**FIFTH GENERATION (5G) TECHNOLOGY**

**BY**

**ELIJAH SUNDAY**

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**Abstract**

*The eventual goal of the forthcoming 5G wireless networking is to have relatively fast data speeds, incredibly low latency, substantial rises in base station’s efficiency and major changes in expected Quality of Service (QoS) for customers relative to the existing 4G LTE networks. In order to deal with state-of-the art technologies and connectivity in the form of smart cell phones, internet of things (IoT) devices, autonomous vehicles, virtual reality devices and smart homes connectivity, the broadband data use has risen at a fast rate. Further, to meet the latest applications, the bandwidth of the system needs to be increased widely. This development will be accomplished by using a modern spectrum with higher data levels. In particular, the fifth generation (5G) mobile network seeks to resolve the shortcomings of previous telecommunication technologies and to be a possible primary enabler for future IoT applications. This paper briefly discusses the architecture of 5G, following by the security associated with the 5G network, 5G as an energy efficient network, various types of efficient antennas developed for 5G and stateof-the-art specifications for IoT applications along with their related communication technologies*

**INTRODUCTION**

Telecommunication providers and technology companies around the world have been working together to research and develop new technology solutions to meet growing demands for mobile data from consumers and industrial users. Fifth-generation (5G) mobile technologies represent the next iteration of mobile communications technologies that were designed to improve current (e.g., 3G, 4G) mobile networks. 5G networks are expected to provide faster speeds, greater capacity, and the potential to support new features and services (Shakib, Dunworth, Aparin, & Entesari, 2019).

5G technologies were developed to accommodate the increasing demands for mobile data (i.e., more people using more data on more devices). 5G technologies are expected to serve current consumer demands and future applications (e.g., industrial Internet of Things, autonomous vehicles). 5G technologies are expected to yield significant consumer benefits (e.g., assisting the disabled, enabling telemedicine), industrial benefits (e.g., automated processes, increased operational efficiencies, data analytics), and economic benefits (e.g., new revenues, new jobs). Past experience has shown that companies first to market with new technologies capture the bulk of the revenues. Hence, companies around the world are racing to develop and deploy 5G technologies, and many countries (e.g., central governments), seeing potential for economic gain, are taking action to support 5G deployment. This competition between companies and countries to lead 5G technologies and capture the bulk of the revenues is often called the “race to 5G” (Holma, Toskala, & Nakamura, 2020).

**EVOLUTION OF FIFTH GENERATION (5G) TECHNOLOGY**

The 5G-Advanced evolution is technologically presented as a comprehensive integration of ICT technology, industrial field network technology, and data technology. The communication network after 4G fully introduces IT technology, and the telecom cloud is generally used as the infrastructure. In the actual telecom cloud landing process, technologies such as NFV (Network Functions Virtualization), containers, SDN (Software Defined Network), and API (Application Programming Interface)-based system capability exposure have all received actual commercial verification. On the other hand, the network edge is the center of future business development. Still, its business model, deployment model, operation and maintenance model, especially resource availability and resource efficiency, are pretty different from the centralized deployment of cloud computing. The Linux Foundation proposed that after introducing the concept of Cloud Native to the edge, it also needs to combine the various features of the border to form an edge native (Edge Native) application form. Therefore, the evolution of 5G-Advanced needs to integrate the characteristics of cloud-native and edge-native, achieve a balance between the two through the same network architecture, and finally move towards the long-term evolution direction of and cloud-network integration (Khan, Kumar, Jayakody & Liyanage, 2019).

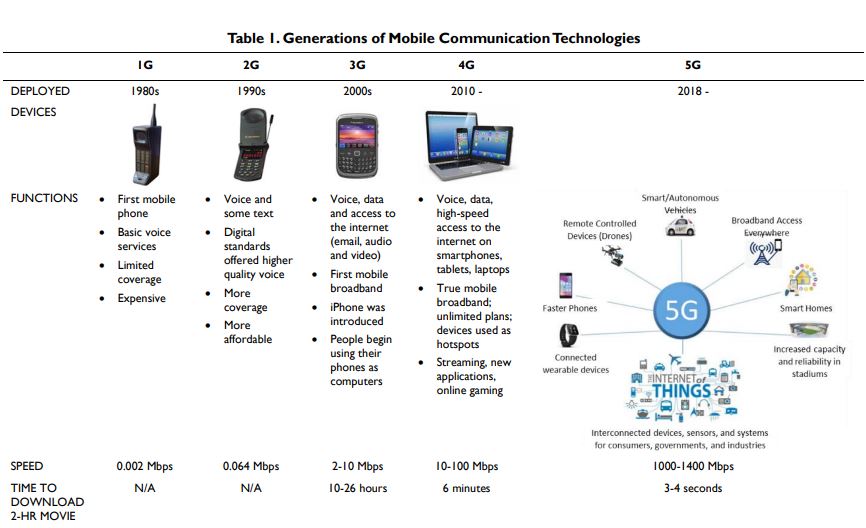


Figure 1: Generations of Mobile Communication Technologies (Frank, 2017)

**Factors Driving the Need for Improved Wireless Networks**

According to Navarro-Ortiz (2020), three factors are driving the need for improved wireless networks. First, there are more people using more data on more devices. Since 2016, more people worldwide have been using more data on mobile devices such as smartphones than on desktops. Globally, mobile data traffic is expected to increase sevenfold from 2016 to 2021, and mobile video is driving that increase. The spectrum used for mobile communications is becoming crowded and congested. Current networks (e.g., 3G, 4G) cannot always meet consumer demands for data, especially during periods of heavy use (e.g., emergencies). During periods of heavy use, consumers may experience slow speeds, unstable connections, delays, or loss of service.

Second, the total number of internet-connected devices, both consumer devices (e.g., smart watches, smart meters) and industrial devices (e.g., sensors that assist with predictive maintenance), has increased. Market research indicates that in 2018 there were 17.8 billion connected devices globally; 7 billion of which were not smartphones, tablets, or laptops, but other connected devices (e.g., sensors, smart locks) that allow users to monitor and manage activities through a mobile device, such as a smartphone, further increasing demand on networks (Navarro-Ortiz, 2020).

Third, industries are relying on internet-connected devices in everyday business operations. Companies use devices to track assets, collect performance data, and inform business decisions. These devices, when connected, form the Internet of Things (IoT)—the collection of physical objects (e.g., health monitors, industrial sensors) that interconnect to form networks of devices and systems that can collect and compute data from many sources. More advanced IoT devices (e.g., autonomous cars, emergency medical systems) need networks that can provide persistent (“always-on”) connections, low latency services (i.e., minimal lag time on commands), greater capacity (e.g., bandwidth) to access and share more data, and the ability to quickly compile and compute data. These are features that current mobile networks cannot consistently support (Navarro-Ortiz, 2020).

## The Emergence of 5G Technologies

Since 2012, telecommunications standards development organizations (SDO), with the help of their industry partners, have been researching ways to improve mobile communication networks; link people, devices, and data through a smart network; and enable a “seamlessly connected society.” Companies are developing new technologies that are expected to improve networks, meet the growing demand for data, support IoT applications, and enable a seamlessly connected society (Kim, Jung & Choi, 2019).

Telecommunication and technology companies experimented with new, higher-band spectrum (i.e., millimeter waves) that could provide greater bandwidth and speed. However, these waves cannot travel long distances or penetrate obstacles (e.g., trees, buildings); companies worked together to develop technologies that capitalize on the strengths of this spectrum (e.g., bandwidth and speed) and address its shortfalls through innovative technology solutions (e.g., placing smaller cell sites close together to relay signals around obstacles and over longer distances). The research identified several solutions that offer vastly improved speeds (from 10 times to 100 times faster than 4G networks), greater bandwidth, and ultra-low latency service (i.e., 1-2 milliseconds (ms) of lag time as opposed to 50 ms for 4G). These solutions address many of the perceived shortcomings of existing networks and offer new features that could support and expand the use of more advanced technologies for consumers and businesses (Khan, 2019).

## Uses of 5G Technologies

5G networks offer the increased bandwidth, constant connectivity, and low latency services which can enhance and expand the use of mobile technologies for consumers and businesses. Consumers are to be able to download a full-length, high-definition movie on their mobile device in seconds; engage in video streaming without interruption; and participate in online gaming anywhere. 5G technologies are expected to create new revenue streams for technology companies and telecommunications providers. 5G technologies are also expected to support interconnected devices (e.g., smart homes, medical devices), and advanced IoT systems, such as autonomous vehicles, precision agriculture systems, industrial machinery, and advanced robotics. IoT technologies are expected to be integrated into industrial systems to automate processes and to optimize operational efficiencies. 5G networks are expected to support the growing IoT industry, enabling device makers to develop and deploy new IoT devices and systems across multiple industries, and sell IoT products globally, yielding significant economic gains for technology companies and for the countries where those companies are located (Brilliantova & Thurner, 2019).

# **USES OF 5G**

**Fast data rate (Gigabytes in instants)**

Fast broadband speeds and smart networks would define the 5G network. It takes around eight minutes to download a 4 G feature film; people will be able to do this in less than five seconds with 5G. Network speed can support technologies such as social networking sites, multimedia television, high resolution and 3D content, augmented reality, robots, driverless vehicles, advanced manufacturing, many others. For the billions of computers that would be connected, not all data has to be transferred concurrently. Some systems involve immediate communication, whereas others can be shared at off-peak hours. Getting networks that continuously manage data traffic and make split-second decisions is essential to the 5G world (Khan et al., 2019).

The 5G network is projected to serve 50 billion portable devices and 212 billion mobile sensors by the end of 2020 and to enable access to 44 zettabytes (ZB) of data. It extends from smartphones and laptops to smartwatches, vehicles, computers, equipment and remote-control devices. Almost all of this should produce a huge quantity of "useful data" that can be evaluated. Scientists predict that this linked world would make it possible to use a far higher proportion of digital data (35 per cent) than before (5 per cent). Wireless technology work is currently exploring a series of developments for a forthcoming wireless network. Highspeed connectivity and low-latency specifications should be the focus for the upcoming 5G system. With 5G, the output is 40 times higher than 4 G, so you can stream 8 K or ultra-3-D videos in only a second (Bianchi, 2016).

## 4K STREAMING

Mobile network usage tends to increase at a very rapid rate due to emerging smartphone technologies such as high-resolution video sharing, online gaming and virtual reality apps. Satellite links have recently been integrated into 5G networks. Since we have shown in the example use case, the measurement of 4 K material is actually restricted to virtual LTE networks. Although 4K content offers the perfect catalyst for assessing 5G mm wave technologies, with regard to the number of users per cell and related transmission speeds needed to assess DASH streaming in real-time. As 5G networks are slowly being phased out globally, it is anticipated that consumers will begin using improved Mobile Broad Band (eMBB) applications on their handheld devices. These technologies, e.g., 4 K and 8 K video sharing as well as virtual or augmented reality devices, provide far greater virtual environments though consuming much higher data rate to enable their seamless deployment to device. The aim of this work is to provide DASH dataset content to evaluate adaptive clients for higher speed networks (Dong, 2018).

## Smart Mobility Using 5G

In the future, we are planning to merge the MIH paradigm with the DMM approaches in the sense of 5G heterogeneous networks, especially vehicle networks. In this type of network defined by a high agility environment, further parameters should be carefully considered, such as network size, vehicle speed, latency and likelihood of failure to produce. Mobility technologies in 5G vary from conventional road / route preparation to new automated driving systems (connected vehicles) and expanded sharing of smart transport. This then concentrated on smart connectivity, which comes beyond the framework of SCOs, posing its key work accomplishments and challenges. In addition, it proposed a system focused on the utilization of 4G and, most notably, of 5G cell networking infrastructures, with a view to enhancing the quality of vehicle communications (Herrera & Botero, 2016).

## Smart Cities Using 5G

All through the immediate future, 5G technology will connect the planet from the biggest megacity to the smallest Internet of Things throughout ever-on-line fashion. Such a linked hierarchy will merge smart cities, smart homes and the Internet of Things into one big cohesive infrastructure. So far, study on Smart Cities and self-organizing networking strategies for 5G wireless networks has been considered: the smart city depends on 5G to enable large M2 M communications, but the actual network is uncertain of the data streaming through it. However, stronger collaboration between the two will result in a shared partnership, as the information generated by the enormous volume of data obtained by the sensors can be used to enhance connectivity performance (Wu, 2017).

In addition, 5G is supposed to put together several various access systems, greatly improving the efficiency of the communication network and making it easier for transfers to take place to exchange information among heterogeneous systems and services. The tactile internet would offer a forum for calculating, managing, tracking and scaling smart devices in actual or virtual reality in smart cities. Ultra-low latency, stability and access quality are the key characteristics of the tactile internet that render it more advanced in 5G (Wu, 2017).

## Augmented Reality on 5G

In recent years, augmented and virtual reality has started to take advantage of the high-speed capacities of video streaming technology and cellular networks. However, constraints such as bandwidth and latency also prohibit us from reaching high-fidelity telepresence and integrated interactive and augmented reality applications. Luckily, both developers and architects are conscious of these problems and have built up 5G networks to help us transition to the new phase of software interfaces (Herrera & Botero, 2016).

5G infrastructure aims to be able to help a variety of both conventional and new technologies, such as device-to-device connectivity and the Internet of Things (IoT). The aim of this research is on 5G features and functionality that can promote the deployment of advanced e-learning systems utilizing AR / VR. In this sense, the opportunity to promote the exchange of data via the creation of extemporary classrooms everywhere through user equipment is also important. To this purpose, an evaluation of recent – primarily European – 5G trials is provided in order to determine the viability of e-learning systems utilizing this technology (Bianchi, 2016).

# **MEDICAL IMPACT OF 5G TECHNOLOGY**

We have divided the subject in two portions, one is good medical impacts we termed it as positive impacts similarly for bad impacts, we used the term negative impacts (Navarro-Ortiz, 2020).

## Positive Impacts

The 5G network allows new open doors for human services with imaging, diagnostics, information investigation, and treatment with its most remarkable availability, savvy supervision, and data/information abilities. It incorporates wearable and remote sensors which are associated with the system through the web of things (IoT) gadgets. The wearable gadgets and sensors screen clinical information, for example, vivacious signs, individual wellbeing, and physical movement and transmit the information electronically. These gadgets will convey at no other time seen tele medicine judgment and treatment administrations (Navarro-Ortiz, 2020).

Likewise give video conferencing of high goals, at the same time conveying greatness care at reasonable charges. These gadgets produce improved information and progressively precise examination for getting data. 5G will bring steady and dependable client experience and an improved clinical consideration and it will likewise help in some basic clinical capacities which require higher unwavering quality and lower idleness (Navarro-Ortiz, 2020).

The 5G will significantly advance the mix of virtual and reality, which is basic for far reaching recovery preparing, just as compact furthest point restoration and telemedicine because of its specialized qualities. Also, we analyzed social insurance as for 4G and 5G advances and give a review of online interview, online wellbeing checking, remote finding, and versatile automated medical procedure. In view of the writing audit and basic investigation, we have reasoned that ramble correspondence for the arrangement and upkeep of basic foundations is the most testing situation that can be conveyed to the following period of our work (Khan et al., 2019).

Telemedicine or e-Health will permit scaling up of human services frameworks to meet a rising populace, particularly in remote, rustic and low-salary regions, by utilizing advances, for example, remote discussion and medical procedure. Specialists utilizing telemedicine will approach haptic input, which will take into consideration the sentiment of touch to be transmitted. Patients will have the option to quantify their own vitals at a small amount of the expense and with incredible accommodation (Shakib et al., 2019).

5G empowered social insurance upset that will be driven by 5G remote innovation and completely bolstered by other related advances. We give a portrayal of every one of the different included advances and their potential for medicinal services, while giving pointers to existing writing and advances. We likewise introduced a contextual analysis on the monetary benefits that will be offered by 5G innovation empowered medicinal services. Further, we have featured the energizing examination and execution openings in building this eventual fate of 5Gempowered social insurance while likewise pinpointing the considerable difficulties included and the potential traps (Khan et al., 2019).

## Negative Impacts

Alongside gigantic number of advantages remote innovation has additionally one of the most obliterating ecological and wellbeing dangers and dangers to individual freedom at any point made. It is turning out to be broadly realized that 4G and 5G innovations cause numerous damages to human wellbeing. Malignancy is just a single issue, and one that is effectively understood. 4G and 5G cause 720! (factorial) various illnesses in individuals, and can destroy everything that lives yet a few types of microorganisms. A few pathogens and certain parasites are made progressively harmful by chosen frequencies of RF. Bugs and winged creatures are as of now being murdered by the RF communicates. There are different approaches to convey that do not require radio waves, nor wires, which cause no harm to any type of life (Khan et al., 2019).

The non-ionizing 5G RF-EMF can carry on like high LET ionizing radiations which have the most extreme vitality affidavit per unit separation. Considering the low infiltration and high vitality statement per unit separation of 5G, this can prompt age of significant levels of free radicals in a short separation which thus expands the danger of skin malignancy (Khan et al., 2019).

# **CONCLUSION**

This paper reviewed various aspects of the 5G network, it discussed various segments that are necessary for the deployment of 5G network. 5G networks would be smarter and more effective to serve huge amount of radio spectrum, from a basic sensor to a complex self-driving vehicle, from embedded sensors in all sorts of hardware to automated cars, from aircraft to smart businesses and towns, 5G networks will link everything to one another, from a user to the web. 5G network is the next forthcoming technology and it has very high network capacity, lower latency and much higher bandwidth in comparison to the current network. In other words, 5G would contribute to one of the biggest technical revolutions in the human history, with infinite use cases. Not only can it will change human lives but it also aims to preserve them by improved emergency care and rising traffic accidents.

**RECOMMENDATIONS**

This paper recommends that before the commercialization of 5G technology it is very important to keep improvement on the network capability and flexibility to cope with the various use cases and for business models.

Also, it recommends that it is important to keep eye on the efficiency of the 5G technology in terms of energy and cost. In this article we have presented the energy efficiency areas of 5G, various efficient antennas for 5G mobile network, architectures and wide uses of 5G technology in our lives.

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