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REVIEW ARTICLE

AN ANALYSIS OF 5G WIRELESS NETWORKS

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ABSTRACT

Every major telecom in the world is working to make it even faster because everyone loves speed and, more specifically, fast internet. Stable internet connections are becoming more and more important for smartphones, watches, homes, and automobiles. The fifth generation of technology, or 5G, is here to help us survive in a world where speed is changing every second and where we demand more and more technology. Some of the most important goals that must be achieved in the future, or in a world beyond 4G, are increased capacity, improved data rate, decreased latency, and quality service. Large-scale improvements in the 5G cellular architecture are necessary to meet these demands. The 5G cellular network architecture and some of the key emerging technologies that can help the architecture become more human and better meet user demands are primarily the focus of this paper. The primary focus of this paper's coverage of 5G details is device-to-device communication and massive multiple input multiple output technology (D2D). A general, credible 5G cellular network architecture is put forth using guidelines from online books and thorough research on the subject.

KEYWORDS

5G, cloud, and D2D

1. INTRODUCTION

The "G" in 5G stands for "generation," and the number 5 represents the technological advance. The first generation of wireless phone technology was 1G, and in the early 1990s, when businesses made it possible for users to send text messages between two cellular devices, the technology was upgraded to 2G, which captivated the world. The world eventually transitioned to 3G, which gave people the freedom to make phone calls, send text messages, and browse the internet at lightning speeds. Many of the features that were only possible with third generation wireless were improved by 4G. People could make phone calls, send text messages, and browse the web at lightning speed. They could also download and upload large video files quickly and without any problems. Then, businesses enhanced 4G connectivity with LTE, an acronym for "long term evolution." As the quickest and most reliable type of 4G, LTE began to compete in the market with other technologies like WiMax. Both approaches produced comparable results, but it was crucial to establish a standard that everyone could follow. By accelerating 4G technology even farther with LTE, the groundwork for 5G was laid. Ultra HD and 3D video download and upload will be made simpler with 5G. Thus, we can assert that there has been an increase in the pace of life. Imagine updating your info; it would be fascinating.

Link between a fire hose and a garden hose. The distinction will be audible and worth noting. The Next-Generation Mobile Network.

The following prerequisite is listed by ALLIANCES for 5G networks:

- Higher Data Rates
- One gigabit per second to numerous employees on the same floor of an office
- Spectral efficiency is improved compared to 4G.

- Coverage velocity
- Improved signalling effectiveness
- LTE drastically reduces the amount of legacy

Since the introduction of the first 1G system, the Nordic mobile telephone in 1982, a brand- new mobile generation has emerged nearly every ten years. 1992 saw the commercial launch of the first "2G" system, while 2001 saw the launch of the "3G" system. In 2012, the first 4G systems that were completely IMT Advanced compatible were created. The development of 4G systems started in 2001 or 2002 because the 2G (GSM) and 3G (IMT-2000 and UMTS) standards took an extended period of about 10 years from the official initiative of the R&D projects. In Fig. 1, the development of wireless is depicted. The early wireless technology generations are shown in terms of data rate, mobility, network coverage, and spectrum competency. The data rate, mobility, coverage, and spectral efficiency all rise with the spread of wireless technologies. It also demonstrates that the 1G and 2G technologies use circuit switching, while the 2.5G and 3G technologies combine both circuit and packet switching, and the next generation of technologies, 3.5G through today's 5G, employ packet switching. It clarifies the distinction between licenced spectrum and unlicensed spectrum in addition to these other variables. While Wi-Fi, Bluetooth, and WiMax use unlicensed frequency, all the emerging generations use licenced spectrum (Tushara and Vardhini, 2016).

This essay is divided mostly into the following sections:

- Generational evolution
- 5G cell phone network design
- 5G wireless network emerging technologies
- Conclusion

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1.1 Below is A Chronological Breakdown of Every Generation

1.1.1 1G

The first generation of wireless telephone technology is referred to as 1G (or 1-G) (mobile telecommunication). In the early 1980s, the first generation was announced, with a maximum data rate of 2.4kbps. Total Access Communication System, Nordic Mobile Telephone, and Advanced Mobile Phone System were the subscribers (TACS). The drawbacks of the first generation included subpar capacity, careless handoff, subpar accent associations, and a lack of safety precautions because audio calls were accumulated and played in radio towers, increasing the call's vulnerability to unnecessary connections, or noises from the third party. The radio signals used by 1G networks are primarily analogue, whereas 2G networks employ digital encoders, which is the primary distinction between the two mobile network systems (1G and 2G). We are aware that both systems use digital signalling to link the radio towers— which pay attention to the handsets—to the rest of the telecommunications networks. However, while the tone of voice itself during a call is programmed to digital signals in 2G, its modulation is done on a higher frequency, typically 150 MHz and up, in 1G. This inherent benefit of digital over analogue led to the substitution of 1G for 2G.

1.1.2 2G

The abbreviation for second-generation wireless telephone technology is 2G (or 2-G). The three main advantages of 2G networks over those of its forerunners were as follows:

- digital encryption was used for phone talks;
- 2G systems were much more efficient on the spectrum, enabling higher levels of mobile phone adoption.
- 2G pioneered data services and sparked the development of SMS text communications.

All text messages sent over 2G are digitally encrypted as stated above, allowing for the transfer of data in such a way that only the intended receiver can receive and read it, making it more advanced than 1G in terms of privacy. 2G technologies enabled the various mobile phone networks with the services such as picture messages, text messages, and MMS (multimedia messages).

1.1.3 3G

The third generation was then introduced, and it was founded in late 2000. The world receives transmission rates of up to 2Mbps from it. The primary goal of the third generation (3G) system was to successfully combine high-speed mobile access with services based on the Internet Protocol (IP). A cutting-edge improvement was created for ensuring QoS in addition to transmission rate. Additional features like increased audio quality and global roaming made 3G a notable and high-quality generation. The main complaint about 3G mobile devices is that they consume more power than the majority of 2G models. From a commercial standpoint, 3G network plans are more expensive than 2G plans. Wideband Code Division Multiple Access, also known as WCDMA, Universal Mobile Telecommunications Systems (UMTS), and Code Division Multiple Access (CDMA) 2000 technologies are used in 3G, along with the introduction of the evolving High Speed

Uplink/Downlink Packet Access (HSUPA/HSDPA) and Evolution-Data Optimized (EVDO) technologies, which have created an intermediate wireless. Services that provide an information transfer rate of at least 200 kb/sec are supported by 3G communications networks. The 3.5G generation, which sits between 3G and 4G, offers an increased data throughput of 5 to 30 Mbps.

1.1.4 4G

The successor to 3G and even more exciting, 4G is the fourth generation (4th) of wireless mobile telecommunication technology. A 4G system must offer the ITU's IMT-defined capabilities. In general, advanced 4G is referred to as the offspring of 3G and 2G standards. Currently, Long Term Evolution (LTE) standardisation is progressing.

As upcoming 4G standards and the 3rd generation partnership project's implementation of WiMAX, or Mobile Worldwide Interoperability for Microwave Access (3GPP). A 4G system enhances existing communication networks by providing an all-encompassing, dependable IP-based solution. Users will receive amenities like phone, data, and multimedia on a 24/7, anywhere basis for a significantly higher data charge than previous generations (Vijaya et al., 2016). Multimedia Messaging Service (MMS),

Digital Video Broadcasting (DVB), video chat, High Definition TV programming, and mobile TV are examples of applications that utilise a 4G network.

1.1.5 5G

Large global telecom consortia are already trying to develop 5G-related global values. Although the majority of those standards haven't been finalised, experts still anticipate that they will have some global interoperability in addition to being more compatible with 4G and 3G. Beam Division Multiple Access (BDMA) and/or Filter Bank Multi Carrier (FBMC Multiple Access), two new advanced access technologies, can now readily replace 4G with 5G as user demand increases rapidly. When the base station is in communication with the mobile stations, the idea behind BDMA approaches may be understood. Each mobile station is given an orthogonal beam, which we can divide using the BDMA approach based on the locations of the mobile stations for unrestricted numerous accesses to the mobile stations (Palattella et al., 2016). This also improves the system's capability, and is the major method of this communication. Based on current trends, it is believed that 5G cellular networks can overcome six challenges that 4G cannot effectively solve, including:

- Higher capacity, higher data rate
- Reduced end-to-end latency, connection to large devices, and
- 5: lower cost
- 6: Reliable Quality

2. 5G CELLULAR NETWORK LAYOUT.

For 5G designers, there are many challenges. The physical scarcity of radio frequency (RF) bands required for cellular communications is one of the biggest obstacles. Additionally, these frequency ranges have been extensively utilised, leaving no additional space in the current cellular bands. A further difficulty is that using modern wireless technologies requires a lot of energy (Ashton, 2009). Regarding environmental issues, cellular operators have observed and stated that the energy used by base stations accounts for more than 70% of their electricity expenditure. The numerous access approaches in the network are nearly at a standstill and require an immediate upgrade, according to research on the current 5G network on the market. According to reports, current technology like OFDMA should last for at least the next 50 years. Additionally, there is no need to update technology. The wireless configuration had evolved from 1G to 4G. As an alternative, once 4G is operationally established commercially, the inclusion of an application, or we can say improvement made at the basic network, is prompting the package providers to shift to a 5G network. There was widespread consensus, nonetheless, that the 5G network should outperform the 4G network in the following ways:

- I. One thousand times the system capacity
- II. A spectral efficiency increase of 10
- III. energy conservation
- IV. Data speed.

2.1 Times More Cells Per Second Than Usual.

To satisfy the needs of the user and overcome the difficulties presented by the 5G system, significant modifications in the design philosophy of the 5G wireless cellular architecture are required. With wireless cellular architecture, an outside base station is constantly present in the centre of a cell, aiding communication, allowing mobile users to connect or interact whether inside or outside (Albreem, 2015). Wireless communications will incur costs due to reduced spectrum effectiveness, data rate, and energy efficiency as a result of the signals having to pass through the walls of the interior to provide communication between inside and outside base stations. To overcome this challenge, it has been proposed to distinguish between outside and interior settings when developing the 5G cellular architecture. The loss caused by the building's walls being penetrated will be somewhat lessened with the aid of this designing strategy. This strategy, or, perhaps more accurately, this plan, will be backed by the use of massive MIMO technology, which deploys a scattered array of antennas geographically and is made up of tens or hundreds of antenna units. Since MIMO systems at the moment only use two or four antennas, the concept of massive MIMO systems, which has been introduced, focuses primarily on harnessing the benefits of large array antenna elements in terms of significant performance gains. In order to set up or build a huge massive MIMO network, we must first equip the external base stations with substantial antenna arrays and some of them are discretely placed around the hexagonal cell and linked to the base station using the quickest wires.

i.e. optical fibre lines, which are primarily supported by massive MIMO technology. Mobile devices used outside typically have a certain number of antennas installed, but with cooperation, a big reel antenna array can be constructed.

This, when combined with base station antenna arrays, creates usable large MIMO networks. In order to establish connection with exterior base stations using line of sight components, we have placed large antenna arrays outside of each structure. In order to communicate with users present indoors, the wireless access points that are present inside the building are related, or you would say connected, with the enormous antenna arrays through cables. This will significantly improve the cellular system's energy efficiency, cell average output, data rates, and spectral competency, but at the expense of increased, or very high and levelled infrastructure costs. Users inside buildings will just need to connect to or communicate with wireless access points thanks to the advent of this architecture and this cutting-edge strategy, while enormously erected antenna arrays will continue to be installed outside the structures. Certain technologies, such as Wi-Fi, Small Cell, Ultra Wideband, Millimeter Wave Communications, and Visible Light Communication (VLC), are effective for little range communications with great data rates for the communication that needs to be formed inside, i.e. for indoor communication. Higher frequencies, which are not normally used for cellular communications, are being utilised by technologies like millimetre wave and visible light communication (VLC). However, because these high frequency waves cannot be filtered from dense objects, using them outside or for long distance applications is not a good idea.

Raindrops, gases, and some types of flora can disperse materials effectively and with ease. Due to their huge bandwidth, visible light and millimetre wave communications technologies can increase the transmission data rate for indoor settings.

As is well known, the architecture of the 5G wireless cellular network consists primarily of just two logical layers, i.e. A radio network, first 2: cloudy network.

The radio network is made up mostly of many component kinds that serve various purposes. The network function virtualization (NFV) cloud typically consists of a User plane entity (UPE) and a Control plane entity (CPE), both of which conduct advanced layer functionalities relating to the User and Control plane, respectively. XaaS, which is essentially the connection between a radio network and a network cloud, is one of the terminologies related to this area. A broad architecture for the 5G cellular network has been put forth in this study. Therefore, the best way to describe XaaS is to say that it is the link between several emerging technologies including Massive MIMO networks, Cognitive Radio networks, and mobile and static small-cell networks. Additionally, this proposed design aims to demonstrate how network function virtualization works.

i.e., the 5th Generation cellular network architecture's NFV cloud. In this suggested 5G cellular network design, the concepts of Device to Device (D2D) communication, small cell access points, and Internet of Things (IoT) have also been included. Therefore, we may conclude that the suggested 5G cellular network architecture can serve as a foundation for the eventual standardisation of the 5G network. Since there are many issues that need to be resolved in order to comprehend the wireless network design and 5G networks in-depth and broadly, respectively.

3. NEW INNOVATIONS FOR 5G WIRELESS NETWORKS

The volume of mobile and wireless traffic is estimated to grow 1,000-fold over the next ten years, and this will eventually be dominated by the anticipated 50 billion or more connected devices that will be connected to the cloud by 2020. Offering higher stability and scalability for handling the growing number of users while also enhancing capacity, cost, and spectrum utilization when there is a rapid increase in the number of connected devices, are the corrective measures used to address various issues. Today's world is evolving at the speed of light, and we are relying more and

more on technology to communicate more quickly (Shyam, 2017). To this end, the overarching technological goal is to offer a system notion that supports:

- A 1000-fold increase in data volume per region
- Increase the number of linked devices by 10 to 100 times.
- An increase in the usual user data rate of 10 to 100 times
- increased battery life by up to 10 times for MMC devices, which use low power Massive Machine Communication.
- There is a 5x reduction in end-to-end, or E2E, latency.

In this essay, I have attempted to cover every stage of the internet's growth, and I have also discussed emerging technologies in detail, along with the technical issues that may arise as a result of many factors (Tetri and Vuorinen, 2013).

4. CONCLUSION

The 5th Generation wireless cellular communication systems' requirements for data throughput, spectral efficiency, latency, capacity, energy efficiency, and quality of service have all been thoroughly reviewed in this study. The 5G wireless network architecture, massive MIMO technology, network function virtualization (NFV) cloud, and device-to-device communication are all covered in detail in this article. Some short-range communication technologies, such as Wi-Fi, Small cells, Visible light communication (VLC), and millimetre wave communication (MVC) technologies, have been explained in terms of better quality in the future and increased data rate for the inside users and at the same time reduces the pressure from the outside base station. In order to meet the legitimate routine desires, some key promising technologies and the upcoming generation have also been discussed. These include large-scale MIMO and Device to Device communication (D2D) in attentive and intervention management, multi-radio access technology ultra dense networks, full-duplex radios, millimetre wave communication (MVC), and Cloud Technologies generally with radio access networks, spectrum allocation with cognitive radio, and software defined networks.

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