SURVEY OF QUALITY OF EXPERIENCE IN CLOUD GAMING

Asif Ali Laghari et al.
CloudCom 2017
Introduction

- Popularity of cloud gaming has increased since late 2000’s which attract the industry and academia

1. Survey and analyze the previous cloud gaming models and architectures

2. Provide aspects of future development, which will help to provide QoS according to SLA and increase user satisfaction level for cloud gaming
Cloud Gaming

- Render the game at **cloud side** and the gaming video is forwarded to users via high speed network
- Users **send input data** to cloud server and **receive the video frames** for interaction
QoE Provision Architectures

■ Requirements need to be met
  - High processing, high bandwidth network
  - Low packet delay and loss
  - Acceptable frame rate

■ Different parameter for assessment of QoE
  - Video rate
  - Multiplayer platform performance
  - Bandwidth
  - Virtual machine placement
Popular Architectures

■ **GamingAnywhere**
  - An open source cloud gaming system
  - Less network delay compared to the previous systems
  - Network speed is still a major issue

■ **CloudFog** lightweight system
  - Supernodes are used as fog based concept
  - High QoE on low speed networks
  - Increasing user coverage
Analytics

Streaming Based Approaches

- An appropriate and efficient video codex used in streaming can improve QoE a lot
- Three related papers will be introduced in this section
A new bit allocation scheme is proposed on MB layer based on ROI. Important objects are detected and ROI values of every pixel can be generated along with rendered picture. Can compress trivial areas of frame and manage the bitrate for slow networks but not suitable for every user. This approach will not improve the overall QoE of game users.
Subjective MOSs were collected on different games with different frame rates and bitrate.

2 optimal and efficient algorithms were proposed to maximize the average ($\text{EFF}_{avg}$) and the minimum ($\text{EFF}_{min}$) MOSs across all gamers.
2016
Metzger et al.

- End-to-End (E2E) lag model for video games was presented
- Simulation results show that low frame rate has dominant influence on the game frame rate
- The model explains the lag of different type of games and is important for design of QoE assessment
Analytics

Network Based Approaches

- Network is important for cloud gaming for it’s a bridge between the client and cloud server for data transfer
- Another three related papers will be introduced in this section
2013
Jarschel et al.

- Evaluate subjective QoE to analyze the effect of the network delay and packet loss during playing the cloud gaming

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<th>Scenario ID</th>
<th>Delay (ms)</th>
<th>Packet loss (%)</th>
<th>Direction</th>
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<tr>
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2014
Slivar et al.

- Subjective QoE assessments of traditional online gaming and In-home streaming (GA) were proposed
- Widespread use of in-home game streaming is possible if adequate video quality is guaranteed
2017
Muhammad et al.

- Cloud server *send/receive sets of instructions* instead of sending rendered frame data to client
- This model is good for cloud gaming under *low bandwidth for short time period*
Considerations

Following parameters will be considered in the future during the development of cloud gaming models and architectures:

- *Design of QoE capture*
- *Technical parameters*
- *Heterogeneity*
- *Mobility Management*
Considerations

Design of QoE Capture

- Only subjective QoE is considered in cloud gaming but still objective QoE feature are required as well
- Analysis of subjective and objective data can provide information about QoE accuracy and SLA comparison
Considerations

Technical Parameters

- Bitrate or data rate
- Frame Rate
- Throughput
- Network (Packet loss and Delay)
Considerations

Heterogeneity

- As the size of cloud increases the different type of hardware are added to provide more resources
- The future gaming model need to support heterogeneous device and utilize available resource for faster game rendering
Considerations

Mobility Management

- Most mobile users playing games via cellular networks and their location is changed due to mobility
- Data offloading, signal weakness and handoff are disturbing for cloud gaming
- Automatic switching among the different network without disturbing the game can be useful to players
Future Directions

- Speculation-based technology
- Adjustable gaming frame rate depends on network conditions
- Cloud management to ensure QoS according to SLA
- Features of subjective and objective QoE/QoS
- Controlling QoE in runtime environment and QoE optimization
Conclusion

- The paper provides review and analysis the cloud gaming models and architectures based on the QoE of video and network parameters
- Give the definitions of the key concept and background and types of QoE
- Studies and suggestions for future development of cloud gaming are also presented
THANKS FOR LISTENING

Any Question?