Technical Seminar Report

On

CLOUD GAMING

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BACHELOR OF TECHNOLOGY
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Submitted
By

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Mahbub College Campus, S.D. Road, Secunderabad -03(2021-2022)

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CERTIFICATE

This is to certify that the Seminar project entitled **"CLOUD GAMING"** is a bonafide work carried out by **M.RUTHVIK MOHAN (18P71A0578)** in partial fulfillment of the requirement for the award of the degree of **BACHELOR OF TECHNOLOGY** in **COMPUTER SCIENCE & ENGINEERING** from Swami Vivekananda Institute of Technology affiliated to JNTU, Hyderabad, under our guidance and supervision.

The results presented in this topic have been verified and are found to be satisfactory. The results embodied in this topic have not been submitted to any other university for the award of any other degree or diploma.

Internal Guide	Head of the Department
Mr. Manish	**Dr. J. Manoranjini**
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Department of CSE,	Department of CSE,
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DECLARATION

This is to certify that the work reported in the present project entitled "**CLOUD GAMING"** is a record of bonafide work done by us in the Department of Computer Science and Engineering, Swami Vivekananda Institute of Technology, JNTU Hyderabad. The reports are based on the project work done entirely by us and not copied from any other source. We submit our project for further development by any interested students who share similar interests to improve the project in the future.

The results embodied in this project report have not been submitted to any other University or Institute for the award of any degree or diploma to the best of our knowledge and belief.

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M.RUTHVIK MOHAN

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CLOUD GAMING:From On-Premises to the Cloud

Introduction:

Cloud gaming has been a topic of interest in the gaming industry for several years now. The concept of cloud gaming is to remotely render an interactive gaming application and stream the scenes as a video sequence back to the player over the internet. The great majority of less capable devices that only support thin clients, such as smartphones and tablets, are now included in the user base of these new gaming services, which has enormous advantages. The gaming industry has been revolutionized with the emergence of cloud gaming platforms such as OnLive and Gaikai. The $380 million purchase of Gaikai by Sony, an industrial giant in digital entertainment and consumer electronics, and the forthcoming integration of Gaikai and Sony's Play Station 4 show that cloud gaming is beginning to move into the mainstream.

Background and related work:

Cloud gaming has been a topic of interest in the gaming industry for several years now. The concept of cloud gaming is to remotely render an interactive gaming application and stream the scenes as a video sequence back to the player over the internet. This new paradigm of gaming services brings immense benefits by expanding the user base to the vast number of less powerful devices that support thin clients only, particularly smartphones and tablets. The gaming industry has been revolutionized with the emergence of cloud gaming platforms such as OnLive and Gaikai. The $380 million purchase of Gaikai by Sony, an industrial giant in digital entertainment and consumer electronics, and the forthcoming integration of Gaikai and Sony's Play Station 4 show that cloud gaming is beginning to move into the mainstream.

Existing cloud gaming platforms tend to focus on private non-virtualized environments with proprietary hardware, where each user is mapped in a one-to-one fashion to a physical machine in the cloud. Modern public cloud platforms heavily rely on virtualization, which allows multiple virtual machines to share the underlying physical resources, making truly scalable play-as-you-go service possible. Despite their simplicity and ease of deployment, current cloud gaming platforms haven't fully utilised the modern cloud's capabilities in order to expand to extremely high scales with flexible services. However, moving games to a public cloud, such Amazon EC2, is not simple. For efficient virtual resource sharing with little overhead, the system components should be carefully planned. Modern game engines also depend on dedicated graphics processing units in addition to the general purpose CPU as the complexity of 3-D rendering rises (GPUs). While contemporary virtualization systems have virtualized GPU cards to some extent, their performance has historically been poor for the given ultrahigh memory transfer demand and the unique data flows.

Recent advances in terms of both hardware and software design have not only increased the usability and performance of GPUs but also created new classes of GPUs specifically for virtualized environments. A representative is NVIDIA's recently released GRID Class GPUs, which allows multiple virtualized systems to each utilize a dedicated GPU by placing several logical GPUs on the same physical GPU board. It also contains a hardware H.264 video encoder and similar onboard hardware. Other market leaders, including Intel's Quick Syne Video and Advanced Micro Devices' (AMD's) video coding engine, offer encoders in its GPUs. With the help of these new hardware developments from almost all of the main GPU vendors, we can now deploy online gaming systems in a public cloud setting.

Essential Characters Of Cloud Gaming:

The essential characters in the process of cloud gaming include the following:

1. **Game Developer:** The game developer creates and develops the game that will be played on the cloud.
2. **Cloud Server:** The cloud server is responsible for running the game on the cloud and providing the necessary resources for the game to run smoothly.
3. **Thin Client:** The thin client is the device that the player uses to interact with the game. It is responsible for displaying the video from the cloud rendering server and collecting the player's commands and sending the interactions back to the cloud.
4. **Player:** The player is the person who is playing the game. They interact with the game through the thin client and control the game's actions.
5. **Network:** The network is responsible for transmitting the video and player interactions between the cloud server and the thin client. A stable and fast network is essential for a smooth gaming experience.
6. **Video Encoder:** The video encoder is responsible for compressing and encoding the video data before it is sent to the thin client. This is necessary to ensure that the video can be transmitted over the network efficiently.
7. **Video Decoder:** The video decoder is responsible for decoding the video data on the thin client and displaying it on the screen.
8. **Game Engine:** The game engine is the software that controls the game's physics, graphics, and other interactive elements. It is responsible for rendering the game's scenes and providing the game's logic.
9. **GPU:** The GPU is a dedicated graphics processing unit that is responsible for rendering the game's 3D graphics. It is an essential part of modern game engines and is necessary for providing a high-quality gaming experience.

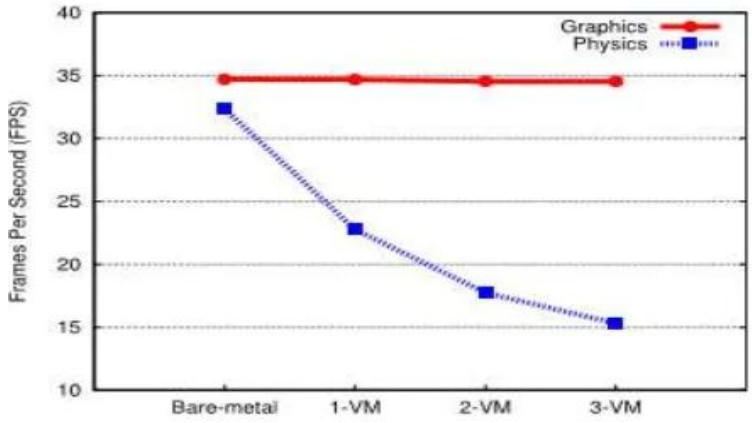
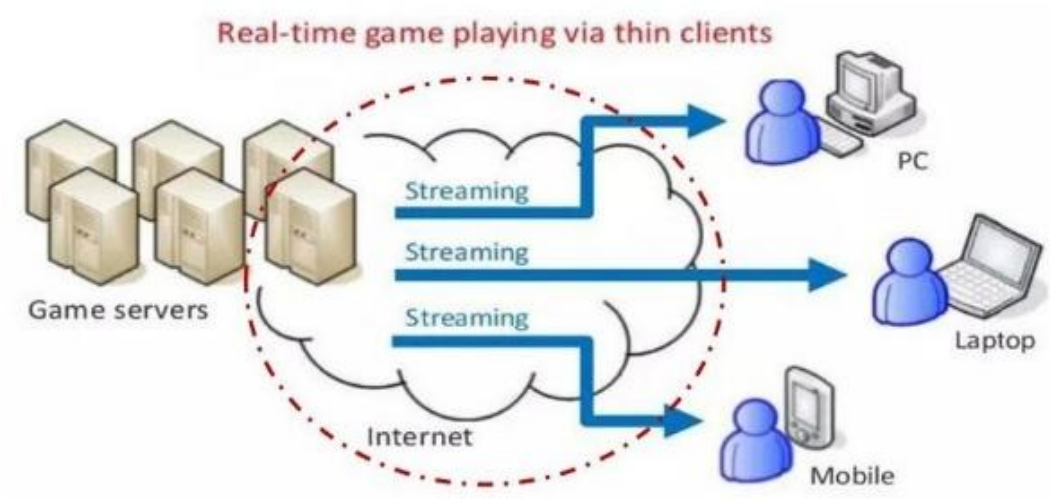
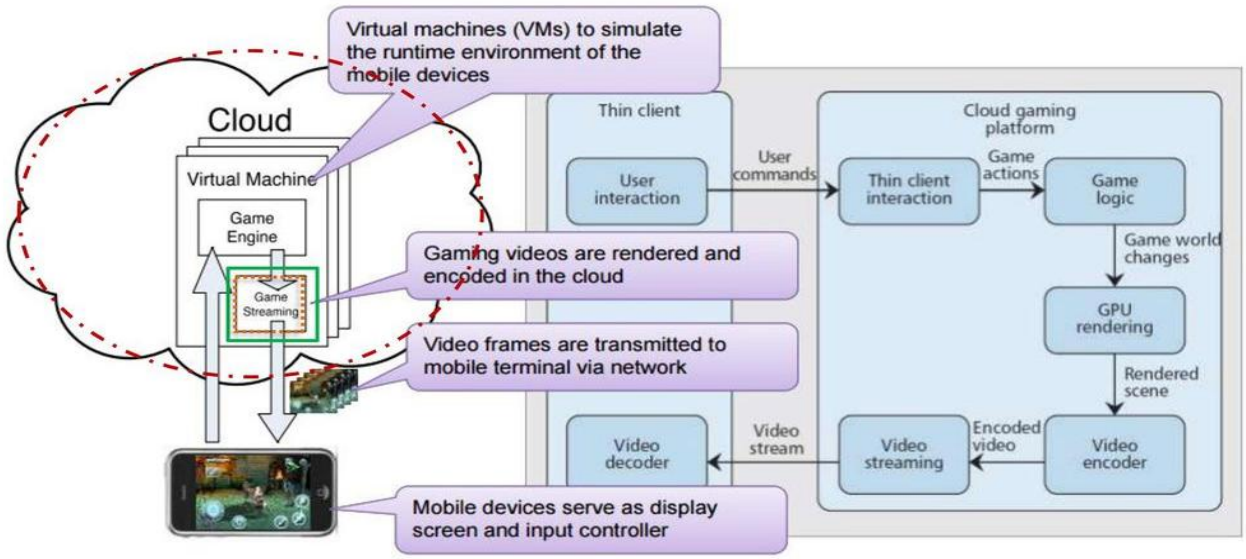


Fig.Advanced:3DMark frame rate.

Architecture:





Design and Implementation:

The design and implementation of a cloud gaming system can be broken down into several key components:

1. **Remote Rendering:** The most important aspect of cloud gaming is the ability to render the game remotely in the cloud and stream the video back to the player. This requires a powerful and scalable cloud infrastructure capable of handling the high-definition 3-D rendering and video encoding.
2. **Thin Client:** The player interacts with the game through a thin client, which is responsible for displaying the video from the cloud rendering server and collecting the player's commands and sending the interactions back to the cloud.
3. **Virtualized Environment:** Public cloud platforms heavily rely on virtualization, which allows multiple virtual machines to share the underlying physical resources, making truly scalable play-as-you-go service possible.
4. **GPU Virtualization:** Modern game engines rely not only on the general purpose CPU for computation but also on dedicated graphics processing units (GPUs). GPU virtualization is essential for effectively sharing resources with minimal overhead.
5. **Game Engine Integration:** The game engine must be integrated with the cloud infrastructure and the thin client to ensure smooth and seamless gameplay.
6. **Network Optimization:** High-definition video streaming requires a stable and fast internet connection, thus network optimization is crucial for the quality of service.

In terms of implementation, a cloud gaming system can be built on top of existing public cloud platforms such as Amazon EC2 or Microsoft Azure. The system can also leverage existing open-source cloud gaming systems such as Gaming Anywhere for Android OS.

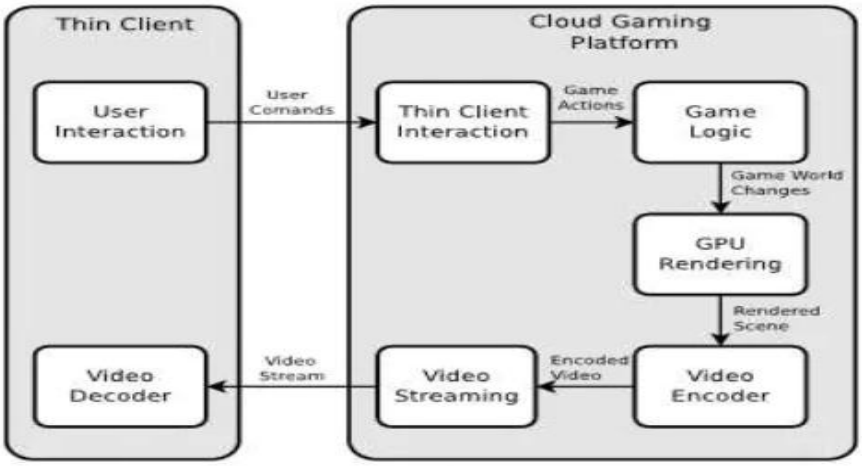


Fig. Rhizome architecture

Differences between tradional gaming and cloud gaming:

Traditional gaming refers to playing games on a dedicated gaming console or PC, where the game is stored and executed on the local device. This typically requires a high-end system with a powerful processor and graphics card to run the game smoothly. The player must also have a physical copy or digital download of the game to play it.

Cloud gaming, on the other hand, refers to playing games on a remote server accessed through the internet. The game is stored and executed on the remote server, and the player interacts with the game through a thin client, such as a web browser or streaming app. The player does not need to have a high-end system to run the game, as the processing power and graphics are handled by the remote server. The player also does not need to have a physical copy or digital download of the game, as they can access it through the cloud gaming platform.

The main difference between traditional gaming and cloud gaming is that in traditional gaming the game is stored and executed on the player's device, while in cloud gaming the game is stored and executed on a remote server and the player interacts with the game through a thin client. This allows for cloud gaming to be accessible to a wider range of devices and eliminates the need for expensive hardware.

Advantages of Cloud gaming:

1. **Increased accessibility:** Cloud gaming allows players to access high-quality games on a wide range of devices, including smartphones and tablets, without the need for expensive hardware.
2. **Improved scalability:** Cloud gaming can handle large numbers of players and deliver a seamless gaming experience, even during peak usage times.
3. **Reduced costs:** Cloud gaming eliminates the need for expensive hardware and software, reducing the cost of gaming for both players and game developers.
4. **Enhanced graphics and performance:** Cloud gaming allows for the use of powerful servers and GPUs, delivering high-quality graphics and improved performance for players.
5. **Easy game updates and maintenance:** Cloud gaming allows game developers to easily update and maintain games, ensuring that players always have access to the latest versions.
6. **Better data analytics:** Cloud gaming provides game developers with real-time data analytics and player behavior insights, allowing them to make data-driven decisions and improve the gaming experience.
7. **Flexibility:** Cloud gaming allows players to access their games on different devices and platforms, making it more convenient and accessible.
8. **Easy cross-platform play:** Cloud gaming enables players to play with friends on different platforms and devices, which is very convenient.

9. **Better performance:** Cloud gaming ensures that the game's performance is not affected by the player's device's performance, as it is rendered on the cloud servers.

Issues and Challenges of Cloud Gaming:

1. **Latency:** The biggest challenge faced by cloud gaming is latency, which is the delay between a player's input and the corresponding action on the screen. This can cause issues such as lag and stuttering, making the game unplayable.
2. **Bandwidth:** Cloud gaming requires a high-speed internet connection and a large amount of bandwidth. This can be a problem for players living in areas with poor internet infrastructure.
3. **Security:** Cloud gaming platforms store sensitive data such as user login information and financial details. This makes them vulnerable to hacking and cyber attacks.
4. **Quality of Service:** The quality of service offered by cloud gaming providers can vary greatly. This can lead to problems such as poor graphics and low frame rates.
5. **Cost:** Cloud gaming can be more expensive than traditional gaming, especially for players who prefer to own their games rather than renting them.
6. **Scalability:** Cloud gaming platforms need to be able to handle a large number of players at any given time. This can be a challenge for providers, as they need to scale their infrastructure to meet demand.
7. **Compatibility:** Cloud gaming platforms may not be compatible with all devices, which can be a problem for players who want to access their games on multiple devices.
8. **Reliance on Third-Party Providers:** Cloud gaming platforms rely on third-party providers for infrastructure and services. This can be a problem if the provider experiences issues, resulting in service disruptions for the gaming platform.

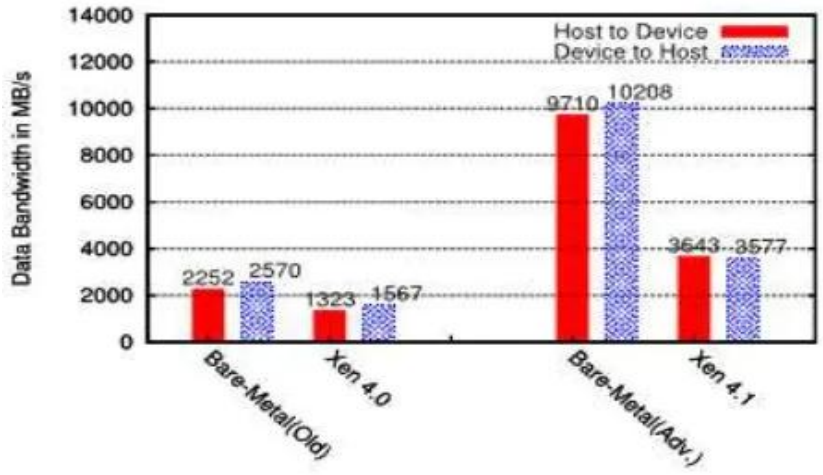


Fig:Memory bandwidth by the system.

SWOT Analysis:

Strengths:

- Cloud gaming allows for high-definition 3-D rendering and provides a flexible, scalable platform for gaming.
- It can expand the user base to a vast number of less powerful devices that support thin clients only, particularly smartphones and tablets.
- Cloud gaming enables play-as-you-go services and reduces the need for powerful hardware on the client side.
- It can also decrease the cost of game development by leveraging the resources of the cloud.

Weaknesses:

- Cloud gaming requires a fast and stable internet connection, which can limit the number of players who can participate.
- Cloud gaming services can be expensive and may require subscription fees.
- Some players may prefer the control and customization options that come with traditional gaming.
- The quality of cloud gaming may vary depending on the provider, leading to a lack of consistency for players.

Opportunities:

- Cloud gaming could expand the gaming market by providing a platform for players with less powerful devices.
- New technologies such as 5G and edge computing could improve the speed and stability of internet connections, making cloud gaming more accessible.
- Cloud gaming could enable new business models, such as pay-per-play or subscription-based services.
- Cloud gaming could also enable the development of new and more complex games that would not be possible on traditional gaming platforms.

Threats:

- The rise of mobile gaming could reduce the demand for cloud gaming services.
- New technologies such as virtual and augmented reality could make cloud gaming less attractive to players.
- The cost of cloud gaming services could limit the number of players who can afford to participate.
- Security and privacy concerns could also limit the adoption of cloud gaming.

Future Scope:

As the gaming industry continues to evolve and adapt to new technologies, the shift towards cloud gaming is becoming increasingly evident. The ability to stream high-quality games to a wide range of devices, along with the scalability and flexibility offered by cloud computing, make it an attractive option for both game developers and players alike.

One potential future scope for cloud gaming is the integration of virtual and augmented reality. By utilizing cloud resources, VR and AR gaming experiences could become more accessible and widely available, potentially revolutionizing the gaming industry.

Another area of growth for cloud gaming is the expansion into the mobile gaming market. As more and more consumers turn to their smartphones and tablets for gaming, the ability to stream high-quality games to these devices through the cloud could greatly increase the reach and revenue potential for game developers.

Additionally, the use of blockchain technology in cloud gaming could also lead to new possibilities in terms of in-game economies and player-to-player trading.

Overall, the future of cloud gaming looks promising as the technology and infrastructure continue to improve and expand. As the gaming industry continues to evolve and adapt to new technologies, the shift towards cloud gaming is becoming increasingly evident. The ability to stream high-quality games to a wide range of devices, along with the scalability and flexibility offered by cloud computing, make it an attractive option for both game developers and players alike.

Conclusion:

The gaming industry is constantly evolving and cloud gaming has become a reality. The emergence of cloud gaming platforms such as OnLive and Gaikai has revolutionized the gaming industry and it is moving into the mainstream. The $380 million purchase of Gaikai by Sony, an industrial giant in digital entertainment and consumer electronics, and the integration of Gaikai and Sony's Play Station 4 show the potential of cloud gaming. The benefits of cloud gaming are numerous, including the ability to expand the user base to less powerful devices, the ability to play games on-demand, and the ability to reduce the costs of gaming by eliminating the need for expensive hardware.

However, there are also challenges associated with cloud gaming. One of the biggest challenges is the migration of gaming services to a virtualized cloud environment. This requires careful planning for effective virtual resource sharing with minimal overhead. Additionally, as the complexity of 3-D rendering increases, modern game engines rely on both general-purpose CPUs and dedicated graphics processing units (GPUs). While GPU cards have been virtualized to some degree in modern virtualization systems, their performance has historically been poor for the given ultra-high memory transfer demand and the unique data flows.

Recent advances in both hardware and software design have increased the usability and performance of GPUs and have created new classes of GPUs specifically for virtualized environments. A representative example is NVIDIA's recently released GRID Class GPUs, which allows multiple virtualized systems to each utilize a dedicated GPU by placing several logical GPUs on the same physical GPU board. It also contains a hardware H.264 video encoder and similar onboard hardware encoders are available in GPUs from other industry leaders such as Intel's Quick Syne Video and Advanced Micro Devices (AMD's) video coding engine. These new hardware advances from nearly every major GPU vendor allow us to take a step forward in the deployment of online gaming systems in a public cloud environment.

In conclusion, cloud gaming is a revolutionary technology that has the potential to change the way we play games. The benefits of cloud gaming are numerous, but there are also challenges associated with migrating gaming services to a virtualized cloud environment. However, recent advances in hardware and software design have increased the usability and performance of GPUs and have created new classes of GPUs specifically for virtualized environments. These advances make it possible to take a step forward in the deployment of online gaming systems in a public cloud environment. With the constant evolution of cloud gaming, the future of gaming looks very promising.

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