International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 10 Issue 8 ǁ August 2022 ǁ PP. 127-134

Effects of 5G Technology and its Challenges

Dr R Shankar Dr S Duraisamy
[*1] *Assistant Professor Department of Computer Science Chikkanna Government Arts College Tirupur , Tamilnadu, India*
[*2] *Assistant Professor Department of Computer Science Chikkanna Government Arts college Tirupur , Tamilnadu, India*
Corresponding Author: Dr R Shankar

Abstract
Radio technologies have evidenced a rapid and multidirectional evolution with the launch of the analogue cellular systems in 1980s. Thereafter, digital wireless communication systems are consistently on a mission to fulfill the growing need of human beings (1G, …4G, or now 5G). There are many challenges to address when we move towards 5G standard which demands much higher data rate, ultra low latency, high reliability and security. As we know, fourth generation wireless communication technology LTE and LTE advanced has already been deployed all over the world. 5G –wireless technology requires a new standard to support ultra fast, low latency services to customers. So, this article describes the 5G technology emphasizing on its salient features, technological design (architecture),applications, advantages, shortcomings, challenges, and future scope.

Keywords: *Radio Technology, Future, 5G, Wireless, Capacity*

Date of Submission: 26-07-2022 Date of acceptance: 09-08-2022

I. INTRODUCTION

5G Wireless Technology is the 5th generation of mobile networks and an evolution from the current 4G LTE networks. It is specially designed to fulfill the demands of current technological trends, which includes a large growth in data and almost global connectivity along with the increasing interest in the Internet of Things. In its initial stages, 5G Technology will work in conjugation with the existing 4G Technology and then move on as a fully independent entity in subsequent releases.

Fifth-generation wireless (5G) is the latest iteration of cellular technology, engineered to greatly increase the speed and responsiveness of wireless networks. With 5G, data transmitted over wireless broadband connections can travel at multi gigabit speeds, with potential peak speeds as high as 20 gigabits per second (Gbps) by some estimates. These speeds exceed wire line network speeds and offer latency of below 5 milliseconds (ms) or lower, which is useful for applications that require real-time feedback. 5G will enable a sharp increase in the amount of data transmitted over wireless systems due to more available bandwidth and advanced antenna technology. To support 5G use cases, networking technology must become virtualized, automated, cloud native, and flexible.

Wireless systems are using Orthogonal Frequency Division Multiplexing (OFDM) with extensive area coverage, high amount at millimeter waves (10 mm to 1 mm) covering a frequency range of 30 GHz to 300 GHz, and permitting a 20 Mbps data rate to distances up to 2 km. The millimeter- wave band is the most active solution to the current surge in wireless Internet usage. These provisions are capable of providing wireless world wide web (WWWW) applications.

1.1 What is 5G Technology?

The 5G technology is expected to provide a new (much wider than the previous one) frequency bands along with the wider spectral bandwidth per frequency channel. As of now, the predecessors (generations) mobile technologies have evidenced substantial increase in peak bit rate.

Then how is 5G different from the previous one (especially 4G)?

The answer is it is not only the increase in bit rate made 5G distinct from the 4G, but rather 5G is also advanced in terms of

- High increased peak bit rate
- Larger data volume per unit area (i.e. high system spectral efficiency)
- High capacity to allow more devices connectivity concurrently and instantaneously
- Lower battery consumption

- Better connectivity irrespective of the geographic region, in which you are
- Larger number of supporting devices
- Lower cost of infrastructural development
- Higher reliability of the communications

As researchers say, with the wide range of bandwidth radio channels, it is able to support the speed up to 10 Gbps, the 5G *WiFi* technology will offer contiguous and consistent coverage − "wider area mobility in true sense."

1.2 5G - Technology

If we look back, we will find that every next decade, one generation is advancing in the field of mobile technology. Starting from the First Generation (1G) in 1980s, Second Generation (2G) in 1990s, Third Generation (3G) in 2000s, **Fourth Generation (4G)** in 2010s, and now Fifth Generation (5G), we are advancing towards more and more sophisticated and smarter technology. Fig1 shows technology evolution. 5G is a unified, more capable air interface. It has been designed with an extended capacity to enable next-generation user experiences, empower new deployment models and deliver new services.

Figure 1 Technology Evolution

1.3 Salient Features of 5G

5th Generation Mobile Network or simply 5G is the forthcoming revolution of mobile technology. The features and its usability are much beyond the expectation of a normal human being. With its ultra-high speed, it is potential enough to change the meaning of cell phone usability. In Fig 2 represents the most important salient features of 5G technology.

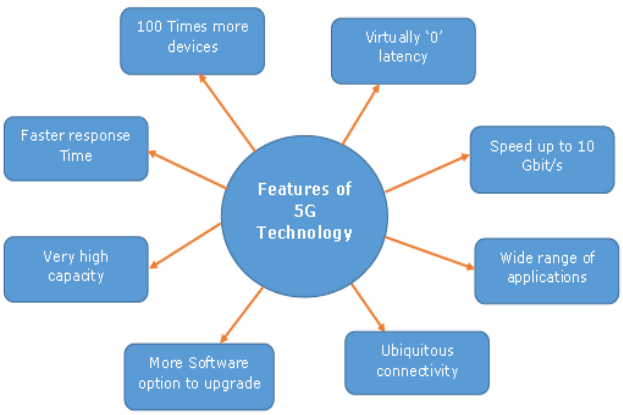

Figure 2 Salient Features of 5G

With a huge array of innovative features, now you're smart phone would be more parallel to the laptop. You can use broadband internet connection; other significant features that fascinate people are more gaming options, wider multimedia options, connectivity everywhere, zero latency, faster response time, and high quality sound and HD video can be transferred on other cell phone without compromising with the quality of audio and video.

II. 5G - ARCHITECTURE

Architecture of 5G is highly advanced its network elements and various terminals are characteristically upgraded to afford a new situation. Likewise, service providers can implement the advance technology to adopt the value-added services easily.

However, upgradeability is based upon cognitive radio technology that includes various significant features such as ability of devices to identify their geographical location as well as weather, temperature, etc. Cognitive radio technology acts as a transceiver (beam) that perceptively can catch and respond radio signals in its operating environment. Further, it promptly distinguishes the changes in its environment and hence respond accordingly to provide uninterrupted quality service.

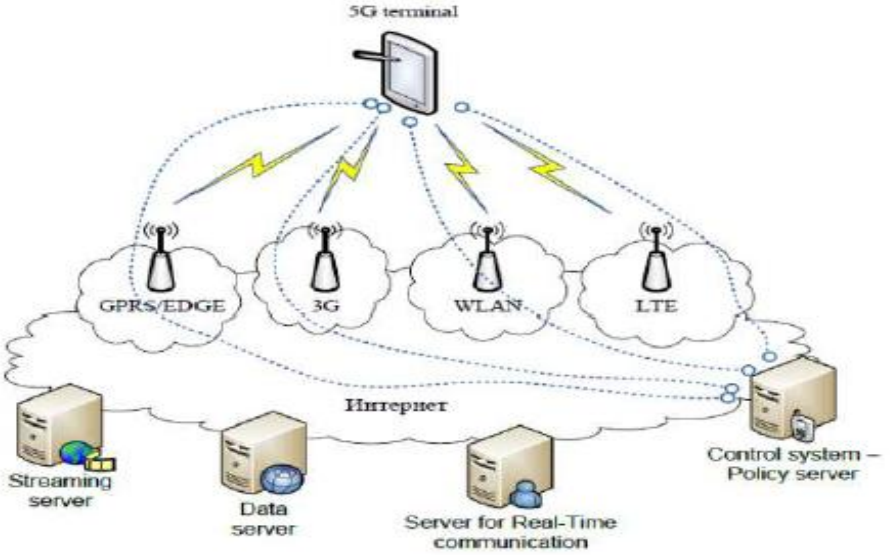

Figure 3 Architecture of 5G

As shown in the following figure 3, the system model of 5G is entirely **IP** based model designed for the wireless and mobile networks.

The system comprising of a main user terminal and then a number of independent and autonomous radio access technologies. Each of the radio technologies is considered as the IP link for the outside internet world. The IP technology is designed exclusively to ensure sufficient control data for appropriate routing of IP packets related to a certain application connections i.e. sessions between client applications and servers somewhere on the Internet. Moreover, to make accessible routing of packets should be fixed in accordance with the given policies of the user

2.1 How does 5G Wireless Technology Work?

There are basically 2 main components in the 5G Wireless Technology systems i.e. the Radio Access Network and the Core Network. Let's see these in detail in figure 4 .

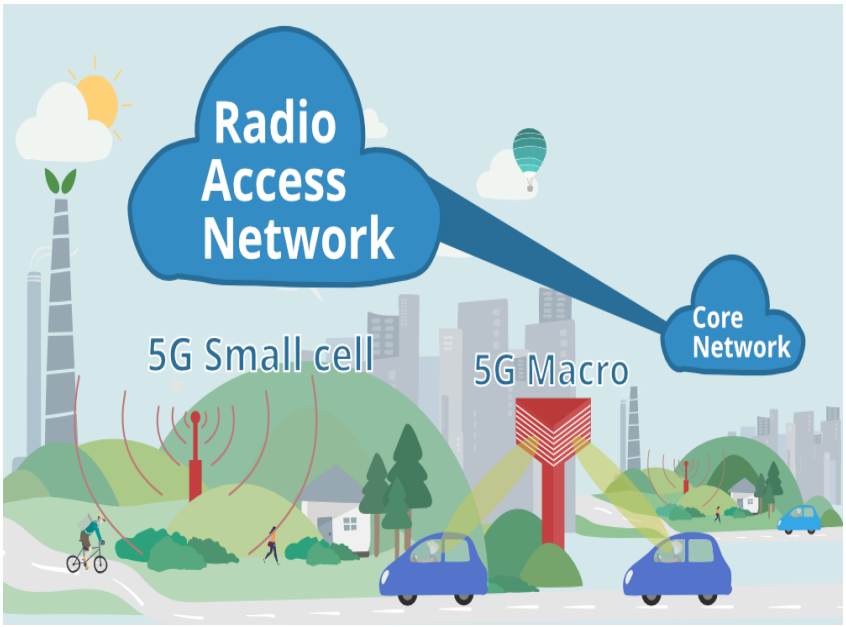

Figure 4 5G Wireless Technology

1. Radio Access Network: The Radio Access Network mainly includes 5G **Small Cells** and **Macro Cells** that form the crux of 5G Wireless Technology as well as the systems that connect the mobile devices to the Core Network. The 5G Small Cells are located in big clusters because the millimeter wave spectrum (that 5G uses for insanely high speeds!) can only travel over short distances. These Small Cells complement the Macro Cells that are used to provide more wide-area coverage. Macro Cells use **MIMO** (Multiple Inputs, Multiple Outputs) antennas which have multiple connections to send and receive large amounts of data simultaneously. This means that more users can connect to the network simultaneously.

2. Core Network: The Core Network manages all the data and internet connections for the 5G Wireless Technologies. And a big advantage of the 5G Core Network is that it can integrate with the internet much more efficiently and it also provides additional services like *cloud-based services*, *distributed servers* that improve response times, etc. Another advanced feature of the Core Network is *network slicing* (Which we talked about earlier!!!).

2.2 5G - Applications

5G technology is adorned with many as well as distinct features, which applicability is useful for a wide range people irrespective of their purposes (as shown in the *mweb* image).

Some of the significant applications are:

- It will make unified global standard for all.
- Network availability will be everywhere and will facilitate people to use their computer and such kind of mobile devices anywhere anytime.
- Because of the IPv6 technology, visiting care of mobile IP address will be assigned as per the connected network and geographical position.
- Its application will make world real Wi Fi zone.
- Its cognitive radio technology will facilitate different version of radio technologies to share the same spectrum efficiently.
- Its application will facilitate people to avail radio signal at higher altitude as well.

2.3 5G - Advancement

Application of 5G is very much equivalent to accomplishment of dream. It is integrated with beyond the limit advance features in comparison to the previous technologies. In fig 5 shows the sample example of 5G advancement.

Figure 5 Advancement of 5G

In comparison to previous radio technologies, 5G has following advancement

- Practically possible to avail the super speed i.e. 1 to 10 Gbps.
- Latency will be 1 millisecond (end-to-end round trip).
- 1,000x band width per unit area.
- Feasibility to connect 10 to 100 numbers of devices.
- Worldwide coverage.
- About 90% reductions in network energy usage.
- Battery life will be much longer.
- Whole world will be in *wi fi* zone.

III. 5G - ADVANTAGES AND DISADVANTAGES

5^{th} generation technology offers a wide range of features, which are beneficial for all group of people including, students, professionals (doctors, engineers, teachers, governing bodies, administrative bodies, etc.) and even for a common man.

3.1 Advantages of 5G Technology

There are several advantages of 5G technology; some of the advantages have been shown below

- High resolution and bi-directional large bandwidth shaping.
- Technology to gather all networks on one platform.
- More effective and efficient.
- Technology to facilitate subscriber supervision tools for the quick action.
- Most likely, will provide a huge broadcasting data (in Gigabit), which will support more than 60,000 connections.
- Easily manageable with the previous generations.
- Technological sound to support heterogeneous services (including private network).
- Possible to provide uniform, uninterrupted, and consistent connectivity across the world.

3.2 Disadvantages of 5G Technology

Though, 5G technology is researched and conceptualized to solve all radio signal problems and hardship of mobile world, but because of some security reason and lack of technological advancement in most of the geographic regions, it has following shortcomings

- Technology is still under process and research on its viability is going on.
- The speed, this technology is claiming seems difficult to achieve (in future, it might be) because of the incompetent technological support in most parts of the world.
- Many of the old devices would not be competent to 5G, hence, all of them need to be replaced with new one expensive deal.
- Developing infrastructure needs high cost.
- Security and privacy issue yet to be solved.

IV. 5G - CHALLENGES

Challenges are the inherent part of the new development; so, like all technologies, 5G has also big challenges to deal with. As we see past i.e. development of radio technology, we find very fast growth. Starting from 1G to 5G, the journey is merely of about 40 years old (Considering 1G in 1980s and 5G in 2020s). However, in this journey, the common challenges that we observed are lack of infrastructure, research methodology, and cost. Fig 5 shows challenges of 5G technologies

Figure 6 5G Challenges

Still, there are dozens of countries using 2G and 3G technologies and don't know even about 4G, in such a condition, the most significant questions in everyone's mind are

- **How far will 5G be viable?**
- **Will it be the technology of some of the developed countries or developing countries will also get benefit of this?**

To understand these questions, the challenges of 5G are categorized into the following two headings :

- Technological Challenges
- Common Challenges

4.1 Technological Challenges

- **Inter-cell Interference:** This is one of the major technological issues that need to be solved. There is variations in size of traditional macro cells and concurrent small cells that will lead to interference. Figure 7 shows the various technological challenges of 5G.

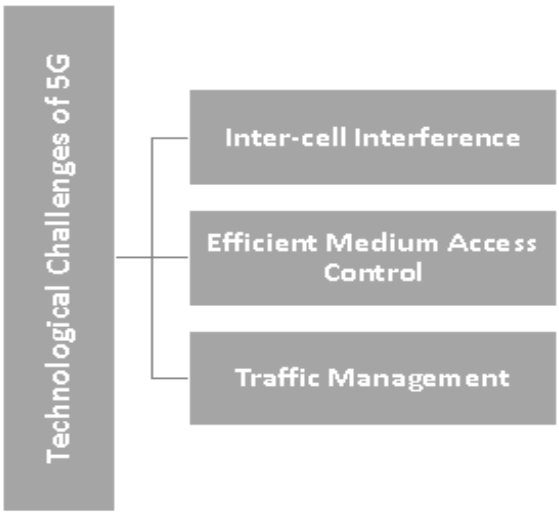

Figure 7 Technological Challenges of 5G

- **Efficient Medium Access Control:** In a situation, where dense deployment of access points and user terminals are required, the user throughput will be low, latency will be high, and hotspots will not be competent to cellular technology to provide high throughput. It needs to be researched properly to optimize the technology.
- **Traffic Management:** In comparison to the traditional human to human traffic in cellular networks, a great number of Machine to Machine (M2M) devices in a cell may cause serious system challenges i.e. radio access network (RAN) challenges, which will cause overload and congestion.

4.2 Common Challenges

In fig 8 shows that various common challenges involved in 5G technologies.

- **Multiple Services:** Unlike other radio signal services, 5G would have a huge task to offer services to heterogeneous networks, technologies, and devices operating in different geographic regions. So, the challenge is of standardization to provide dynamic, universal, user-centric, and data-rich wireless services to fulfill the high expectation of people.

Figure 8 Common Challenges of 5G

- **Infrastructure:** Researchers are facing technological challenges of standardization and application of 5G services.
- **Communication, Navigation, & Sensing:** These services largely depend upon the availability of radio spectrum, through which signals are transmitted. Though 5G technology has strong computational power to process the huge volume of data coming from different and distinct sources, but it needs larger infrastructure support.
- **Security and Privacy:** This is one of the most important challenges that 5G needs to ensure the protection of personal data. 5G will have to define the uncertainties related to security threats including trust, privacy, cyber security, which are growing across the globe.
- **Legislation of Cyber law:** Cybercrime and other fraud may also increase with the high speed and ubiquitous 5G technology. Therefore, legislation of the Cyber law is also an imperative issue, which largely is governmental and political (national as well as international issue) in nature.

V. CONCLUSION

Nowadays mobile users have much awareness of the cell phones (mobile) technology. The 5G technologies include all the types of innovative structures which makes 5G mobile technology most powerful and in a huge demand in near future. Several researches and discussions are going on across the world among technologists, researchers, academicians, vendors, operators, and governments about the innovations, implementation, viability, and security concerns of 5G. 5^{th} generation technology is designed to provide incredible and remarkable data capabilities, unhindered call volumes, and immeasurable data broadcast within the latest mobile operating system. Hence, it is more intelligent technology, which will interconnect the entire world without limits. Likewise, our world would have universal and uninterrupted access to information, communication, and entertainment that will open a new dimension to our lives and will change our life style meaningfully. Moreover, governments and regulators can use this technology as an opportunity for the good governance and can create healthier environments, which will definitely encourage continuing investment in 5G, the next generation technology.

REFERENCES

[1]. https://www.rfpage.com/what-are-the-challenges-in-5g-technology/
[2]. Mr. Vinayak Pujari, Dr. Rajendra Patil and Mr. Kajima Tambe " Research Paper on Future of 5G Wireless System" "Emerging Advancement and Challenges in Science, Technology and Management " 23rd & 24th April, 2021
[3]. https://www.tutorialspoint.com/5g/5g_technology.html
[4]. R.Shankar and S.Duraisamy , IoT Technology is Benefiting Today's Modern Farming Industry ,International Journal of Computer Sciences and Engineering(IJCSE),Vol.-6, Issue-11, pp.727-732, Nov-2018
[5]. https://www.geeksforgeeks.org/what-is-5g-wireless-technology-and-how-it-works/

Dr.R.Shankar has received his Bachelor of Physics from Bharathiar University in 1995, Master of Computer Applications from Bharathiar University in 1998 M.Phil from Bharathiar University in 2004 and Ph.D (Computer Science) from Bharathiar University in 2018. He is currently working as an Assistant Professor in Chikkanna Government Arts College. His research interests cover the Networks, Sensor Networks, Neural Networks and Cloud computing with over 70 technical publications. He has 23 years of teaching experience in both UG and PG disciplines.

Dr.S.Duraisamy has received his Bachelor of Science in Computer Science from Bharathiar University in 1994, Master of Computer Applications from Bharathiar University in 1997, M.Phil from MS University in 2002 and Ph.D(Computer Science) from Alagappa University in 2008. He is currently working as Assistant Professor in Chikkanna Government Arts College. His research interests cover the Object Oriented Systems, Sensor networks, Neural Networks and Web Queering with over 107 technical publications. He has 25 years of teaching experience in both UG and PG disciplines.