phones equipped with depth sensors, spatial cameras) and display technologies (e.g., VR HMDs, AR Glasses, MR HMDs, glasses-free autostereoscopic displays, and multiscopic displays), video services are evolving from traditional two-dimensional video to beyond 2D video-related services. Integrating beyond 2D 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 beyond 2D video formats and codecs are still hampering its widespread success. These include stereoscopic 3D frames, representation techniques like Multi-view, Tiled Multi-view, Multi-views plus Depth, Point Clouds, RGBD, Dynamic Mesh, and Implicit Neural Representation, existing 3GPP codecs and also other codecs that address the compression of the above representation formats, as for example defined in MPEG, Khronos, W3C, JCT-3V, etc… as well as market relevant non-standardized solutions.

Therefore, in order to determine appropriate beyond 2D video formats and codecs for different services, it is essential to evaluate their feasibility and performance, considering implementation constraints, performance indicators, and interoperability considerations.

Beyond 2D 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. Future evolutions of mobile networks are expected to provide significant opportunities for beyond 2D video services. Moreover, beyond 2D-related features like multi-viewpoints generation, rendering, view interpolations (views and sources) and 2D-to-beyond 2D 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 of interest and potentially beneficial, taking into account aspects such as operational expenses,computing latency or power consumption. Additionally, the implementation constraints of capturing, 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 are worth to be further investigated, for example:

* In TR 26.905, stereoscopic 3D frames were addressed as the primary format for beyond 2D video content. However, this approach typically results in reduction in 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. Other potential beyond 2D formats should also be studied to address these limitations.
* 3GPP services extension (e.g., 2D-to-beyond 2D conversion) to support beyond 2D video-related features.
* Communication and networking solutions need to be investigated to meet the delay and data rate requirements for beyond 2D video-related services.

In Release 16 to 18, in TR 26.918 and TR 26.928, beyond 2D 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) additional information and supporting transport protocols for these formats needs to be considered.

In Release-18 3GPP SA WG 4 completed 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 stereoscopic 3D video content.

# 4 Objective

The study item has the following objectives:

1. Identify and document beyond 2D formats, that are market-relevant within the next years, generated from

established and emerging capturing systems (including cameras for spatial video capturing), contribution, and

usable on display technologies (smartphones, VR HMDs, AR glasses, autostereoscopic and multiscopic displays).

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.

2. Establish and document a set of beyond 2D video end-to-end reference scenarios, including real-time communication, streaming services, split rendering, and messaging and workflows (capturing, encoding, packaging, delivery, decoding, rendering, including general constraints on latency, as well as complexity) to support 3GPP network related delivery and devices leveraging the generation or display technologies. This includes identifying and defining relevant beyond 2D formats in the context of above workflows, and representation technologies to support delivery of these formats within 3GPP networks.

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

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

NOTE 3: The scenario priority will be determined as the first step following the agreement on the specification skeleton and scope.

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

NOTE 4: Reuse existing performance results from MPEG or other standard organizations, fitting in the evaluation framework defined in 3GPP may be considered and is recommended to be done. If there are no suitable existing performance results, communication with MPEG to ask for potential further evaluation on selected topics may be done, but 3GPP may also initiate the evaluation independently of MPEG.

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

NOTE 5: 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, 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 Characterization of Beyond 2D Video Formats and Codecs* | *SA#107* | *SA#108* |  |

|  |
| --- |
| 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

None identified.

# 9 Supporting Individual Members

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| --- |
| Supporting IM name |
| China Mobile Com. Corporation |
| Qualcomm Incorporated |
| ZTE |
| Xiaomi |
| Fraunhofer HHI |
| China Unicom |
| Huawei |
| Nokia Corporation |
| Philips |
| InterDigital Europe |
| Samsung Electronics Co. Ltd |