**3GPPSA4 131-bis-e MeetingS4-250596**

Online, 11 – 17 April 2025

**Source: China Mobile**

**Title: [FS\_Beyond2D] Clause 4.1 Introduction to Beyond 2D Video Formats**

**Agenda item: 9.6**

**Document for: Agreement**

**1. Introduction**

This document provides an introduction section to Clause 4, Beyond 2D Video Formats.

**2. Proposal**

It is proposed to agree the following changes to the 3GPP draft TR 26.956 V0.3.0

\* \* \* First Change \* \* \*

## 4.1 Introduction

This section provides an overview of the Beyond 2D Video formats that have reached a certain amount of maturity as they can be generated from established and emerging capturing systems (including cameras for spatial video capturing) and can likely be rendered on existing display technologies (smartphones, VR HMDs, AR glasses, autostereoscopic and multiscopic displays). These formats include: stereoscopic 3D video, Multi-view plus Depth, dense dynamic point clouds and dynamic meshes. Emerging formats such as Neural Radiance Fields (NeRF), light fields, and 3D Gaussian Splatting (3DGS) are documented as formats under research. Table 4.1-1 summarizes the Beyond 2D Video formats documented in this study, highlighting their representation principles, advantages, challenges and compression technologies.

**Table 4.1-1 Summary of Beyond 2D Video Formats**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Name** | **Example** | **Representation principle** | **Advantages** | **Challenges** | **Codecs** |
| **Stereoscopic 3D and extensions** |  | A Stereoscopic View is defined as the perception of depth created by the brain's ability to fuse two slightly different images from each eye, based on the parallax difference between them.  | - Simplicity- Extensibility- Widely device support- Increasing adoption in the industry | * Limited user experiences (3DoF and 3DoF+)
 | Frame-packing and HEVCMV-HEVC... |
| **Multi-view Plus Depth** |  | Multi-view video is a frame-based representation format that each frame of the video represents a still that can be viewed from any perspective within a viewing space that is informed by the provided camera positions. The representation optionally support depth maps of same resolution.  | - Real-time capturingServes as an intermediate step in photogrammetry workflowsWdely device supportRealistic rendering quality | * High Data Volume
* Production relies on accurate depth estimation/refinement tools
 | MV-HEVCMIV... |
| **Dense Dynamic Point Clouds** |  | A volumetric representation using 3D points with spatial coordinates and attributes (e.g., color, reflectance). Contains high-density point sets (>500K points/frame) enabling detailed, closed-surface rendering. | Simple in structure and representationHigh-fidelity 3D reconstructionLess pre-processing needed | * Large Data Volume
* Difficult to edit/transform
* Potential rendering artifacts (aliasing/holes)
 | V-PCCG-PCC... |
| **Dynamic Mesh** |  | A dynamic mesh is an object that represents a collection of vertices, edges and triangular faces (organized in polygons) defining the object's geometry that can be modified procedurally. | Good visual qualityWidely used representation for 3D assets in the commercial marketFriendly to GPU, can be used for real-time rendering. | * Large Data Volume
* Ongoing standarization of compression, storage, and transmission protocols
* Hard to edit
 | DracoV-DMC... |
| **Format Under Research** |
| **Light Fields** |  | A light field, or lightfield, is a vector function that describes the amount of light flowing in every direction through every point in a space | * Immersive visual expereience
* Allow the high fidelity of models, textures, lighting, and reflections
* Lightfield captures are holographic
 | * Large Data Volume
* Have restrictions in the volume they can captures
* Current handheld devices struggle to load these resources in real-time.
 | LVC... |
| **NeRF** |  | NeRF is the implicit representation of a 3D scene or object using a fully-connected (non-convolutional) deep network. | * Photo-realistic visual quality
* Improved view synthesis capabilities
* Flexibility
* Unsupervised Training
 | * Massive Data Volume
* More computationally demanding and slower than 3DGS
* Not effective for handling dynamic content
 | Under study |
| **3D Gaussian Splattings** |  | 3D Gaussian Splatting (3DGS), also referred as Gaussian Splatting Radiance Field, is an explicit radiance field based 3D representation that represents  3D scene or objects using a large number of discrete 3D anisotropic balls or particles, each defined by its spatial mean μ and covariance matric ∑. | * Photo-realistic visual quality
* Real-time Rendering with GPU acceleration
* Accurate Reconstruction
* Can handle dynamic and deformable objects
 | * A lack of industry agreement on the 3DGS format(s)
* Not yet fully compatible with existing rendering pipelines
* High memory usage and Computation complexity
 | Under study |



\* \* \* End of Changes \* \* \*