

Chinas 5G Communication Technology Development Status and Countermeasures

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Abstract: With the acceleration of the global informatization process, 5G communication technology, as a new generation of mobile communication technology, with its advantages of high speed, low delay and large connection, has brought great development opportunities for all walks of life. This paper mainly analyzes the development status, challenges and countermeasures of Chinas 5G communication technology, and looks forward to the future development trend. In general, Chinas 5G communication technology has made remarkable achievements in policy support, infrastructure construction and technological innovation, but it still faces some challenges. In order to better promote the development of Chinas 5G communication technology, we need to increase policy support, strengthen industrial chain coordination, improve innovation capacity, improve regulatory policies and regulations, promote the integration of 5G technology and vertical industries, and pay attention to 5G security and privacy protection and other issues.

Keywords: 5G communication technology, Development status, Challenges, Countermeasures and development trend.

1. Introduction

With the acceleration of the global informatization and digitalization process, 5G communication technology, as a new generation of mobile communication technology, will become the key to the development of the global communication industry in the next six years with its characteristics of ultra-high speed, low delay and high connection number. 5G technology will have a profound impact in a number of fields, including but not limited to smart home, intelligent transportation, industrial automation, and medical and health care. For China, the development of 5G technology is not only related to the transformation and upgrading of the communication industry, but also related to the improvement of the overall competitiveness of the country.

In this context, this paper aims to analyze the development status of Chinas 5G communication technology, identify the challenges faced in the development process, and put forward corresponding countermeasures. Through in-depth research, this paper hopes to provide reference for relevant policy formulation and industrial development, and further promote the healthy development of Chinas 5G communication technology.

2. Development Status of 5G Communication Technology in China

2.1. 5G network infrastructure construction

Chinas 5G network infrastructure construction is an important part of the development of 5G technology. As of 2023, China has established the world's largest 5G network. Operators are investing huge sums of money to speed up the construction of 5G base stations to achieve nationwide coverage. These base stations use the latest 5G technology and equipment, capable of supporting higher data transmission speeds and lower latency.

The Chinese government has attached great importance to the construction of 5G network infrastructure, and has introduced a series of policies and measures to encourage and

accelerate the construction of 5G network. These policies include providing fiscal subsidies, optimizing land use policies, and providing tax incentives. The implementation of these policies has effectively reduced the construction cost of operators and accelerated the deployment of 5G networks.

The construction of the 5G network infrastructure also includes the construction of the core network. The core network is the brain of the 5G network, which is responsible for processing and forwarding data and realizing various functions of the network. The 5G core network built by Chinese operators adopts the latest technology and architecture, which can provide higher performance and stronger reliability.

In addition, Chinese operators also actively adopt open interfaces and open source technologies to achieve the flexibility and scalability of the core network. This enables 5G networks to better adapt to the future technology developments and business needs of [1].

Overall, China has made significant progress in building its 5G network infrastructure. With the continuous expansion and improvement of the 5G network, Chinas 5G technology will better serve the social and economic development.

2.2. Development of 5G Terminal Equipment

Chinas 5G terminal devices are developing rapidly, covering smartphones, tablets, Internet of Things devices and other forms. By 2023, many domestic manufacturers, such as Huawei, Xiaomi, OPPO, and vivo, have launched their own 5G phones, constantly promoting market upgrading. These 5G phones have not only improved their speed, but also made significant improvements in photography, games, voice interaction and other aspects, meeting the diverse needs of users.

With the gradual popularization of 5G networks, 5G tablet computers and Internet of Things devices have gradually entered the market, bringing new vitality to education, medical care, smart home and other fields. With its advantages of high speed and large bandwidth, 5G tablet computer has become an important tool for distance education and online conference. Internet of Things devices can realize

high-speed connection through 5G network, making the construction of smart cities more efficient, such as intelligent transportation, intelligent security and other fields of [2].

In addition, China has also made remarkable achievements in the innovation of 5G terminal equipment. Virtual reality (VR), augmented reality (AR), driverless driving and other high-tech fields have extremely high requirements for 5G terminal equipment, while Chinese manufacturers are constantly breaking through the bottleneck of terminal equipment in these fields through technological innovation.

However, the development of 5G terminal equipment in China also faces some challenges. For example, the relatively high cost of 5G terminal equipment may lead to lower consumers' willingness to buy. In addition, the current 5G application scenarios are not rich, which also affects the user's acceptance of 5G terminal devices. Therefore, the future development of 5G terminal equipment in China not only requires manufacturers to make continuous technological innovation to improve the performance and cost performance of equipment, but also requires relevant departments to promote the development of 5G application scenarios to provide more market space for 5G terminal equipment.

2.3. 5G Application Scenarios and Business Innovation

The development of China's 5G communication technology has brought unprecedented opportunities to all industries. With the support of the high bandwidth, low latency and large connection characteristics of 5G network, many application scenarios can be realized, and business innovations are constantly emerging.

First, in the industrial sector, 5G technology allows production equipment and machines to be connected in real time, thus improving production efficiency and safety. In addition, 5G technology can also support remote control and virtual reality training, providing strong technical support for industrial production [3].

Secondly, in the medical field, the high bandwidth and low latency characteristics of 5G technology make remote diagnosis and remote surgery possible. In addition, 5G networks can also realize real-time monitoring and data transmission of medical devices, providing more convenient and efficient support for medical services.

Third, in the field of transportation, 5G technology provides reliable network support for driverless and intelligent transportation systems. Through 5G network, vehicles can be connected in real time, and traffic signals can be controlled intelligently, thus improving the efficiency and safety of road traffic.

In addition, 5G technology also has a wide application prospect in smart city, smart home, virtual reality, e-sports and other fields. The high bandwidth and low latency characteristics of 5G network provide a good experience for hd video streaming, virtual reality games and other services, making these services widely popularized by [4].

In short, the development of China's 5G communication technology has brought rich application scenarios and business innovations to all industries. With the continuous popularization and improvement of 5G network, it is believed that more industries will benefit from 5G technology in the future and realize digital transformation and upgrading. However, to fully leverage the potential of 5G technology, the joint efforts of all parties are needed to promote the

application and innovation of 5G technology in various fields.

2.4. Policy Support and Industrial Chain Coordination

Policy support and industrial chain coordination play a crucial role in the development of 5G communication technology in China. The government has provided a lot of policy support in the development of 5G technology to promote the construction of 5G network infrastructure, the development of 5G terminal equipment, and 5G application scenarios and business innovation. The government's attention to and strong support for 5G technology has provided a strong guarantee for the development of 5G technology.

In addition, industrial chain coordination is also an important factor in the development of 5G communication technology in China. The development of 5G technology requires the close cooperation and collaborative work of various links, including network infrastructure construction, terminal equipment manufacturing, application scenario development, etc. The government has achieved the rapid development of 5G technology by promoting the coordination and cooperation of all links of the industrial chain.

The government is also actively promoting the integration of 5G technology and vertical industries to achieve the wide application of 5G technology. The government encourages 5G enterprises to cooperate with manufacturing, transportation, medical and health care and other industries to promote the application of 5G technology in various fields. This integration can not only promote the development of 5G technology, but also bring more innovation and development opportunities to various industries, [5].

However, although policy support and industrial chain coordination have achieved remarkable results in the development of China's 5G communication technology in China, there are also some challenges. For example, the effect of policy support may be affected by the strength and effect of policy implementation, and the coordination of the industrial chain may face competition and cooperation problems within the industrial chain. Therefore, while continuing to promote policy support and industrial chain coordination, the government also needs to pay attention to and solve these challenges to promote the sustainable development of China's 5G communication technology.

3. Challenges and Countermeasures of China's 5G Communication Technology Development

3.1. Technical Challenges

3.1.1. Millimeter-wave communication technology

Millimeter-wave communication technology is a key component of 5G communication technology, with a working frequency of between 30GHz and 300GHz. Compared with the traditional Sub-6GHz frequency band, millimeter-wave communication technology has higher transmission rate, wider bandwidth and lower latency, which can meet the needs of future big data, high-definition video, virtual reality and other application scenarios. However, the millimeter-wave communication technology also faces many challenges in the practical application process.

First, the propagation characteristics of millimeter-wave communication technology make it vulnerable to multipath effect and scattering during the transmission process, which

leads to severe signal attenuation. In addition, the millimeter-wave communication technology is also relatively weak in its ability to walk through the walls, limiting its coverage in the indoor environment. Therefore, in order to improve the coverage and transmission quality of millimeter-wave communication technology, intensive deployment of base stations is needed, and technologies such as large-scale MIMO are adopted to enhance the signal receiving capability.

Secondly, the millimeter-wave communication technology puts forward higher requirements for the design and manufacturing of terminal equipment. The transmission and reception of high-frequency signals requires special devices and antenna technologies, which increases the cost and complexity of 5G terminal equipment. In addition, millimeter-wave communication technology also has some challenges in the energy consumption of terminal equipment, which needs to reduce the energy consumption of [6] by optimizing the algorithm and improving the device efficiency.

However, millimeter-wave communication technology has great potential in the field of 5G communication. Its high frequency band resources are rich, can provide greater bandwidth and faster rate, to meet the growing data transmission demand. At the same time, millimeter-wave communication technology can support a wider range of business scenarios, such as large-scale Internet of Things, autonomous driving and so on. Therefore, in the future development of 5G communication technology, the millimeter-wave communication technology will become one of the key factors.

In order to overcome the challenges of millimeter-wave communication technology and give full play to its advantages, China should increase investment in research and development and promote technological innovation. At the policy level, enterprises should be encouraged to carry out the research and industrialization process of millimeter wave communication technology, and the corresponding standards and regulations should be formulated to provide a good environment for the development of millimeter wave communication technology. In addition, it is necessary to strengthen cooperation and exchanges with the international community, learn from advanced experience, and jointly promote the progress of 5G communication technology.

3.1.2. Large-scale MIMO technology

Large-scale MIMO technology is one of the keys of 5G communication technology, which significantly improves the performance and efficiency of wireless communication by using multiple antennas at the sending and receiving ends. In 5G networks, the application of large-scale MIMO technology brings many advantages, such as increasing system capacity, improving spectrum efficiency, reducing transmission latency and improving connection reliability [7].

First, the large-scale MIMO technology is able to significantly increase the total capacity of the wireless communication system. By using a large number of antennas at the sending and receiving ends, multiple parallel data transmission paths can be formed, which are independent of each other and can transmit more data at the same time, thus greatly increasing the overall capacity of the system.

Second, the large-scale MIMO technology improves the spectral efficiency. With the same spectrum resources, higher data transmission rates can be achieved, which means more efficient use of valuable radio spectrum resources. This is crucial for the modern communication environment with tight spectrum resources.

Moreover, large-scale MIMO technology helps to reduce transmission delays. Since the signal can be transmitted through multiple paths at the same time, the system can complete the transmission and receiving of data in a shorter time, which is of great value for the application scenarios with high real-time requirements (such as autonomous driving, telemedicine, etc.).

Large-scale MIMO technology also improves the connectivity reliability of wireless communication systems. Through the use of multiple antennas, a stronger signal receiving capacity can be achieved, and a stable connection can be maintained even in the environment of weak signals. This is especially important for improving the network coverage and the performance of the edge regions.

However, the implementation of the large-scale MIMO technology also faces some challenges. For example, it requires higher computing power and larger storage space to handle complex signal processing algorithms. In addition, the deployment and management of multiple antennas also brings additional hardware and maintenance costs. Therefore, how to improve the performance while maintaining the cost control is a problem that needs to be considered in the promotion and application of large-scale MIMO technology.

Despite the challenges, the great potential of large-scale MIMO technology makes it an important research direction in 5G communication technologies. With continuous advances in technology and further cost reduction, it is expected that large-scale MIMO will play an increasingly critical role in the future of wireless communication systems.

3.1.3. Network slicing technology

Network slicing technology is one of the important innovations in 5G communication technology, allowing operators to meet the specific needs of different users and applications by creating multiple virtual networks on the same physical network infrastructure. These virtual networks, or network slices, are able to provide customized services, including different bandwidth, latency, reliability, and other parameters, thus providing optimized network performance for different usage scenarios.

In 5G networks, network slicing technology enables network resources to be allocated according to demand, and improves resource utilization and service efficiency. For example, for applications that require low latency and high reliability, such as autonomous driving or telemedicine, the desired network performance can be ensured through network slicing. For high-traffic data applications, such as HD video streaming or cloud games, network slicing can provide greater bandwidth and faster data processing speed.

However, the network-slicing technology also brings new challenges. First, it requires greater flexibility and programmability of network devices (such as base stations, routers, etc.) to support the dynamic creation and configuration of multiple slices. Second, network slices require more efficient management and scheduling mechanisms to ensure resource isolation and optimal allocation among different slices. In addition, network slicing technology also needs to solve the problem of coordination and optimization across slicing resources to ensure that the performance of the whole network is not affected.

In order to meet these challenges, Chinese scientific research institutions and enterprises are doing a lot of research and development work on network slicing technology. This includes the management framework design of the network slicing, the optimization of the slice scheduling algorithm,

and the standardization of the network slicing technology. At the same time, the Chinese government is also actively promoting the introduction of relevant policies to support the development and application of network slicing technology.

In general, network slicing technology is an important innovation in 5G communication technology, which provides customized network services for different applications and improves the efficiency of the use of network resources. While this technology brings new challenges, China is expected to make important breakthroughs in this field through scientific research innovation and policy support, [8].

3.2. Challenges of industrial development

3.2.1. Lack of industrial chain coordination

The development of 5G communication technology in China cannot be separated from the cooperation of the entire industrial chain, including equipment manufacturers, communication operators, Internet companies, chip manufacturers and other links. However, at present, China's 5G industry chain coordination is still insufficient to a certain extent.

First, the synergy between equipment manufacturers and communications operators is not close enough. The construction and operation of 5G networks require a large number of base station equipment and terminal equipment, and equipment manufacturers often fail to fully meet the specific needs of operators when developing and producing this equipment. In addition, in the process of network planning and construction, operators fail to fully take into account the production capacity and technical level of equipment manufacturers, resulting in a mismatch between equipment supply and network construction.

Second, the collaboration between chip makers and equipment manufacturers is also problematic. 5G chips are the core link of the whole 5G industry chain, but their research and development and production are faced with challenges such as high technical difficulty, large investment and long cycle. There is a certain gap between Chinese chip manufacturers and international leading enterprises in terms of technology level and production capacity, which leads to the dependence of domestic equipment manufacturers on imports in the high-end chip field, which affects the independent controllable ability of the whole industrial chain [9].

In addition, the coordination between Internet enterprises and the communication industry is also insufficient. The high speed and low delay characteristics of 5G network provide a broad space for the development of various Internet applications. However, Internet enterprises are still in the exploratory stage in 5G application innovation, and the lack of coordination with the communication industry makes the last kilometer of 5G industry chain has not been fully connected.

In view of these problems, China should take the following measures to strengthen the coordination of the 5G industrial chain. First, strengthen the government guidance, promote the deep cooperation between equipment manufacturers and operators to realize the seamless connection between network construction and equipment production; second, increase the technical development support for chip manufacturers, improve the independent innovation ability of domestic chip industry and reduce the dependence of equipment manufacturers on imported chips; third, encourage the cooperation between Internet enterprises and communication

industry, jointly explore the innovation direction of 5G application, and promote the improvement and development of 5G industrial chain.

3.2.2. Lack of innovation ability

China has made remarkable achievements in 5G communication technology, but it still faces some challenges in its innovative development. First of all, although China ranks among the top in the world in terms of the number of 5G patents, the transformation efficiency of innovation achievements needs to be improved, and there are some obstacles in the transformation process from laboratory research to commercial application. Second, competition at home and abroad is fierce, Chinese enterprises and research institutions have made relatively few original breakthroughs in core technologies, and some key technologies and equipment still rely on imports. Moreover, the domestic innovation ecology is not fully mature, and the lack of long-term investment and continuous research and development mechanism, leading to the lack of innovation capacity.

To meet this challenge, China needs to take the following measures: First, strengthen basic research and applied research, increase R & D investment, and focus on long-term technology accumulation. Second, deepen cooperation between industry, university and research institutes, and promote resource sharing and collaborative innovation among enterprises, universities and research institutions. Third, cultivate innovative talents, improve the quality of personnel training, and attract global outstanding talents. Fourth, optimize the innovation environment, establish and improve the intellectual property rights protection system, and encourage enterprises to innovate. Fifth, through policy guidance, we will support enterprises to increase technological transformation and equipment renewal, and improve the technical level of the industrial chain.

To sum up, the problem of China's insufficient innovation capacity in the field of 5G communication technology needs to be solved through various efforts. Only by continuously promoting technological innovation can China occupy a favorable position in the global 5G competition [10].

3.2.3. International competition pressure

With the rapid development of 5G communication technology in the global scale, the international competition pressure has become an important challenge for China's development in this field. First, as one of the world's largest communications markets, China is facing competition from other countries in the promotion and application of 5G technology. The United States, Europe, Japan and other countries and regions are actively promoting the development of 5G technology, and striving to occupy a favorable position in the global communication industry in the future. These countries have strong strength and advantages in 5G technology research and development, standard setting and infrastructure construction, which has put great pressure on China's 5G development.

Secondly, the development of 5G technology is not only a competition in the communication industry, but also a contest in the scientific and technological strength of various countries. As a new generation of communication technology, 5G technology will have a profound impact on the economic development, social progress and international competitiveness of all countries. Therefore, all countries are trying to promote the development of 5G technology and strive to take the initiative in the future international scientific and technological competition. This has put China under huge

international competition pressure in the development of 5G technology.

In addition, international standards for 5G technology are full of competition. The right to set standards means the dominant right to industrial development, which has an important influence on the countrys scientific and technological strength and international status. In the process of setting 5G standards, China needs to compete with other countries for the right to set standards, so as to gain more voice and influence in the international competition. This is both an opportunity and a challenge to [11] for Chinas 5G technology development.

In the face of international competition, China should increase investment in 5G technology research and development, enhance its independent research and development and innovation capabilities, and strive to obtain more core technologies and patents in the field of 5G technology. At the same time, China also needs to strengthen communication and cooperation with global partners, jointly promote the international standardization process of 5G technology, and strive to occupy a favorable position in the global 5G market competition. By actively participating in international competition, China is expected to achieve greater development in 5G technology and make greater contribution to the countrys economic growth and scientific and technological progress.

3.3. Policies and Regulatory Countermeasures

3.3.1. Increase policy support

Policy support is one of the most important means to promote the development of 5G communication technology. The Chinese government attaches great importance to the development of 5G technology, and has introduced a series of policies and measures to promote the construction and development of 5G networks.

First of all, the government has defined the strategic goal of 5G development and focused on the development of 5G as a national strategic emerging industry. The government has formulated a series of plans and guidance for 5G development, and clarified the timetable and roadmap for 5G development, providing a clear direction for 5G development [12].

Second, the government has given strong support to 5G infrastructure construction. The government has increased investment in the construction of 5G base stations, providing financial subsidies and tax incentives for base station construction to reduce the construction costs of operators and accelerate the coverage of 5G networks.

In addition, the government has also actively promoted innovation in 5G application and encouraged enterprises to develop and apply 5G technology. The government has set up a series of special funds to support the research and industrialization of 5G key technologies, promote the pilot application of 5G technology in industry, medical care, education and other fields, and promote the development of the 5G industry.

At the same time, the government has also strengthened oversight of the 5G industry and formulated a series of regulations and standards to ensure the safe and stable operation of 5G networks. The government will strengthen the supervision of 5G frequency resources to ensure the rational use and effective protection of frequency resources.

To sum up, the government has provided strong support for the development of 5G communication technology by increasing policy support. These policies and measures will

help promote the construction and development of 5G network, promote the innovation of 5G application, promote the development of 5G industry, and enhance Chinas international competitiveness [13].

3.3.2. Improve regulatory policies and regulations

In the development process of 5G communication technology, the improvement of regulatory policies and regulations is an important means to ensure industrial development, maintain market order and ensure information security. First of all, the regulatory authorities need to update and improve relevant laws and regulations in a timely manner according to the new features and applications of 5G technology to ensure the legitimacy of the construction and operation of 5G networks. This includes provisions on spectrum allocation, network infrastructure deployment, and data protection.

Second, with the widespread use of 5G networks, regulatory policies also need to focus on new challenges, such as network slicing and vertical industry integration. Regulatory authorities should formulate corresponding policies and guiding principles to promote the rational distribution and efficient use of network resources, protect the rights and interests of consumers, and ensure the fairness and transparency of network services.

In addition, the security and privacy protection of 5G networks are the focus of regulatory policy attention. Regulators should strengthen supervision over 5G network security, formulate strict information security standards and protective measures, and guard against security risks such as network attacks and data leakage. At the same time, it is also necessary to put forward higher requirements for the protection of personal information to ensure the security and privacy of user data [14].

In terms of transnational cooperation and international competition, China should actively participate in the formulation of international standards and the construction of a global regulatory system, and promote the formation of a fair, open and transparent international market environment. This will not only help enhance Chinas position in the global 5G industry chain, but also help promote the healthy development of 5G technology in the world.

In general, improving regulatory policies and regulations is a dynamic process, which requires the joint efforts of regulators, enterprises and all sectors of society to constantly adapt to the development of 5G technology and market demand, and ensure the safe, efficient and sustainable development of 5G network.

3.3.3. Promote the coordinated development of the industrial chain

Promoting the coordinated development of the industrial chain is one of the important countermeasures to promote the development of Chinas 5G communication technology. First of all, the government departments should increase their support for all links of the 5G industry chain, including core chips, base station equipment and terminal equipment, so as to realize the improvement and optimization of the industry chain. Secondly, the government should promote the in-depth cooperation between the upstream and downstream enterprises of the industrial chain, strengthen information sharing and technology exchange, so as to improve the overall technological innovation ability and competitiveness of the industrial chain. In addition, the government should also encourage industrial chain enterprises to strengthen cooperation with scientific research institutions and

institutions of higher learning, make full use of research and development resources at home and abroad, and jointly carry out key technological breakthroughs.

At the same time, the government should actively promote the integration of 5G technology and vertical industries, and promote the expansion and upgrading of the industrial chain. For example, application innovation in intelligent manufacturing, driverless driving, telemedicine and other fields will help promote the rapid development of the 5G industry chain. In addition, the government should also strengthen international cooperation and actively participate in the formulation and promotion of international standards, so as to enhance the influence of China's 5G industry chain in the global market [15].

In order to realize the coordinated development of the industrial chain, the government should also improve the relevant policies and regulations, and strengthen the supervision of the 5G industrial chain. For example, we will formulate regulations on cyber security and privacy protection to ensure the safe and stable operation of 5G networks. At the same time, the government should also increase the publicity and promotion of excellent enterprises in the 5G industry chain, and improve the social awareness and support for the 5G industry.

To sum up, promoting the coordinated development of the industrial chain is an important countermeasure to promote the development of 5G communication technology in China. By strengthening government support, promoting industrial cooperation, promoting the integration of technology and industry, strengthening international cooperation, and improving relevant policies and regulations, it will help promote the rapid development of China's 5G industry chain, and lay a solid foundation for the prosperity and sustainable development of the 5G industry.

4. Development Prospects and Suggestions for China's 5G Communication Technology in China

4.1. Integration of 5G Technology with Vertical Industries

The integration of 5G technology and vertical industries is an important direction for the development of 5G communication technology in China. The high-speed, low latency and large connectivity characteristics of 5G have provided strong support for the digital transformation of all walks of life. First, in the field of industrial Internet, 5G technology can realize real-time connection of various equipment in the factory, improve production efficiency and safety. For example, in the field of intelligent manufacturing, 5G technology can support the collaboration of robots and artificial intelligence systems to realize the automation and intelligence of the production process. In addition, in the energy field, 5G technology can be applied to smart grid and smart gas and power systems to realize remote monitoring and control, and improve energy efficiency [16].

Second, in the field of healthcare, 5G technology can support telemedicine and the medical Internet of Things, providing more convenient medical services for doctors and patients. For example, through the 5G network, doctors can view patients' medical images in real time for remote diagnosis and treatment. At the same time, 5G technology can

also be applied to driverless cars, smart cities, virtual reality and other fields, bringing more convenience to people's lives.

However, the integration of 5G technology and vertical industries also faces some challenges. First of all, different industries have different application requirements, requiring customized 5G solutions for different industries. Secondly, vertical industries have higher requirements for the reliability and security of 5G networks. In addition, the integration of 5G technology and vertical industries requires the joint efforts of the government, enterprises and scientific research institutions to strengthen the cooperation between the upstream and downstream of the industrial chain, and promote the innovation and implementation of 5G applications.

To sum up, the integration of 5G technology and vertical industries will provide strong support for the digital transformation of all walks of life and bring more convenience to people's lives. However, in order to achieve the deep integration of 5G technology and vertical industries, many challenges need to be overcome, strengthen industrial chain cooperation, and promote the innovation of 5G application and the implementation of [17].

4.2. International Development of 5G Network

With the continuous development of global communication technology, the international development of 5G network has become the focus of countries competing for the commanding heights of science and technology and market competition. China has strong competitiveness in this field, and has not only achieved remarkable results in the domestic market, but also played an important role on the international stage.

First, China has made great progress in building its 5G network infrastructure. By 2023, China has built the world's largest 5G network, covering all major cities and some rural areas. In addition, China is speeding up the construction of 5G base stations to further improve network coverage and quality. This has laid the foundation for the international development of 5G network.

Second, China has also made a breakthrough in 5G terminal equipment. Domestic and foreign manufacturers have launched 5G mobile phones, tablet computers and other terminal devices to meet the diverse needs of users. In addition, China also actively promotes the application of 5G in other terminal devices, such as smart home and driverless driving, providing rich application scenarios for the international development of 5G network.

China is also competitive in 5G application scenarios and business innovation. Chinese manufacturers and operators have launched a series of innovative 5G applications in the domestic and foreign markets, such as VR, AR, cloud games, etc., bringing a new experience to users. In addition, China has also actively deployed 5G vertical industry applications, deeply integrating with industry, medical care, education and other fields, providing strong support for the international development of 5G network [18].

In order to promote the internationalization of 5G networks, China has actively participated in the formulation and cooperation of international standards. Chinese manufacturers and operators join hands with global partners to promote the standardization of 3 GPP and other international organizations and provide unified technical specifications for global 5G network construction. At the same time, China has also strengthened exchanges and cooperation with other countries in the field of 5G, and jointly

discussed the international development strategy of 5G network.

However, the internationalization development of 5G network still faces many challenges. First, technical challenges, such as millimeter-wave communication, large-scale MIMO and other key technologies need to be further research and improvement. Secondly, in terms of industrial chain coordination, it is necessary to further strengthen the cooperation between domestic and foreign manufacturers and operators to promote the common development of upstream and downstream enterprises in the industrial chain. In addition, the international competition pressure is also increasing, countries have increased investment to compete for market share.

To sum up, Chinas 5G network internationalization development has achieved remarkable results, but it still needs to strengthen innovation and breakthrough in terms of technology and industrial chain coordination. In the future development, China should continue to give full play to its own advantages, actively participate in international competition and cooperation, promote the international development of 5G network, and provide more convenient and efficient communication services for global users with [19].

4.3. 5G Security and Privacy Protection

With the rapid development of 5G communication technology, network security and user privacy protection have become the focus of people's attention. The wide application of 5G networks makes large amounts of personal and industry data more vulnerable in the transmission process, so it is crucial to ensure the security and user privacy of 5G communication technologies.

First, 5G networks need to face security threats from different aspects, including cyber attacks, data leakage, malicious software and so on. In response to these threats, effective security measures should be taken, such as strengthening network monitoring, establishing a security protection system, and timely updating security patches, to ensure the stable operation of the 5G network.

Secondly, user privacy protection is an important part of 5G network security. With the popularity of 5G networks, user data and behavior information will be more abundant, which requires network operators to strictly abide by relevant laws and regulations when collecting, storing and using user data, and effectively protect users' privacy rights and interests. At the same time, users should also enhance the security awareness, to avoid sensitive operations in the unsafe network environment, so as to avoid personal information leakage.

In addition, the government and enterprises should strengthen investment in 5G network security and privacy protection, increase technology research and development and talent training, and improve the overall level of network security and privacy protection. At the same time, strengthen international cooperation to jointly address transnational cyber security and privacy protection challenges [20].

To sum up, 5G network security and user privacy protection is a long-term and arduous task. Only through the joint efforts of the government, enterprises and individuals can we ensure the security and stability of the 5G network and provide users with safe, convenient and efficient communication services. In China, the government has attached great importance to 5G network security and privacy protection, and has formulated a series of relevant policies

and regulations, providing a strong guarantee for the security development of 5G network.

4.4. Continue to Promote Technological Innovation

Continuously promoting technological innovation is one of the important strategies for the development of 5G communication technology in China. In the development and application of 5G technology, technological innovation is the key driving force, which is of great significance for enhancing national competitiveness, meeting market demand and promoting economic development.

First, the continued promotion of technological innovation will help to improve the performance and coverage of 5G networks. Through continuous development and optimization of 5G technology, network speed can further improve, reduce latency, improve connection density, and achieve wider and more efficient network coverage. This will help to meet the needs of all kinds of users for high-speed, high-quality networks, and improve the user experience.

Secondly, technological innovation helps to promote the expansion of 5G application scenarios and business innovation. 5G technology is characterized by high speed, low delay and large connection, and can be widely used in intelligent manufacturing, driverless driving, telemedicine, virtual reality and other fields. Through technological innovation, more forward-looking and innovative 5G applications can be continuously developed to promote industrial upgrading and transformation.

In addition, the continuous promotion of technological innovation will also help to enhance Chinas international competitiveness in the 5G field. Around the world, countries are competing to develop 5G technology, compete for market share and technological commanding heights. By increasing technological innovation, China can make more breakthroughs in 5G and enhance its international status and influence.

In order to realize technological innovation, we need to start from the following aspects:

(1) Increase R & D investment. The government and enterprises should increase their investment in 5G technology research and development to provide sufficient financial support for technological innovation.

(2) Cultivate talents. We will strengthen the training of talents in communications, electronics and other related fields, improve the quality and innovation ability of talents, and provide talent guarantee for 5G technology innovation.

(3) Strengthen international cooperation. Cooperate with advanced international enterprises and research institutions to share technological achievements and accelerate the pace of technological innovation.

(4) Optimize the policy environment. A series of policies and measures conducive to 5G technological innovation will be formulated to provide a favorable policy environment for technological innovation.

In short, the continuous promotion of technological innovation is crucial to the development of Chinas 5G communication technology. By increasing investment in R & D, cultivating talents, strengthening international cooperation and optimizing the policy environment, Chinas innovation capacity and competitiveness of 5G technology can be continuously enhanced and the sustainable development of 5G industry can be promoted.

5. Conclusion

In the past few years, China has made remarkable achievements in the field of 5G communication technology, not only making breakthroughs in the construction of network infrastructure, but also promoting the development of 5G terminal equipment and the innovation of application scenarios. However, with the continuous development of 5G technology, we are also faced with some challenges, such as technical problems, industrial development bottlenecks and international competition pressure. To cope with these challenges, we need to increase policy support, improve regulatory policies and regulations, and promote the coordinated development of the industrial chain. At the same time, we also need to further improve our innovation capabilities, promote the deep integration of 5G technology and vertical industries, and realize the international development of 5G networks.

Overall, China has made remarkable achievements in the development of 5G communication technology, but efforts still need to be strengthened in many aspects. We have every reason to believe that through the joint efforts of the whole society, China will make greater breakthroughs in the development of 5G communication technology and make greater contributions to China's economic and social development.

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