3GPP achievements on VR & ongoing developments on XR over 5G

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5G VISION

- Address demands and business contexts of 2020 and beyond.
- Enable a fully mobile and connected society.
- Empower socio-economic transformations in countless ways.

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From the vision to standards

3GPP SA4 addresses the media distribution and codecs aspects such as audiovisuals and conversational services
Checkpoint on VR (360)

April 2016 – June 2017: Study on Virtual reality

Video systems
- Human factors
- FOV and lenses
- Optical aberrations

Audio systems
- Channel based
- Object based
- Scene based

VR Video Workflow
- Capture
- Stitching
- Projection
- Packing
- Encoding/decoding
- Rendering

VR Audio Workflow
- Content production
- Audio production formats
- Rendering systems
- Data exchange
- Ambisonics analysis
- Rendering

3GPP TR 26.918
Virtual Reality (VR) media services over 3GPP

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Checkpoint on VR (360)

Release 15 Technical specification for streaming services

- Definition of client architecture and API for VR streaming services
- Set of operating points covering the large range of device capabilities from Carboards to high-end tethered HMDs.
- Definition of Media profiles: mapping of operating points to DASH delivery
- System metadata is added to support rendering of 360 experiences on 2D screens, including the aspects of rendering without pose information

3GPP TS 26.118
Virtual Reality profiles for streaming applications
Checkpoint on VR (360) - TS 26.118

VR Streaming client architecture and API

- DASH Access Engine
  - MPD
  - Segment
  - 3GPP VR Track

- File Decoder
  - File Parser
  - 3GPP Operation Point
  - Media Decoder
  - Decoded Signal
  - Rendering Metadata

- VR Renderer
  - Viewport Presentation

- VR Application
  - Static and Dynamic Configuration and Control

- Sensor
  - Pose

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VR Streaming client architecture and API

- Access Engine
- File Decoder
- Media Decoder
- VR Renderer

File Decoding Process:
- File Parser
- Media Bitstream
- Decoded Signal
- Rendering Metadata

Interop points:
- 3GPP VR Media Profile
- 3GPP VR Operation Point
- 3GPP VR Rendering Scheme
- 3GPP VR Viewport

Static and Dynamic Configuration and Control:
- VR Application
- Sensor

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Video Operating points

- **Basic**: Based on **H.264/AVC** High Profile Level 5.1 for **mono** only, single stream, and reuse of single DASH adaptation set.
- **Main**: Based on **H.265/HEVC** High Profile Level 5.1 allowing mono and **stereo**, single stream, but either a single or **multiple independent Adaptation Sets** may be offered, such that a client can choose based on its current pose.
- **Flexible**: based on **H.265/HEVC** High Profile Level 5.1, but in addition to the Main Video features, it permits to **stream and combine multiple tiles** at the receiver for improved quality.

<table>
<thead>
<tr>
<th>Operation Point name</th>
<th>Decoder</th>
<th>Bit depth</th>
<th>Typical Original Spatial Resolution</th>
<th>Frame Rate</th>
<th>Colour space format</th>
<th>Transfer Characteristics</th>
<th>Projection</th>
<th>Rotation</th>
<th>RWP</th>
<th>Stereo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic H.264/AVC</td>
<td>H.264/AVC HP@L5.1</td>
<td>8</td>
<td>Up to 4k</td>
<td>Up to 60 Hz</td>
<td>BT.709</td>
<td>BT.709</td>
<td>ERP w/o padding</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Main H.265/HEVC</td>
<td>H.265/HEVC MP10@L5.1</td>
<td>8, 10</td>
<td>Up to 6k in mono and 3k in stereo</td>
<td>Up to 60 Hz</td>
<td>BT.709 BT.2020</td>
<td>BT.709</td>
<td>ERP w/o padding</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Flexible H.265/HEVC</td>
<td>H.265/HEVC MP10@L5.1</td>
<td>8, 10</td>
<td>Up to 8k in mono and 3k in stereo</td>
<td>Up to 120 Hz</td>
<td>BT.709 BT.2020</td>
<td>BT.709, BT.2100 PQ</td>
<td>ERP w/o padding CMP</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Checkpoint on VR (360) - TS 26.118

Audio Operating point

MPEG-H 3D Audio Baseline profile. This technology enables the distribution of channel, object and scene-based 3D audio.

- Additional interesting technologies enabling the distribution of channel, object and scene-based 3D audio were considered, and the characterization results of all proposed technologies are documented in TR 26.818.
Extended Reality over 5G

Study Item launched in July 2018

Extended Reality (XR)
- an envelope that includes
  - VR (Virtual Reality)
  - AR (Augmented Reality)
  - MR (Mixed Reality)

The study addresses:
- VR cases in more than 360° navigation
  - 3DOF+ with fixed body
    - 3 axis rotations + 3 axis translations limited to head movement
  - 6DOF
    - Full free navigation (user can walk and look around)
- AR cases where synthetic objects are overlaid with the real environment
- MR cases where those synthetic additions are meant to be part of the real world
Extended Reality over 5G

Objectives

• **Analysing** the different technologies and equipment in place that provide an Extended Reality experiences.
• **Collecting** the associated use cases and identifying the 3GPP service(s) they map to
• **Identifying**
  • media formats (including audio and video), metadata, accessibility features...
  • client and network architectures and APIs that support XR use cases
  • QoS service parameters and other core network and radio functionalities that would be required or at least beneficial for XR use cases
• Possibly **conducting subjective tests** so as to estimate the audio and video formats and encoding parameters required for ensuring the quality of experience as considered necessary
Extended Reality over 5G

Reference architecture under consideration
Extended Reality over 5G

Some Use cases identified so far...

- 3D messaging
  - Ability to capture and send 3D models via MMS
- Streaming of Immersive 6DoF
  - Free navigation/multiple viewpoints in video content
- Immersive online gaming and spectator mode
  - Free navigation in CGI content

- Remote assistance in Industry
  - AR guided assistance for onsite operations
- Realtime 3D communication
  - Immersive conferences including poster sharing
- Online shopping with AR
  - Augmented reality placement of products at home
- AR streaming with Localization registry
  - On-site virtual guides (museums...)

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Extended Reality over 5G

Other topics on track

• **QoE Metrics for VR**
  - Objective: define device capability and latency metrics for the optimization of the quality of experience
  - Timeline: Release 16 (end of 2019)

• **Immersive Voice and Audio Services (IVAS)**
  - Objective: Immersive extension of the EVS (enhanced Voice Services) codec defined by 3GPP
  - Timeline: Release 17 (end of 2020)

• **Immersive Teleconferencing and Telepresence for Remote Terminals (ITT4RT)**
  - Objective: introduce immersive media support for 3GPP conversational services.
  - Timeline: Release 17 (end of 2020)

• **5G Media Streaming architecture (5GMSA)**
  - Objective: Modular architecture for streaming services including edge compute and slicing
  - Timeline: Release 16 (end of 2019)
For more Information

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