

An Overview of the State of Online and Mobile Communication Systems as of Right Now

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Abstract:

In the past several decades, many wireless network technologies have emerged. To keep up with the skyrocketing demand for new connections throughout the globe, wireless network standards have been fast changing. The advent of 3G mobile communication networks cleared the door for the development of programs optimized for use on smartphones, which in turn led to the rapid spread of smartphones throughout the world. Increases in data transfer speed and support for more complex multimedia applications are only two of the many ways that 4G networks outperform their 3G predecessors. In most of the world, 5G will replace the current standard for wireless connectivity, 4G. 6G network systems, the successor to 5G networks, will increase capacity and decrease latency by using higher frequencies. From 3G and 4G through 5G and 6G, the advantages and downsides of each generation of wireless networking are examined in detail in this study.

Keywords:

Standards and technology for wireless networks; mobile communication systems; the third, fourth, fifth, and sixth generations of networks.

Introduction

The explosion of data has been caused by the widespread use of wireless technology. There are a number of significant ways in which wireless networks have surpassed their wired predecessors. Radio waves and infrared light are both viable options for wireless data transfer. It was critical to develop cutting-edge systems for processing and transmitting signals. These techniques were critical for dramatically boosting wireless capacity without significantly increasing bandwidth or power consumption [1]. The wireless network might provide high-speed connectivity without the costly installation of fiber optics or coaxial cables. The growing number of users has, however, caused bottlenecks, slow connections, and reduced bandwidth. Since the needs of the people who will be using these technologies in the distant future are always evolving, it is essential that they be updated often. The development of 3G was a joint effort by satellite and terrestrial engineers. In contrast 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 use of OFDMA and other technologies sets it apart. It is anticipated that the 5G network would make better use of available spectrum than the 4G system did.

With each cycle, the network's data throughput per unit frequency increases. 5G should be able to handle the anticipated growth in network traffic because of its high data transfer rates. The specifications of the 6th generation wireless network are still up for debate, but it is believed that mobile coverage would be available anywhere in the world at rates of up to 1 terabit per second. This study will examine the differences between 3G, 4G, 5G, and 6G networks in terms of data transfer speeds, bandwidth, latency, and adherence to industry standards.

A NEW GENERATION (3G)

It was originally offered by NTT DoCoMo in Japan in October 2001 and was a major milestone in the development of 3G. The merging of several 2G wireless communication networks created this worldwide system. This new generation is distinguished from its predecessors by its ability to integrate many cellular technology standards into a single architecture, such as CDMA, GSM, and TDMA [1]. Since WCDMA, CDMA2000, and Wi-Max were all backwards-compatible with the underlying networks' protocols, they were all potential interface modes. Thanks to its implementation of many protocols, this technology facilitates not only the quick transfer of data but also improved voice, audio, and video quality. The network's foundation was built on voice call switching and general packet radio service (GPRS). The improvements made by the third-generation (3G) of mobile networks over the previous-generation (2G) are many.

3G's Standout Attributes

Compared to other networks, it was shown to have higher functionality. Having a top speed of 2 Mbps seemed quite promising. It provided a broad range of options, including voice calls, file transfers, and media playing. It made it possible to move people and goods, communicate through circuits and packages, make several connections at once, and send and receive both spoken and numeric information. Its sending and receiving timing might be synchronized or asymmetrical. It enabled large data transfers, bandwidth, and file sizes to be sent

and received over email. usually popular at the time [2] was mobile messaging, usually known as SMS and MMS.

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's WiFi. 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

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 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 - 31.0Mbps	300Mbps - 1Gbps	Upto 20Gbps	Multi-Gbps to Tbps
Bandwidth	1.5 - 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 www	NA
Service	Integrated high quality audio, video and data	Dynamic Information access	Dynamic Information Access, wearable devices with IA capabilities	NA
Core Networks	Packet Network	Internet	Internet	Internet
Handoff	Horizontal	Horizontal and Vertical	Horizontal and Vertical	Horizontal and Vertical
Standards	WCDMA, CDMA2000	OFDMA, MIMO	CDMA, MIMO	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 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.

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