

# Application Research Based on 5G Wireless Communication Technology

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**Abstract**—With the continuous development of science and technology, network technology is changing from each passing day. Nowadays, smart phones and other products are gradually popularized. China's mobile network technology is also developing rapidly. The development of communication technology has driven the development of society. Nowadays, the development of 5G wireless communication technology has greatly promoted the research of related technologies. With the advancement of the times, the number of people surfing the Internet has also increased greatly. China's wireless communication technology will be greatly developed, and its application prospects are very broad, which has laid a great foundation for future scientific research and played a certain role. This paper further studies through the research of the core technology of 5G wireless communication technology. The core technologies of 5G wireless communication technology mainly includes wireless transmission and network architecture technology, Non-orthogonal multiple access technology, D2D communication networking, MIMO antenna technology, simultaneous co-frequency full-duplex technology, intelligent technology. With the advancement of time, 5G technology will be commercialized after 2020, which will meet the rapid development of mobile Internet services in the future and bring new experiences of users. As the research progresses, the key technologies of 5G will gradually become clear, and will enter the stage of standardization research and formulation in the next few years. 5G communication technology is the most advanced mobile communication technology. Compared with 4G communication technology, it is more than ten times faster than its data transmission speed, and has a significant advantage in fast transmission rate. From the practical application of 5G communication technology, the transmission speed can be guaranteed in the case of 28 GHz band 1Gbpses, and the transmission speed of 4G communication technology under the same conditions can only reach about 73Mbps, and the asymmetric data transmission capability is only higher than 3Mb/s. It can be seen that 5G communication technology achieves a significant increase in transmission speed.

**Keywords**-Network Technology; 5G Wireless Communication Technology; Application Prospects

## I. OVERVIEW OF 5G WIRELESS COMMUNICATION TECHNOLOGY

### A. 5G wireless communication technology

With the continuous development of the information industry, wireless communication technology has become an important part of people's production and life. The Italian Marconi conducted radio transmission and reception experiments in 1897, a move that marked the era of human access to wireless communications. Since then, wireless communication technology has been greatly developed in both theoretical and technical applications. 5G wireless communication technology is the fifth generation mobile communication technology. It was developed on the basis of the 4th generation mobile network of certain innovations and transformations. Compared to the previous 2G, 3G, 4G, 5G technology, they have taken advantage of them. Make up for the shortcomings of previous signal differences and network instability. There is no uniform definition of 5G technology [1]. The general consensus that has emerged is that 5G is a convergence of technologies, scenarios, and uses, not just the invention of a single new wireless access technology. From the development status of 5G communication technology, 5G wireless communication technology uses nanotechnology, privacy and confidentiality technology, and pays more attention to the security, agility and flexibility of communication technology transmission. Greatly increase the transmission speed and reduce the energy consumption. 5G wireless communication technology

can better protect personal privacy, analyze and solve problems in time, and greatly enhance the protection of communication technology.

At present, the 5G wireless communication technology we are studying is in the key stage of research and development. 5G has high stability, low delay and large capacity. 5G wireless communication technology captures signals more widely. Users can experience high-speed networks anytime, anywhere. The 5G network can adapt to the special requirements of the network of some special industries to meet the needs of different people. 5G has a higher bandwidth. This will mean that users will enjoy a good network experience of high-speed networks. In the near future, 5G mobile communication technology will soon be available.

### B. 5G wireless communication technology features

At present, most mobile network devices have large power consumption. Whether it is a smart phone, a tablet, a wristband, etc, the power consumption is too large and too fast, which brings a very bad experience to the user. The research of 5G wireless communication technology is to improve the shortcomings such as large power consumption and fast power consumption, so as to achieve the minimum energy consumption standard. It allows users to achieve a high-quality network experience while achieving low power consumption. Through cloud computing and SDN technology, the 5G communication system reduces the power consumption by troubleshooting information that occurs to data usage and blocking invalid information.

5G technology is modified and extended for the basis of the original technology. The 5G signal needs to be fully covered and fully received. Achieve seamless connectivity of 5G wireless communication systems, enabling more users and people in remote areas to access high-quality, high-speed network services. Inject new vitality and vitality into the development of the economy.

Network speed is also an important part of network traffic. In today's network technology, when a large number of people uses the network at the same time, network congestion, network to delay, etc, the network speed will drop sharply, greatly reduces the user's online experience. The research of 5G wireless communication technology has greatly improved the phenomenon of network cradle and network to delay. Prevent these undesirable phenomena from happening.

5G communication technology is a full communication platform compatible with 2G, 3G and

4G network communication technologies. The platform supports the use of multiple network communication technologies. Ability to access multiple wireless technologies. Greatly expanded the functions of wireless communication technology. 5G communication has good compatibility and solves problems such as system instability. Especially in the aspect of network payment, the security of payment is greatly improved.

### C. The core technology of 5G wireless communication technology

#### 1) Wireless transmission and network architecture technology

In order to improve business capabilities, 5G will have new breakthroughs in wireless transmission technology and network technology [2]. In terms of wireless transmission, technologies that can further exploit the potential for improving spectrum efficiency will be introduced. For example, the use of code modulation technology, multi-antenna technology, new waveform design technology, multiple access technology and so on. In the wireless network, a more flexible and intelligent network architecture and networking technologies, such as a software-defined wireless network architecture using separate technologies for control and forwarding, will be adopted. A unified self-organizing network and so on. Figure 1 shows the topology of the 5G wireless communication networks.

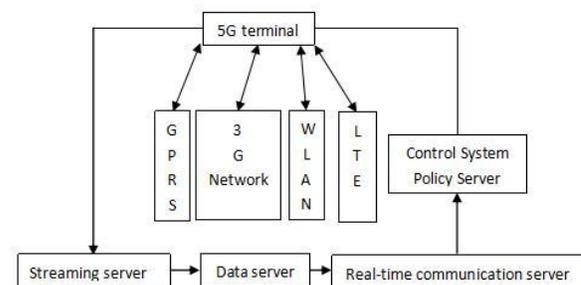


Figure 1. Schematic diagram of the topology of a 5G wireless communication network

#### 2) Non-orthogonal multiple access technology

Non-orthogonal multiple access technology is adopted, non-orthogonal access is adopted at the transmitting end, interference information is actively introduced, and correct demodulation is realized by a serial interference cancellation (SIC) receiver at the receiving end. The transmission of high frequency bands is the future development trend of communication applications. We know that the

traditional mobile communication operating frequencies is mainly concentrated on 3 GHz, which makes the resources on the spectrum very crowded, and in the high frequency bands such as millimeter waves, centimeter waves, etc. The spectrum resources available in the band are relatively rich to enable transmission of very high speed and short range communications. Meet the needs of 5G capacity and transmission rate. The non-orthogonal multiple access technology in 5G wireless communication mainly applies non-orthogonal transmission of the transmitting end of data information, so that the interference information can be actively introduced, and then realized by the serial interference cancellation receiver at the receiving end of the data information. Correctly adjusted. The subchannel transmission of the non-orthogonal multiple access technology uses orthogonal frequency division multiplex (OFDM) technology, so that the channels that are orthogonal between the subchannels are independent of each other without interference. However, a subchannel is allocated to a large number of users, and a plurality of users on the same subchannel use a non-orthogonal frequency division multiplex technique, that is, mutual interference problems occur between users. The problem is to carry out multi-user detection through the serial interference cancellation technology at the receiving end of the data information.

### 3) D2D Communication Network

The existing wireless communication technology is based on the base station, and has certain limitations, such as problems in coverage and capacity of the system. Although the relay technology and the multi-point cooperation technology can improve the coverage performance of the cell and increase the throughput of the cell edge user, the base station and the relay node are fixed in position, the network structure and the service are not flexible enough, and the overall coverage of the system and the user of the cell edge are Experience still has a lot of room for improvement. The D2D communication system is used for networking, which can realize direct communication between communication systems, expand network connection and networking mode, realize network communication in short distance, and the channel quality is relatively high, which can achieve higher data rate and lower implementation. The delay and less loss greatly improve the transmission efficiency of the communication. The efficient use of spectrum resources are realized. D2D can improve link flexibility and networking reliability. Ultra-dense networking can greatly improve the

capacity of the channel, improve network coverage, and can split traffic between services, more flexible network deployment, and more efficient frequency reuse.

### 4) MIMO Antenna Technology

Multi-antenna technology has been applied to a variety of wireless communication systems as a means of improving spectral efficiency and reliability of transmission. For example, 3G systems, WLAN, LTE, LTE-A, and the like. According to the information theory, the more the number of antennas, the more obvious the spectrum efficiency and reliability improvement. Especially when the number of transmitting antennas and receiving antennas is large, the MIMO channels capacity will increase linearly from the minimum value of the number of transmitting antennas. Therefore, when a large number of antennas are used, a good method is provided for greatly increasing the channel capacity. Due to the limitation of the space, complexity and the like of the multi-antenna system, in the current wireless communication system, there are not many antennas configured at the transceiver end. For example, in the LTE system, up to 4 antennas are used, and in the LTE-A system, up to 8 antennas are used [3]. However, due to its huge energy and gain, research on MIMO-related technologies for large antennas has attracted the attention of researchers. In the case of a single cell, the base station is equipped with a multi-user MIMO system that greatly exceeds the number of antennas of the mobile station [4]. With large-scale MIMO systems, 4G 8-port multi-user MIMO systems are no longer able to meet people's needs, and large-scale MIMO is needed to improve spectral efficiency and energy efficiency. With the rapid development of wireless communication, the demand for data traffic is increasing, and the available spectrum resources are limited. Therefore, it is particularly important to improve the efficiency of spectrum utilization. Multi-antenna technology is an effective means to improve network reliability and spectrum efficiency. It is currently being applied to various aspects of wireless communication, such as 3G, LTE, LTE-A, etc. The increase in the number of antennas can ensure the reliability of transmission. And spectral efficiency. In order to adapt to the trend of mobile data traffic densification and break with the limitations of existing cellular systems, the researchers proposed to significantly increase the number of cooperative nodes or cells in the hotspot coverage area, or replace the current multi-array with large-scale array antennas at each node. The antenna, thus forming a large-scale cooperative wireless communication

environment (as shown in Figure 2), so that deep mining utilizes wireless spatial dimension resources to solve the spectrum efficiency problem and power efficiency problem of future mobile communication.

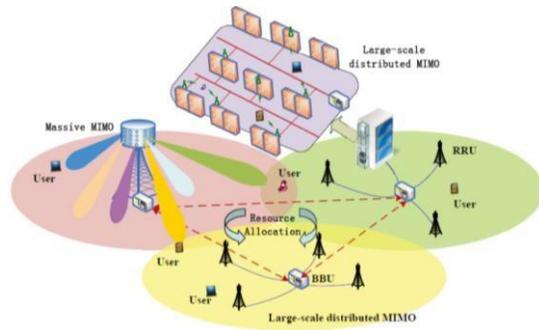


Figure 2. (Color online) Large-scale cooperative wireless communications

Large-scale MIMO is extended and extended for the basis of MIMO, and a large-scale array antenna is arranged on the base station side. The use of simple precoding and detection methods in large MIMO minimizes the effects of noise and fast fading on the system. Large-scale MIMO systems have many advantages. For example, large-scale spatial resolution can be improved compared with previous ones, and deep space resources can be mined. This allows multiple users in the network to utilize large-scale resources on the same time-frequency resource. The spatial freedom provided by MIMO communicates with the base station simultaneously. Thereby, the efficiency of the spectrum is greatly improved on increasing the density and bandwidth of the base station. Large-scale MIMO systems also concentrate the beam over a narrow spatial range, which can greatly reduce interference. Massive MIMO can greatly reduce the transmit power [5], thereby improving power efficiency. When the number of antennas is large enough, the simplest linear precoding and linear detectors will tend to be optimal, and both noise and uncorrelated interference are negligible.

As the economy continues to evolve, the demand for channel capacity is increasing. To overcome the multipath fading effect, MIMO technology has been applied to multipath communication environments in 4G LTE communication systems. In order to increase the channel capacity of the MIMO antenna system, it is necessary to reduce the envelope correlation coefficient (ECC) of the antenna system. This factor is closely related to the impedance matching and isolation from multiple sets of antennas in an MIMO system. The lower isolation reduces the ECC, resulting in a reduction in channel capacity. Therefore, the improvement in isolation from

antenna elements in MIMO systems is a key issue in MIMO antenna design. In order to improve the isolation, there are five methods. Introduce branch structures, defective structures, metamaterials, decoupling and networking. For the quaternary antenna system, a metamaterial structure and a planar mushroom body structures are used to improve the isolation from the antenna elements. The existing structure of these four-element antennas is not enough to reduce the isolation from antenna elements placed in parallel. For the 5G terminal antenna, we propose a two-layer super-material mushroom structure that improves the isolation from antenna elements. The double-layer mushroom body wall is orthogonally placed in the quaternary antenna to block and absorb the near-field space field between the antenna elements, thereby greatly improving the isolation from the entire antenna system.

The advantages of MIMO technology are mainly the following. A new wireless communication technology in which a transmitting end transmits signals through a plurality of transmitting antennas, and a receiving end uses a plurality of antennas to receive signals. High data throughput is achieved by improving the nature of channel capacity, which is a core advantage of MIMO technology. In addition, MIMO technology can significantly improve the reliability of data transmission and reduce the bit error rate. By adopting MIMO technology, the transmission distance and throughput of the communication system can be greatly improved on increasing the channel bandwidth and total transmission power.

##### 5) Simultaneous Co-frequency Full-duplex Technology

We know that traditional wireless communication technology cannot realize the function of two-way communication because of its own limitations. The 5G cores/technology currently studied to solve this problem, and realizes two-way communication between simultaneous simultaneous full-duplex technology. Implementing both the uplink and the downlink while using the same frequency resources for two-way communication can theoretically double the resource utilization. However, full-duplex simultaneous-frequency technology also faces a technical problem. In the process of transmitting and receiving signals, because the power gap is very large, it will cause very serious self-interference. Therefore, the primary problem to be solved are interference cancellation. Eliminating interference is a huge problem facing researchers today. At the same time, the same-frequency full-duplex technology also faces

many difficulties under multi-antenna MIMO technology, which requires us to continue research and innovation in the future, and strive to solve this major problem.

#### 6) *Intelligent Technology*

With the combination of computer technology and wireless technology, the concept of cloud base station has been introduced into 4G. In 5G, the central network will be a cloud computing platform composed of a large server, and the router connected with the base station is a data exchange function. Switch network. The macro base station side has cloud computing functions and big data storage functions, and calculations that cannot be processed in time will be submitted to the network cloud computing center. There are more forms of base stations or terminals, such as inter-machine communication supporting Internet of Things, multimedia communication between people, communication between people and machines, and remote wireless control functions. Different services use different frequency bands, antennas and connections. For different ways, it is necessary to have the functions of intelligent configuration, intelligent identification, automatic mode switching, and form a framework of self-organizing network.

## II. DEVELOPMENT AND APPLICATION OF 5G WIRELESS COMMUNICATION TECHNOLOGY

With the continuous development of the economy, science and technology are also advancing with rapid innovation. The 4G currently used can no longer meet the needs of large-scale network services, and people pay more attention to the development of 5G core technologies, hoping to change these conditions. Nowadays, countries all over the world are paying attention to the development of 5G technology. At present, Huawei enterprises in China are constantly conducting research and development. Compare with 4G networks, 5G networks pay more attention to network resource utilization, establish new network architecture, improve network system throughput and so on.

At present, 5G communication technology has gradually become the research object of people. With the continuous improvement in the scientific level, the development of 5G communication technology is becoming more and more mature. I believe that in the future, we will face the vast number of netizens with a new look, so that they enjoy a high speed and enjoy a high speed. The high frequency efficiency of 5G wireless communication technology will continue to

increase, and the capacity of the network will be greatly improved. The main driving force for the development of 5G wireless communication technology is the rapid development of mobile Internet. Conversely, the rapid development of mobile Internet has promoted the development of emerging mobile communication services. At present, the specific service services of the fixed-line network are provided with users through network technology, which requires powerful background services, which puts higher requirements on the 5G wireless communication technology system. These requirements are mainly reflected on the system capacity and The quality of transmission of information data. 5G wireless communication technology should be closely connected with other wireless communication technologies to provide basic support for the development of network communication technology.

With regard to the development trend of science and technology and the current mobile network technology, the development of 5G wireless communication technology tends to introduce more advanced wireless transmission technology, and continuously improve the utilization of network resources. After 5G wireless communication introduces advanced wireless transmission technology, The utilization of network resources will be more than ten times higher than that of 4G mobile communication. With the new architecture, 5G wireless communication technology will inevitably have new architectures in the process of development, such as high-intensive cell structure, etc. The new architecture can further to expand the intelligence capabilities, while at the same time being able to Improve the throughput of wireless network systems. In-depth mining of frequency resources, frequency resources are very important in the development of mobile communication technology, there is a shortage of frequency resources in the development of 4G mobile communication technology, which limits the further development of mobile communication technology. Therefore, in the future development of 5G wireless communication technology, frequency resources will be intensively explored, such as visible light, millimeter wave and high frequency band. In addition, 5G wireless communication technology will inevitably have a breakthrough in network technology and wireless transmission technology. In terms of network technology, the network structure and network architecture will be more intelligent and flexible; in the case of wireless transmission technology, the use of spectrum resources is mainly strengthened.

One of the biggest innovations of 5G wireless communication technology is that it can better protect personal information. If there are obstacles in the process of information transmission, 5G wireless communication technology can find corresponding problems in time and effectively apply information protection. Compared with the traditional wireless communication technology, 5G communication technology has many advantages, which absorbs the advantages of traditional communication technology and makes its application more flexible, thus making it more competitive., to better provide people with communication and information transmission services. When constructing communication projects, the coverage of 5G networks will be even wide.

China's 5G system is meeting the needs of more people. At present, the 5G system is mainly applied to the Android system, and the firewall against the Android system is strengthened to enhance the security of the system. The installation system is a layered architecture, mainly including the program cloud and framework layer and the operation layer , and the kernel layer is four layers. In the layered architecture system, the kernel layer of the system uses 5G nano core technology, which can completely separate the basic files and hardware parts from the Android system. With the advantages of the high-speed trunk transmission technology of 5G communication technology, the space occupied by the storage space can be reduced. It can effectively enrich the external devices of the high- end hardware part. The openness of the Android system is relatively strong, which poses a great challenge to the security performance of data. The use of nanotechnology in 5G communication systems can effectively solve this problem. The data content is greatly encrypted, and the use of quantum cryptography can effectively avoid the leakage of communication information. Great guarantees for the security of Android. With the 5G communication system, you can enjoy a higher speed and secure network. The 5G communication system has good compatibility and can be better utilized in more fields. A seamless connection to the global network.

The 5G communication system is also applied to the light field camera, which greatly increases the camera's transmission rate , storage rate, and rich surveillance video content. The 5G communication system can communicate with machines, such as the Internet of Vehicles, automatically locate the vehicle, navigate , and even autopilot. Types of human-computer interaction, such as automatic biometrics, telemedicine with sensors. The type of interaction

between people, such as the type of high-speed multimedia, the function of the terminal projector, the function of implementing 3D images, and the like. It can be seen that the future 5G communication system will be applied to all walks of life, and the development prospects are very good.

### III. FUTURE TRENDS OF 5G WIRELESS COMMUNICATION TECHNOLOGY

At present, 4G wireless communication technology is applied to all walks of life, and wireless communication technology has become an indispensable part of people's lives. The 5G wireless communication technology is further researched and developed on the basis of 4G wireless communication technology, . So it is very necessary to study 5G wireless communication technology. It is believed that 5G wireless communication technology will be incalculable in the future development. The role. Future research on wireless communication technology is a long-term and arduous task. It is a very complicated system engineering. Not only theoretical knowledge and key technologies, but also the support of various government departments. Only in this way can we reach the level of research and development of mobile communication in China. The development of 5G wireless communication technology can bring great convenience to people, and the prospect is very considerable. 5G wireless communication is the development trend of network technology. Its emergence will not only bring a more secure and high-speed network, but also enable seamless connection between global networks. At the same time, the good compatibility of 5G wireless communication enable it to be used in more fields. In the coming period, we should increase research on related aspects and provide strong technical support for the development of 5G.

As the development of the network society will bring about a surge in mobile data traffic, it is expected that data traffic will increase by 1,000 times for the next 10 years; at the same time, connected devices will show tremendous growth, the emergence of the Internet of Things and other new innovative applications. It will spawn tens of billions of connected devices, with 50 billion devices connected by 2020, with unprecedented diversity requirements and wireless connectivity- related applications. In addition, due to the increase in the number of devices, the diversity of application scenarios and the diversity of requirements will inevitably require more and more advanced functions of next-generation mobile communication technologies, requiring more efficient, comfortable and secure access and sharing of

information, and It is carried out by improving capacity, energy efficiency, and spectrum efficiency. With the advancement of time, 5G technology will be commercialized after 2020, which will meet the needs of the rapid development of mobile Internet services in the future. Come to a new experience. As the research continues to deepen, the key technologies of 5G will gradually become clear, and will enter the standardization research and development stage in the next few years.

The five application scenarios facing 5G technology include ultra-high-speed scenarios, providing high-speed data network access to mobile broadband users in the future; supporting large-scale populations, providing high-quality mobile broadband experience for high-density areas or occasions; best experience anywhere, anytime, Ensuring that users still enjoy high quality service while on the move; ultra-reliable real-time connectivity ensures that new applications and user instances meet stringent standards in terms of latency and reliability; ubiquitous object communication ensures efficient processing of diverse Equipment communication , including machine type equipment and sensors.

Although the current 4G communication network can meet the needs of most people for the network, it is undeniable that there are many shortcomings such as imperfect network coverage, slow transmission speed and high cost. Therefore, in the research and development of 5G communication technology, we also It is mainly aimed at improving this , aiming to provide users with a good network experience and meet the increasing demands of users. Summarizing the above points, the emergence of 5G communication technology can be said to be a kind of impact and challenge on network development, enabling the construction of multiple different users and regional networks, with the utmost to ensure network communication. The actual performance is improved. Therefore, 5G communication technology has a promising future of the future development . 4G communication technology meets most of our daily needs, but with the rapid development of social and economic levels and the growing demand for user communication, 4G communication technology will inevitably become backward, unable to meet the more requirements of users. Therefore, based on the rapid development of modern technology, the development of 5G communication technology is inevitable, and this requires researchers to continuously strengthen research on 5G communication technology, improve its applications and services, and then improve the quality

of communication services. On the basis of ensuring the reduction of production and operation cost input, we will expand the coverage and depth of communication networks as much as possible, so that 5G communication engineering technology can achieve better economic and social benefits. I believe that the future development of 5G technology will get better and better.

#### IV. CONCLUSION

With the continuous development of science and technology, higher requirements are put forward for wireless communication networks. 5G is based on the evolution of 4G wireless communication. I believe that the future development direction is based on the "human experience" as the development direction to better meet the needs of human beings and obtain higher quality online experience services. Innovate and develop in the fields of terminal , wireless, network, and business. It is believed that the future 5G network will combine the advantages of cellular networks and local area networks to promote the rapid development of the information industry. The technical goal of 5G is to increase the mobile data traffic by 1000 times, the typical user data rate by 100 times, the rate is higher than 10 Gbit/s, the number of connected devices is increased by 100 times, and the battery life of low-power MMC (machine type equipment ) is increased by 10 Double; end-to-end delay is reduced by a factor of 5. 5G may need to select 2 000 Mbit/s spectrum resources from the 2~6 GHz frequency band. The spectrum of the ultra-high frequency band may be more suitable for indoor coverage scenarios. The specific frequency band selection needs further study.

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