

# Research on the Status Quo of 5G Technology Development in China

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## Abstract

**On November 17, 2016, the Polar Code solution with independent intellectual property rights promoted by China's Huawei was determined as a 5G short code standard by 3GPP, which means that China officially entered the global competition market of a new generation of mobile communication technology. This article takes the introduction of the evolution trend of 1G to 5G, the global 5G patent distribution and the development of 5G industry in major regions of the world as the starting point, and expounds the development challenges and advantageous opportunities facing 5G technology with China's independent intellectual property rights. Take the current situation of Huawei's 5G solution development overseas as an example to analyze the current 5G situation in China, use the PEST model and Porter's five-force model analysis to analyze the macro environment of China's 5G development, and clarify the benefits of China's 5G solution in the global market status.**

## Keywords

**5G; property rights distribution; environmental analysis.**

## 1. Introduction

Seizing the opportunity of industry replacement and developing new industries can provide a strong impetus for the country to come first. The industrial replacement that broke out in the first industrial revolution in 1759 and the adjustment of the information industry caused by the rise of computer science and technology in 1870 all pushed its founders, the United Kingdom and the United States, to the status of powerful nations. Now that the world has entered the information age, information technology continues to promote innovation to change everything and affect our lives. The independent innovation of 5G technology has become a good carrier for China to become a world power. China should seize the opportunity to drive relevant departments, agencies, operators, equipment manufacturers, application manufacturers and other enterprises and institutions to jointly build 5G to lead the world, rely on technological advantages to win international markets in global expansion, and help Huawei and ZTE develop into globalization Communication enterprise.

Starting from 4G based on China's 3G technology, the country attaches great importance to the research and development of next-generation communication technologies. All major regions in the world regard 2019 as the first year of 5G, and comprehensively start 5G construction at the national strategic level. German IPlytics released a 5G patent report at the end of 2018. Among the number of standard essential patent applications required for 5G communications, the top ten Chinese companies accounted for three, accounting for 34%, of which Huawei ranked first. As the leading direction of the contemporary mobile communications field, 5G's leadership in 5G largely means that the country's economy can gain more initiative and guide the changes in the world's political and economic landscape.

## 2. Literature Review

In the article "Relationship of Intellectual Property Strategy, Independent Technology Innovation and Enterprise Competitiveness" [1] by Li Mingxing and others in Jiangsu University School of Management, combining with the actual situation in China at present, it points out the lagging nature and industry The disadvantage of the cluster in the global value chain. And through the establishment and calculation of structural equation models, it puts forward requirements and solutions for the application and implementation of my country's intellectual property strategy and the upgrading of industrial clusters. Intel demonstrated the 5G industrial revolution [2]. Lemstra pointed out that building market momentum through 5G leads change [3].

In the "5G Economic and Social Impact White Paper" [4] released by the China Information and Communications Academy in June 2017, it explained in more detail how 5G as a new generation of mobile communication technology can drive industrial upgrading and transformation and drive digital economic growth. Through the transmission mechanism of 5G multi-network integration and multi-scenario support, make a forecast report on the direct and indirect economic growth that 5G may bring. The report pointed out that with the official commercial use of 5G in 2020 as the base year to 2030, the direct output and indirect output driven by 5G development over the past ten years reached 6.3 trillion yuan and 10.6 trillion yuan, respectively. In addition to stimulating economic growth, its employment opportunities are expected to reach 19.5 million. The application of 5G has driven the development of all aspects of society.

## 3. Overview

### 3.1. 5G Concept and Evolution

Throughout the evolution of the communications industry, from 1G in the analog era to 4G in the mobile Internet era, to 5G in the Internet of Everything era, mobile communication technology has been updated almost every 10 years.

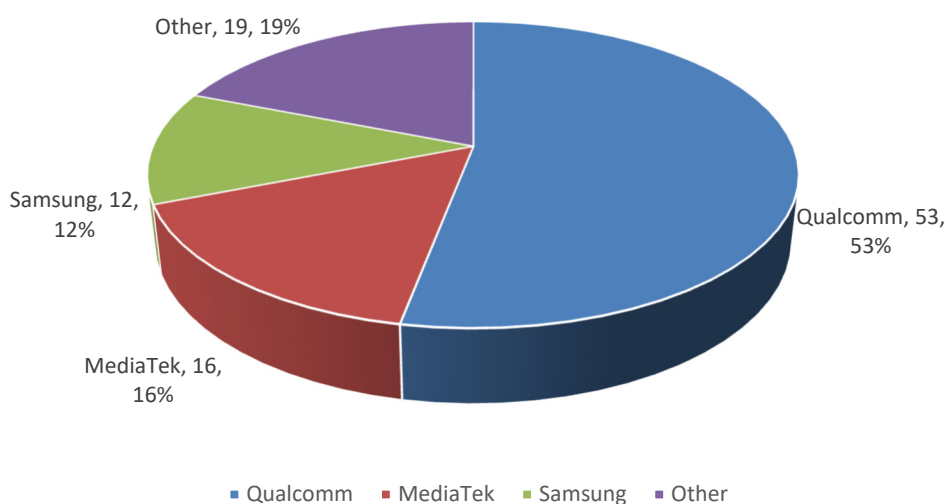
5G, the full name of The 5th Generation Mobile Communication Technology, is the fifth generation mobile communication technology. Unlike previous independent and brand new wireless access technologies 2G, 3G and 4G, 5G is the technological evolution of existing wireless access technologies (including 2G, 3G/4G and WiFi) and some newly added complementary wireless access technologies The name of the integrated solution is [11]. 5G completes a seamless and smooth transition of any space with a unified and unified standard, which is a true deep-converged network. The 5G network can ensure efficient communication between different devices, meet the diverse user needs of mobile phones, tablets and smart wearable products under the same base station, and on this basis, improve the communication between the user equipment and the wireless network and server. Connection performance, to achieve more efficient transmission support for more data [12]. ITU (International Telecommunication Union, International Telecommunication Union) in the "5G White Paper" identified three major scenarios of 5G applications. As the first application scenario, eMBB (Enhanced Mobile Broadband) requires 5G to have a higher rate and larger bandwidth. The transmission speed exceeds 10Gbps, which is equivalent to 100 times that of 4G. It can achieve 4K, 8K ultra-high-definition video, VR/AR, etc. Virtual reality and augmented reality business requirements; second is mMTC (large-scale machine communication), that is, the Internet of Everything in the world, to realize the needs of personal wearables, smart homes, smart cities, Internet of Vehicles and other Internet of Things; third is uRLLC (ultra high reliability ultra low Time-delay communication), the immediate delay requirement is as low as 1ms, to achieve high-reliability applications in specific industries such as autonomous driving and telemedicine

in the Internet of Vehicles. It is foreseeable that once 5G is officially commercialized, the communications industry will usher in a new wave of waves, and at the same time drive a number of trillion-scale emerging industries, opening a new era of interconnection and deep integration.

### 3.2. Global 5G Market Pattern Analysis

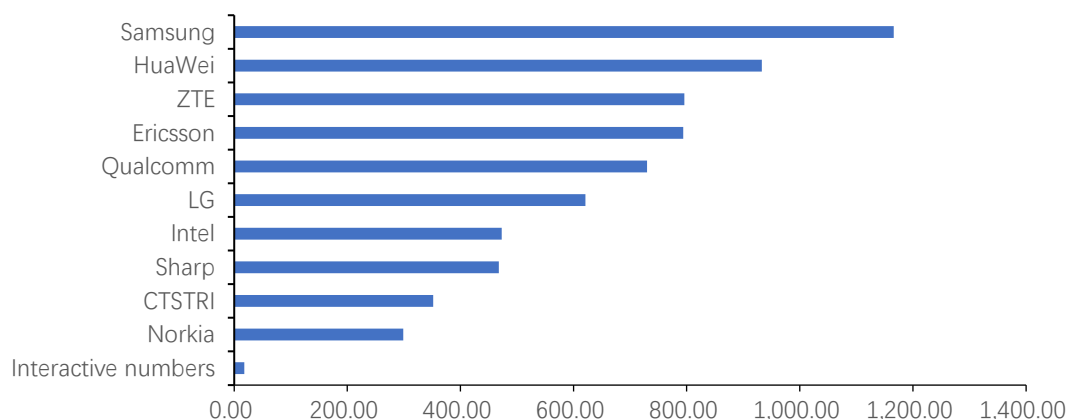
#### 3.2.1. 5G Technology Patent Allocation

The transformation of each generation of mobile communication technology is a contest between big powers and giants, and the competition between giants and giants. The historical experience from the 1G era to the 4G era tells us that whoever takes the lead in the transformation will be able to Behind have the right to speak and dominate. Taking the 4G mobile terminal market as an example, its core communication baseband chips are mainly controlled by internationally renowned manufacturers such as Qualcomm, Samsung, MediaTek, Huawei, and Intel. According to the research report of the consulting agency Strategy Analytics, the top five global cellular baseband processors in 2017 were Qualcomm, MediaTek, Samsung LSI, HiSilicon and Spreadtrum. The market leader Qualcomm had a 53% baseband market share in 2017. See Figure 1.

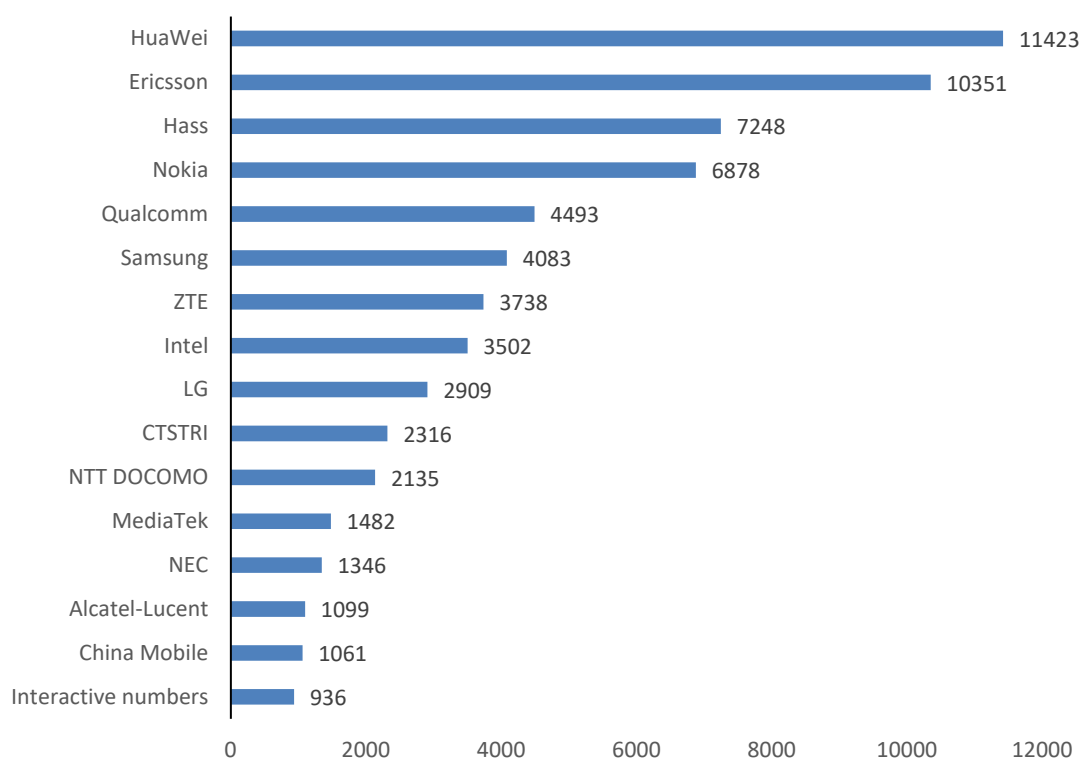


**Figure 1.** 2017 global baseband chip market competition status (Source: Strategy Analytics)

In the current booming 5G market, Qualcomm has not maintained its leading edge in the 4G communication baseband market. According to a 5G patent report released by IPlytics at the end of 2018, as shown in Figure 2, the standard essential patents required for 5G communication Among the number of applications, three of the top ten companies in China accounted for 34%, and Huawei ranked first. In another indicator, 5G standard technical contribution ranking, Huawei continues to maintain the first advantage, and three companies including HiSilicon, ZTE, and China Telecom Science and Technology Research Institute are among the top ten, as shown in Figure 3.



**Figure 2.** 5G SEP ranking (source: German patent data company IPlytics)



**Figure 3.** Ranking of global 5G standard technical contributions (Source: German patent data company IPlytics)

Now entering the 5G era, its integration as a cross-border technology is different from past generations of mobile communication technology. The characteristics of multi-tasking, multi-application and multi-scenario form a user-centric information ecosystem. The key role of 5G standard patents cannot be ignored.

**3.2.2. Overview of Global 5G Development**

As the leading direction in the field of contemporary mobile communications, 5G's leadership in 5G means that the country's economy can gain more initiative. At present, major countries and regions around the world are accelerating 5G technology promotion and commercial deployment. Communication agencies, communication operators and related equipment manufacturers from various countries have invested unprecedented enthusiasm in 5G. At present, major countries and regions in the world have comprehensively launched the national 5G communications industry layout work from a national strategic perspective, trying to

dominate the communications industry chain. The development of 5G in major countries and regions in the world is shown in Table 1 below:

**Table 1.** Global 5G development situation (source: public data collation)

Area	5G progress	Driving force
<b>China</b>	<ul style="list-style-type: none"> <li>·In November 2017, the Ministry of Industry and Information Technology announced the 5G spectrum plan</li> <li>·Ministry of Industry and Information Technology has launched 5G technology testing since the end of 2015, and has completed the third phase of testing</li> <li>·China Mobile's 5G terminal realizes gigabit rate download on multiple existing networks</li> <li>·On June 6, 2019, the Ministry of Industry and Information Technology issued 4 5G licenses</li> </ul>	Technology Innovation + Business Drive
<b>America</b>	<ul style="list-style-type: none"> <li>·The FCC has announced the launch of 5G frequency band planning in July 2016, hoping to lead the development of global 5G, especially 5G high-frequency technology</li> <li>U.S. telecommunications giant AT&amp;T launched 5G network commercial services in the United States at the end of 2018</li> <li>Verizon launched Chicago and Minneapolis as the starting point for 5G commercials in April 2019 to launch 5G network services for ordinary users</li> </ul>	Business-driven
<b>Japan</b>	<ul style="list-style-type: none"> <li>·5G spectrum strategy released in 2016</li> <li>NTTDoCoMo plans to launch 5G network at the 2020 Tokyo Olympics</li> <li>· Softbank plans to deploy 5G by 2020</li> </ul>	Driven by major international events
<b>Korea</b>	<ul style="list-style-type: none"> <li>·In early 2018, the 5G pre-commercial trial frequency band was opened</li> <li>·South Korea provides 5G application services at the Pyeongchang Winter Olympics in February 2018, ushering in the first large-scale commercial use of 5G</li> <li>SK Telecom, Korea Telecom, LG Uplus launched 5G network services for ordinary users in April 2019</li> </ul>	Driven by major international events
<b>Europe</b>	<ul style="list-style-type: none"> <li>·In November 2016, the European 5G spectrum strategy was released</li> <li>Launched 5G technology trials in 2018, and as of the end of 2018, mobile operators had 138 5G trials in 28 EU countries</li> <li>·The EU promotes 5G research with 5GPPP as the main body, focusing on the application of 5G technology in vertical industries. Germany has made it clear that it will be officially commercialized in 2020</li> </ul>	Business-driven

1) Current status of 5G development in China

China's IMT-2020 (5G) promotion team started the 5G technology research and development test in January 2016, and completed the final stage of testing in September 2018. It is planned to achieve 5G official commercial use in 2020; in early 2019, China's Hainan, Yunnan, Hainan, etc. The city started the pilot work of 5G networks, and regional 5G networks were completed and started to trial; in April, China, Shanghai, Jilin, Shenzhen, Heilongjiang, Xi'an and other places have completed the first 5G phone dialing; June 6, 2019, the Ministry of Industry and Information Technology Mobile, China Telecom, China Unicom, China Radio and Television issued 5G licenses.

2) Current status of 5G development in the United States

In October 2018, US President Trump issued a spectrum strategic task. This task is mainly aimed at the US Department of Commerce, urging it to accelerate the formulation of a long-term national spectrum strategy to prepare for the deployment of new generation networks. In the same period, the US telecommunications operator giant Verizon launched 5G Home services in 4 cities in the United States and launched 5G network services for ordinary users in April 2019 with Chicago and Minneapolis as the starting point for 5G commercial.

### 3) Current status of 5G development in Japan

Japan's NTTDoCoMo plans to officially launch a 5G network with the 2020 Tokyo Olympics as the driving point to achieve large-scale commercial use.

### 4) Current status of 5G development in South Korea

In May 2014, South Korea's Samsung Corporation released to complete the development of the first mobile transmission network based on 5G core technology. It is planned to complete relevant technical tests by 2020 for 5G commercial use; in February 2018, South Korea in Pyeongchang The Winter Olympics launched 5G application services, ushering in the first large-scale commercial use of 5G; in April 2019, the three major operators in South Korea used Samsung Galaxy S10 5G mobile phones to provide 5G network services for ordinary users.

### 5) Current status of 5G development in Europe

In the "European Union 5G Declaration-Promoting the European Deployment of the Fifth Generation Mobile Communication Network" released in July 2016, 5G was described as "a key enabler of the digital revolution", helping to promote European 5G network construction as soon as possible. . In September 2016, in the "5G for Europe: An Action Plan" published by the European Commission, the European 5G construction was issued for each member country to select at least one city to provide 5G services in 2020, and each member country will achieve some regions by the end of 2020 at the latest A clear indicator of the large-scale operation of commercialization.

## 3.3. Main Factors Driving the Development of 5G Services

### 3.3.1. Population

According to the 2019 digital report jointly released by Internet research institutions We Are Social and Hootsuite, as of December 2018, the global population had reached 7.5 billion people, and the number of Internet users was 4.388 billion. Internet users accounted for about 58% of the total global population. In China, this figure is close to 60%. The statistics report released by the China Internet Network Information Center in February this year shows that China's population is 1.386 billion, and the number of Internet users is 827 million, accounting for 59.6% of the total population. The increase is 3.8%, see Figure 4. In recent years, as shown in Figure 5, China's population has stabilized at about 18% of the world's total population. In 2018, the proportion of Chinese netizens reached 18.89% of the world's population. According to China's emphasis on Internet popularization and the scale of Chinese netizens in the past five years The rate of development, this ratio will soon be surpassed.

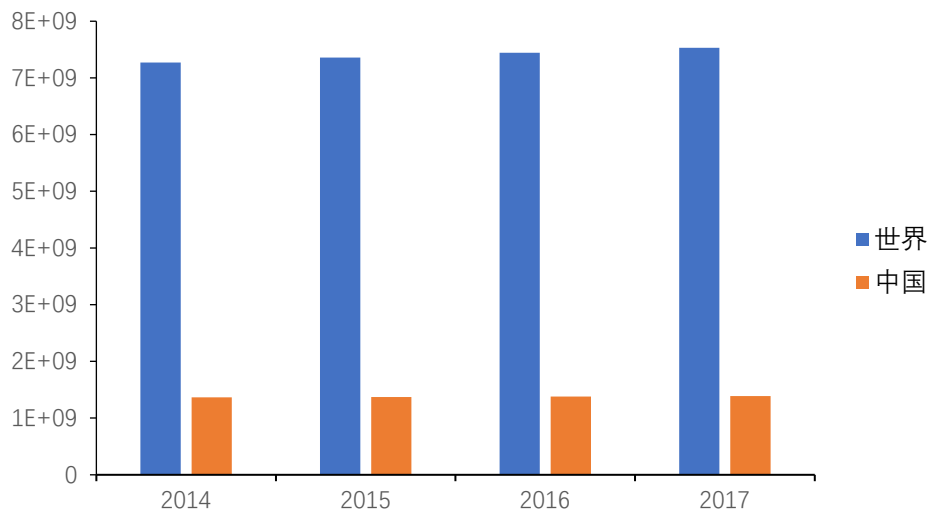


Figure 4. 2014-2018 world population and China population comparison chart (Source: CNNI China Internet Development Statistics Survey)

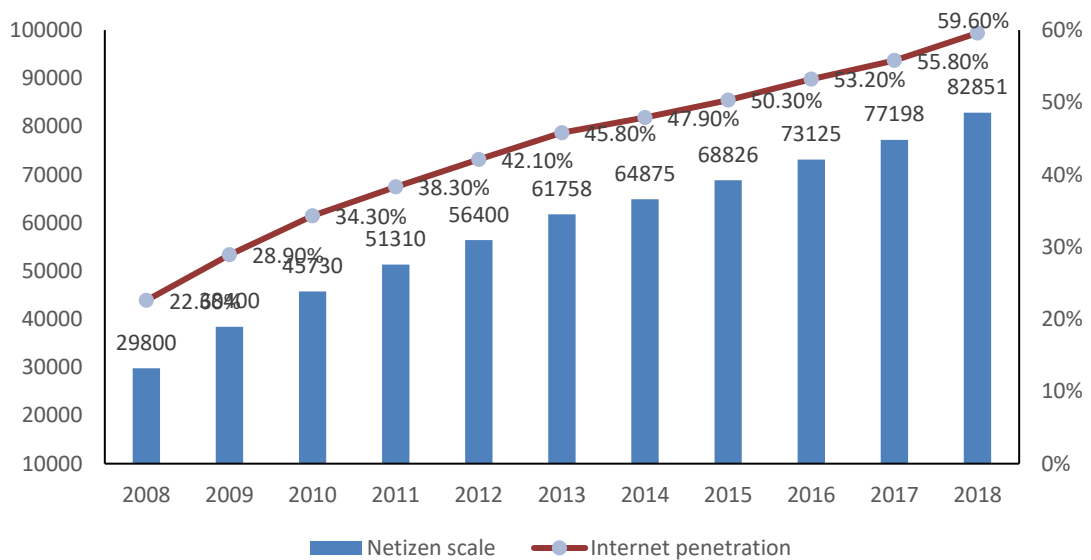
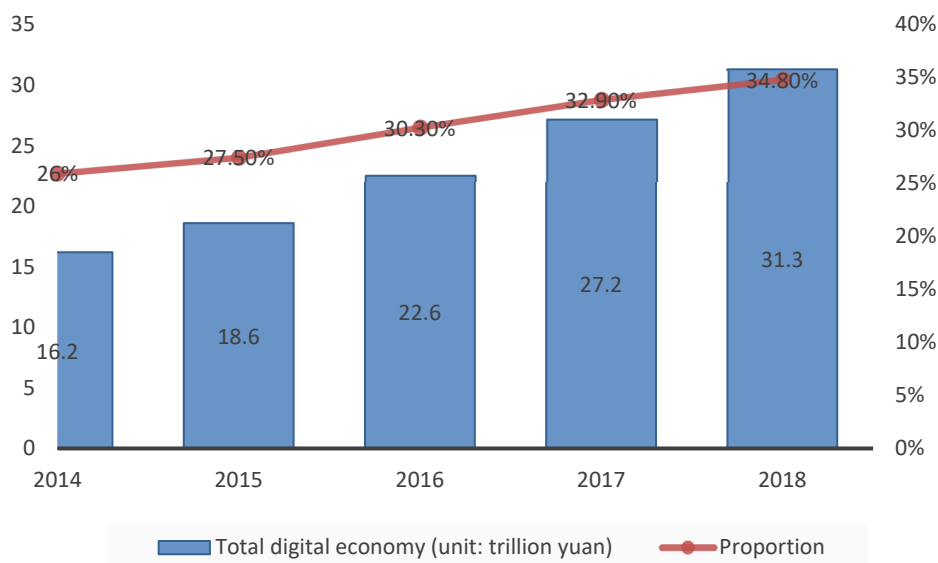


Figure 5. The scale and Internet penetration rate of my country's Internet users in 2008-2018 (Source: CNNI China Internet Development Statistics Survey)

### 3.3.2. Economy

According to World Bank data, China's GDP reached 90 trillion yuan in 2018 to 15% of the global economy, and every major move in my country's economic construction will have a huge impact. In recent years, the digital economy has gradually grown into a leading force to promote my country's GDP growth, and the information and communication industry, which has the largest application of 5G technology, also belongs to it. It is collated according to the China Digital Economy White Paper released by the China Academy of Information Technology in the past four years. From 2014 to 2018, China's digital economic output value increased from 16.2 trillion yuan to 31.3 trillion yuan, and its share of GDP also increased from 26% in 2014 to 34.8% in 2018, with a nominal annual growth rate of 19.74% year-on-year. It has become an important growth pole of China's GDP, the specific data is shown in Figure 6



**Figure 6.** Total Digital Economy and Its Proportion from 2014 to 2018 (Source: China Information and Communications Technology Institute)

### 3.3.3. 5G Industry Chain

Thanks to my country's decades of manufacturing base and industrial upgrades, covering all links of the 5G industry chain, my country can be self-sufficient, which is a rare advantage in countries around the world today.

It is not difficult to see from the 5G architecture system of terminals, base station systems, network architectures, and application scenarios. 5G is not just a 5G network that we call daily. 5G includes a 5G industrial system, which covers from Terminal to all links in the actual application process. Taking our daily WeChat information transmission through the mobile phone 4G network as an example, the information edited by the user should be sent to the mobile phone antenna through the WeChat application, and sent to the base station near the user through the mobile phone antenna, the base station will send our information to the provincial network node, Then send it to the provincial network node where our chat partner is located through this network node, and then send it to the chat partner's mobile phone antenna through the base station, and then display it in the other party's chat interface in real time. This is a complete WeChat The whole process of information transmission. In this process, the realization of each function depends on the basic hardware and software products, and the manufacturers involved in the hardware and software products are numerous, so what we call 5G is more inclined to the 5G network, and the 5G industry chain is the real one. 5G competition main battlefield. From the perspective of 5G function, the whole industry chain is more concrete. Taking the network planning and design of the supporting system as a starting point, to the basic layer construction, then to the transport layer, application layer, and finally to the scene realization layer that we feel best, it can be said that almost every level has the shadow of Chinese manufacturers. Technically, our country still seems to be very lacking. Of course, this is also the starting point for the Chinese manufacturers in the 5G industry chain.

With a huge population base, good economic environment, strong policy support, and a perfect 5G industry chain, China has laid a solid foundation for 5G. According to the forecast report released by the GSMA in March 2019, by the end of 2018, nearly 1.2 billion independent mobile users with 82% of the total population in China became the world's largest mobile market; China's 5G research and development started early and the market is broad. By 2025, China's 5G The network construction is mature and will have 460 million 5G connections, accounting for 28% of the total connections. China is expected to become the world's leading 5G market.



## 4. Analysis of China's 5G Strategic Environment with Huawei as an Example

### 4.1. Current Status of Huawei 5G

The domestic enterprise Huawei as the world's largest telecommunications equipment provider is not only the glory of the Huawei Group itself, but also a sign that Chinese companies have gone abroad to the world. In November 2016, the Polar Code solution with independent intellectual property rights controlled by Huawei in China was determined as the control channel coding solution for 5G eMBB application scenarios, and ranked first in the 2018 5G standard technical contribution ranking. The fluctuation of Huawei's 5G development will affect the development of 5G throughout China. In a sense, Huawei 5G has become synonymous with China's 5G.

According to the information disclosed on Huawei's official website, Huawei has 180,000 employees worldwide, including 80,000 R&D personnel. There are 14 research institutes and 36 joint innovation centers around the world. In 2018, Huawei and other countries built more than 1,500 networks to cover 170 countries around the world, serving more than 3 billion people, and achieved annual sales revenue of RMB 721,202 million, an increase of 19.5% year-on-year.

As of April 2019, Huawei actively cooperated with operators and related industry departments in various regions of the world to successfully win 40 5G commercial contracts, and the business map spans the Middle East, Southeast Asia and the Americas. Huawei regards 5G core technology research and development as the top priority for innovation and development. In 2018 alone, R&D expenditures amounted to more than 100 billion yuan. As of the end of 2018, the number of 5G standard essential patents owned by Huawei was 1,970, accounting for 17%, ranking first in the world. It is a consensus in the industry that Huawei leads in 5G.

Despite holding multiple global 5G contracts, Huawei is still caught in a huge "block" situation. In 2018, Huawei's 5G overseas development was besieged by the United States, Australia, and other countries, and market access restrictions were adopted to unite the European Union and its main partners to boycott Huawei. Including "Meng Wanzhou's detention in Canada", "Huawei's arrest of Polish employees" and the US comprehensive ban on Huawei in May 2019, Huawei is experiencing huge difficulties in advancing the global commercialization of 5G. According to foreign media reports, the Federal Communications Commission (FCC) has opened the "THz wave" frequency band to prepare for 6G research and development. Various countries around the world are competing to build a 5G network. The United States is holding China's main force of 5G, Huawei, and the other side is closely preparing for 6G, trying to seize the market in advance by taking advantage of time.

Huawei's 5G global commercial strategy of "from outside to inside and from beginning to end" has frequently been hindered. In contrast, as early as 2009, the relevant institutions have launched early research on 5G technology. Under the leadership of IMT-2020 (5G), my country has completed all 5G technology research and development tests. To advance the 5G commercial process, we must first solve the technical path of network selection in the deployment of 5G networks. Huawei's overseas strategy is blocked, and the three major operators in China swing the NSA architecture to the SA architecture camp. Network construction strategy swings have negative feedback on China's 5G commercial process. influences. This also fully explains the status quo that my country and South Korea and the United States have not yet introduced relevant progress messages after the 5G network services for ordinary users have been launched recently. The domestic 5G network service and 5G commercial process have been slow.

China occupies the absolute demographic dividend and economic strength advantage. In addition, Huawei, ZTE and other independent research and development efforts, the "Made in China 2025" strategy, coupled with the international influence of Alibaba, Tencent and other global Internet companies have made China the world's largest communications market and the largest Internet market. The demand for 5G is inestimable, and China's success in 5G will certainly affect the world. Therefore, China's domestic demonstration role is crucial. China should be the home of enterprises leading Huawei's 5G development, such as Huawei and ZTE. How China's 5G development will affect the overseas development of these enterprises' 5G [13].

## 4.2. PEST Analysis of Domestic 5G

### 4.2.1. Policy Environment Analysis

The European government's support for GSM, the US and Japanese government's competition for CDMA, and the development of mobile communications in the past are all completed with strong government support. This strong support is no exception to this day. From the domestic 5G frequency planning in 2016 to the successful completion of 5G spectrum resource allocation in 2018, the Chinese government attaches great importance to 5G development and frequently issues 5G development policies, as shown in Table 2. It can be seen that the government has played an important role in promoting 5G technology research and development, standard setting, and network construction.

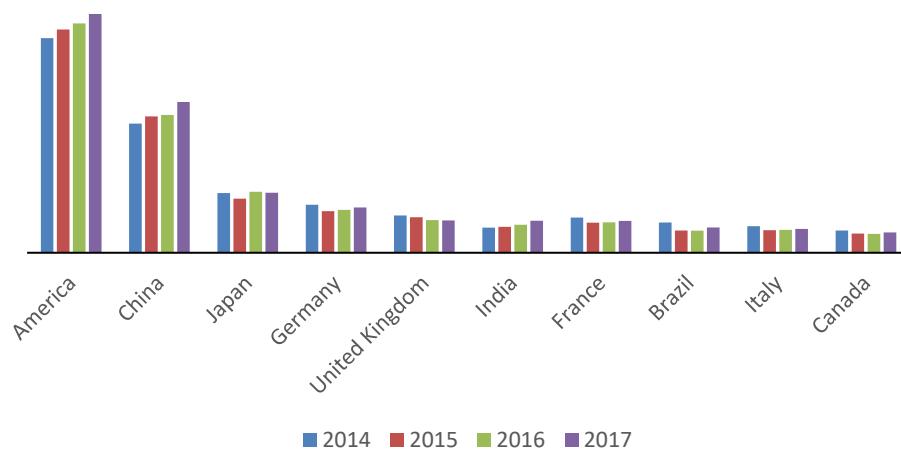
**Table 2.** my country's 5G industrial policy

Time	Policy name	Main content
2015	"Made in China 2025"	Fully break through the fifth generation mobile communication technology
2015	"Thirteenth Five-Year" National Strategic Emerging Industry Development Plan	Vigorously promote the fifth generation of mobile communications (5G) joint research and development, testing and pre-commercial ten points
2016	"National 13th Five-Year Plan for National Informatization"	Speed up the development and industrialization of 5G technology
2017	"Information and Communication Industry Development Plan (2026-2025)"	By the end of the 13th Five-Year Plan period, it has become one of the global leaders in 5G standards and technologies
2017	"Guiding Opinions on Further Expanding and Upgrading Information Consumption to Continuously Unleash the Potential of Domestic Demand"	Accelerate strict implementation of the fifth generation mobile communication standards, technical tests and industrial advancement
2018	"5G Development Prospects and Policy Orientation"	My country's 5G will initially meet commercial conditions in the second half of 2019
2018	"Three-year action plan for expanding and upgrading information consumption (2018-2020)"	Propose to accelerate the research and technical test of 5G standards, promote the construction and application of 5G large-scale networking demonstration projects to ensure the launch of 5G commercial
2018	"Improvement of the implementation plan of the consumption promotion mechanism (2018-2020)"	Proposed to further expand and upgrade information consumption, increase network speed and fee reduction, and accelerate the commercialization of the fifth generation mobile communication (5G) technology

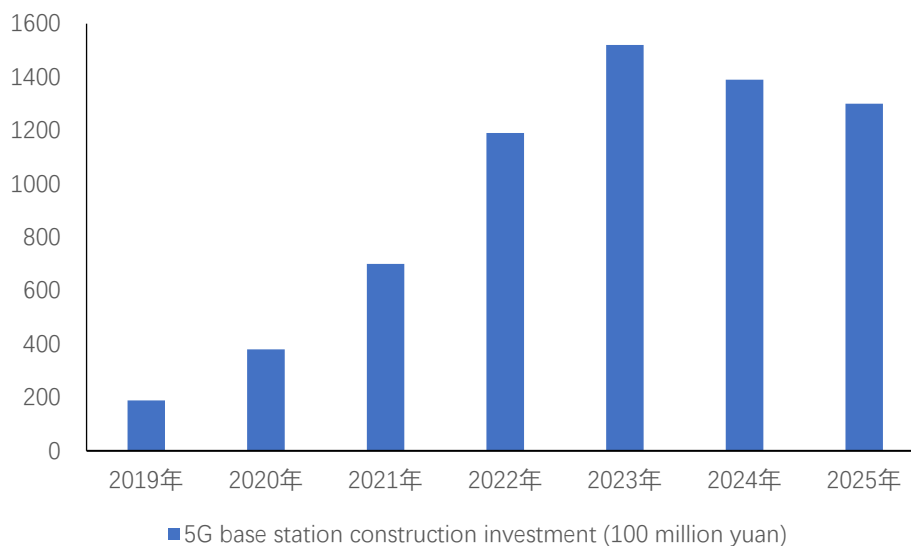
At this stage, my country's independent intellectual property rights 5G technology patents account for 34% of the world, and winning the 5G short code standard is largely driven by the country's good 5G policy. Accelerate the 5G standardization process, seize 5G spectrum, relax policies in 5G-related industries, and provide financial support to relevant enterprises. A good 5G policy environment will accelerate the transformation of 5G construction achievements and promote the achievements of my country's communications industry at the forefront of the world.

**4.2.2. Economic Environment Analysis**

China, as the second largest economy, has maintained a sustained and stable growth trend in recent years. Its economic situation is optimistic, as shown in Figure 7.



**Figure 7.** Overview of GDP of the top ten countries in the global GDP ranking in 2014 (Source: World Bank)



**Figure 8.** 5G base station construction investment forecast in the next 7 years (Source: Guanyan World)

With the expansion of the country's overall economic scale, my country's fiscal expenditures on education, medical care, and public services have continued to increase. The development and

accumulation of the capital market guarantee the funds for 5G construction. For the communications industry, the South China Morning Post in Hong Kong predicted that the main investment of China's three major operators in 5G infrastructure will reach 1.23 trillion yuan in the next 7 years. The amount of 5G base stations will be double that of 4G. The construction of 5G base stations will start in 2019. Investment is showing rapid growth, see Figure 8.

The gross national product has shown a steady growth trend, the national living standard has been improved, the per capita disposable income is considerable, and the proportion of national consumption outside of clothing, food, housing and transportation has gradually increased. According to data released by the Ministry of Industry and Information Technology in April, as of the end of March, the total number of mobile phone users in my country reached 1.597 billion, and the total number of fixed Internet broadband access users reached 423 million. Combining the situation of 4G users and broadband high-access rate users, the demand of Internet users in my country is developing towards a high-speed trend. China has a huge market size and number of users.

The living standard is good, and the continuous increase of users' network speed requirements has spawned many IoT application scenarios such as smart homes and Internet of Vehicles, which will become a new round of 5G growth hotspots. 5G demand has entered a period of rapid growth.

#### **4.2.3. Social Environment Analysis**

The continuous growth of my country's economic level has driven the improvement of national living standards. Maslow's hierarchy of needs shows that after satisfying the basic needs of life, citizens begin to consume in a high-level direction to satisfy spiritual needs. With the advent of the Internet as the driving point, information flows have increased and information acquisition has been networked. In 2011, the Internet erupted in an all-round way, and the user's demand for the Internet exploded every year. The National Bureau of Statistics showed that China's mobile Internet access traffic reached 71.1 billion GB in 2018, an increase of 189% year-on-year. 6 times as much.

The popularity of the Internet has accelerated the growth of user scale. The convergence of online and offline services such as mobile payment and smart travel and the diversification of smart terminals have driven the development of users' communication needs towards high quality. The development of the 5G industry has shown a positive trend. According to the relevant characteristics of the three major scenarios defined by 5G, multi-device high-speed transmission, the Internet of Things uses 5G technology as the infrastructure to start the era of Internet of Everything. The Internet of Things is a combination of radio frequency identification, infrared induction, GPS positioning, wireless transmission, sensing and information processing technology and communication equipment to intervene objects in the network and cooperate in the fields of intelligent identification, positioning, tracking and monitoring. IoT applications involve scenarios such as smart wearables, Internet of Vehicles, smart industry, and smart medical care. With the integration of new technologies such as artificial intelligence and cloud computing and the Internet of Things, a data connection network covering all parts of the country will be formed, and 5G will usher in a new stage of integrated innovation and large-scale development.

#### **4.2.4. Technical Environment Analysis**

Since the establishment of the IMT-2020 (5G) promotion group in 2013, the Ministry of Industry and Information Technology of my country will lead relevant departments and enterprises to conduct 5G technology research and development to promote the development of 5G in my country. China's 5G technology research and development test was launched in January 2016. It is implemented in three stages: key technology verification, technical plan verification and system plan verification. All tests have been completed by the end of 2018.

Except for the delivery of the three-stage test satisfaction answer, the domestic 2018 The number of 5G-related patent applications is 10,637. China's 5G technology-related patent application status is prominent, and 5G has obvious development advantages.

### **4.3. Analysis of Five basic Domestic 5G Competitiveness**

#### **4.3.1. Competition among Enterprises**

5G standard competition Just like the cross-border business competition in other fields, China's self-developed 5G technology also faces rejection and attacks from international competitors. From the operator Dao manufacturers, in addition to domestic Huawei, ZTE, China Mobile, etc., Qualcomm, Nokia, Ericsson, Samsung, LG and other global communications majors are closely watching the development of 5G standards. The core of the 5G standard battle lies in the competition for channel coding. As early as 2015, there were three candidates for 5G channel coding in the world, including Europe-led Orange SA, Turbo codes from Ericsson camp, LDPC codes from Qualcomm, Nokia, Intel and Samsung camps led by the United States, and Polar codes from Huawei camp led by China. The LDPC code of the United States defeats the international coding standard of the Polar code data channel by virtue of its advantages in large-scale data encapsulation performance. At the 3GPP conference in November 2016, the polar code promoted by China became the international coding standard for control channels. Therefore, the main competitor of Polar codes is the LDPC in the United States. After the end of the Turbo code, in Europe, which has long been under US control, the Orange SA and Ericsson camps are likely to follow the LDPC in order to maintain their position and interests in the communications field. In addition to the long-term relationship between Japan and the United States, the LDPC camp is strong.

Four major US mobile operators AT&T, Verizon, Sprint and T-Mobile tried 5G technology and equipment under the support of Qualcomm's leading technology. After the end of 2018, they launched 5G-related business services in the United States. Samsung and LG's efforts in 5G have enabled South Korea to achieve the first large-scale commercial use of 5G in the 2018 Winter Pyeongchang Olympics. In April 2019, it relied on Samsung's 5G terminal product S10 to launch 5G network services for ordinary users. Japanese operators NTT Docomo and NEC jointly tested 5G, and officially launched 5G commercial use in the 2020 Tokyo Olympics. After Huawei was banned, ZTE domestically lost the largest contract in Germany. Nokia and Ericsson successively won European 5G orders and seized the European 5G market. In April 2019, the latest report released by British market research company HIS Markit showed that Ericsson ranked 24% in terms of global 5G mobile communication equipment supply share, followed by Nokia and Huawei with 20% and 17% shares, respectively. Thereafter, Huawei and ZTE, which continue to win global 5G orders, do not have an advantage, and communication equipment vendors, chip manufacturers, and operators in the global 5G industry chain are competing for 5G.

#### **4.3.2. Industry Entry Barriers**

At present, global communication equipment manufacturers have formed a competitive landscape represented by foreign Ericsson, Nokia, and domestic Huawei and ZTE. The four major equipment manufacturers are stepping up competition for global commercial orders and are working hard in their respective subdivisions. Huawei is focusing on developing 5G chips and laying 5G base stations; ZTE actively proposes commercial technology solutions; Ericsson and Nokia actively win major operators. According to the information released by the major equipment vendors, Huawei has obtained 40 5G commercial contracts. ZTE has cooperated with more than 30 operators. Ericsson and Nokia also have more than 30 5G contracts. In addition to the 5G performance of leading companies such as Qualcomm and Samsung, the global 5G pattern members have determined that market share will gradually appear.

5G is ushering in new frequency bands, new air interfaces, and new scenarios. The network architecture is much more complicated than 4G. The high-complexity technology requires a

whole set of construction work to be explored in the unknown field. 5G construction costs are high, and only the three major Chinese operators will invest up to 1.23 trillion yuan in 5G infrastructure in the next 7 years, an increase of 68% over 4G construction investments. Therefore, from the perspective of market and capital, 5G industry barriers are high, and it is difficult to have new entrants.

#### **4.3.3. Development of Alternative Products**

The successive iterations of mobile communication technology have resulted in new results. 5G is no exception. As a new generation of mobile communication technology after 5G, 6G will set off a wave of replacements to replace 5G once it is successfully developed. According to foreign media preparations. Various countries around the world are racing to build a 5G network. At this time, the United States has adopted market access restrictions to drag China's 5G main force, Huawei. On the other side, it is closely preparing for 6G, trying to seize the time to seize the market in advance. Compared with 4G, 5G currently has technical limitations such as Massive MIMO. The mMTC and uRLLC scenarios defined by 5G cannot be realized. In addition, the US enthusiasm for 6G research and development, 5G is likely to continue the fate of 3G quickly becoming the history of communications.

Seven operators, including the United States and South Korea, have taken the lead in launching 5G services for initial commercial use. Looking back at the promotion of each generation of mobile communication technology, 2G GSM or 3G CDMA are all driven by the dominant players in the commercial process, through the realization of a small-scale demonstration effect to promote large-scale development and promote the global application. If China does not seize the 5G window period to plan domestic 5G commercial deployment, accelerate 5G spectrum planning and commercial license issuance, and form a demonstration role as soon as possible. Once the global 5G market pattern is formed, China's 5G development prospects are worrying. As the world's largest population country and the second largest economy, China has enough consumers and enterprise users to provide sufficient markets for the development of domestic 5G-related industries. For China's 5G to make global progress, the prerequisite must be to develop the domestic market first. To form a positive feedback promotion mechanism to drive the international market, realize the realization of 5G investment as soon as possible, and have sufficient funds to invest in 6G research and development.

#### **4.3.4. Bargaining Power of Suppliers**

For China to achieve global commercialization of 5G, it must integrate into the global industrial chain and develop more international partnership mechanisms. Huawei, ZTE, Ericsson, Nokia, etc. in the middle reaches of the 5G industry chain all need to produce antennas/RF devices, baseband chips, semiconductors, and packaging. Device materials are supported by upstream manufacturers such as Samsung, TSMC, Ziguang Zhanrui, and Hynix. These enterprises also attach great importance to the development of 5G, and seize the information industry replacement to get the maximum benefit based on investment in 5G construction. Huawei, ZTE, Datang Telecom and other midstream manufacturers are equipped with a procurement expert team. First, they strictly control the procurement process and evaluate the procurement plan to effectively reduce gray income and control the procurement risk of components. Second, they are professional procurement teams. Able to master the bargaining power and gain greater price advantage. No matter which part of the 5G industry chain, we must fully promote the commercialization of 5G as soon as possible. It is the entire industry that accelerates its development and matures. After the scale of the entire market expands, suppliers in China's 5G industry chain can achieve better development.

#### **4.3.5. Buyer's Bargaining Power**

5G commercial involves the entire 5G industry chain including equipment manufacturers, chip manufacturers, operators, etc., but the direct entrance for users to enjoy 5G network services

is the operator. In the face of operators, the bargaining power of buyers is only reflected in the two options of different operators and different telecom service packages. At this stage, based on the protection of the operator's market order, consumers do not have any channels to adjust package pricing issues with operators, nor can they realize the transfer of operators with current telecommunications service information. Except for the order of enterprises to obtain a certain price advantage by quantity, There is no bargaining space in the huge personal consumer market, and the bargaining power of individual consumers is almost zero. Under the traditional model, telecom operators use ARPU (Average Revenue Per User), which is the average revenue per user, as their business revenue measurement indicator. ARPU focuses on time division, which refers to the contribution of each user to the operator's revenue in a specific time period. The key role of high-end users for ARPU is reflected. The business development strategy that has always focused on high-end customers in telecommunications operations is the actual application of the "two-eighth rule".

In the Internet era, especially for network products represented by 5G, operators should break the "two-eighth rule" and follow the "long-tail theory" to focus on the personal consumer market. Break the barriers of high-end customers and ordinary individual users, fully open 5G services at a low price, and provide near-free 5G services to harvest a larger user scale. On the basis of doing a good job in network services, we will enhance the value positioning of enterprises, take big data, Internet of Things, cloud computing and other new-generation information technologies as key development targets, and make full use of operators' marketing capabilities and social influence advantages to introduce 5G mobile office and smart home And other businesses, in the "entry-platform-connection" mode, a single "communication basic service system" to "digital information interconnection architecture". Apple's iTunes Music and Tencent Technology WeChat are typical long-tail theories and successful cases of providing free products in the Internet era: providing a nearly free service to the huge consumer market, giving it full bargaining power to harvest large-scale users and good reputation , Carry out value-added services (such as iTunes music library purchase, WeChat wealth management, etc.) to obtain profits.

## 5. Summary

As the third scientific and technological revolution, information technology has greatly promoted the transformation of human society, economy, politics and culture. Mobile communication iteratively updates and subverts the communication mode of humans and the information mode of the entire society. Internet thinking and the application of Internet of Things scenarios involve industry chains in all walks of life. Huawei, ZTE, etc., as pioneers in the domestic and global communications markets, the level of maturity of their mobile communications technology represents to a certain extent the comprehensive strength of mobile information technology. At present, major countries and regions in the world are actively promoting 5G trials and commercial plans, accelerating the national 5G communications industry layout, trying to occupy an upstream position in the communications industry chain, and striving for 5G standards and industry development dominance. The features of high-speed, low-latency, and high-reliability of the fifth-generation mobile communication technology can realize the application scenarios of cross-border integration of artificial intelligence, big data, cloud computing, and Internet of Things technologies to meet the needs of users in the new era.

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