The Future of Games: A Study on Cloud Gaming

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Abstract: Recent developments in cloud computing and gaming industry has made cloud gaming a reality. It is a new way to experience a high quality gaming without premium hardware. Cloud gaming offers accessibility of games anytime and anywhere. In cloud gaming, games run on high end hardware in servers with a light-weight thin client receiver on the other side. The hardware on the server renders the game scene and streams back to the client on internet. Cloud gaming is getting popular day by day however, it also faces some challenges. In this paper, we survey the cloud gaming platform and its issues, current commercial services and future research options.

I. INTRODUCTION

Cloud computing has provided countless new openings for both existing and upcoming applications. The infrastructure of cloud gaming provides larger storages, high performance computing, reliable hardware which is ideal for executing games. In cloud gaming, the server where the games are stored does all the computation work which includes game scene rendering, game logic processing, video encoding and video streaming. The thin client on the player’s side does not contain any type of high quality hardware, the main objective of the thin client is to capture the game actions and send them to the server for processing and displaying the incoming game scene from the servers. Figure 1 shows how cloud gaming services work. Cloud gaming is not only restricted to PC and console games, it is also making advancement in mobile gaming as well.

The first cloud gaming technology was demonstrated by G-cluster at E3 in the year 2000. The original idea was to offer cloud gaming service over Wi-Fi to handheld client devices. Later in 2005, video game developer Crytek started research on a cloud gaming system for Crysis, but halted the development in 2007 to wait for the infrastructure and cable internet providers to fulfill the task [1]. Another startups in cloud gaming services like OnLive [2] and Gaikai [3], didn’t last long with OnLive shutting down and Gaikai got acquired by SONY. This followed by the new competition between two major companies, Sony’s Playstation Now [4] and Nvidia’s GeForce Now [5]. This shows the increase of interests of cloud gaming by developers and gamers both. Liquid sky, a new developing cloud gaming service promising a free service to gamers with high quality computing power packed in the servers.

II. ARCHITECTURE

The server side of cloud gaming comprises of two components.

(i) Game logic, interacts with the game environment.
(ii) Game scene renderer, renders the game scene processed by game logic

The thin client comprises of two low-complexity components.

(i) The command receiver, captures the user commands.
(ii) Video decoder, decodes and displays the video on screen...

All the communication between thin client and server happens over the internet.
As seen in the Figure 1, It follows certain steps to complete one iteration of game scene to be generated and played by the gamer. The steps are as follows:

After gamer selects and starts the game to be played.

**STEP 1:** The user plays the game by entering action commands through a keyboard/mouse or a controller. Those are captured by the command receiver and sent to the server.

**STEP 2:** The game commands received on the server will be used by game logic to make changes into the game environment.

**STEP 3:** Changes from game logic will be sent to the GPU rendering, which converts it into a game scene.

**STEP 4:** The created game scene will be taken as an input in video encoder which compresses and encodes the game scene.

**STEP 5:** Encoded game scene then will be streamed back to thin client by the video streaming over the internet.

**STEP 6:** Video decoder of the thin client will decode the game scene and display it on the user’s screen.

### 2.1 ARCHITECTURE ISSUES

During this whole process, there are many areas in which this platform gets its challenges to overcome. Some of the issues are as follows:

1. **Latency:** It is the delay in the overall process. This can happen in this architecture in 3 places
   (i) When user sends commands to the server. (ii) When game scene is generated and encoded and (iii) When the game scene is streamed back. This issue can be a problem for this service and the solution for this problem can be better internet connection and better algorithms for encoding and decoding[6].

2. **Internet Connection:** All of the processes require a fast internet connection which can not be available to every user, it depends from user to user. This issue can make game scenes delay.

3. **Encoding-decoding algorithms:** The quality of the game scene video depends upon the encoder, if the encoder is not up to the mark it can create blurry scenes or low-quality game scenes. This can be overcome by more research and development into encoding of game scenes to make a better quality of experience for users[6].

### III. CURRENT SERVICES

Currently, The cloud gaming market is run by two platform/services by companies like Sony and Nvidia. The **Playstation Now** [4] by Sony and **Geforce Now**[5] by Nvidia are trending and mostly used gamers around the world. Both of the services are almost same. The difference between both is that PS Now uses 8 PS3 as the computing power and Geforce Now uses GRID systems. All the new game titles can be streamed through these services with cheap pricing plans like $10-20 a month approximately. Detailed comparision between both services are shown in below table.

![Cloud Gaming Architecture](image-url)
### Table 1: GeForce Now v PS Now

<table>
<thead>
<tr>
<th></th>
<th>GeForce NOW</th>
<th>Playstation NOW</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td>2448 GFlops</td>
<td>192 GFlops</td>
</tr>
<tr>
<td><strong>Max Quality</strong></td>
<td>1080p 60fps</td>
<td>720p 30fps</td>
</tr>
<tr>
<td><strong>Device</strong></td>
<td>Nvidia Shield</td>
<td>Sony TV and Playstation</td>
</tr>
<tr>
<td><strong>Games</strong></td>
<td>50+</td>
<td>100+</td>
</tr>
<tr>
<td><strong>Pricing</strong></td>
<td>$8/mo</td>
<td>$20/mo</td>
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Apart from these two services, a new emerging service called “Liquid Sky” [7] is in the beta phase. This service provides free access to its server computers with use of sky credits. The new thing about Liquid sky is it offers game titles from almost all online libraries available like steam, origin and Uplast.

The requirements of currently streaming services are a good internet connection, 20Mbps+ recommended for 1080p 60fps games and 5Mbps+ for 720p 30fps.

### IV. FUTURE RESEARCH FIELDS
There are many ways in which overall cloud gaming experience can be better.

1. **Game Engine Integration for Cloud gaming:**
   As seen in the current architecture, the server transmits the encoded stream to user. In this process how the rendered scenes are captured and rendered remains ad-hoc. What can be done is to modify the game source code to program the engine to send out each game scene update once the rendering is finished. By this we can consider the integration of games and cloud gaming platforms. To do this, the framework need to understand the utilization of the game engines and how their platform will handle game scenes.

2. **Video Encoding:** Encoding being a significant part in measuring video quality of the game, further developments and research can be conducted in this area. Currently services uses H.264 Video codec to compress and encode the video for every game. Every game graphic quality is different, some may feature cartoon like graphics whereas some may feature realistic graphics. There are more chances of better video codec development to match the rendering for every game.

3. **Server Hardware Enhancements:** Every game is developed in a way that it takes advantage of full GPU storage and memory. This can create a issue in servers if a common GPU is provided and multiple games are running simultaneously. This can decrease the rendering and display performance of the GPU and makes it a challenging research direction. To overcome, the servers should provide different GPU for each games to let the game run its best and provide a good experience to the users.

4. **Quality of Experience:** The ultimate goal of any cloud gaming service should be to maintain the QoE of its user’s. game playing process is dynamic and it changes according to user inputs therefore there are chances of delay in the process which can be challenging for cloud gaming service.
providers. In some cases, player’s system requires different quality parameters than the default one like internet bandwidth, screen size. So the cloud gaming platform should automatically configure to player’s system to provide a better and satisfactory gaming experience. Also, if the player’s internet bandwidth is low and there is more packet loss, then the platform should set its rendering and streaming capabilities accordingly.

5. **Server selection:** Cloud gaming service will feature many servers across the globe, now the challenge is to provide player with the best server possible depending on the ping of the player. So that the game quality and latency remains in control.

V. **CONCLUSION**

Cloud gaming getting is getting popular and better each day providing players with gaming experience like never before. However, there is wide scope of improvement which can change the gaming industry.

In this article, we viewed the cloud gaming architecture and its issue and also the current scenario of the cloud gaming with comparison. We have also viewed some of the research possibilities in cloud gaming which can be carried out in the future to improve the overall experience. The current cloud gaming is not only limited to PC games but it has reached to mobile games also. There is a lot of scope of new and creative ideas in this field which can change the way games are played.

**REFERENCES**