The Fifth Generation of Cellular Communication

ENG. HUSSAIN MOHAMMED ALI
Transmission Department
The Higher Institute of Telecommunication and Navigation
The Public Authority for Applied Education and Training
SHUWAIIKH EDUCATIONALI, KUWAIT
Email: hus.3li@gmail.com

Abstract: - When it was first implemented, the current fourth generation, 4G, mobile network opened a wide window of opportunities and uses for the mobile phone users. However, this network is gradually reaching its limits, and the need for a more capable network is becoming more apparent. Big events such as sports events, festivals and big concerts have created many problems and obstacles for telecommunications service providers around the world. The huge number of phones that compete to benefit from the services of telecom companies naturally lead to a collision and collision of cellular services such as text updates, Images, and social media, which leads to the non-lifting and loading only after the end of the event dispersion of the crowds.

Fortunately, this will be resolved after the expected implementation of the fifth-generation, 5G, cellular communication networks. The 5G is expected to reach unprecedented levels of up to 10,000 Mbps, exceeding the 1000 Mbps limit for 4G networks. Combined with NFV (Network Functions Virtualization) solutions, the software-enhanced platform will improve operational flow and accelerate speeds to meet the needs of more than 7 billion Internet users with more than 60 billion devices.

In this paper we will discuss the 5G network and show its advantages over the currently used 4G network. We show the benefits and the overwhelming possibilities and applications that will become feasible after its implementation, we will also discuss different type solutions and its methodology for enhancing the network performance like NFV, using new multiple access technology and increasing frequency band for having networks that can themselves improve the level of services they provide and enhance the amount of data traffic they can manage without having to raise their cost.

Key-Words: - Cloud computing, Mobile wireless networks, Infrastructure, Virtualization, 4th and 5th Generation of Cellular Network

1 Introduction

In recent decades, increased use of communications technology by about accelerating the need for access to telecommunications services is very high transport capacities, as well as the need for continuous development in the communication and transfer of information networks economically information technology provides significant financial returns for investors in this sector. The continuing need to increase data traffic is a major challenge for technology makers, who have led to continuous development in the telecommunications technology sector, which has resulted in the emergence of multiple technologies and generations of telecommunications networks. That the continuous development of technology is a solution to all the challenges facing modern communications with its applications of all the transfer of voice, video, multimedia and other media that transmit data in general. The amount of data transfer and efficiency of the system enabled the frequencies used this technique to provide the speed of data amounted to approximately 100 M / bps and this represents a very high speed compared to its predecessors of second-generation technologies and third. Supports current technologies such as the fifth and the fourth-generation technology addresses (IPv6), which enables the use of a large number of wireless devices by increasing addresses (IP) available from except the participation of a limited number of titles between a large number of devices, and this contributes to bridging The gap between data exchange between wireless local area networks (LANs) and mobile networks.

2 Background

The first experience of the mobile communications systems was introduced in 1980. The first experiment was presented at the European Telecommunications and Post Office (CEPT), which was identified by the European Telecommunications Standards Institute (ETSI), which was introduced at the beginning of 1991 (GSM) system, the system began operating in 1992, and it is worth noting that the first mobile communications system was installed in Germany.

Use the technique For analog communications, which is the same technology used in commercial analogue radio systems. Most of this generation is aware that the devices used are relatively large and require a large battery for operation or continuity, as these devices did not enable the user to use the spectrum efficiently; The few frequencies supported by the technology have been used by small groups of society, such as business people or senior leaders.

Mobile communications have grown remarkably as a result of the increasing need for them, especially after the introduction of second-generation systems in early 1990 This technology was adopted on digital broadcasting, which allows for the optimal use of the frequency spectrum supported by this technology, as well as the adoption of relatively small and inexpensive devices can be carried, and these devices were initially designed for voice transmission only, and after adding improvements to the technology can be transferred SMS messages.

The success of the second generation technology was in sync with the growth of the Internet and its development, where it was obvious to do, the second generation operators tried to provide data transmission services with voice services, after adding improvements to the system, operators were able to provide those services to users at relatively acceptable speeds. The improvements added to the second generation technology (2G to 2.5G) (GPRS). As a result of the gradual increase in the use of data packets and for the purpose of meeting user needs, the second generation was achieved after the launch of the EDGE technology, which enabled users to obtain larger capacities for larger data transmission.

The third generation technology was officially announced and implemented in early 2000, and this technology was implemented by the user until 2005, when technology developed from 3G to 3.5G, which in turn provided relatively high capacity data packets through surface development And the use of an appropriate frequency spectrum enabled the user to use data applications, download and transmit information, and this was to calculate the maximum rate of data transmitted and the time of arrival at the rate of at least 200 kilobits per second. When smart phones are becoming more popular, Acceleration of bandwidth Within a few short years, high demand has accelerated data processing to standard development, and today's 3G networks can be available anywhere at speeds of 200 kbps and 12 times that number.

For the fourth generation network, the network should provide maximum data transfer rates of at least 100 Mbps for mobile (and used in cars and trains ...) and at least 1 gigabyte per second for nearby connections (pedestrians and fixed users). But not all 4G networks are equal, they come at different levels, some are faster and others are more widely used. The most popular uses include LTE, WiMAX and HSPA +, but LTE remains the most widely used.

It should also be noted that each new generation of wireless broadband requires the cellular company to make updates in its towers, which means that the user must also develop his phone so that the company can send or receive signals through the new infrastructure. The third generation technology cannot communicate over the fourth generation network, but modern generations of phones are always designed to be compatible with previous versions, which means that any fourth generation phone can connect to a third generation or second network.

First Generation	Second Generation	Third Generation	Fourth Generation
1980	1991	2000	2011
Basic Vice services using analog protocol	Designed primarily for voice using the digital standards (GSM/CDMA)	First mobile broadband utilizing IP protocols (WCDMA/CDMA2000)	True mobile broadband on a unified standard (LTE)
			

Table 1. Comparative between old cellular communications

3 Evelution of Cellular Network

As we discussed in the previous sections, we need to find a solution to the problem of Internet speed, increase the number of subscribers in cellular network and also increase the scope of service coverage, so in this section we will talk about advantages and disadvantages of the current network (4G) and the future (5G).

3.1 Fourth Generation (4G)

Fourth generation of mobile telecommunication technology (LTE-Advanced) stands for Long Term Evolution Advanced, is a cellular network technology that offers higher performance than its previous. Radio Access network is one of the component of LTE Advanced network, allow to achieve high capacity rates [1] and latest standards for wireless broadband IP-based which is designed to effectively support packet-based communication and was developed by 3GPP to be a fourth generation of mobile telecommunication technology standard, Since the WIMAX and LTE version support only less than 1GB/s peak bit rate. Both are not fully IMT -Advance complaint, but are often branded 4G by service provider[2].

The LTE consists of two main components: E-UTRAN and EPC, the E-UTRAN consisting of advanced transmission and receiving stations also called eNB, which differ from those of the second generation (2G) and third generation (3G) stations as they perform more complex operations than to transfer, manipulate then convert user data and broadcast some messages to control. The most important specifications technology of the LTE network is such as MIMO and OFDM have greatly increased network performance. Downlink speeds range from 100 to 326 Mbps depending on the number of antennas used in the transmitter and the receiver as well as the modulation method. In the Uplink, the speed ranges from 50 to 86 MB Per second. In other words, it will enable users to watch HD videos quickly without having to wait for download, facilitate video conversations at high speed, download a movie in less than 5 minutes to access it without an Internet connection. Online gamers will be able to enjoy playing with their partners without stopping to download. For software developers and applications, they will help them develop websites, games and phone applications by adding new capabilities and functionality to high-speed technologies that improve the quality of these applications. Cloud Computing is the provision of large storage space for users on a server that is accessed online and solves out the problem of carrying a storage device. A user can access data anytime at any place [3], while providing some software as services to users to help them store and retrieve data in an easy and secure way.

3.2 Fifth Generation (5G)

The fifth generation is technically defined according to IMT-2020 standards. This is expected to be available by 2020, but of course it will take longer before covering the world. Here, it should be noted that technology industry to be able to provide fifth-generation technology on a small scale in the coming days.

The fifth generation is the development of the fourth generation used in most countries of the world, so there are several features and differences in some properties for the fourth generation, although there is no accurate statistics on the speeds of the fifth generation, but it is sure that the speed will be more than twice the speed of the fourth generation, and the fifth generation will not only serve mobile devices it also deal with all devices that deal with the Internet and the Internet object (IOT), which will provide high-speed communication regardless of where these devices will provide the fifth generation technology for the industry For mobile communications applications expanded to include significant improvements in physical infrastructure, such as roads, ports, and transportation systems; indeed, the fifth-generation technology will push forward the future of the digital economy, and will lead suppliers of ICT a central role.

The current frequency spectrum and the newly distributed spectrum are designed for radio communication purposes where the radio systems are intended to be used on a global scale; the distribution of the spectrum has many benefits of facilitating economies of scale, roaming, reducing the complexity of hardware design, Spectrum efficiency and the potential for minimization of cross-border frequency interference; as a result, a decision by the World Radio Management Conference (WARC-92) identified the first 1992 frequency bands allocated for the operation of future mobile network.

It is important to know that there is no single frequency range that can meet all the standards required for the deployment of IMT systems, particularly in countries with diversity in

geographic and population density; therefore, multiple frequency ranges must be used to meet the capacity and coverage requirements of IMT systems Since the World Radio Management Conference of 1992, the successive World Radio communication Conferences held in 1997, 2000, 2007 and 2015 have identified additional frequency bands for IMT, (450 MHz, 6 GHz) to meet the rapidly growing demand for mobile communications, particularly mobile broadband data; while WRC-15 has made good progress in identifying additional frequency bands and globally coordinated arrangements below 6 GHz (A) For the operation of IMT, it was recognized that in the future the need for large adjacent contiguous spectrum groups at higher frequencies for these systems would likely arise; the Conference therefore invited the ITU-R to study 11 frequency bands in the range of (24 GHz and 86 GHz) as ranges that can be determined by the provider to be used for International Mobile Telecommunication.

Each of the independent radio technology is considered to be as the IP link for the outer internet world [4]. 5th Generation of cellular network is combination of technologies that are mentioned in diagram:

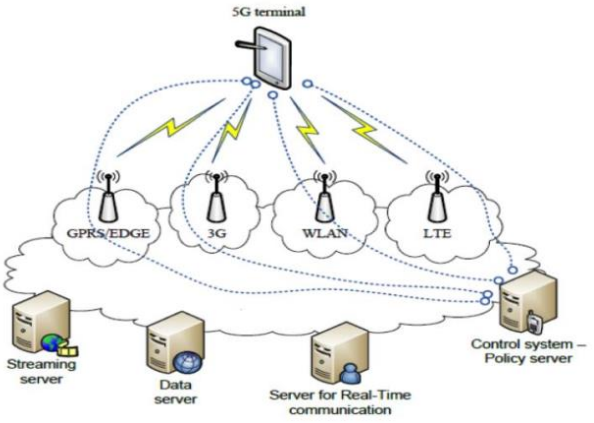

Fig.1 5th Generation technologies Source [6]

3.2.1 Advantages of 5th Generation:

The most important advantages offered by the fifth generation of cellular networks:

1. Very high speed by provide spectrum extension with micrometer waves, with intensification of cells for the purpose of increasing the efficiency of the spectrum used.
2. There is no noticeable delay with low voltage.
3. Ability to connect large amounts of devices to each other through the network (IOT).
4. Flexible and programmable networks with a very high degree of safety.
5. Download 3D high definition video within few minutes.
6. Work and play in cloud computing.
7. Self-driving cars.
8. Smart buildings.
9. Using Nanotechnology which can work in many applications like communication, medical, transportation, agriculture, home products [5].

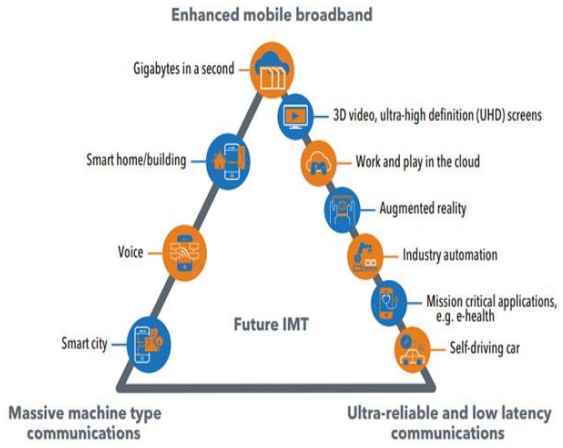

Fig.2 5th G ITU-R IMT-2020 recommendation Source [6]

3.2.2 Division of fifth generation networks:

In order to respond to the different types of equipment and devices, the radio interface of the device and antennas will include many specialized behaviors. These behaviors are referred to as section types. One section is specially designed for ultra low voltage and high reliability such as highly reliable and low another type of partition is specifically designed for devices that do not have large batteries (such as sensors)

Since it would be very costly to allocate a complete end-to-end network for each type of division, the network infrastructure supporting the fifth generation (and probably the fourth generation) would use sharing techniques (virtualization and cloud computing) Cloud-based statistical multiplexing techniques and packets to enable sections to use each other's resources when available; in this way network partitions can be

implemented and transformed into reality, all components of which should operate in a harmonious manner, and a large part of the technology challenges The fifth generation is linked to providing the appropriate amount of harmony that ensures the consistency of the process from one party to another.

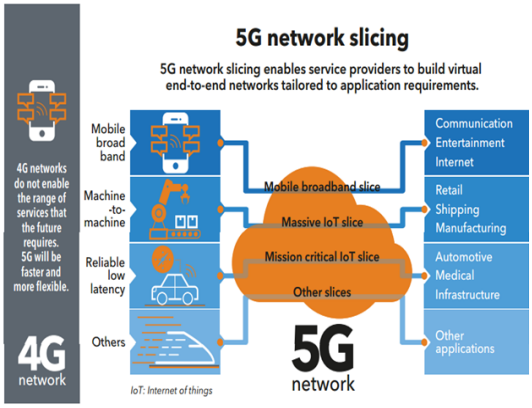

FIG.3 5TH GENERATION SLICING Source [6]

3.3 Comparative Study of Fourth and Fifth Cellular Communication Generations

Cellular Generation	Fourth Generation	Fifth Generation
Establish	2011	2020
Data Rate Speed	200 Mbps to 1 Gbps	More then 1 Gbps
Frequency Band	700 MHz, 1700-2100 MHz, 1900MHzand 2500-2700 MHz	3300 – 4200 MHz and 4400 – 4990 MHz
Standard	Signal Unified Standard LTE Advance Wi-Max	Signal Unified Standard
Web Standard	IPv 6	IPv6
Technology	Digital Broadband Packet with very high throughput	Proposed: Combination of LAN,WAN,PAN with unified IP
Multiple Access	CDMA	CDMA and BDMA
Features	Convert data and voice over IP Higher Bandwidth to provide multimedia service at lower cost	Access to different wireless technology (wireless world wide web)

Table 2. Comparison study between 4th and 5th generation of cellular communications

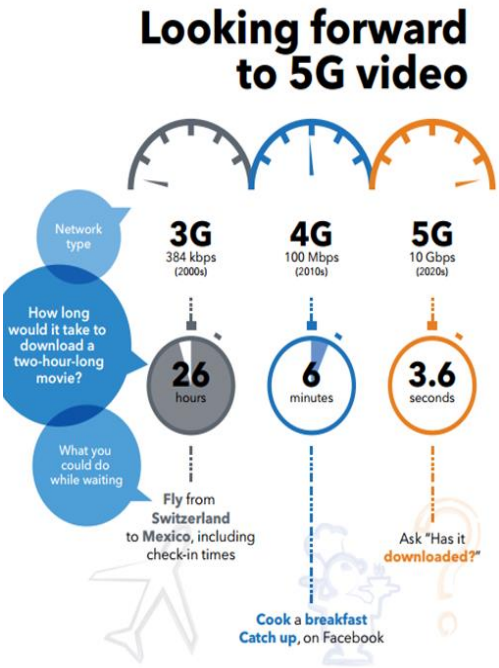

Fig.4 Comparison diagram between 3rd,4th and 5th Generation Source [6]

4 Conclusion

By enabling the fifth generation of cellular networks, the future of the big industry will change forever. For the first time ever, the industry will be able to connect athletes to the network, take advantage of smart stadiums and immersive experiences. Imagine, for example, the ability to access instant information about athletes and real-time, or the ability to instantly watch clips on your phones from within the stadium, or watch the game from the location on the pitch. This is a trend that is accelerating towards it, something that will change the reality of the industry forever. Other new and full-blown things will appear:

1. Virtual Reality VR Experiments.
2. Internet stuff and electronic security.
3. The future is supported by the fifth generation of cellular networks.

Major events, such as the Tokyo Olympic Games, are undoubtedly the first step towards the future of the fifth generation of cellular networks, but it is already clear, and from now on, the countless possibilities that will be presented.

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