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Cloud computing technology applied in 5G mobile communication network

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Abstract. 5G mobile communication network and cloud computing are the technological products and focus of today's era. Compared to 5G, 5G has seen a huge increase in peak speeds to 10-20Gbit/s, air interface latency as low as 1ms and much more. Cloud computing uploads data to the cloud so that users can access it more easily. They bring great convenience and high working efficiency to people's life. The use of cloud computing in 5G could make more efficient.5G, as a combination of new technology and cloud computing, will become a much larger market. This paper mainly describes the theoretical basis of 5G mobile communication network and cloud computing, the application of cloud computing in 5G (including automatic driving technology, surgery mobile communication network) and the current dilemma and the improvement needed. It aims to further promote the combination of 5G mobile communication network and cloud computing.

Keywords: 5G, cloud computing, mobile communication network.

1. Introduction

Nowadays the Internet of Things is an important topic. The Internet of things can not only bring convenience to work, but also facilitate life. Devices are interconnected and information is shared, improving production efficiency and productivity, and reducing production costs. It will advance intelligence and information technology and present fresh opportunities and difficulties for societal advancement. The birth of cloud computing and 5G bring great technical support to the Internet of Things. 5G could also further improve the efficiency of cloud computing [1].

This paper aims to introduce technology of cloud computing and 5G, research the combination of cloud computing and 5G, how will it be developed and applied in the future and the current predicament and its improvement. This paper studies cloud computing technology application in 5G mobile communication including automatic driving technology and telemedicine Surgery. Self-driving cars, sometimes referred to wheeled mobile robots, are a type of intelligent car that makes use of a computer system to realize driverless driving. It has a long history dating back to the 20th century, and in the early 21st century, it seems to be following the practical trend. Autonomous vehicles rely on a

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variety of technologies, including artificial intelligence, computing visually, radar, monitoring equipment, and global positioning systems, to enable computers to drive cars safely and autonomously without any active human input.

The term "telemedicine" refers to that when the injured are in remote areas or the local medical conditions are lacking, remote sensing and other technologies can be used to carry out surgery for the injured, which greatly improves the convenience of surgery and also improves the efficiency.

2. Theoretical basis

2.1. Theoretical basis of cloud computing

The Internet has been around since 1960, However, the phrase gained popularity sometime after IBM and Google announced their partnership in that field in October 2007 [2].

Cloud computing is a type of distributed computing, which is split a huge data processing program into countless small programs. Following that, the system's numerous servers process and analyze these little programs to produce results and deliver them to users. Briefly, simple distributed computing, which involved solving job distribution and pooling the results, was cloud computing in its early stages. As a result, cloud computing is often referred to as grid computing. With the use of this technology, effective network services can be produced by processing tens of thousands of data in only a few seconds. Essentially, a "cloud" is a network. Cloud computing is a network that offers resources, to put it simply. Resources on the "cloud" can be obtained by users at any time and used as needed. In the commercial sector, the idea of the cloud has existed for a very long time in a variety of forms. In order to deliver software and data, it mostly refers to a grid of computers acting as a service-oriented architecture [2]. Service is the core idea of cloud computing, so the services realized through cloud computing are called cloud services. According to cloud computing's fundamental tenets, the characteristics and advantages of cloud services are shown in the following aspects:

1. Data is in the cloud. "Cloud computing" will be an important turning point in the development of information technology by connecting large arrays of computers into a social institution that provides computing services to users around the world. As cloud computing advances, the Internet's computer architecture will change from "server + client" to "cloud service platform + client". "Cloud computing" will change the traditional production mode based on personal computers, and will eventually change the way people obtain information, share content, and communicate with each other. It is no longer important whether individuals' own computers. You don't need to buy and install a lot of software packages on your computer. You just need to connect to "cloud services".

2. High reliability and versatility. To provide high reliability of services, "Cloud" uses techniques like fault-tolerance of multiple copies of data and interchangeability of computer nodes. Cloud computing, however, is not intended for any applications. Ever-changing apps can be built with "cloud" support, and multiple applications can run at once on the same "cloud."

3. High versatility and reliability. The cloud can be scaled up by customer needs, and customers can also buy what they need.

4. Low price and convenience. The cloud's special fault-tolerant facilities can use very cheap nodes to form the cloud, so users can easily use the cloud. Moreover, the cloud does not increase the cost of data center management for users, and users can also use low-cost facilities, greatly improving resource utilization and convenience.

5. Data sharing. Data and programs can be easily shared between many devices thanks to cloud computing.

Cloud computing has unlimited potential to be explored and exploited by people. To overcome the problems and risks existing in cloud computing at the present stage, cloud computing will replace the current traditional computing model and become the core of the next generation of IT technology. The Hardware components of cloud computing is shown in figure 1.

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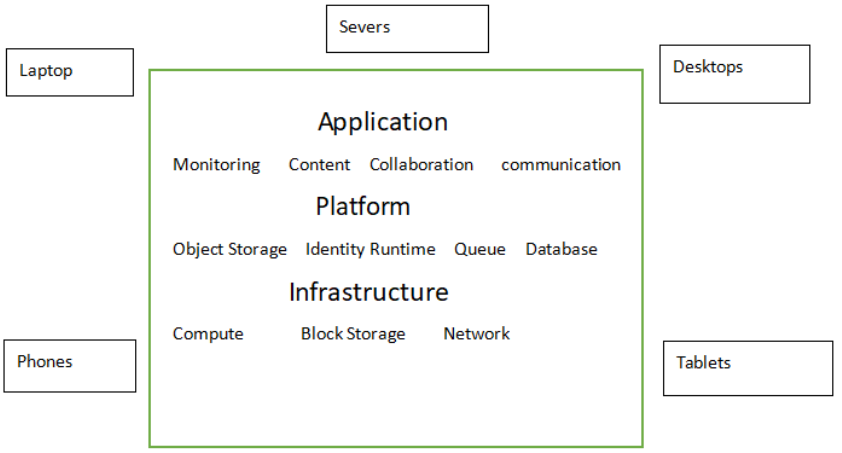

Figure 1. Hardware components of cloud computing.

2.2. Overview of 5G

Mobile communication has experienced the development of 1G,2G,3G and 5G. Each development brought great changes to society at the time. The total daily mobile traffic is expected to expand by 67 times from 186 terabyte (TB) to 12540 TB in the representative Western European countries between 2010 and 2020, while the total global mobile traffic of 351 exabyte (EB) in 2025 indicates an increase of 174% from 2020 [3].

A next generation of broadband mobile communication technology known as 5G is characterized by fast speed, low delay, and big connection sizes. When compared to fourth generation (5G) cellular systems, the fifth generation (5G) wireless communication systems are predicted to offer a spectral and energy efficiency growth by a factor of at least 10, as well as an increase in area throughput by a factor of at least 25 [3]. The 5G communication facilities serve as the network infrastructure for connecting people, things, and machines. The following are some ways that 5G's service-oriented networking architecture differs from 5G:

1. While 5G is a reference point-based architecture, 5G is a bus-based architecture.
2. The way that nes interacts has altered. Similar to 5G, service-oriented interfaces rather than manual processes are used for interconnection.
3. The architecture of the 5G network is more dispersed. A few 5G network features, like MME session management, mobility management, etc., are debundled, and a few new network features are added (such as NSSF slice selection and MRF network function discovery).

In general, the difference between 5G core network architecture and 5G core network architecture is that the architecture is servitization, CU separation and network slicing.

2.3. Demand of development

Cloud computing combined with 5G can improve the transmission efficiency of cloud computing. The end user should be considered as the service subject of cloud computing technology while studying the development requirements of the 5G mobile communication network. This paper should promptly develop and improve the 5G mobile network to, for instance, meet users' expectations for high data flow, high resolution, high definition, and other video services or game services, as well as to ensure the cloud storage function of pertinent data. This is done by catering to the various needs of end users [4]. Cloud computing technology applied in 5G mobile communication networks should be combined with life and work. For example, the technology can be used in automatic remote driving and telemedicine.

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3. Cloud computing technology application in 5G mobile communication

5G network and cloud computing technology can optimize each other. Cloud computing technology can reduce the cost input of network architecture as much as possible, achieve the development goals of economy, safety and efficiency, and maximize the application value of 5G mobile communication network in work and life. 5G communication networks boast faster data transmission rates, low delay and fewer echoes, making cloud computing faster and more convenient. With the continuous expansion of users of cloud computing technology, its business scope is gradually expanding, and the applications related to cloud computing technology and 5G communication technology are also gradually increasing.

3.1. Automatic driving technology

At present, most companies are working on autonomous driving at the level of single-vehicle autonomous driving, most of which is at L2 level. Even if it reaches L3 level, it may be limited by laws and regulations, so it is not easy to test the view of L3. The difference between different levels of autopilot is shown in Figure 2.

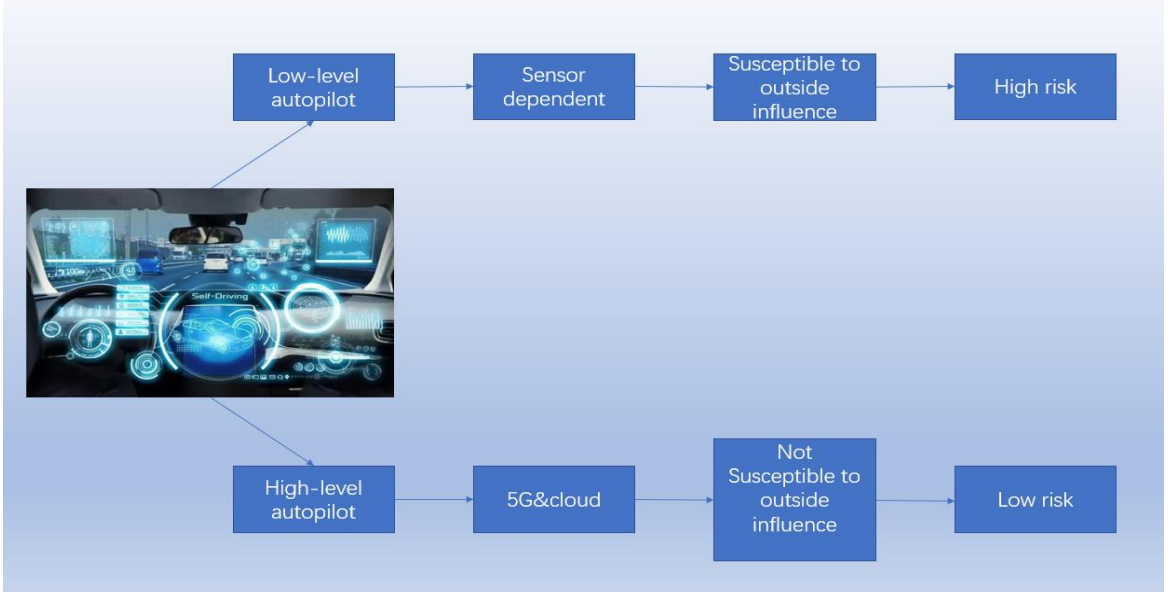

Figure 2. Different levels of autopilot.

Cloud computing and 5G have the potential to break the shackles of bike intelligence and take autonomous driving to the next level. The advantages of cloud computing technology for handling large amounts of data can also be of great help. At present, most intelligent connected cars are in the manual driving and autonomous driving dual mode. This situation is based on two reasons: first, the current technology and supporting facilities are not fully mature; Second, drivers cannot get rid of their dependence on driving. For both reasons, autonomous driving is still in its very early stages.

If cars use networks to sense where other vehicles and pedestrians are, then networks need to process a lot of data in a short amount of time, and cloud computing can play to its advantage. After all, there are usually a lot of cars and pedestrians on the street, and the situation is very complicated.

At the same time, as an object that often moves at a higher speed, if the car chooses to connect to the network to obtain surrounding information, including the location of other connected vehicles and the location of other objects on the road, then the communication quality of the network needs to be very good. The characteristics of 5G communication are "fast speed, low delay and large bandwidth", which can well meet these characteristics.

As the technology of autonomous driving becomes more and more perfect, a traffic efficiency calculation model is established to calculate the time consumed by a vehicle passing through. In this paper, traffic lights and other related facilities will be combined to block the intersection that interferes

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with the operation of the fire truck, and then variable planning and adjustment of the signal light after the fire truck passes, and finally the traffic order will be restored to normal. Through these measures, this paper can get the dispatching mechanism of special vehicles in general, and use these mechanisms to assist the realization of 5G autonomous driving [5].

Aiming at the problems such as the speed of low-level autonomous driving cannot be accurately controlled and the response speed is very slow, this paper proposes a vehicle speed detection and control method of autonomous driving system based on 5G network and cloud computing technology. This paper plans to use 5G and cloud computing to connect cars to each other, and the terminal will collect vehicle data, including position, speed, acceleration, mass, and orientation. After that, the least square method is used to construct different motion models for different vehicles, in which various data mentioned above are included. Through such a model, and calculate the limit speed that can ensure the safety, to solve the speed control model of the vehicle autonomous driving system, so as to get the best solution of the speed control of the vehicle autonomous driving system, to achieve the speed control of the autonomous vehicle. The experimental speed control method can effectively improve the speed control accuracy of the system, up to about 99%, and the calculation time is very short, which can meet the requirements of real-time control in high-speed moving vehicles [6].

3.2. Telemedicine surgery -- medical industry

Medical industry is the pioneer in the application of electronic information technology in the field of reality. With the rapid development of science and technology, digital medicine has been continuously developed. Mixed reality technology provides a new way for the precision and personalized treatment of surgical diseases. In the medical industry, remote surgery is linked to cloud computing technology and 5G communication. Through 3D reconstruction of traditional image data, the 3D model is projected into the real scene through 3D glasses, which realizes the integration of the virtual world and the real world. Its application in the medical process can make the diagnosis more intuitive. In this field, 5G transmits data at a speed of more than 1Gbps/s in the 28GHz ultra-high frequency band, and its low communication delay makes telemedicine realize real-time sharing. With the characteristics of high broadband, low delay, and large connection, 5G has become a new trend of innovation and development in the medical field by combining with mixed reality. Medical industry is the pioneer in the application of electronic information technology in the field of reality. With the rapid development of science and technology, digital medicine has been continuously developed. Mixed reality technology provides a new way for the precision and personalized treatment of surgical diseases. In the medical industry, remote surgery is linked to cloud computing technology and 5G communication. Through 3D reconstruction of traditional image data, the 3D model is projected into the real scene through 3D glasses, which realizes the integration of the virtual world and the real world. Its application in the medical process can make the diagnosis more intuitive. Figure 3 depicts the possible flow of telemedicine enabled by 5G and cloud computing.

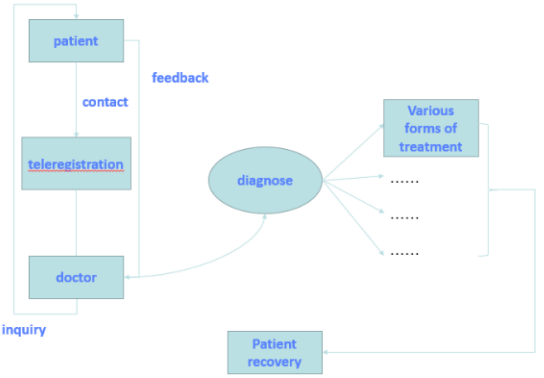

Figure 3. Telemedicine based on 5G and cloud computing.

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In order to provide a more reliable and efficient video data stream in telemedicine applications, this paper envisages the integration of 5G into telemedicine-related operations. With the development of the Internet of Things, 5G technology is being applied to telemedicine and can be carried forward. At present, researches on the application of 5G technology and cloud computing in telemedicine mainly focus on the video compression technology based on Lagrange encoder and H.265 protocol. This technology is applied to transmit 5G network video data in telemedicine, to achieve the effect of real-time interaction between doctors and patients. H.265 protocol is based on KNN encoder and combines multiple sensors, enabling more and more fields and personnel to apply telemedicine. A variety of sensors are placed at the transmitting and receiving base stations, enabling the transmitting, and receiving devices to exchange data efficiently and precisely. As for the data transmission performance between this method and the current mainstream methods, collision error, propagation error, perceptual error and visual security of encryption can be used to evaluate and compare. By comparing the performance of the proposed model with the existing model based on LE's single buffer, this paper can conclude that the KNN classifier based single buffer based on multi-sensor technology has better performance recognition, to realize telemedicine [7].

In this field, 5G transmits data at a speed of more than 1Gbps/s in the 28GHz ultra-high frequency band, and its low communication delay makes telemedicine realize real-time sharing. With the characteristics of high broadband, low delay, and large connection, 5G has become a new trend of innovation and development in the medical field by combining with mixed reality.

4. Dilemma and improvement

The difficulties and improvement measures faced by 5G mobile communication are shown in the following table 1.

Table 1. Difficulties faced by 5G communication and improvement measures.

Dilemma	***Improvement measures***
Network delay	Network architecture optimization
Cost problem	Cost reduction
Security risks	Research and development of new security mechanisms

This chapter will make a detailed analysis of its predicament and improvement.

4.1. Current predicament

In the development of 5G mobile communication networks, cloud computing faces the following difficulties:

1. Network delay: 5G mobile communication network structure is a bit cumbersome. There are still some limitations in the application process of 5G mobile network, resulting in the smooth application of cloud computing in 5G mobile communication network. While 5G networks are fast, communicating directly with cloud computing servers will add latency to data transfers. This poses a challenge for applications that require low latency, such as real-time gaming, smart healthcare, etc.

2. Cost problem: In 5G mobile communication network, a large amount of data needs to be processed and stored, so operators need to invest a lot of money to build cloud computing infrastructure. Cloud computing applications in 5G mobile communication networks have higher costs, strong dependence on manufacturers, and large use of optical fibre. For small operators and businesses, this may not be an economically viable option.

3. Security risks: Cloud computing requires data to be stored on the Internet and relies on public networks for transmission. That means it is vulnerable to security issues such as hacking and data breaches. It is especially sensitive to some application scenarios with high security requirements, such as finance and power industries [8].

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4.2. Future improvement and optimization

In view of the difficulties cloud computing faces in the development of 5G mobile communication network, this paper can take the following measures to improve it:

1. Network architecture optimization: Data transmission latency can be reduced by migrating more computing and storage functions to edge devices. At the same time, network virtualization technologies such as SDN and NFV can also improve network performance [9].

2. Research and development of new security mechanisms: In order to cope with the growing security threats, this paper need to develop better security mechanisms. For example, end-to-end encryption and identity authentication are used during data transmission to ensure data security.

3. Cost reduction: Integration of 5G and cloud computing will require significant investment in infrastructure and maintenance costs. Therefore, it is necessary to introduce new and cost-effective technologies and solutions, and reduce operating costs by improving efficiency and saving energy.

4. Promotion of new technologies and service schemes: In order to support the integrated development of 5G and cloud computing, it is necessary to constantly study and promote new technologies and innovative service schemes. For example, blockchain and other technologies are applied to cloud computing to improve its reliability, transparency, and other features.

In conclusion, in the development of 5G mobile communication networks, measures such as better architecture design, research and development of new security mechanisms, cost reduction, and promotion of new technologies and service schemes should be taken to improve the dilemma faced by cloud computing [10].

5. Conclusion

The application and development of 5G mobile communication network cannot be separated from the support of cloud computing and other powerful network technologies. The advantages of cloud computing technology in 5G communication technology are not only reflected in speeding up the data transmission rate and improving the efficiency of data use, but also as the carrier of various virtual network technology models, highlighting its greater value in the optimization process of mobile communication system. The application of cloud computing technology has promoted the development of 5G mobile communication network to a large extent, but there are still some problems. It is necessary to improve cloud computing technology in different aspects in the future development process, so as to make its support for 5G network technology more solid.

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