Ongoing Standardization Activities of Gaming Quality of Experience

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Motivation (I)

- 2.3 billion gamers will spend $137.9 billion on video games in 2018\(^1\)
- Cloud Gaming is one of the most challenging online service
- Companies in the past could not provide acceptable QoE
- Identification of relevant influencing factors
- Investigate methods for gaming QoE assessment
- Apply this knowledge to develop a gaming QoE opinion model

\(^1\) Newzoo quarterly update of its Global Games Market Report 2018
Motivation (II) – What is Cloud Gaming?
- Collaboration of Berlin Institute of Technology and T-Labs (Prof. Sebastian Möller)
- Investigation of QoS and QoE of OnLive (Dennis Pommer)
- Dissertation about influencing factors (Justus Beyer)
- Taxonomy defining gaming QoE (Steven Schmidt)
### What is Gaming Quality of Experience?

<table>
<thead>
<tr>
<th>Influencing factors</th>
<th>User</th>
<th>System</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experience</td>
<td>Static factors</td>
<td>Game genre</td>
<td>Physic. &amp; social environment</td>
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<tr>
<td>Playing style</td>
<td>Dynamic factors</td>
<td>Game structure</td>
<td>Extrinsic motivat.</td>
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<tr>
<td>Intrinsic motivat.</td>
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<td>Game rules</td>
<td>Service factors</td>
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<td></td>
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<td>Server</td>
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<td></td>
<td></td>
<td>Channel</td>
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<tr>
<td></td>
<td></td>
<td>Player &amp; device</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Quality of Experience (QoE)</th>
<th>Quality features</th>
<th>Player experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tension</td>
<td>Hedonic</td>
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<tr>
<td></td>
<td>Immersion</td>
<td>Acceptability</td>
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<td></td>
<td>Positive affect</td>
<td>Pragmatic</td>
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<tr>
<td></td>
<td>Negative affect</td>
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<td></td>
<td>Learnability</td>
<td></td>
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<tr>
<td></td>
<td>Intuitivity</td>
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<td></td>
<td>Challenge</td>
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<td></td>
<td>Competence</td>
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<td></td>
<td>Flow</td>
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</tbody>
</table>

**Input quality**

**Output quality**

**Interactive behavior**

**Interaction quality**

**Learnability**

**Intuitivity**

**Playing quality**

**Hedonic**

**Pragmatic**

**Acceptability**

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[2]
- Creation of **3 work items** in ITU-T SG-12 [3]

- **ITU-T Rec. G.1032 (10/2017) – G.QoE-gaming:**
  - Influence factors on gaming quality of experience

- **ITU-T Rec. P.809 (05/2018) – P.GAME:**
  - Subjective evaluation methods for gaming quality

- **Future ITU-T Rec. G.OMG (studied in Q.13/12):**
  - Opinion model for gaming applications
• Connection with other researchers from AIT in Vienna, FER in Zagreb, University Würzburg, QoE-Net
• Variety of studies
  • **Feedback delay** of mobile devices
  • **Environment** influencing factors
  • **Physiological** measurement for gaming QoE
  • Impact of display size, game type, network delay
  • Open-Source Mobile Cloud Gaming Platform [4]
• Approved Recommendation for G.QoE-Gaming (ITU-T Rec. G.1032)
• Stronger focus on video encoding parameters
• Collaboration with Nabajeet Barman (Kingston)
  ▪ Building gaming video datasets
  ▪ Quality assessment metrics
  ▪ Content comparison
• Evaluation of subjective test paradigms and questionnaires assessing gaming QoE

- **Human** influence factors
  - Gaming experience, Intrinsic and extrinsic motivation, static and dynamic human factors (age, gender), human vision

- **System** influence factors
  - Game genre, mechanics and rules, temporal and spatial features (pace, accuracy), visual perspective, aesthetics and design characteristics, learning difficulty, device portability and size, input and output modalities
  - Network and encoding parameters: delay, jitter, bandwidth, framerate, resolution, rate controller, GoP, motion range, audio and video compression

- **Context** influence factors
  - Physical environment factors, Social context, Service factors, Novelty
- Approved Recommendation for P.GAME (ITU-T Rec. P.809)
  - Encoding Complexity Classification
  - Characteristics responsible for delay sensitivity
    - Saeed Sabet (Simula - Oslo) collaboration
  - Questionnaire assessing input quality
  - Dimension-based assessment of video quality
  - Separation of spatial video and interaction quality
  - Proposal for structure of G.OMG
Ongoing Standardization Activities of Gaming Quality of Experience


- **QoE aspects** of gaming including five engagement concepts
- **Test paradigms: interactive vs. passive**
- **Passive** viewing-and-listening tests with audiovisual stimuli
- **Interactive tests** with game scenes
- Experimental set-up: duration, environment, game material
- How to ensure similar stimuli for participants
- Collection of **questionnaires** and scales
- Player performance measurement
Comparison of interactive and passive tests

![Comparison of interactive and passive tests](image-url)

- **Predict** overall quality or individual quality aspects based on encoding and network parameters
- Two modes depending on available information about game content
- **Scope:**
  - Considering relevant factors identified in ITU-T Rec. G.1032
  - Network planning tool (infrastructure and resource distribution)
  - Target services: cloud gaming
  - Target group: non-professional gamer
  - Not: VR gaming, mobile devices, social aspects (but might be applicable)
  - Not: influence of the design of games or the motivation of users to play
Future ITU-T Rec. G.OMG

<table>
<thead>
<tr>
<th>Influencing Factors</th>
<th>Quality Features</th>
<th>Predicted Gaming QoE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Game Type</strong></td>
<td></td>
<td></td>
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<tr>
<td>Delay Sensitivity</td>
<td>Spatial Video Quality</td>
<td>Q_max</td>
</tr>
<tr>
<td>Encoding Complexity</td>
<td></td>
<td>Overall Gaming Quality (MOS)</td>
</tr>
<tr>
<td><strong>Encoding Parameter</strong></td>
<td></td>
<td></td>
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<tr>
<td>Bit Rate (BR)</td>
<td>Temporal Video Quality</td>
<td>Overall Gaming Quality (MOS)</td>
</tr>
<tr>
<td>Resolution (Res)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Key Frame Interval (KFI)</td>
<td></td>
<td></td>
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<tr>
<td>Frame Rate (FR)</td>
<td>Responsiveness Feedback</td>
<td>Acceptance</td>
</tr>
<tr>
<td><strong>Network Parameter</strong></td>
<td></td>
<td></td>
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<tr>
<td>Packet Loss (PL)</td>
<td>Controllability</td>
<td></td>
</tr>
<tr>
<td>Delay (D)</td>
<td>Interaction Quality</td>
<td></td>
</tr>
</tbody>
</table>

References:
[8]
Future ITU-T Rec. G.OMG

How do you rate the overall quality of your gaming experience?

extremely bad  bad  poor  fair  good  excellent  ideal

I received immediate feedback on my actions.

strongly disagree  disagree  undecided  agree  strongly agree

Fragmentation

fragmented  unfragmented
Future ITU-T Rec. G.OMG

- Requirement specification submitted in May 2018
- Data assessment process will be discussed in Dec 2018
- Spatial video quality shows no impact on input quality

<table>
<thead>
<tr>
<th>Database Name</th>
<th>Paradigm</th>
<th>Parameters</th>
<th>N</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIDEO_DB</td>
<td>passive</td>
<td>bitrate, framerate, resolution, KFI, packet loss</td>
<td>150</td>
<td>Berlin</td>
</tr>
<tr>
<td>DELAY_DB</td>
<td>interactive</td>
<td>round-trip delay</td>
<td>30</td>
<td>Berlin</td>
</tr>
<tr>
<td>FRAME_DB</td>
<td>interactive</td>
<td>encoding framerate</td>
<td>30</td>
<td>London</td>
</tr>
<tr>
<td>PACKET_DB</td>
<td>interactive</td>
<td>input packet loss</td>
<td>30</td>
<td>Oslo</td>
</tr>
<tr>
<td>GRID_DB</td>
<td>interactive</td>
<td>bitrate, framerate, resolution</td>
<td>30</td>
<td>Berlin</td>
</tr>
</tbody>
</table>
Remaining challenges

- Input are system influence factors, potentially augmented by human and context influence factors
- Game characteristics largely determine the impact of system influence factors
- Parametric description of game characteristics missing
- Physiological measurement methods
- Performance metrics
- Fast development of cloud gaming systems
  - Individual network protocols (packet loss influence)
  - Current models not accurate for GPU encoding
Thank you for your Attention!

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We are always searching for collaborations 😊

Visit
www.qu.tu-berlin.de
for more information.
References


