Research on the Development of the Fifth-Generation Technologies

Yulin Cheng[1,*]

[1]*Changchun University of Science and technology, Science Department, Jilin, China, 130012*
Corresponding author. Email: Chengyulin829@126.com

ABSTRACT

Telecommunication providers have been working tirelessly to improve the services they offer since the invention of mobile phones. The progress is done by the providers to increase their reach, attract more people and make the services better. First-generation (1G) was the first network to be established but faced with coverage and was only limited to voice calls. To address these problems, the telecommunications investors have created second-generation (2G), third-generation (3G), fourth-generation (4G) and fifth-generation (5G) mobile networks. The new mobile networks usually come with new features such as better speeds and services. The paper explores the development of 5G mobile network and what it means to different industries. The research problem discussed in the paper is intended to establish whether the cost of 5G development is manageable and viable. Additionally, the research objectives will investigate what it takes to develop 5G from 4G, the elements and the current state of implementation in different economies in the world. After its implementation, the 5G mobile network will help solve speed problems and enhance user experience with its high speed. The significant technologies for the latest mobile network involve cloud computing, software-defined networking (SDN) and Internet of things (IoT). IoT puts together SDN and cloud-based services to improve services for the users. The paper comprehensively discusses 5G in the introduction, literature review, methodology and analysis.

Keywords: 5G development, Qualitative research strategy, Interpretation

1. INTRODUCTION

In the past two decades, mobile communication has made advancements to better its wireless networks. The advancements have been boosted by the growing demand for better services in industrial and human spheres. 5G development is influenced by the challenges and problems that have hindered the performance of 4G, 3G, 2G and long term evolution (LTE) networks. Every generation was developed to come with a particular level of performance such as better capacity and speed. To be referred to as "G network" meant that that the network design had specific features that supported different technologies [1]. Before the creation of 3G and 4G, countries and organizations implemented their standards to boost performance. After 3G and 4G, firms and nations built their networks to the same levels irrespective of the company or country. The improvements enabled devices to be used in many countries without making significant changes[2]. The major advantage of this is that the telecommunication providers enjoyed economies of large scale to provide services to the users. Though 4G network was relatively reliable, some companies and countries obtained Long-Term Evolution (LTE) boosting features to get better capacity and faster speeds.

To make the new developments, 5G depends on the preceding mobile networks to increase networks speeds and improve the user experience for the users[3]. Telecommunication providers note that 5G has achieved great developments in communication involving data. 5G will provide better security, wide coverage and energy conservation compared to the networks that have been in use before. Countries that already have the 5G services are enjoying better services compared to those that are still using the previous mobile networks before 5G.

The research objectives are to establish if the world is ready for the 5G mobile network, to know how technologies such as cloud computing, Internet of things (IoT) and software-defined networking (SDN) help in the development of 5G and to find out what it takes to develop 5G mobile network as well as its deployment.

2. ANALYSIS

Secondary sources show that many sectors have digitized their services and the development of the 5G network has brought a new experience. The health, education, industrial and technological sectors greatly depend on the mobile networks to reach different stakeholders. New mobile network will ensure that the services being offered in the sectors are digitized and the user experience is improved. The sectors need the 5G network to market their products and services through their social media platforms through posts[4]. Reaching their prospective customers also depend on the 5G network as there have been complains that the networks are slow. Countries that have already adopted the 5G network have their citizens ahead of the rest of the world enjoying better data speeds and coverage.

Interviews with many stakeholders indicated that 5G network has introduced additional features and infrastructure to enable its use. The technologies include Application Programming Interface (API), Software Defined Network (SDN) and Network Function Virtualization (NFV) to help in the network's commercialization. 5G is the future of business growth[5]. Countries that have already adopted the new mobile network are witnessing better speeds when streaming online and larger capacity supporting high definitions. Through industrial development, agriculture systems, information technology, and advanced communication, the new network is expected to boost services in interconnected devices. 5G will support the growing need for advanced technology in different companies.

2.1 Key Modules in Analysis

Developing the 5G mobile network modules is expensive and requires a lot of money to establish. The demand module and graphical interface module require resources to study and set up so that the 5G deployment can run smoothly.
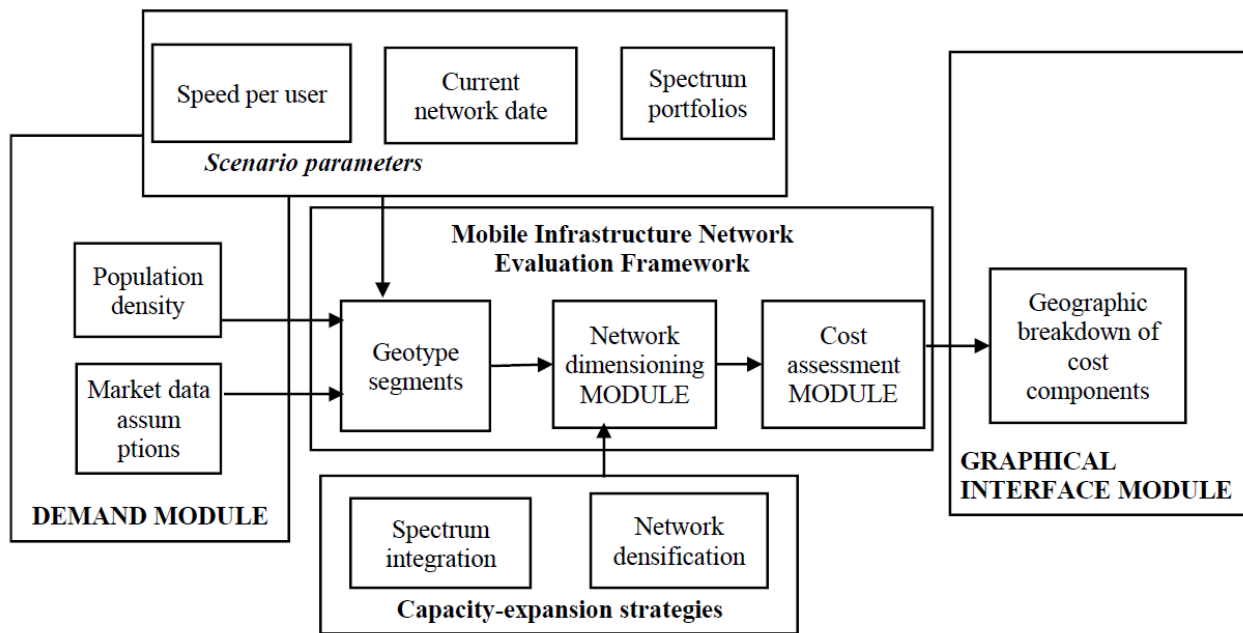

Figure 1: Key Modules of 5G networks

Telecommunication providers noted that technology enthusiasts are talking about 5G mobile networks and it is only a matter of time before consumers start adopting it irrespective of the cost. The major challenge with its adoption right now is the high cost that comes with it. High cost of acquiring the latest mobile network has seen only the major world economies adopting it. Developing countries will wait a bit longer to fully enjoy the services[6]. The threat facing the new mobile network is threatened by cyberattacks but new factors like IoT, private network and virtual 5G can bring more challenges. If users are unwilling to accept the challenges, they will most likely be victimized by hacking of their devices, software, and interconnected systems. The virtual features give cybercrime perpetrators new points of entry to stage the attacks through the increased number of connected gadgets.

Interviews revealed that availing the high speed that comes with 5G requires a wide geographic coverage known as spectrum. To get the spectrum, each country has to follow their laws and regulations regarding technology to allocate and use it[7]. That means that different regions will get the 5G connection at different times when they have made necessary preparations working with different costs depending on how well their regions are prepared for the deployment.

The development will help companies to get closer to their suppliers, customers and other stakeholders to receive more information. Preceding network generations have always come with greater speeds gut the 5G will push this further. It is predicted that the speed of 5G mobile network can go up to 10GB/S which is close to 100 times the speed of 4G network. A speed like that will avail the best experience for consumers as downloading contents that took hours to download will only take a minute.

Fifth-generation (5G) mobile networks use new enhanced methods and technologies to avail improved services by bettering capacity and speeds. The development of 5G started to help consumers bridge the demand and create new services[8]. 5G is designed to help in different fields like the industrial revolution and mobile communication. Sectors that are greatly benefitting from 5G development are medical, management and security[9]. 3G and 4G networks cannot support and meet user demands of higher speeds at a time when the user wants to perform complicated tasks. During the performance of complicated tasks, unstable mobile connections triggered the development of 5G to solve the loss of service and delays.

Though still in the early stages of operation, the services of 5G mobile networks are being enjoyed by 68 nations around the globe. The commercial deployment has begun and by April 2021, thousands of selected industry software and applications were using them. When the year ends, millions of users will be enjoying the services through their mobile phones. Other networks previously used will be slowly phased out when the world completely decides to go for better networks. Different from the earlier networks, 5G is seen as the basis of industrial digital change. The globe's big economies have asked 5G to be part of their long-term industrial advancements. The European Union has proposed a digital plan, 2030 Digital Compass plan, to help in the commercial process for different sectors that would need the new mobile network. South Korea is the first country that deployed 5G and is working on 5G+ to ensure that they get the best experience from the new technology[10]. Japan is also working on Beyond 5G (B5G) to ensure that its citizens get the past from the advanced mobile network that has not reached some countries. China has set a goal of having 5G+ network as the main mobile network used in its industries.

Telecommunication companies started creating 5G networks in 2018. Since that time, the commercialization of the latest network is expanding around the globe. Players in different sectors agree that the new mobile network will make their work easier and solve different problems that have been seen with the previous networks. Big economies in the world need 5G to help their advancements in industrial growth. The development of 5G network will help different industries in making major steps in communication.

2.2 Comparison of the most basic features of 4G and 5G

2.2.1 5G network

5G is a fifth generation mobile network that was launched in 2019. 5G doesn't have a specific owner but Qualcomm has played a major role in establishing the build-up technology to the network. 5G devices are connected to the internet and telephone network by radio waves through a local antenna in the cell. They have a greater band width than 4G network thus making it have higher downloading speeds of 10GBPS5G is 100 times faster than 4G network. 5G network ranges from 50mbps to 1gbps. It has the air latency (the delay between sending and receiving information) of 8-12 milliseconds and it's higher during handovers from 50-500 milliseconds depending on the type of handover but is still lower than for 4G. In order to reduce error rate to a minimal it uses adaptive modulation and coding scheme (mcs) thereby reducing the speed 5G network does support most devices except for the advanced ones i.e. Samsung s21+ and iPhone 12 and above.

2.2.2 4G network

4G is the 4th generation network of mobile technology. Its user terminal was manufactured by Samsung and was launched on December 14th 2009 by two Scandinavian capitals that is Stockholm (Ericsson and NOKIA Siemens network systems) and Oslo (a Huawei system). The network was founded by Telia Company AB.4G network has a downloading speed of 14-100mbps. Its uploading speed is up to 8mbps. It uses several frequency bands widths i.e. Frequency Division Duplexing (FDD) Time Division Duplexing (TDD) etc. 4G network has low latency which is important in online conferences and online gaming. It allows users to browse the web and stream HD videos on mobile devices this makes the phones to be like laptops or desktop.

Table 1. Comparsion between 5G and 4G technologies

Technology	5G Technology	4G Technology
Technology	Involves IP and uninterrupted combination of broadband,	Includes IP and uninterrupted amalgamation of broadband: WLAN, WAN/LAN and PAN

	WAN/LAN/WLAN 22/PAN and other 5G deployment tools	
Data bandwidth	1Gbps and more	2Mbps to 1Gbps
Multiple access	BDMA and CDMA	CDMA
Frequency band	3-300GHz	2-8GHz
Hand off	Horizontal and vertical	Vertical and horizontal
Service	HD streaming, dynamic information access, efficient global roaming	Dynamic information access, HD streaming, wearable devices
Start from	2015	2010
Classification	Packet data, all IP, Digital broadband	Digital broadband and packet data
Principles	BDMA and CDMA	Network-LMPS, OFMDA, CDMA
Core Network	Flatter IP network and 5G NI	All IP network

These are the most important features for 5G and 4G mobile networks. Without them, the networks would not work properly. Acquiring and installing these features come at a cost and can be expensive.

3. CONCLUSION

The development of 5G has been driven by users' and company needs. 5G avails better services and is created after 1G, 2G, 3G and 4G. Technologies used to develop 5G depend on the technologies that were used to create other inferior mobile networks. The distribution of 5G technologies is just starting and countries around the globe want to be among the first nations to market 5G technologies and capture the largest market. Distribution of 5G is approximated to be at its peak by 2035 when different countries and companies will have adopted the new technology in their dealings. The shortcomings of the research are that it fails to reveal the exact cost of 5G mobile network deployment and how countries can acquire different spectrums. Future research should focus on determining the exact cost of 5G development that can be used by different stakeholders as a guideline.

REFERENCES

[1] Bhalla, M. R., & Bhalla, A. V. (2010). Generations of mobile wireless technology: A survey. International Journal of Computer Applications, 5(4).

[2] Bria, A., Gessler, F., Queseth, O., Stridh, R., Unbehaun, M., Wu, J. & Flament, M. (2001). 4th-generation wireless infrastructures: scenarios and research challenges. IEEE Personal Communications, 8(6).

[3] McNair, J., & Zhu, F. (2004). Vertical handoffs in fourth-generation multinetwork environments. IEEE Wireless communications, 11(3).

[4] Andersson, D., & Nilsson, E. (2018). Internet of Things: A survey about knowledge and thoughts.

[5] Greenbaum, E. (2018). 5G, Standard-Setting, and national security. Harvard National Security Law Journal.

[6] Laskai, L., & Sacks, S. (2018). The Right Way to Protect America's Innovation Advantage. Foreign Affairs, 23.

[7] Ruppersberger, C. A., & Rogers, M. (2012, October). Investigative Report on the US National Security Issues Posed by Chinese Telecommunications Companies Huawei and ZTE, a Report by Chairman Mike Rogers and Ranking Member CA Dutch Ruppersberger of the Permanent Select Committee on Intelligence, US House of Representatives, One Hundred Twelfth Congress, Second Session, October 8, 2012. In United States. Congress. House. Permanent Select Committee on Intelligence. United States. Congress. House. Permanent Select Committee on Intelligence.

[8] Gupta, A., & Jha, R. K. (2015). A survey of 5G network: Architecture and emerging technologies. IEEE access, 3.

[9] Amanatullah, Y., Lim, C., Ipung, H. P., & Juliandri, A. (2013, June). Toward cloud computing reference architecture: Cloud service management perspective. In International Conference on ICT for Smart Society (pp. 1-4). IEEE.

[10] Brake, D. (2016). 5G and next generation wireless: Implications for policy and competition. Information Technology & Innovation Foundation.