

## Directional Research on 5G Networks and Game Streaming Services

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### **Abstract**

*With the recent commercialization of the 5th generation mobile communication technology (5G), interest is focused on full-fledged wireless communication service products in related industries that apply the technology. In this paper, "the problems of the cloud-based video game streaming service market, which has been stagnant for a long time due to the existing 4G-based transmission delay, processing delay, and price issues, and the problems of 5G mobile communication, which began commercialization in 2019."*

*We contains information about what type of positive changes a cloud-based video game streaming service incorporating technology will bring.*

**Keywords:** *5th Generation Mobile, 5G mobile, Gathering, Game Streaming, Cloud*

### **1. INTRODUCTION**

On April 3, 2019, 5G mobile communication services were commercialized for the first time. 5G is a communication technology that is more advanced than the existing 4th generation communication and has a maximum speed of 20Gbps. Compared to LTE, the maximum speed is faster and the processing capacity is greater. Virtual reality, autonomous driving, and Internet of Things technologies can be implemented through its strengths of ultra-low latency and hyper-connectivity.

Such advancements in communication technology have created sufficient conditions to bring back attention to the sluggish cloud-based game streaming market. Cloud computing-based game streaming services, which were commercialized even before the 5th generation of mobile communications, have attracted great expectations due to their potential to overcome spatial and financial constraints for game users.

However, contrary to expectations, this service had technical problems so significant that it could safely be considered a failure. One of them is the time delay problem. Because gameplay is performed in a streaming manner, the control signals input by the gamer through the keyboard or gamepad are not immediately reflected on the gamer's terminal screen and have a 'delay time'. In turn-based games such as board games, the time delay problem did not have a significant impact on the game, but in games where reaction speed is important, such as real-time strategy simulation games and fighting games, the slow response speed was applied as a fatal disadvantage to smooth gameplay.

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As the interest of users gradually cooled due to the above situation, the number of users in the game streaming service market decreased significantly, and now, except for some companies, most of the services have been terminated. However, with the commercialization of the 5th generation mobile communication technology, the time delay problem, which was a fatal drawback of cloud game streaming services, could be largely resolved, and the cloud game streaming service market began to emerge again, led by global conglomerates.

This paper analyzes existing cloud computing-based game streaming services in Chapter 2. Chapter 3 analyzes the characteristics of the 5th generation network technology and the changes this technology will bring to the game streaming market. Chapter 4 concludes by describing what game developers need to prepare for the changing streaming market.

## 2. EXPERIMENTS

### 2.1 5G mobile communication

#### 2.1 What is 5G?

Fifth generation (5G) mobile communication, as defined by the International Telecommunication Union (ITU), refers to providing data transmission speeds of up to 20Gbps and an experienced transmission speed of at least 100Mbps or more anywhere. The official name is 'IMT-2020' and the goal is to commercialize it globally in 2020.[5].

#### 2.2 Characteristics of 5G

A characteristic of 5G is low latency. Low latency means that there is no delay in response speed when communicating between objects. Comparing Long Term Evolution (LTE), the currently used 4G mobile communication technology, with 5G, theoretically the maximum speed of 5G is 20 times faster and the lag time is 1ms, which is 1/20th of LTE's 20ms [6]. According to an article dated February 20, 2018, "KT, along with Samsung Electronics and Qualcomm, is conducting data communication based on the 5G NR (New Radio) standard, the 5G international standard of 3GPP (Global Organization for Mobile Communications) at Samsung Electronics Digital City in Suwon, Gyeonggi-do. "It was successful," he said.

#### 2.3 Network Slicing

The core of 5G is network slicing. Network slicing means creating a logically separated network end-to-end, including Device, Access, Transport, and Core, through one physical network, and creating a dedicated network specialized for that service for various services with different characteristics. It is provided [8]. In other words, the core of network slicing is to reduce costs and build infrastructure quickly by creating multiple logical networks on one physical network.

Before 5G, mobile communication services only required a network structure optimized for mobile phones. However, with the advent of the Internet of Things era, network slicing has become an essential technology in this era where communication between IoT and M2M is important, and 5G network slicing is becoming a major issue at IETF meetings.



Figure 1. Differences between existing transaction methods and blockchain methods[1]

While the previous CDMA (2nd generation), WCDMA (3rd generation), and LTE (4th generation) were merely communication networks connecting mobile phones, 5G is a technology that goes beyond mobile phones and connects all electronic devices. Accordingly, 5G is expected to bring about tremendous changes in various fields, including smart factories, telemedicine, unmanned delivery, and cloud and streaming games, in conjunction with virtual reality (VR), Internet of Things (IoT), artificial intelligence (AI), and big data. [5].

### **3. RESULTS**

#### **3.1. cloud computing**

##### 3.1.1 What is cloud computing?

Cloud computing refers to a computer environment in which information is permanently stored on servers over the Internet and temporarily stored on clients such as desktops, tablet computers, laptops, and smartphones [1]. In other words, the concept is that all user information is stored on a server via the Internet, and the stored information can be used anytime, anywhere on any device that can use the Internet.

The etymology of the term cloud computing is unclear, but it was used as a metaphor for the Internet and is currently used to refer to a platform for distributed computing. References to cloud computing in the modern sense appeared in 1996 with an initial mention in Compaq internal documents [2].

##### 3.1.2 Advantages of cloud computing

When individuals or companies use cloud computing services, they save most of their time and human resources, including the cost of maintaining, repairing, and managing their own computer system, server purchase and OS costs, system update costs, and software purchase costs. can be reduced. In addition, information loss on the hard disk may occur due to any external shock or internal system problem, but if you use a cloud computing service, you can store your data more safely because the risk that an individual would have to bear is borne by a professional cloud computing service company. In addition, you can overcome storage space limitations, and you can view and modify documents registered in the cloud from anywhere without having to build your own server.

##### 3.1.3 Problems of cloud computing

A cloud computing service is a service that manages the role of servers previously used by individuals or companies. As a result, companies that provide cloud computing services cannot be free from external physical shocks and hacker attacks. If the server is hacked, personal information may be leaked, and if a server failure occurs, data becomes unusable. Although we have established more systematic defense measures than any other individual or company, we are concerned that perfect security cannot be achieved.

#### **3.2 Game streaming service**

##### 3.2.1 What is a game streaming service?

A game streaming service is a service that allows you to play games by accessing a platform without having to download the game or purchase a CD [3]. If the user has a specific device that can transmit and receive data over the Internet, the game can be played anytime, anywhere as long as there is Internet access.

##### 3.2.2 Advantages of game streaming services

To play games in an environment before game streaming services, game data had to be saved on PC, mobile, or console. The device that stored the game read the game's data and performed the necessary calculations, and the efficiency of this process was greatly influenced by the performance of the device. In order to have a comfortable gaming experience, users had to invest a lot of money in improving the performance of their devices. However, if you use a game streaming service, the cloud center bears the burden of computation to run the game and only the final graphic results of the processed data are streamed to the user, so the user's device only spends resources on receiving images and transmitting input data. You

just need to consume it. For this reason, users who use game streaming services do not need separate execution time or update processes. Additionally, since game data is stored on a cloud server, high-end devices are not required, lowering the barrier to entry.

### 3.2.3 Disadvantages of game streaming services

Cloud gaming services still have many technical limitations. Since the concept is to enjoy games over a network, latency issues are the biggest problem [4].

Long latency becomes a fatal weakness when users play games that require real-time response. Users become frustrated because they cannot respond immediately, and if they are continuously exposed to such situations, they will eventually stop using the service.

## 4. DISCUSSION

### 4.1 Playstation Now (PS Now)

#### 4.1.1 What is PS Now?

Playstation Now (PS Now) is a cloud game streaming service developed by Sony Interactive Entertainment. PS Now, launched on July 31, 2014, acquired a video game streaming technology provider called 'gaikai' in 2012[9] and released on April 2, 2015. We acquired a patent from 'OnLive', a cloud virtualization technology provider in Mountain View, California, and incorporated it into our own technology [10].

#### 4.1.2 Features

A feature of PlayStation Now is that the platform allows users to stream games to PS4 or PC without directly purchasing a PS2, PS3, or PS4 console. PS Now is currently available in some European countries, North America, and Japan.

#### 4.1.3 Minimum specifications

The specifications for using PS Now are as follows:

#### 4.1.4 Disadvantages

The downside of PS Now is low-quality video with limited bandwidth. Since it is fixed at 720p, users with high-end PCs or the latest version of consoles will be dissatisfied with the quality unless they intentionally play games with low specifications.

Another disadvantage of PS Now is that additional service costs, such as having to use only a designated controller and paying additional fees to play multiplayer, put pressure on consumers' wallets.

### 4.2 Nvidia GeForce Now

#### 4.2.1 What is GeForce Now?

GeForce Now is a cloud gaming service provided by Nvidia. The law is only in operation in North America or some European countries, and as of April 26, 2019, it is a free beta service.

#### 4.2.2 Features

A unique feature of GeForce Now is Ultra Streaming Mode. This mode emphasizes that it can transmit over 60 to 120 FPS and reduces latency.

#### 4.2.3 Service

At GTC (GPU Technology Conference) 2019, Nvidia announced the GeForce Now Alliance, a partnership with operators using Nvidia RTX servers. The first partners were LG U+, a domestic telecommunications company, and Softbank of Japan [12].

### **4.3 Xcloud**

(MicroSoft) This is a cloud game streaming service being prepared by MS. This project is called Project XCloud, and MS Gaming Cloud Vice President Karim Choudhary said, "The ultimate goal of XCloud is currently under internal testing and is scheduled to be released in 2019[11]."

### **4.4 Stadia**

#### **4.4.1 What is Stadia?**

This is a video game streaming service released by Google. In the pre-release development stage, it was called Project Stream. Stadia is a service based on YouTube, and you can enjoy games at FHD 60 frames through real-time streaming anytime, anywhere on any device that has the specifications for YouTube playback.

#### **4.4.2 Hardware specifications**

The hardware specifications of the server provided by Stadia are as follows.

In order to provide users with the highest quality AAA gaming environment, we have partnered with Intel and AMD to produce and use stadia-specific CPUs and GPUs with specifications that are different from those of regular PCs.

#### **4.4.3 Features**

Stadia's unique advantage is that it is a service linked to YouTube, the world's largest video platform. You can participate in the game of a streamer who broadcasts game streaming through YouTube with one click. Stadia allows you to instantly save your game playing status and share it with other users. Additionally, it supports integration with Google Assistant, which is familiar to Google users, providing immediate help to users who may have difficulty using it.

## **5. CONCLUSION**

In the early days, companies providing game streaming services attempted to solve the latency problem by converging 4G network technology and cloud computing technology. However, as they were unable to solve complex problems such as limitations in the development of 4G network technology, the number of products being serviced, and frequent errors, they were unable to shake off consumers' complaints and ended most of their services.

Complex problems still exist, but they are gradually improving with technological advancements. With the advent of Giga Internet and 10 Gigabit Internet services, which provide 10 times faster speeds than existing 100 Mbps Internet services, the speed of wired networks has increased dramatically. Although it has not yet improved significantly, the commercialization of 5G networks will solve the problem of speed delays in wireless communication. This is because the basic foundation has been laid.

Most game streaming companies preparing services recently are advertising the quality of cloud game streaming they will provide in the future, emphasizing their low latency and fast networking speeds. This is because the problem with game streaming companies that previously failed to provide services was the time delay issue. This is because we believed that if 5G technology was applied to our network and user platforms, we would be able to provide services stably, unlike existing failed companies. At the time when Google, a giant dinosaur company, launched a service called Stadia, most people had mixed expectations that Google would be able to do it.

For a cloud-based game streaming service to succeed, technology that creates fast and smooth communication is important, but support from telecommunications companies and the government to create such a communication environment is also important.

The prevailing opinion is that it is too early to commercialize the current 5G mobile communication. In

fact, when you go out on the street with a smartphone that supports 5G, you will often find areas where you cannot receive a proper signal. Only 5G mobile communication, which emphasizes ultra-low latency, still has results that do not even reach the level of 4G LTE [13]. Because 5G has a high frequency band, the wavelength does not travel as far as 4G. To compensate for these shortcomings, it is necessary to install more 5G base stations than the existing generation. I believe this will be resolved over time, but the time and cost involved are too variable to predict. Even if facilities are completed nationwide, it is inevitable that delays will occur if the distance between the cloud center and users is long. Therefore, game streaming companies will be able to provide proper services to consumers only by establishing cloud centers in each service country and building infrastructure.

The next-generation game streaming service is promoting cross-platform as its basis. It is a big advantage that consumers can enjoy AAA games on a variety of devices without being concerned about hardware limitations, but I wonder if cross-platform has much meaning because the interface that the game requires from the user and the limits of the interface that the device can provide are different. Do it too. Companies will only be able to make use of the meaning of cross-platform if they design a new interface compatible with each game with the cooperation of game companies or make and sell external interface equipment.

In order to succeed in the game streaming market, the participation of game developers is also an important factor. Looking at Stadia's Stream connect function, you can create a completely different genre of game play experience by using game data, such as using video as a texture in the game, importing audio to your screen, etc. [14]. Creating a new ecosystem for the game genre by differentiating it from existing games will have a very positive effect on the game streaming market.

## REFERENCE

- [1] Doosan Encyclopedia, Cloud Computing,
- [2] Antonio Regalado, Who Coined 'Cloud Computing'?, Technology Review, MIT, 2011.10.31
- [3] pmg Knowledge Engine Research Institute, Game Streaming, Naver, Naver Knowledge Encyclopedia, Dictionary of Current Affairs
- [4] Oh Won-seok, cloud games, blotter, Naver, IT in terms
- [5] Kim Il-hwan (Deputy Director of KT Network Strategy Division), 3GPP 5G standardization trend, TTA Korea Information and Communication Technology Association, ICT Standard Weekly, 2016.03.07
- [6] wiki, 5G, 2019.04.18.
- [7] Maeil Business Newspaper, verification of compatibility between heterogeneous equipment based on 3GPP 5G NR standards, Yonhap News, 2018.02.20.
- [8] Yoo Chang-mo, Son Jang-woo, 5G Core Technology-E2E Network Slickng, NETMANIAS, 2015.11.23.
- [9] wikipedia, en.wikipedia.org/wiki/Gaikai, 2019.04.25.,
- [10] wikipedia, en.wikipedia.org/wiki/OnLive, 2019.04.25.
- [11] Microsoft blogs.microsoft.com/blog/2018/10/08/project-xcloud-gaming-with-you-at-the-center, 2018.10.08
- [12] Nvidia blogs.nvidia.com/blog/2019/03/19/geforce-now-alliance/, 2019.03.19.
- [13] www.mk.co.kr/news/culture/view/2019/04/266461/
- [14] https://stadia.dev/intl/en/blog/stream-connect:new-possibilities-for-multiplayer-gameplay/