

A Study of 4G and 5G Networks and its Impact on Mobile Technology

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Abstract: *Users may now access the internet while on the move thanks to mobile cellular data networks. One of the hottest areas creating high-speed wireless networks with innovative technology is mobile wireless cellular communication. A radio network technology is a wireless mobile network. In the last 15 years, mobile wireless technology has skyrocketed. Nowadays, the most frequent mode of communication is through a mobile portable device. From the first generation to the fifth generation, wireless technology has been used in mobile communication. The fourth and fifth generations of mobile networks are discussed in this study. We examine the similarities and differences, as well as the advantages and disadvantages of each. We can see how 4G and 5G have influenced us across a variety of industries.*

Keywords: 4G, 5G, Networks, Bandwidth, Impact, Speed, Data

I. INTRODUCTION

4G stands for fourth-generation wireless, a stage of broadband mobile communications that succeeds 3G (third-generation wireless) and comes before 5G. (fifth-generation wireless). The International Telecommunication Union (ITU) created the 4G wireless cellular standard, which outlines the standard's major aspects such as transmission technologies and data speeds. With each iteration of wireless cellular technology, bandwidth speeds and network capacity have grown. Users of 4G may expect speeds of up to 100 Mbps, however 3G only promises a peak speed of 14 Mbps. Wireless customers may stream high-definition video and audio with 4G download capabilities [1]. 4G also offers wireless broadband, which allows users to access to the internet without the requirement for a fixed, wired connection from an internet service provider (ISP). At its most basic, a 4G connection operates through an antenna that transmits radio waves, allowing mobile devices to connect to mobile networks. Multiple Input Multiple Output (MIMO) and Orthogonal Frequency Division Multiplexing (OFDM) technologies enable 4G transmission and reception. MIMO and OFDM both provide better capacity and bandwidth than 3G. OFDM technology outperforms the key technologies that powered 3G, including TDMA (Time Division Multiple Access) and CDMA (Code Division Multiple Access) [1]. Because more users can be accommodated with MIMO, 4G improves network congestion when compared to 3G.

The fifth generation of mobile networks, 5G Wireless Technology, is an advancement of the present 4G LTE networks. It is specifically developed to meet the demands of contemporary technology developments, which involve a significant increase in data. 5G Wireless Technology is the most recent cellular technology that, among other things, would considerably boost the speed of wireless networks. As a result, the maximum data throughput for wireless broadband connections using 5G would be roughly 20 Gbps. Furthermore, 5G will give more bandwidth and enhanced antenna technology, resulting in significantly more data sent across wireless connections. In addition, 5G technology will be able to 'slice' a physical network into many virtual networks. This implies that operators will be able to supply the appropriate network slice based on how it is utilized, allowing them to better manage their networks. The first nation to adopt on a large scale was South Korea, in April 2019, at which point there were some 224 operators in 88 countries around the world investing in the technology [2]. Except for one carrier that used Huawei equipment, all 5G carriers in South Korea employed Samsung, Ericsson, and Nokia base stations and equipment. Samsung was the largest of these vendors, having sent 53,000 base stations out of a total of 86,000 deployed in the country at the time.

II. WORKING

2.1 4G Networks

4G operates in much the same way as 3G, just quicker. Using high-speed download and upload packets, 4G allows you to enjoy broadband-style speeds even when you are not connected to Wi-Fi. Users may frequently get speeds of up to 21Mb while travelling, however this is affected by geography[3]. For example, a larger metropolis will have quicker speeds than a tiny town. 4G is simply a high-tech radio technology. You may have even noticed masts covering the country. These masts transmit the signals required for 4G to function, and the challenge for engineers and coders is to compress as much data as possible into these signals. As a result, the network is quicker and more efficient.

4G is a protocol that, like 3G, delivers and receives data in packets. However, the operation of 4G varies from that of 3G. 4G is totally IP-based, which implies that it employs internet protocols for voice data as well. Conforming to this one standard reduces the likelihood of data becoming jumbled while travelling numerous networks, resulting in a more smooth experience for us consumers. 4G, like all mobile broadband, functions by your device interacting with a base station. Base stations are technical terms for the masts that we've all noticed springing up around the country. This mast is responsible for relaying data from your device to the internet and back.[3]

2.2 5G Networks

Wireless communications systems transmit data over the air using radio frequencies (also known as spectrum). 5G works in the same way as 4G, but uses higher radio frequencies that are less crowded. This enables it to carry more data at a much quicker rate. These higher bands are referred to as 'millimeter waves' (mm waves). They were previously unlicensed, but regulators have made them available for licensing. They had mostly gone unnoticed by the general public since the necessary equipment was both unavailable and prohibitively expensive. While higher bands transfer information quicker, there may be issues when sending over long distances. Physical things such as trees and buildings can readily obstruct them [2]. To address this issue, 5G will employ numerous input and output antennae to enhance signal and capacity across the wireless network.

Smaller transmitters will also be used in the technology. Rather of employing single stand-alone masts, they are mounted on buildings and street furniture. According to current predictions, 5G will be able to accommodate up to 1,000 more devices per meter than 4G.

III. ADVANTAGES AND DISADVANTAGES

3.1 4G Networks

In the first part of the 2010s, 4G mobile networks mostly supplanted 3G networks. They brought with them unrivalled speed and efficiency, which aided in elevating the market and underpinning the mobile revolution [4]. Internet access on mobile devices is increasingly more of a need than a luxury, yet even the 4G standard has drawbacks. Here are some of its advantages and disadvantages.

A. Advantages

- Download files quickly via a wireless network.
- 4G technology is ten times quicker than 3G technology.
- Broader bandwidth
- Access the Internet, instant messaging, social networks, streaming media, video calling, and other services with ease.
- Exceptional vocal quality
- Privacy, security, and safety have all been improved

B. Disadvantages

- Consumers are compelled to purchase a new gadget in order to enable 4G.
- People will have to pay more for data.
- New frequencies necessitate the addition of new components to cell towers.

- Because 4G mobile networks employ many antennas and transmitters, consumers may have shorter battery life on mobile devices than on 3G networks. This would need the adoption of bigger mobile devices with higher battery power. [5]

3.2 5G Networks

Customers have seen many generations of data technology develop in the last few years as Smartphone technology has evolved. It all started with 3G, then 4G LTE, and now 5G is the most recent technology [6]. 5G represents a significant potential for developers to create apps that take use of fast, high-speed, low-latency networks. However, like with any data network, it is critical to understand the benefits and drawbacks of 5G. So, let's go through some of the benefits and drawbacks of 5G.

A. Advantages

- More efficient and simple to handle
- Unbroken uniform connection
- Video streaming in high quality
- Large bidirectional bandwidth
- All users' speed has been increased.

B. Disadvantages

- Slower upload speeds as compared to download speeds
- 5G-enabled phones will endure a massive battery drain. If you want to use your phone for a whole day on a single charge, you'll need better battery technology.
- It will take some time before it reaches the rest of the world, particularly in isolated locations.
- It requires a very advanced Mobile device that supports 5g networks.

3.3 Comparison between 4G and 5G

Here's a breakdown of the major differences between the two networking technologies

A. Speed

In most discussions regarding 5G, the term "speed" is frequently used to distinguish it from 4G. That seems reasonable, given that each successive cellular generation has been much quicker than the previous one. Although 4G may already attain maximum speeds of up to 100 Mbps, real-world performance is usually limited to 35 Mbps. With a theoretical peak speed of roughly 20 Gbps and current real-world rates ranging from 50 Mbps to 3 Gbps, 5G has the potential to be 100 times faster than 4G. [7]

B. Latency

The time it takes for a packet of data to move between two points is known as latency. It's the latency that slows down any data transfer, regardless of how quick the connection is otherwise. 4G networks now have a latency of around 50 milliseconds, whereas 5G networks are predicted to have a latency of around 1 millisecond. Reduced latency will be crucial in many applications where 5G will allow connected devices to rely on the cloud for data processing, such as self-driving cars, which might utilize 5G to allow a cloud-based AI to make real-time navigational choices.

C. Coverage

Even after a decade of 4G, there are still some distant and rural places with poor 4G coverage throughout the world. Because 5G is still in its early stages, coverage is basically non-existent outside of a few big cities. It will take many years for 5G to reach a coverage level comparable to 4G, and it will be divided into three types (high-, medium-, and low-band 5G), each with its own speed and bandwidth. Currently, you can find 5G in a total of about 100 cities in the US [7]. 5G network will take some time to be available in few cities in India

D. Bandwidth

The bandwidth, or capacity, of 5G is predicted to be much higher than that of 4G. This is partly due to 5G's significantly more effective utilization of available frequency. 4G uses just a small portion of the available spectrum, from 600 MHz to 2.5 GHz, whereas 5G is split over three bands. Each band has its own frequency range and speed, as well as diverse consumer, corporate, and industry applications and use cases. That means 5G has a significantly larger capacity.

IV. IMPACT ON VARIOUS SECTORS

In India, mobile technology has progressed through four phases, with each network generation improving on the last. Every new generation of networks is focused on reducing network congestion and increasing network speed. 5G has been both evolutionary and revolutionary for the globe in this sense. 4G networks were introduced in the late 2000s as the fourth-generation broadband cellular network technology. The 4G network is 50 times faster than the 3G network it replaces. High-definition mobile TV, smooth phone conversations, video conferencing, and much more are all possible with 4G. However, as the number of IoT devices grows by leaps and bounds, existing 4G networks may struggle to match customer demands for massive data transfer volumes and quicker speeds. 4G and 5G networks have a very big impact on the following sectors:

4.1 Gaming

Games have latency. When you're playing, it takes around 20 milliseconds for you to see something on the screen. It takes a few more milliseconds to understand it and then react to it. After that, there is a slight delay before the action you take happens on the screen. This is latency, and it is part and parcel of game design. So, it makes sense if the speed of the connection is fast, latency is lower, and the experience is better. The latency of 5G is as low as 5 milliseconds [8]. In the realm of gaming, a difference of 15 milliseconds is a major deal. When you include in all of the other things on your mind, those few precious fractions of a second might make the difference between life and death for your virtual gaming character. Currently, gaming needs dedication. You must choose a platform and stick to it. It might be a console, phone, TV, or PC, but once picked, you must complete the game on it. Because it permits streaming, 5G will make gaming platform neutral. You will be able to stream a game, just like you can watch any programme or TV on Netflix or Amazon Prime. Because of the slow input response of 3G and 4G, this was not practicable.[8]

4.2 Video Streaming

Over-the-top (OTT) services have revolutionized the way people consume digital media in recent years. Viewer expectations for streaming platforms like Amazon Prime, Hulu, and Netflix continue to rise in tandem with this development, as OTT video delivery services become the focal point of households throughout the world.

As the demand for seamless live video streaming and high-quality content grows, neoteric 4G and 5G technology gives a profitable potential to elevate the OTT viewer experience to new heights. Because video consumes the bulk of mobile internet capacity today, the improved connectivity will give new opportunities for digital streaming companies. Video-on-demand viewers will be able to say goodbye to stop-start streaming and buffering videos thanks to the 5G network's low latency and ultrafast download rates, which are up to 10 times faster than current network connectivity.

The 5G network's capabilities will also assist media marketers. It will reduce ad delay to around a millisecond, preventing many viewers from experiencing buffering difficulties.[9] Fixed Wireless Access-based video transmission is one of the most promising options to keep an eye on. Aside from this significant improvement, we may anticipate the debut of HD videos and the expansion of video transmission. Those in the OTT business can expect increased campaign expectations as screen sizes and viewership grow. Nonetheless, you'll be able to watch full HD films even while you're on the road thanks to the enhanced bandwidth availability and dependability [9].

4.3 Agriculture

Farmers throughout the world are utilizing IoT technology to improve agricultural operations such as water management, fertigation, animal safety, and crop monitoring. Real-time data gathering might be enabled by 5G, allowing farmers to monitor, manage, and automate agricultural systems to improve profitability, efficiency, and safety.

4.4 Transport

5G would improve visibility and control for transportation systems ranging from public buses to commercial logistic fleets. Improved vehicle-to-vehicle communications will be possible with 5G, allowing for greater self-driving car testing. Cities will be able to obtain more data on their transportation systems because to these networks.

V. CONCLUSION

Mobile phones have become an indispensable component of our daily lives. Their current state is the result of several generations of development. In this paper, we have examined the numerous generations of mobile wireless technology, as well as the benefits and drawbacks of each iteration. We've seen a comparison of 4g and 5g technologies, as well as the differences in features and performance between the two. 4G and 5G have had an influence on several sectors of society, particularly mobile technology, and their implementation has opened the doors to more efficient functioning in various domains. The 5G network has had a significant influence on the gaming industry, since we can now enjoy lag-free game play. There are still plenty of research possibilities in this sector.

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