Media Operations Use Case for an Augmented Reality Application on Edge Computing Infrastructure

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Sections 5.1 and 5.2 have been updated

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### Section 5.1 Update: XR Workload Characteristics

<table>
<thead>
<tr>
<th>Application</th>
<th>Throughput Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image and Workflow Downloading</td>
<td>1 Mbps</td>
</tr>
<tr>
<td>Video Conferencing</td>
<td>2 Mbps</td>
</tr>
<tr>
<td>3D Model and Data Visualization</td>
<td>2 to 20 Mbps</td>
</tr>
<tr>
<td>Two way Telepresence</td>
<td>5 to 25 Mbps</td>
</tr>
<tr>
<td>Current-Gen 360 degree video (4K)</td>
<td>10 to 50 Mbps</td>
</tr>
<tr>
<td>Next-Gen 360 degree video (8K, 90+ FPS, HDR, Stereoscopic)</td>
<td>50 to 200 Mbps</td>
</tr>
<tr>
<td>6DoF Video or Point Cloud</td>
<td>200 to 1000 Mbps</td>
</tr>
</tbody>
</table>

Table 1: Throughput of some XR Applications

- As seen from the table [METRICS_1], an XR application such as our use case transmits a larger amount of data per unit time as compared to traditional video applications:
  - As a result, issues arising out of heavy tailed parameters such as long-range dependent traffic [METRICS_2], self-similar traffic [METRICS_3], would be experienced at time scales of milliseconds and microseconds rather than hours or seconds.
  - Additionally, burstiness at the time scale of tens of milliseconds due to multifractal spectrum of traffic will be experienced [METRICS_4].
Section 5.1 Update: Operational Consequences of XR Workload Characteristics

- The operational consequences of XR traffic having characteristics such as long-range dependency, and self-similarity is that the edge servers to which multiple XR devices are connected wirelessly could face long bursts of traffic.

- In addition, multi-fractal spectrum burstiness at the scale of milli-seconds could induce jitter contributing to motion sickness.

- The operators of edge servers will need to run a 'managed edge cloud service' [METRICS_5] to deal with the above problems.
  - Functionalities that such a managed edge cloud service could operationally provide include dynamic placement of XR servers, mobility support and energy management [METRICS_6].
  - Providing Edge server support for the techniques being developed at the DETNET and RAW Working Groups at the IETF could guarantee performance of XR applications.
Section 5.2 Update: XR Performance Metrics

<table>
<thead>
<tr>
<th>Application</th>
<th>Expected End-To-End Latency</th>
<th>Expected Data Latency</th>
<th>Possible Implementations/ Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR-based remote surgery with uncompressed 4K (3840x2160 pixels) 120 fps HDR 10-bit real-time video stream</td>
<td>Less than 750 microseconds</td>
<td>Greater than 30 Gbps</td>
<td>World’s first remote surgery over 5G</td>
</tr>
<tr>
<td>Mobile AR based remote assistance with uncompressed 4K (1920x1080 pixels) 120 fps HDR 10-bit real-time video stream</td>
<td>Less than 10 milliseconds</td>
<td>Greater than 7.5 Gbps</td>
<td>Assisting maintenance technicians, Industry 4.0 remote maintenance, remote assistance in robotics industry</td>
</tr>
<tr>
<td>Indoor and localized outdoor navigation</td>
<td>Less than 20 milliseconds</td>
<td>50 to 200 Mbps</td>
<td>Theme Parks, Shopping Malls, Archaeological Sites, Museum guidance</td>
</tr>
<tr>
<td>Cloud-based Mobile AR applications</td>
<td>Less than 50 milliseconds</td>
<td>50 to 100 Mbps</td>
<td>Google Live View, AR-enhanced Google Translate</td>
</tr>
</tbody>
</table>

Table 2: Traffic Performance Metrics of Selected XR Applications

- The adjoining Table 2 [METRICS_6] shows a taxonomy of applications with their associated expected latencies and bandwidths. Our use case requires an RTT of 20ms at most and preferably between 7-15ms as discussed earlier. The required bandwidth for our use case as discussed in section 5.2 is 200 Mbps-1000 Mbps.
Section 5.2 Update: Operational Consequences of XR Performance Metrics

• Since our use case envisages multiple users running the XR applications on their devices, and connected to an edge server that is closest to them, these latency and bandwidth connections will grow linearly with the number of users.
  • The operators should match the network provisioning to the maximum number of tourists that can be supported by a link to an edge server.
Some additional changes in the draft for WG’s consideration

• Distinguish between the response times required by the XR applications such as our use case and end-to-end latency metric used by network operators.

• Update the numbers as per the above distinction including stating that the latency and throughput numbers reflect the current technology i.e. 2018-till present.

• With these additional changes does the WG think the document will be ready for WGLC?
References


