A REVIEW OF WIRELESS TECHNOLOGY FOR 5G

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ABSTRACT

5G stands for fifth-generation technology. Due to the continuous rise in internet usage for a multitude of objectives, everyone has a growing demand for high-speed internet. Following 1G, 2G, 3G, and 4G networks, 5G is a recently created wireless technology that offers customers next-generation user experiences with a number of improved features, including rapid speed, outstanding reliability, wide network coverage, bandwidth, and low latency. The three main types of connected services that utilise 5G are mission-critical communications, the massive Internet of Things, and enhanced mobile broadband.In order to satisfy all of the ever-increasing requirements of the future, even those that are currently conceivable, 5G was developed to be capable of doing so. This paper provides an overview of the latest 5G wireless technology and its development from 1G to 5G.

KEYWORDS: *5G, wireless technology, wireless technology evolution, core architecture.*

INTRODUCTION

The age of wireless communication began in the early 1970s. Wireless technology for mobile devices has advanced. From the first to the fifth generations, there have been significant technological advancements. during the ensuing forty years [1]. Fifth-generation wireless technology is referred to as 5G. Because of it, users have never previously experienced such a high bandwidth. The fifth group of technology is more powerful and will be in great demand in the future due to its numerous cutting-edge, unique features [1]. Mobile phones can now use extremely high bandwidth thanks to 5G technology [2]. The following properties of 5G technology have so far been identified:

The great resolution, massive bidirectional bandwidth, and enhanced data rates, and enhanced Quality of Service (QoS) are all advantageous for extremely mobile customers.

PAGE EVOLUTION OF WIRELESS TECHNOLOGY

Rapid advancements in mobile technology in recent years have led to an increase in the use of mobile communication. This change is a result of the sharp increase in the number of telecom users. The first generation (1G), second generation (2G), third generation (3G), fourth generation (4G), and fifth generation (5G) of mobile communication technologies are all included in this revolution [1].

First Generation (1G): The first generation (1G) was introduced in the 1980s and is commonly termed as a cell phone. It operates on an analogue system. It provides the following mobile technologies: Push to Talk (PTT), Improved Mobile Telephone Service (IMTS), Advanced Mobile Telephone System (AMTS), and Mobile Telephone System

(MTS) It makes use of an analog radio transmission with a frequency of 150 MHz.

Second Generation (2G): The second generation was finished in the late 1990s. The 2G mobile communication system, which is digital in nature, is still widely used in many parts of the world. Despite being mostly voice-based, this generation also had SMS and email features. In the 850–1900 MHz frequency range, this generation employs two digital modulation techniques: code division multiple access (CDMA) and time division multiple access (TDMA).

Third Generation (3G): 3G services combine fast mobile connectivity with Internet Protocol (IP)-based services. [2]. Packet switching technology is used to convey data. Circuit switching is used to understand voice communication. besides spoken communication. The bundle also includes new features, including global roaming, as well as data services, television, and video access. Where calls are placed: 144 kbps for rural and satellite calls, 384 kbps for urban calls, and 2 Mbps for low-range and interior calls [1]. The frequency range in which these networks function is between 1.8 and 2.5 GHz [2].

Fourth Generation (4G): Up to 100 Mbps download speeds are made possible with 4G technology. In addition to 3G's characteristics, 4G provides other services like faster data transfer, clearer TV viewing, and multimedia newspapers. One definition of 4G technology is Long Term Evolution (LTE) [1]. 4G systems are expected to improve existing communication networks by offering a complete and safe IP-based

solution. Voice, data, and multimedia content will be accessible to users at any time and from any location, at a much Compared to its predecessors, the current generation delivers higher data rates. [2]. The goal of 4G development is to satisfy the speed and quality of service (QoS) needs of upcoming applications such as wireless internet access, digital video, mobile TV, multimedia message service (MMS), and video chat.

What is 5G technology?

The fifth generation of mobile technology is known as 5G. The use of high-bandwidth mobile phones has changed as a result of 5G technology. The user has never before used such costly technology. These days, mobile phone users are well-versed in mobile technology. With all of its cutting-edge features, 5G technology is expected to become the most potent and sought-after in the near future. 5G technology has a large phone memory, rapid dialling, an audio player, video playback, MP3 and camera recording, and a host of other unthinkable features. Pico nets are available, and children are increasingly using Bluetooth technologies [5].

COMPARISION OF 1G TO 5G

Generation	Speed	Technology	Key Features
1G (1970 –1980s)	14.4 Kbps	AMPS,NMT, TACS	Voice only services
2G (1990 to 2000)	9.6/ 14.4 Kbps	TDMA,CDMA	Voice and Data services
2.5G to 2.75G (2001-2004)	171.2 Kbps 20-40 Kbps	GPRS	Voice, Data and web mobile internet, low speed streaming services and email services.
3G (2004-2005)	3.1 Mbps 500- 700 Kbps	CDMA2000 (1xRTT, EVDO) UMTS and EDGE	Voice, Data, Multimedia, support for smart phone applications, faster web browsing, video calling and TV streaming.
3.5G (2006-2010)	14.4 Mbps 1-3 Mbps	HSPA	All the services from 3G network with enhanced speed and more mobility.
4G (2010 onwards)	100-300 Mbps. 3-5 Mbps 100 Mbps (Wi-Fi)	WiMax, LTE and Wi-Fi	High speed, high quality voice over IP, HD multimedia streaming, 3D gamming, HD video conferencing and worldwide roaming.
5G (Expecting at the end of 2019)	1 to 10 Gbps	LTE advanced schemes, OMA and NOMA	Super fast mobile internet, low latency network for mission critical applications, Internet of Things, security and surveillance, HD multimedia streaming, autonomous driving, smart healthcare applications.

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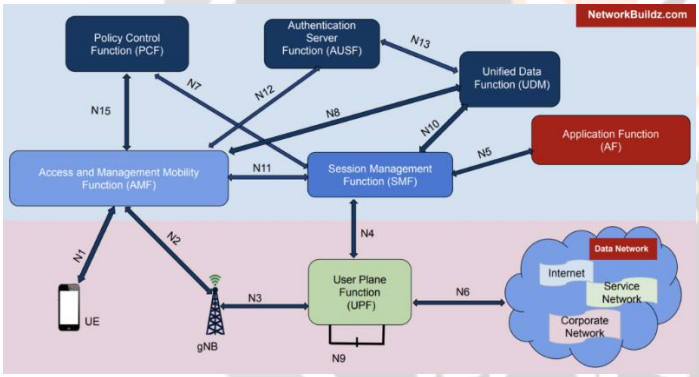
Core Architecture of 5G: 5G consists of three main parts; one of them is the 5G core network, which makes it possible for 5G networks to function at an advanced level (source). The other two parts are the devices or terminals used by individuals to access and utilise various communication services and the 5G access network (5G-AN). As seen in the

5G core diagram, the 5G core uses a cloud-aligned service-based architecture (SBA) to handle session management, verification, safety, and circulation combination from linked plans. All these features necessitate intricate network function linkage.

The components that make up the 5G core's architecture include :

• The User Plane's (UPF) operation
• Data network (DN), including Internet access, operator services, and third-party services
• Access and mobility management's (AMF) main purpose
• How the Authentication Server (AUSF) operates
• NSSF, or Network Slice Selection Function
The function of session management (SMF)
• Network Exposure's (NEF) function
The function of policy control (PCF)
• Function of NF Repository (NRF)
• UDM, or unified data management
• The Application Function (AF) is in charge of transporting
carrying out particular software tasks.

5G was created from the ground up and has unique network features for every service. Because of this, this design is also known as the 5G core service-based design (SBA). The following 5G network topology diagram [7] shows the key components of a 5G core network.



How it operates: Using the 5G New Radio Access Network, User Equipment (UE) such as 5G smartphones or cellular phones can connect to the 5G core and ultimately to Data Networks (DN) such as the Internet. The Access and Mobility Management Function (AMF) acts as a single-entry point for the UE connection, selecting the appropriate Session Management Function (SMF) to handle the user session based on the service that the UE has requested.

The User Plane Function (UPF) is responsible for transferring IP data flow (user plane) between the User Equipment (UE) and external netwok.

With the help of the Authentication Server Function (AUSF), the AMF is able to authenticate the UE and utilise 5G core services.

The policy control system uses the framework provided by other functions such as the Unified Data Management (UDM), Application Function (AF), Session Management Function (SMF), and Policy Control Function (PCF). It applies policy decisions and retrieves subscription information to regulate network behaviour.

The 5G network architecture is clearly more complex in its operation, but this complexity is required to provide

better service that can be tailored to the many 5G use cases [7].

5G's primary enabling technologies Instead of beginning from the beginning, 5G will be built incrementally on top of 4G LTE. These are some of the major technologies that enable 5G[6]

Communication Between D2D

Direct communication can be achieved using device-to-device (D2D) technology. 5G cellular networks will employ D2D millimetre wave communication technology to boost coverage, offer high-speed data rates, and facilitate peer-to-peer applications. Many studies have been conducted to characterise D2D connections inside LTE. While D3D communication focusses on mobile radios, M2M communication expands the possibilities and enables extensive networking among mobile devices. Over 100 billion devices will probably be connected to the 5G backbone via M2M communications.

MIMO

Multiple-input multiple-output, or MIMO, is a method that is crucial to 4G and is expected to play a significant role in 5G. In order to profit from MIMO on a wide scale, massive MIMO increases throughput and spectrum efficiency. Other technologies supporting 5G include millimetre wave communication, ultra-dense networks (UDN), all-spectrum access (ASA), OFDM (orthogonal frequency division multiplexing), and the Internet of Things [6].

Why 5G?

From the user's point of view, there has to be more than simply a greater maximum throughput difference between existing generations and planned 5G techniques; other requirements include [2].
1. Interoperability will become more feasible, and current global operators may experience an increase in income.
2. New and improved techniques for coding and data modulation include strainer bank multi-carrier way-in systems.
3. It is quite advantageous to use millimetre wave frequencies for wireless access and backhaul.
4. The availability of several conduction points with corresponding coverage and the flexibility to use resources for both uplink and downlink transmission in each cell provide improved intrusion and mobility control.
5. To make 5G possible for a range of radio access methods, there should be a single, common platform for all of them.
6. A lower chance of an outage and lower battery use.

5G's drawbacks

The fifth generation (5G) of mobile technology is beginning to gain traction as a better communication network that provides quicker, more reliable connections. This innovative network is making the Internet of Things (IoT) a reality by managing a greater number of devices. However, there are certain disadvantages to take into account, just as with any new technology [10].

Barriers Could Affect Connectivity

5G connectivity has a limited range, thus frequency waves can only go so far. The fact that physical barriers like walls, towers, trees, and buildings impede the 5G frequency adds to this disadvantage. The obtrusions will impede, cause disruptions, or absorb the high-frequency broadcasts. To get over this obstacle, the telecom industry is extending existing cell towers to increase the broadcast reach.

The initial costs of rollout are high

Making changes to the present cellular infrastructure or developing 5G infrastructure would come with hefty costs. Customers will probably bear the brunt of these exorbitant price tags, since the ongoing maintenance costs necessary to keep up the high-speed connectivity will add to this total.

Rural Access Restrictions

Even though 5G could offer actual connectivity for mostly urban regions, rural inhabitants might not always benefit from the connection. As it is, many remote areas of the country do not currently have cell phone coverage. More 5G carriers will concentrate on large cities, ultimately intruding on the outside areas, though this is unlikely to happen very soon.

Battery-Depleting Devices

The batteries in 5G-connected cellular devices don't seem to be able to power the devices for very long. Battery technology has to advance in order to facilitate this increased connectedness, where a single carer can operate a phone for a full day. Customers are complaining that using 5G makes their cellphones heat up more and more in addition to having dead batteries.

Download speeds for uploaded videos don't complement

In some situations, 5G technology may achieve incredible download rates of up to 1.9Gbps. However, the upload speeds—which hardly ever surpass 100 Mbps—are not as remarkable as initially stated. However, the upload rates are faster than 4G LTE when compared to existing mobile connectivity.

Optimistic but pessimistic

Because they are believed to take away from the overall visual attractiveness of the region, most municipalities are against the installation of new mobile phone barbicans or the delay of existing ones. In order to accommodate 5G, infrastructure construction will need to expand, which may not be well received by residents.

CONCLUSION

The idea of an all-IP network and faster data rates are driving the development of wireless and mobile networks, as seen by the annual improvements made to mobile terminals. Additionally, 5G wireless technology promises revolutionary improvements in data capacity, communication volumes, and access to information and entertainment, ushering in an era of unparalleled global connectedness. Even while 5G has a lot of potential advantages, consumers must be aware of and take precautions against any potential disadvantages. Therefore, before extensive implementation, thorough testing and experimentation are essential. Notwithstanding its continuous growth, 5G has the unquestionable potential to transform the mobile market and influence our future, highlighting both its bright future and the necessity of sustained investment in this innovative technology.

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