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A STATE OF THE ART REVIEW OF NETWORK AND MOBILE COMMUNICATIONS TECHNOLOGIES

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Abstract:

For many decades now, wireless network technologies have evolved through several iterations. Overwhelming demand for additional connections globally has led to fast development in wireless network standards to accommodate growing numbers of users. After the advent of the third-generation (3G) mobile communication infrastructure, which allowed for the development of apps tailored to smart phones, the popularity of smart phones skyrocketed all over the world. Fourth-generation (4G) networks are an improvement over their 3G predecessors, with faster data transfer rates and the capability to support richer multimedia applications. 5G is the next generation of wireless technology that will replace the current 4G standard worldwide. The 6G network system is the successor to the 5G system and will employ higher frequencies to increase capacity and decrease latency. This study examines the evolution of wireless networking from 3G and 4G to 5G and 6G, with a focus on their respective strengths and weaknesses.

Keywords:

Mobile communication systems, wireless network standards, and wireless network technology, including third-generation (3G), fourth-generation (4G), fifth-generation (5G), and sixth-generation (6G) networks.

Introduction

The advent of wireless technology has caused a digital revolution. In many respects, wireless networks have shown themselves better than their wired counterparts. Both radio waves and infrared wavelengths may be used for wireless data transfer. It was important to develop cutting-edge signal processing and transmission systems. These techniques were essential in order to significantly increase wireless capacity without requiring more bandwidth or power [1]. The high-speed connections offered by the wireless network were achieved without the costly installation of fibre optics or coaxial wires. However, this has resulted in network congestion, slow connections, and reduced capacity as a result of the increased demand. Since the needs of those who use these distant technologies are always evolving, it is essential that they be regularly updated. To create 3G, engineers merged satellite and terrestrial technologies. When compared to 3G's use of channel access techniques like TDMA (Time-Division Multiple Access), FDMA (Frequency-Division Multiple Access), and CDMA (Code-Division Multiple Access), 4G's usage of OFDMA and other technologies is a notable difference. In terms of spectral efficiency, 5G is thought to be superior than the 4G network. With each successive generation, these networks are able to provide more data per hertz. It is believed that 5G, with its potential to offer several gigabits per second, will be able to handle the anticipated growth in network traffic. Although the details of the 6th generation wireless network are still up for debate, it is anticipated that it would provide worldwide mobile coverage at rates of up to 1 terabit per second. This study will compare and contrast the technical specifications of 3G, 4G, 5G, and 6G networks, including their data transfer speeds, bandwidth, latency, and adherence to industry standards.

A NEW GENERATION (3G)

As the most important stepping stone in actualizing 3G, it was first offered by NTT DoCoMo in Japan in October 2001. Various 2G wireless telecommunications systems were combined to form this worldwide network. What set this generation of technology apart from previous ones was its capacity to bring together in a single framework several cellular technology standards such as CDMA, GSM, and TDMA [1]. The three interface modes—WCDMA, CDMA2000, and Wi-Max—worked seamlessly with the established protocols of the underlying networks. High-speed data transfer, as well as improved voice, audio, and video capabilities, are all thanks to the many protocols included into this technology. General Packet Radio Service (GPRS) and voice call switching were the backbone services of this infrastructure. Third-generation (3G) mobile networks built in part on earlier designs, but with considerable improvements over their predecessors.

3G's Standout Attributes

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determined to be superior to other networks in terms of features. The maximum speed of 2 Mbps was quite encouraging. It offered a wide variety of services, from phone calls to data transfer to multimedia playback. It allowed for the transfer of people and things, circuit and package communications, simultaneous connections, and the transmission and reception of both speech and data. It may send and receive in sync or asymmetrically. It allowed for huge email attachments to be sent and received, as well as high data transfers and bandwidth capabilities. Mobile texting, often known as SMS and MMS, was also a highly used service of this age [2].

Applications

Many new uses emerged with the advent of 3G networks, setting them apart from their contemporaries. Just a few examples of these uses are: The globe might be brought together in real time via the use of video calling. This allowed for online conferences and meetings to take place in real time for a variety of reasons. In addition to expanding the network's reach and user base, this strategy also bolstered the safety of the system. One of the most intriguing features of this generation was its ability to run a wide variety of mobile apps. Third-generation systems use GPS technology, which enables precise location monitoring and provides access to detailed map data. In the end, this was the most important use case. By making websites load quicker and improving connection, it also improved the whole web-browsing experience. This also helped eliminate any hiccups in the TV broadcast caused by latency. The advent of 3G made it possible for people to play 3D games without experiencing any hiccups, which increased their popularity.

FOURTH GENERATION (4G)

TeliaSonera introduced commercially available fourth-generation technology on December 14, 2009, and it is still widely used today. A number of technologies have come together to form the foundation of 4G, including but not limited to wireless GSM, LAN, Bluetooth, computers, other electronics, communication technology, and more. The Open Wireless Architecture (OWA) is the foundation of 4G technology, allowing for seamless and instantaneous connection to any available high-speed home router, such as a neighbour'sWIfi. Using this OWA paradigm as a foundation, 4G technology provides the wireless and mobile sectors with cutting-edge use cases, such as a 3-in-1 product that combines CDMA2000, WLAN, and GPRS; a 3-in-1 product that combines WCDMA, OFDM, and WLAN; etc. [4]. Mobile multimedia, Anywhere, Global mobility solutions over, integrated wireless, and Customized services all fall under the umbrella term "4G," which is also known as "Beyond 3G."

Essential Characteristics

In contrast to previous generations of mobile networks, which relied on a combination of technologies, 4G is a wholly IP-based integrated system that offers speeds of up to 1 Gbps for low-mobility or fixed local networks. Moreover, it provides top-notch security and end-to-end quality of service. It provides faster connections and services since it works at a higher frequency than the 3G network, anywhere between 2 and 8 GHz, and has a wider bandwidth, more than 100 MHz There are several benefits to the convergence of technologies, including improved spectrum efficiency, higher data rates for wireless terminals, and better control over services and multimedia applications [4]. In contrast to earlier standards' use of phase shift keying, 4G makes use of a more spectrally efficient modulation technique, 64-QAM (Quadrature Amplitude Modulation). High data transfer speeds and large storage capacities are available at a cheaper price per bit with 4G. Furthermore, it enables previously unavailable features like service portability and international roaming.

Applications

As the 4G network underwent several changes, new software was developed to take advantage of those improvements. This network met the need for increasingly complex applications like mobile medical and wellness monitoring, as well as content-rich mobile commerce. Mobile telemedicine and monitoring, mobile apps requiring a large amount of data transfer, mobile entertainment, and mobile multi-player gaming are all examples of common uses [5]. In order to find the most efficient route with the least amount of power consumption, 4G uses Ashco networks to incorporate intelligent routing. With 4G, you get better reliability from OFDM over Wi-Max.

Drawbacks

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A large user base is attracted to services that provide a broad variety of useful features and functions. Congestion in the network is caused by this, which in turn slows down connection and data throughput. If several networks are highly integrated and interdependent, then they are more likely to be attacked by malicious code like viruses and worms [6]. Every other network provider usually uses the same "core" network, so if it goes down, the whole system will crash and burn. While the 4G network's complicated design helps keep costs down, it also makes it more difficult to maintain.

The NEXT GENERATION (5G)

Rather of being the exclusive property of any one individual or organisation, 5G is the product of a collaborative effort by several telecom businesses. It is not yet accessible everywhere since it is currently in the testing phase. Initially, 5G was only available in some areas of Minneapolis and Chicago in April of 2019. Using software-defined radios, modulation schemes, and novel error control techniques that can be downloaded via the internet, the 5G terminals are planned to revolutionise wireless communications [7]. 5G is expected to revolutionise wireless technology by providing ultra-low latency and speeds of up to several gigabits per second. Many areas of 5G development are being pushed forward by the 3rd Generation Partnership Project (3GPP). The goal of this period is to link everyone and everything together. For transmission, 5G employs nodes that are mounted on streetlight or utility poles. Since mobile terminals are becoming highly computationally capable devices, the 5G approach is expected to be user-centric. This is because the mobile terminals will be able to support more complex functionalities for performing calculations and will have larger memory space, providing sufficient storage capability for control information [9]. As a result of 5G, national economies would benefit greatly, with GDP expected to increase by about $2 trillion and a large number of new employments produced.

Essential Characteristics

The advent of 5G will irrevocably alter the landscape of wireless communication. Real-time speeds of over 20 Gbps are now available with 5G as it is rolled out in various places across the globe. A study was done where many movies and other data were downloaded, and it was found that a 2 hour and 30-minute movie downloaded in full HD in only 10 seconds. In addition to providing near-instantaneous replies, 5G networks also include increased dependability, vastly expanded network capacity, and a more consistent user experience. It suggests UHD video streaming in both directions and substantial bandwidth shaping in both directions. To maximise efficiency, 5G relies on a policy-based framework to prevent mistakes. Not only does it have a transporter-class gateway, but it also has unidirectional consistency. Additional advantages of 5G over earlier generations include remote diagnostics, remote management, traffic analytics, subscriber monitoring, and many more [7].

Applications

This network's extremely high speed and low latency make it well suited for many complicated applications, including virtualized houses, in which you may manage all parts of your home from anywhere. There is also the possibility of "smart cities," where everything is accessed remotely and work is completed more quickly and accurately thanks to the 5G network. Scalable and heterogeneous UEs would both be well-supported in the 5G network landscape. QoS standards [8] would also be met for data needs including multimedia data, phone communication, and web browsing. As PLC and SCADA atomization become more commonplace for controlling industries and the machinery they employ, 5G will also have an impact there. World Wide Wireless Web, or 5G, will bring about ideal wireless connections in the physical world [7]. With the help of smart grids, energy consumption may be optimised to maximise financial returns and operational efficacy.

GENERATION V SIXTH (6G)

It is expected that the 6G network will replace 5G in the near future. It is anticipated that this network would enter commercial service in 2030. Although nothing has been confirmed as of yet, experts have speculated that it would contain features like high-fidelity mobile holograms, digital replicas, and totally immersive extended reality (XR). Research and development have begun laying the groundwork for what comes after 5G, even if the current iteration of the network is still in its commercial phase. Data transmission rates in the 6G network are reported to be substantially greater than in previous generations, and network traffic can be managed more effectively with little to no delays. The goal of 6G is to offer a network capable of meeting the needs of both current and future consumers and industries, some of which may have specific performance requirements that can only be met by using very high-speed connections [10]. Since 6G is still in its infancy, there is currently no

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reliable information about it. Nevertheless, we can speculate about its likely characteristics, including: (1) an artificial intelligence (AI) and machine learning (ML)-driven air interface for improved optimization; (2) new network architecture paradigms involving sub-networks and RAN-Core convergence.

(3) Added safeguards to protect user data; (4) using cutting-edge privacy and security protocols; (5) utilising wider, more powerful spectrum bands [11]. It is predicted that with this network, almost all functions may be managed from afar. As AI, ML, and networks continue to develop, robots will be able to carry out more complicated jobs, leading to more efficient self-driving vehicles, more advanced smart homes, and more advanced smart cities. These elements suggest that 6G will be the next major advancement in wireless technology. Extensive research and development over long periods of time and substantial financial investment are required to create such a system. The more complicated a system is, the longer it takes to create. Connectivity at the level of 6G will be unprecedented. On the other hand, increased vulnerability to system-breaking faults and viruses results from such interconnectedness. 6G would allow for the compartmentalization of work, which would only serve to further reduce human productivity. The development of this intricate architecture presents several difficulties, including processing power, creating low cost and low power components. Another difficulty [12] is developing the system's design such that it has little impact on the environment without sacrificing functionality. These early assumptions and hopes are what will fuel the growth of these technologies in the future.

VI SUMMARY TABLE I THE FOLLOWING TABLE SUMMARIZES ALL THE ASPECTS OF 3G, 4G, 5G AND 6G:

	3G	4G	5G	6G
Data rates	7.2Mbps - 21.6Mbps	500Mbps - 1Gbps	Upto 20Gbps	Multi Gbps to 1 Tbps
Bandwidth	15-20Mhz	2-8Ghz	24-52Ghz	NA
System	Broadband, CDMA, IP	Unified IP and combination of LAN/WAN /PAN/WLAN	Unified IP and combination of LAN/WAN /PAN/WLAN and wwww	NA
Service	Integrated high quality audio, video and data	Dynamic Information access	Dynamic Information Access, wearable devices with IA capabilities	NA
Core Network	Packet Network	Internet	Internet	Internet
Handoff	Horizontal	Horizontal and Vertical	Horizontal and Vertical	Horizontal and Vertical
Standards	WCDMA, CDMA2000	OFDMA, MCDMA	CDMA, IIDMA	NA
Technology	WCDMA	LTE, WiMAX	MIMO, mm Waves	NA

CONCLUSION

In this paper we covered the technical as well as features and application scopes of the wireless network systems. We also discussed how these systems are vulnerable to various aspects. As the technology is evolving, the demand for more and more features is also rising. So, it is important to keep up with user expectations. All these generations fulfilled the requirements of their eras and will continue to do so. Every generation has solved the demerits of the previous generations and added on to its features and then presented itself. Wireless technology has changed the way we access and connect to various other networks with more efficiency which

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has help us ease the way we do any tasks. Wireless communication systems have always been a major part of overall technological development and has helped reformed many problems of the society.

REFERENCES

[1] O. Fogbound, "Comparative studies on 3G, 4G and 5G wireless technology," IOSR J. Electron. Common. Eng., Volume 9, Number 3, pp. 88–94, 2014.

[2] HeikeKalaallit, "An Investigation of Third Generation (3G) Mobile Technologies and Services," Volume 2, Number 2, Contemporary Management Research, September 2006.

[3] E.Ezhilarasan and M.Dinakaran, "A Review on mobile technologies: 3G, 4G and 5G", Second International Conference on Recent Trends and Challenges in Computational Models, 2017.

[4] Nitika Rawat, "Future and Challenges of 4G Wireless Technology", International Journal of Scientific & Engineering Research, Volume 3, Issue 12, December 2012.

[5] U. Varshney, "4G Wireless Networks," in IT Professional, vol. 14, no. 5, pp. 34-39, Sept.-Oct. 2012, doi: 10.1109/MITP.2012.71.

[6] P., Payaswini & D H, Manjaiah, "Challenges and issues in 4G Networks Mobility Management.", International Journal of Computer Trends and Technology (IJCTT), Volume 4, Issue 5, May 2013.

[7] Modi, Hardik & Gohil, Asvin & Patel, Shobhit, "5G technology of mobile communication: A survey. ", International Conference on Intelligent Systems and Signal Processing, ISSP 2013. 10.1109/ISSP.2013.6526920.

[8] Nisha Panwar, Shantanu Sharma, and Awadhesh Kumar Singh, "A Survey on 5G: The Next Generation of Mobile Communication. ", Elsevier Physical Communication, November 2005.

[9] Aleksandar Tudzarov and Toni Janevski, "Functional Architecture for 5G Mobile Networks. ", Volume 32, July 2011.

[10] A. Mourad, R. Yang, P. H. Lehne and A. de la Oliva, "Towards 6G: Evolution of Key Performance Indicators and Technology Trends," 2020 2nd 6G Wireless Summit (6G SUMMIT), Levi, Finland, 2020, pp. 1-5, doi: 10.1109/6GSUMMIT49458.2020.9083759.

[11] H. Viswanathan and P. E. Mogensen, "Communications in the 6G Era," in IEEE Access, vol. 8, pp. 57063-57074, 2020, doi: 10.1109/ACCESS.2020.2981745.

[12] K. David and H. Berndt, "6G Vision and Requirements: Is There Any Need for Beyond 5G?," in IEEE Vehicular Technology Magazine, vol. 13, no. 3, pp. 72-80, Sept. 2018, doi: 10.1109/MVT.2018.2848498.

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