WIRELESS MOBILE COMMUNICATION – PAST AND PRESENT

A SEMINAR REPORT

Submitted by

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(*MES21MCA-2020*)

to

The APJ Abdul Kalam Technological University

in partial fulfillment of the requirements for the award of the Degree

of

Master of Computer Applications

Department of Computer Applications

MES College of Engineering Kuttippuram
Thrikkanapuram P.O, Malappuram Dt, Kerala, India 679582

February 2023

DECLARATION

I, hereby declare that the seminar report " Wireless Mobile Communication – Past and Present", submitted for partial fulfillment of the requirements for the award of degree of Master of Computer Applications of the APJ Abdul Kalam Technological University, Kerala is a bona-fide work done under the supervision of Mr. Balachandran K P, Associate Professor, Department of Computer Applications. This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

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CERTIFICATE

This is to certify that the report entitled **"Wireless Mobile Communication – Past and Present"** submitted by **JENIYA MAJEED T**, to the APJ Abdul Kalam University in partial requirements for the award of the Degree of Master of Computer Application, is a bona-fide record of the seminar work carried out under my guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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ACKNOWLEDGEMENT

I am grateful to ***Dr. Rahumathunza I.***, *Principal, MES College of Engineering, Kuttippuram,* for providing the right ambiance to do this project. I would like to extend our sincere gratitude to ***Prof. Hyderali K ,*** *Head of the Department, MCA, MES College of Engineering, Kuttippuram.*

I am deeply indebted to the seminar coordinator ***Mr. Syed Feroz Ahamed M.***, *Assistant Professor, Department of Computer Applications* for his continued support.

It is with great pleasure that I express deep sense of gratitude to our seminar guide ***Mr. Balachandran K P.,*** *Associate Professor, Department of Computer Applications,* for his guidance, supervision, encouragement and valuable advice in each and every phases.

I would like to thank all other faculty members and fellow students of MES College of Engineering, Kuttippuram for their warm friendship, support and help.

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ABSTRACT

Wireless mobile communication technologies are improving very rapidly every day. Communication that takes place without using wires or other enhanced conductors is known as wireless communication. Several generations of mobile wireless technologies have started with the 0th generation and continued over the past few decades. Wireless mobile communication networks have been experiencing three generations of change. The first-generation(1G) wireless mobile communication network was the analog system that was used for public voice service with a speed of up to 2.4 kbps. The second generation(2G) is based on digital technology and network infrastructure which supports text messaging. The growth of demand for online information via the internet prompted data connectivity had ultimately led to the third-generation(3G) system. It refers to developing technology standards for the next generation of mobile communication systems. The world of wireless telecommunications is evolving rapidly. An effort to combine multiple technologies into a single standard has been proposed to create a fast and reliable mobile network. Different generations are the result of current development. Several generations of wireless technologies from 0G to 7G are discussed here. As the world moves towards being fully wireless, people demand better quality, higher speed, and increased bandwidth with a reduced cost at any time, anywhere. Wireless technology is important and beneficial to society. A comparison has been presented to explain how each generation uses technology in its execution, application, and usage.

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INTRODUCTION

Wireless mobile communication has come a long way since its inception. In the past, mobile communication was limited to voice calls over analog cellular networks, which were expensive and had limited coverage. The first commercially available mobile phone was launched in 1983, and it was bulky and expensive, making it a luxury item that only a few could afford. Over time, the digital cellular network replaced the analog network, which improved the quality of voice calls and expanded the coverage area. The introduction of SMS messaging in the late 1990s revolutionized mobile communication and made it more accessible to the masses.

In the present day, mobile communication has evolved into a sophisticated and multifunctional system, where mobile devices can access the internet, make video calls, and stream high-quality audio and video content. The advent of 3G, 4G, and now 5G networks has made wireless mobile communication faster and more reliable than ever before. Wireless mobile communication has not only transformed the way we communicate but has also enabled the development of various industries, such as e-commerce, mobile banking, and telemedicine.

The future of wireless mobile communication looks promising, with the continued advancement of technologies such as the Internet of Things (IoT) and Artificial Intelligence (AI) set to make mobile devices even more integral to our daily lives. As the world moves towards being fully wireless, people demand better quality, higher speed, and increased bandwidth with a reduced cost at any time, anywhere. Wireless technology is important and beneficial to society. A comparison has been presented to explain how each generation uses technology in its execution, application, and usage.

CHAPTER 2

LITERATURE REVIEW

2.1 Wireless Communications

Wireless communication refers to the transmission of information between two or more devices without the use of physical wires or cables. It is a broad term that encompasses a range of technologies, including cellular networks, Wi-Fi, Bluetooth, and satellite communication. Wireless communication has become an integral part of modern society, enabling us to stay connected with each other, access information, and perform various tasks from anywhere and at any time. It has enabled the development of numerous industries and applications, from e-commerce and mobile banking to telemedicine and remote work. Wireless communication has also transformed the way we consume entertainment, with streaming services allowing us to watch movies, listen to music, and play games on our mobile devices. Overall, wireless communication has revolutionized the way we interact with the world, making it more convenient, accessible, and efficient

2.2 Mobile Communications

Mobile communications refer to the transmission of information between mobile devices, such as smartphones and tablets, over a wireless network. Mobile communication has become an essential part of our daily lives, enabling us to communicate with each other, access information, and perform various tasks while on the go. The development of mobile communication has gone through various stages, from the first analog cellular networks to the current 5G technology, which offers faster speeds, lower latency, and higher capacity. Mobile communication has also enabled the development of numerous applications and services, such as mobile banking, e-commerce, and social media, that have transformed the way we live and work. Mobile communication has also brought people closer together, allowing us to connect with friends and family who are far away and facilitating global communication and collaboration. Overall, mobile communication has revolutionized the way we interact with the world, making it more convenient, accessible, and connected.

2.3 History of Wireless Mobile Communication

The history of wireless mobile communication can be traced back to the early 20th century, with the development of radio communication technology. The first wireless telegraph system was developed in the 1890s, which allowed messages to be transmitted wirelessly over long distances using Morse code. In the 1940s, the first mobile radio systems were developed for use in police and emergency services. These systems used analog technology and were limited in their capacity and coverage.

The first commercially available cellular network was launched in Japan in 1979, followed by the United States in 1983. The first mobile phone to be commercially available was the Motorola DynaTAC 8000X, which was priced at $3,995 and weighed 2.5 pounds. The 1990s saw the rise of digital cellular networks, which replaced analog networks and allowed for more efficient use of the radio spectrum. The first digital cellular network was launched in the United States in 1991, and GSM (Global System for Mobile Communications) was introduced in Europe in 1992.

The introduction of SMS messaging in the late 1990s revolutionized mobile communication and made it more accessible to the masses. This paved the way for the development of mobile data services such as mobile internet and mobile email. The current generation of mobile networks, 5G, promises to revolutionize mobile communication once again by offering faster speeds, lower latency, and higher capacity. This will enable the development of new applications and services that were previously impossible or impractical on mobile devices.

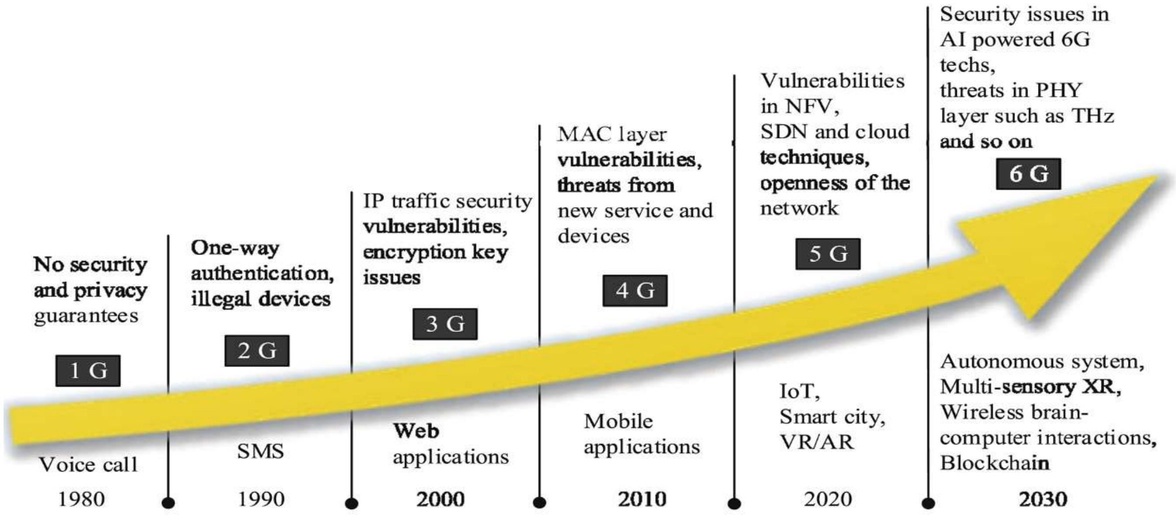

Figure 1- Technological Evolution of wireless networks

CHAPTER 3

CONCEPTUAL STUDY

3.1 Comparisons

Wireless mobile communication has gone through several generations, from the early analog systems of 0G to the current cutting-edge 5G technology. Each generation has brought significant improvements in terms of speed, capacity, and reliability, enabling new applications and services that were previously impossible or impractical. 0G, also known as the pre-cellular era, was the first generation of wireless mobile communication. This was a basic radio communication system that used a single frequency channel to transmit voice signals over short distances. This technology was limited in capacity and coverage and was mainly used in car phones and walkie-talkies.

1G, introduced in the 1980s, was the first cellular network and enabled mobile devices to make voice calls over a wider coverage area. 1G was an analog technology and had limited capacity, which meant that it could only support a small number of users at a time. This generation of mobile communication also saw the introduction of the first mobile phones, which were large and expensive. 2G, introduced in the 1990s, was a digital technology that provided better voice quality and improved capacity over 1G. 2G also enabled the development of SMS messaging, which revolutionized mobile communication and made it more accessible to the masses. This generation of mobile communication also saw the introduction of mobile internet services and the first smartphones.

3G, introduced in the early 2000s, was a significant improvement over 2G, providing faster data speeds and enabling the development of mobile data services such as mobile email and mobile web browsing. 3G also enabled the development of video calling and mobile TV. 4G, introduced in the late 2000s, was a major leap forward in terms of speed, capacity, and reliability. 4G provided much faster data speeds than 3G and enabled the development of new applications and services such as streaming video and online gaming.

5G, the current generation of mobile networks, promises to revolutionize mobile communication once again. 5G offers faster speeds, lower latency, and higher capacity than 4G, enabling the development of new applications and services such as autonomous vehicles, remote surgery, and smart cities. 5G also uses new technologies such as massive MIMO and beamforming to improve network performance and reliability. Overall, each generation of mobile communication has brought significant improvements in technology, capacity, and reliability, paving the way for new applications and services that have transformed the way we live and work.

3.2 Protocols

Each generation of mobile communication has used different protocols to enable communication between mobile devices and the cellular network. Here are some of the key protocols used in each generation:

- 1G: The first generation of mobile communication used analog protocols such as the Advanced Mobile Phone System (AMPS) and Total Access Communication System (TACS). These protocols used frequency-division multiple access (FDMA) to divide the available radio spectrum into channels, which could be used to transmit voice signals.

- 2G: The second generation of mobile communication used digital protocols such as Global System for Mobile Communications (GSM), Code Division Multiple Access (CDMA), and Time Division Multiple Access (TDMA). These protocols used digital signaling to improve voice quality and increase capacity. GSM was the most widely used protocol and enabled the development of mobile internet services such as SMS messaging.

- 3G: The third generation of mobile communication used digital protocols such as Universal Mobile Telecommunications System (UMTS) and Code Division Multiple Access 2000 (CDMA2000). These protocols offered faster data speeds and improved capacity over 2G. UMTS was the most widely used protocol and enabled the development of mobile data services such as mobile email and mobile web browsing.

- 4G: The fourth generation of mobile communication used Long-Term Evolution (LTE) and WiMAX protocols. These protocols provided much faster data speeds than 3G and enabled the development of new applications and services such as streaming video and online gaming.

- 5G: The current generation of mobile networks uses the 5G New Radio (NR) protocol, which is designed to provide faster speeds, lower latency, and higher capacity than 4G. 5G NR uses new technologies such as massive MIMO and beamforming to improve network performance and reliability. 5G NR supports new use cases such as the Internet of Things (IoT), autonomous vehicles, and smart cities.

3.3 Architecture

The architecture of 1G, the first generation of mobile communication, was relatively simple. It consisted of two main parts: the mobile unit, which included the mobile phone and the radio interface, and the cell site, which included the base station and the switching center. The mobile unit communicates with the cell site using analog signals over a single frequency channel, which limited capacity and range. The switching center was responsible for connecting calls between different cell sites and between the cellular network and the public switched telephone network (PSTN). Overall, the architecture of 1G was a basic radio communication system that allowed mobile devices to make voice calls over a wider coverage area than previous technologies.

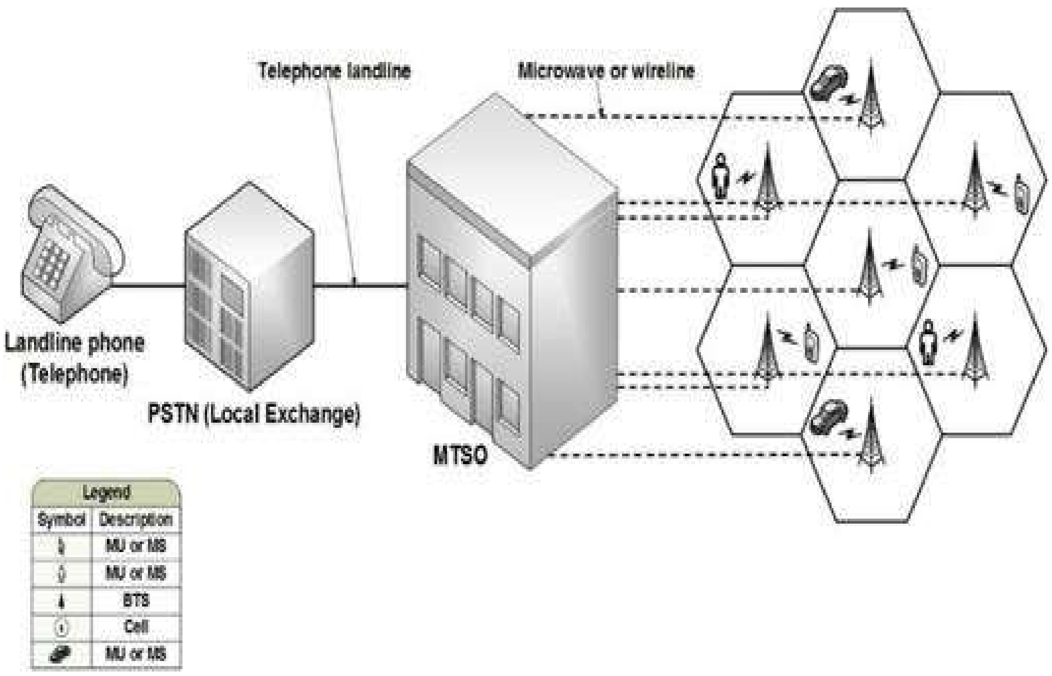

Figure 2- Architecture of 1G

The architecture of 2G, or second-generation, mobile communication was based on a hierarchical cell structure that consisted of a network of base stations, mobile switching centers (MSCs), and operation support systems (OSSs). The base stations, also known as cell sites, were responsible for communicating with mobile devices within their coverage area. The MSCs were responsible for managing the connection between the base stations and the core network, which enabled the mobile devices to communicate with other devices on the network. The OSSs provided support for network management and maintenance, including monitoring network performance, provisioning new services, and diagnosing faults. The architecture of 2G laid the foundation for the development of digital mobile communication and enabled the widespread adoption of mobile phones and mobile internet services.

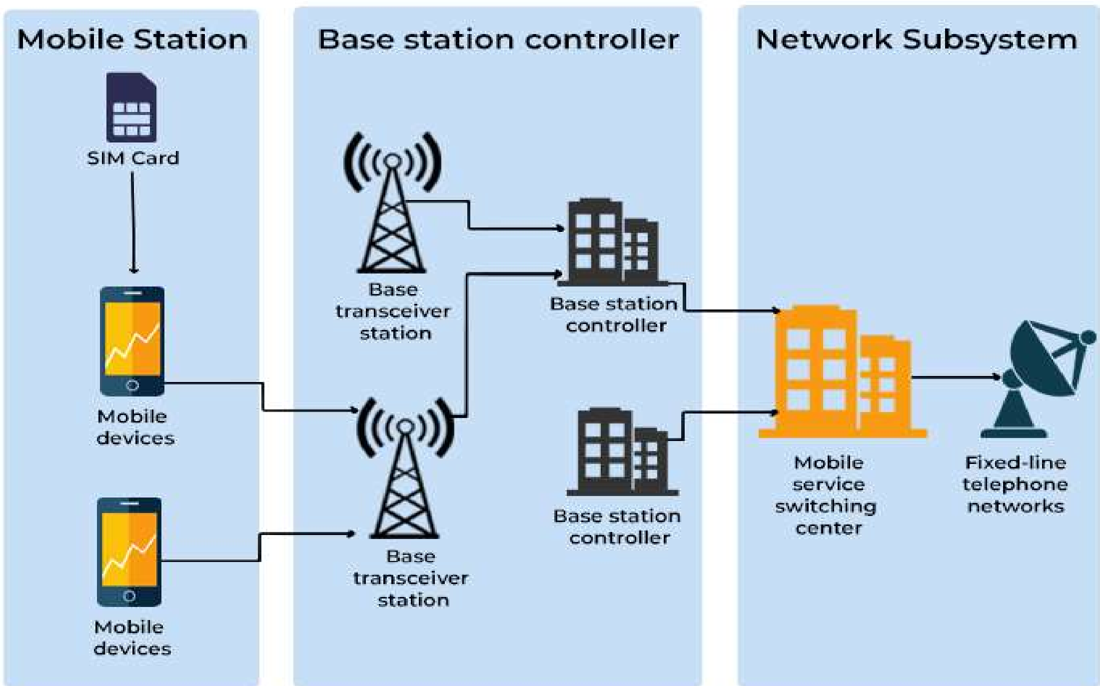

Figure 3- Architecture of 2G

Third Generation (3G) mobile communication systems are based on Wideband Code Division Multiple Access (WCDMA) technologies, which use a wider bandwidth than previous systems to enable higher data rates and improved voice quality. 3G networks are composed of multiple base stations that communicate with mobile devices via radio signals. These base stations are connected to a core network that manages the communication between mobile devices and other networks, such as the internet. The core network also handles tasks such as authentication, billing, and mobility management, allowing mobile users to move between different base stations and maintain their connection

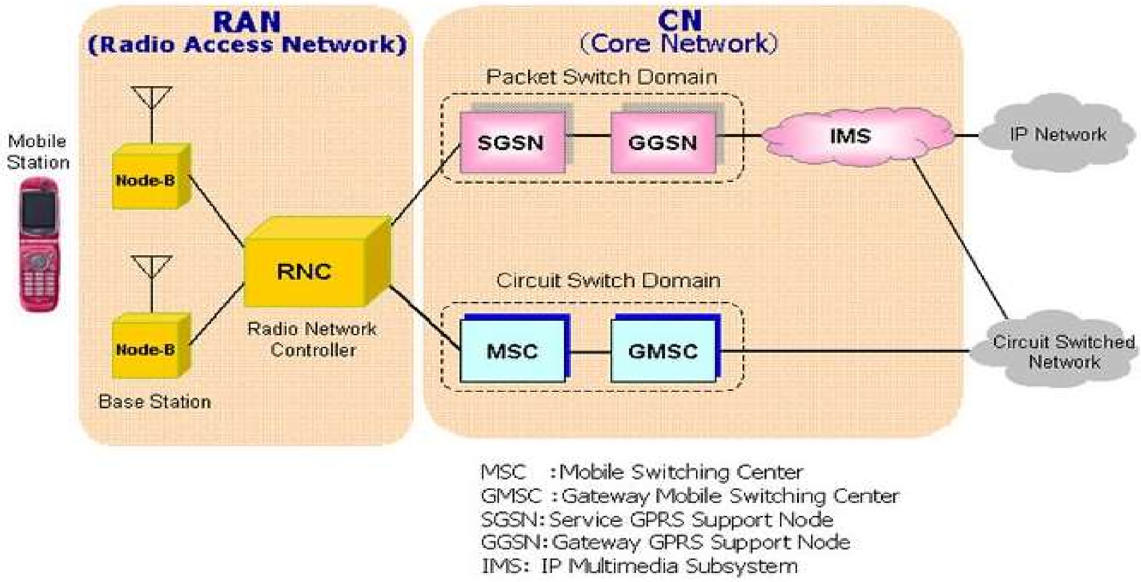

Figure 4- Architecture of 3G

4G (Fourth Generation) wireless network architecture is based on an all-IP (Internet Protocol) packet-switched network, which provides higher data rates, lower latency, and improved reliability compared to previous generations. The core network consists of multiple functional entities, including the Evolved Packet Core (EPC), which manages user authentication, mobility, and session management. The Radio Access Network (RAN) comprises a number of base stations, which use different radio access technologies such as Long-Term Evolution (LTE), WiMAX, and HSPA+. The LTE technology is the most widely used in 4G networks and provides high-speed data transfer capabilities. Additionally, 4G networks employ advanced technologies like Multiple Input Multiple Output (MIMO) antennas, which improve signal quality and coverage

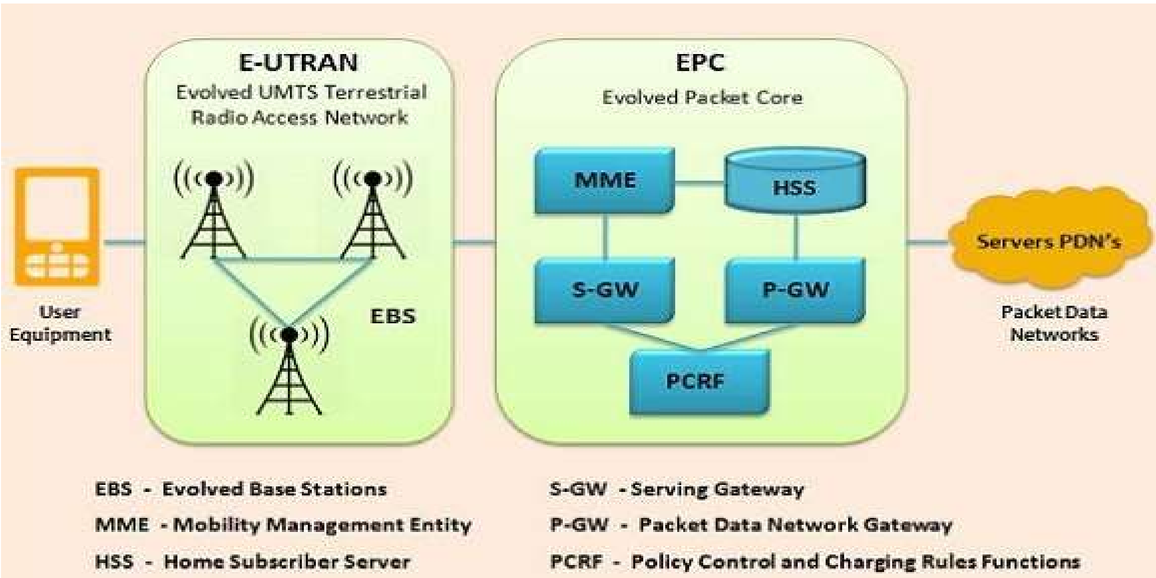

Figure 5- Architecture of 4G

5G is the fifth generation wireless communication technology that promises faster speeds, lower latency, and higher network capacity than its predecessors. It uses a network architecture that includes a combination of existing and new technologies, such as small cells, massive MIMO, and network slicing. The architecture also incorporates a flexible radio access network (RAN) that supports both traditional cellular and new emerging wireless technologies, such as IoT and V2X. Additionally, 5G architecture leverages software-defined networking (SDN) and network function virtualization (NFV) to enable efficient network management and deployment

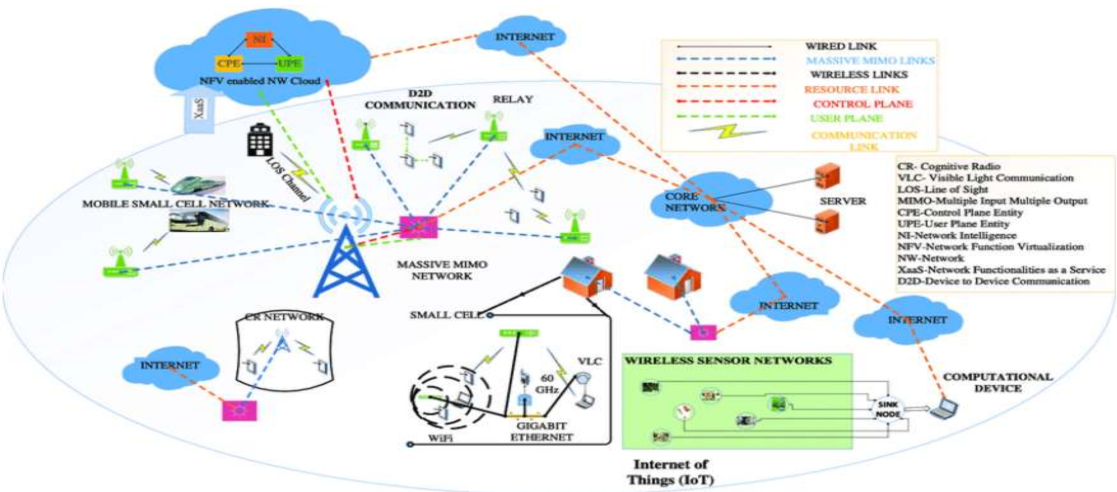

Figure 6- Architecture of 5G

3.4 Challenges

The following are some of the challenges faced in the evolution of wireless communication technologies from 1G to 5G:

1G:

- Limited network capacity: 1G networks were analog and had limited capacity to handle a large number of users.
- Poor call quality: Analog networks were prone to interference and noise, which led to poor call quality.
- Limited coverage: 1G networks had limited coverage and were mainly available in urban areas.

2G:

- Low data rates: 2G networks were mainly designed for voice communication, and their data rates were limited.
- Limited multimedia support: 2G networks did not support multimedia services, such as video streaming and mobile internet.

3G:

- High deployment costs: 3G networks required significant investments in infrastructure, such as base stations and network equipment.
- Limited coverage: 3G networks had limited coverage, and their deployment was mainly focused on urban areas.
- Interoperability issues: The first versions of 3G networks had interoperability issues between different network technologies, which led to service disruptions.

4G:

- Limited spectrum availability: 4G networks required a significant amount of spectrum to provide high-speed data services, which was a challenge in many countries.
- Interference issues: As 4G networks operated in higher frequency bands, they were more prone to interference from physical obstacles, such as buildings and trees.
- Backhaul capacity: 4G networks required high-capacity backhaul connections to provide high-speed data services, which was a challenge in some areas.

5G:

- Infrastructure deployment: 5G networks require significant investments in infrastructure, such as small cell networks and fiber-optic cables, to provide the promised high-speed services.
- Spectrum availability: 5G networks require a large amount of spectrum, which is a challenge in many countries due to limited spectrum availability.
- Security: As 5G networks will enable a large number of new applications and services, ensuring security and privacy will be a challenge.

CHAPTER 4

NEXT GENERATION OF MOBILE COMMUNICATIONS

4.1 Paving way for 5th Generation

Several factors have paved the way for the development and deployment of 5G wireless communication technology:

- Growing demand for high-speed mobile internet: With the increasing use of smartphones and other mobile devices, there has been a growing demand for high-speed mobile internet services. 5G technology is designed to provide faster data speeds and lower latency, which can support new applications such as virtual and augmented reality, autonomous vehicles, and the Internet of Things (IoT).
- Advancements in wireless technology: The development of new wireless technologies such as massive MIMO (Multiple Input Multiple Output) and beamforming, have improved the capacity and coverage of wireless networks. These technologies, along with other advancements in antenna design and signal processing, have enabled the development of 5G networks.
- Spectrum availability: The availability of new spectrum bands, including the millimeter-wave (mmWave) spectrum, has enabled the development of high-bandwidth 5G networks. The use of the mmWave spectrum, in particular, allows for very high data rates and low latency, which are critical for many new 5G applications.
- Investment by industry stakeholders: Significant investment by telecom operators,

technology vendors and governments have supported the development and deployment of 5G technology. This investment has enabled the development of new infrastructure, such as small cells and fiber-optic networks, which are essential for 5G networks.

- Standardization efforts: The development of global standards for 5G technology by organizations such as the 3rd Generation Partnership Project (3GPP) has helped to ensure interoperability and compatibility between different 5G networks and devices. This standardization has also encouraged the adoption of 5G technology by industry stakeholders.

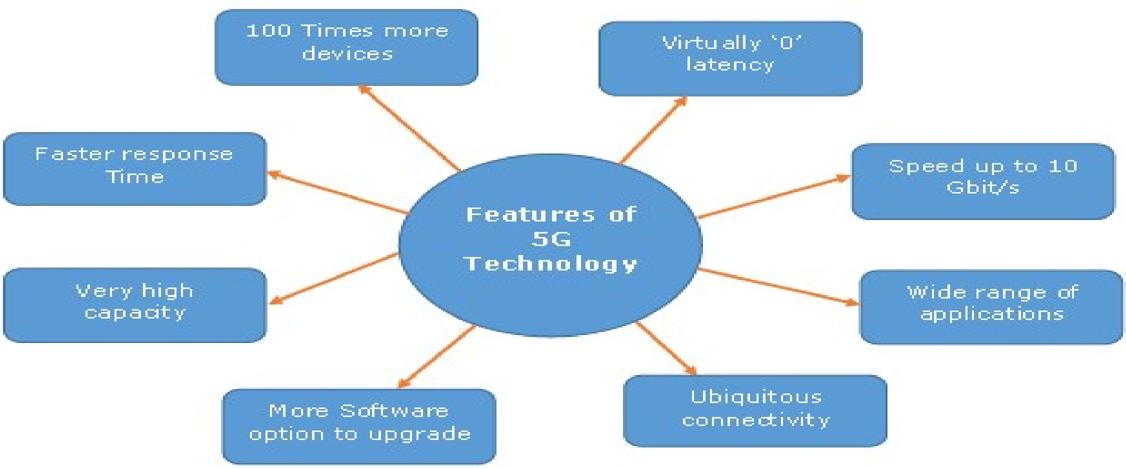

Figure 7- Features of 5G

4.2 Assumptions of 6^{th} Generation and 7^{th} Generation

The expected assumptions of 6G and 7G networks:

6G:

- Terahertz frequency bands: 6G networks may operate in the terahertz frequency bands, which could provide even higher data rates and lower latency than 5G networks.
- Artificial intelligence (AI) and machine learning: 6G networks could integrate AI and machine learning technologies to optimize network performance and enable new applications such as autonomous systems and smart cities.
- Quantum communication: 6G networks could use quantum communication technologies to provide secure and efficient communication channels.

7G:

- Brain-to-machine interfaces: 7G networks could enable brain-to-machine interfaces, which could allow for direct communication between the human brain and computer systems.
- Holographic communication: 7G networks could enable holographic communication, which could allow for immersive communication experiences.
- Integration with space-based networks: 7G networks could integrate with space-based networks to provide global coverage and support new space-based applications.

CHAPTER 5

CONCLUSION

However, wireless mobile communication technology has come a long way since its inception. The first generation of wireless networks was limited to analog voice communication, while subsequent generations brought new features and capabilities such as digital voice, data services, and mobile internet. The current fifth-generation (5G) technology promises to revolutionize wireless communication, providing high-speed data rates, low latency, and massive connectivity, which will support new applications such as autonomous vehicles, virtual and augmented reality, and the Internet of Things (IoT). Each new generation of technology has required significant investments in infrastructure and spectrum, and there have been issues with coverage, interoperability, and security.

As we move forward, it is important to continue investing in research and development to advance wireless communication technology even further. This includes exploring new frequency bands, integrating artificial intelligence and machine learning, and developing new applications such as brain-to-machine interfaces and holographic communication. By doing so, we can continue to push the boundaries of what is possible with wireless communication and pave the way for a more connected and innovative future.

REFERENCES

[1] X. Li, A. Gani, R. Salleh and O. Zakaria, "The Future of Mobile Wireless Communication Networks," *2009 International Conference on Communication Software and Networks*, Chengdu, China, 2009, pp. 554-557, doi: 10.1109/ICCSN.2009.105

[2] Vaigandla, K. K., Azmi, N., Podila , R., & Karne, R. K. (2021). A Survey On Wireless Communications: 6g And 7g. *International Journal of Science, Technology & Management*, *2*(6), 2018-2025.

[3] Tidke, Rani & Uttarwar, Pritee & Dandwate, Deepak & Tupe, Umesh. (2021). A Literature Review On: Wireless Technologies From 0G to 7G. 4. 59-64.