



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Comparative Study Wireless Communication Networks And Generations

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Abstract

Communication plays an important role in development and innovation in technology. Wireless communication is almost 110 years old and has travelled a long distance over the years. The present paper presents the journey of different generations of mobile and wireless communication and the difference of 5G transmission over earlier generations transmission technology.

Introduction

G. Marconi, an Italian inventor, unlocked the path of recent day wireless communications with the help of electromagnetic waves in 1929. The first commercially cellular network, the 1G generation, launched in Japan by Nippon Telegraph and Telephone in 1979, then came 2nd generation in 1990, 3rd generation in 2000 and followed by 4th and 5th generation. There is a remarkable breakthrough in 5G technology and is one of the most basic requirements of artificial intelligence.

Keywords : Generation, wireless, transmission, 5G, BDMA

1st GENERATION TECHNOLOGY (1G)

First generation or 1G refers to the first generation of wireless networking which were used for cell phones. It was introduced in the 1980s with a data rate up to 2.4 kbps. The first commercial automated cellular network was the 1G wireless network, which used analog radio signals. Through 1G, a voice call gets modulated to a higher frequency of about 150 MHz and up as it is transmitted between radio towers. This is done using a technique called Frequency-Division Multiple Access (FDMA). 1G used to have low capacity and unreliable handoff with poor voice links and there were no security issues, since anyone with an all-band radio receiver can listen to the conversation.

2nd Generation (2G&2.5G)

It is based on the technology known as global system for mobile communication (GSM). In this technology for the first time Subscriber Identity Module (SIM) was introduced and a more secured and clear communication was established. Three main benefits of 2G networks over their predecessors were that phone conversations were digitally encrypted, 2G systems were significantly more efficient on the spectrum and 2G introduced data services for mobile, starting with SMS text messages. The 2.5G is the GPRS, General Packet Radio Service, which is an extension of 2G network that has the capacity of launching packet-based services. The primary differences between first and the second generation cellular networks are first generation systems are almost purely analog while the second generation systems are digital. All second generation systems provide encryption transmission. Access technologies used are GSM, TDMA, CDMA.

3rd Generation

The Third Generation (3G) is digital mobile multimedia offering broadband mobile communications with voice, video, graphics, audio and other information. 3G enhanced audio and video streaming and has several times higher data speed. It supports video conferencing and gives IPTV (TV through the Internet) support. 3G is based on CDMA technology. The features of 3G are used in mobile applications, mobile store application, video streaming.

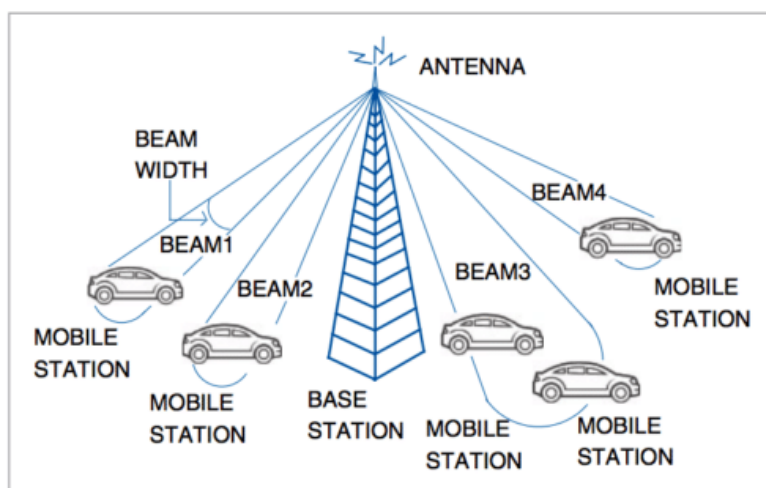
3rd generation was established in late 2000. it has a data rate up to 384 Kbps./for 3.5G 5- 30 Mbps/ for 3.7G Access Technology: Wideband Code Division Multiple Access(WCDMA), Universal Mobile Telecommunication System and Frequency Band 800/ 850/900/1800/1900/2100 MHz this is very useful for video download and conference.

4th GENERATION TECHNOLOGY

4G is the short name for fourth-generation wireless that will replace 3G networks. Providing broadband services would be one of the major goals of the 4G Wireless systems. 4G supports interactive multimedia, voice, streaming video, Internet and other broadband services. It has high speed and capacity. This technology is a fully IP based mobile system. It has better spectral efficiency and has interoperability with the existing wireless standards. The frequency band of 4G is 2-8GHz and the bandwidth is 5-20 MHz . It supports up to 20Mbps or more data rate. It supports packet switching. 4G systems are expected to provide real-time and internet-like services. Smart antennas for multiple-input and multiple-output (MIMO). 4G meets the demand for diverse users

5th GENERATION TECHNOLOGY (5G)

5G stands for fifth generation wireless systems. It is based on the IEEE 802.11ac. The IEEE 802.11 is a set of protocols which is a part of the Wi-Fi networking family, providing high- wireless local area networks (WLANs) on the 5 GHz band. 5G will provide better speeds and coverage than the current 4G. 5G increases network expandability up to hundreds of thousands of connections. Wireless World Wide Web (WWW), Dynamic Ad hoc Wireless Network (DAWN) and Real Wireless World will be a reality with 5G. The aim of 5G is to design a Multi - Bandwidth data path by integrating the current and future networks for new network architecture of 5G real wireless world. The 5G wireless internet networks are real wireless world which shall be supported by CDMA, OFDM, MCCDMA (Multi-Carrier Code Division Multiple Access), UWB (Ultra wideband). 5G technology has extraordinary data capabilities and has ability to tie together unrestricted call volumes and infinite data broadcast within latest mobile operating system. 5G technology would offer high resolution for wireless gadget users and bi-direction large bandwidth shaping. The superior quality services of 5G technology is based on policy to avoid errors.5th Generation (5G) Data rate 10- up to 50Gbps Access Technology Beam Division Multiple Access (BDMA) This increases wireless communication system capacity and handle a large number of users .The number of mobile users is swelling day by day and is expected to grow many folds by the year 2025. Techniques like time division multiple-access (TDMA) and frequency division multiple-access (FDMA) are adopted in communication systems for previous generations . But the frequency and time division among multiple users face problems due to the increasing number of mobile users. In FDMA, frequencies are allocated permanently and hence spectrum will be wasted when stations are not transmitting or receiving. And in TDMA, Multipath interference affects call quality. Switching from one base station cell to the other cell results into dropped calls In BDMA technology, the base station allocates separate antenna beam to each mobile phone or mobile station. This could be done after evaluating position of the mobile stations as well as their moving speeds, then deciding widths and directions of beams for mobile stations with respect to the base station. All the mobile stations communicate with base station when these are in its line-of-sight (LoS) and all the beams are distinct for each individual station. So simultaneous data transmission is possible to different mobile stations at different angles.



To support more number of users, the beam should be divided. Mobile stations located at similar angles can share one beam to communicate with the base station using TDMA. 5G is based on OFDM (Orthogonal frequency-division multiplexing), a method of modulating a digital signal across several different channels to reduce interference. However, the new 5G NR air interface can further enhance OFDM to deliver a much higher degree of flexibility and scalability. This could provide more 5G access to more people and things for a variety of different use cases. 5G can operate in both lower bands below 6 GHz as and 24 GHz and up, which will bring extreme capacity, multi-Gbps throughput, and low latency. 5G is designed to not only deliver faster, better mobile broadband services compared to 4G LTE, but can also expand into new service areas such as mission-critical communications and connecting the massive IoT.

Conclusion

It can be clearly seen that there is major change in technology after 4G but 5g provides wider use including artificial intelligence, medical surgeries, unmanned navigation etc, but there are certain challenges like controlling vehicle mobility across several networks and further R & D is needed. It is also important to consider the health related issues due to high frequency radiation and further study is needed in this regard.

CDMA – Code division multiple access

TDMA -- Time division multiple access

BDMA -- Beam division multiple access

WCDMA -- Wideband code division multiple access

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