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A Study on the Influence of 5G on Intelligent Automation and Industrial Digitization

Pankaj Kuamr Goswami, Associate Professor,
Department of Electronics and Communication Engineering, Teerthanker Mahaveer University,
Moradabad, Uttar Pradesh, India
Email Id- g.pankaj1@gmail.com

ABSTRACT: ***The new Fifth generation (5G) wireless technology is providing us with more efficiency and the ability to move at lightning speed. Though 4G is already active, future traffic in this band is expected to expand steadily along with the number of users and devices that can access it. Recent years have seen the introduction of some research activities and initiatives involving major mobile infrastructure manufacturers, academic institutions, and international mobile network operators, all working to lay the groundwork for 5G mobile communication technologies. Still, not much is known about the structure or capabilities of 5G mobile services when they become available. This study examines the development and evolution of mobile wireless technology, this study shows the significance of 5G revolutionary networks by discussing its main enabling technologies, trends, difficulties, applications in various manufacturing sectors, and contribution to the future of infinite connection, intelligent automation, and industrial digitalization.***

KEYWORDS: ***Augmented Reality, 4G (Fourth Generation), 5G (Fifth Generation), Mobile network.***

1. INTRODUCTION

The term "5G" refers to the fifth generation of wireless communications technology, which is expected to have a transformative effect on many elements of daily life in the not too distant future. Mobile network traffic is continuing to increase at an extremely quick rate as a direct result of the proliferation of new mobile technologies such as high-resolution streaming video, interactive virtual apps, and cloud gaming. Autonomous cars, virtual reality, and Unmanned aerial vehicles (UAVs)are just some of the emerging technologies that will place enormous demands on the internet in the next years, and 4G services will be unable to keep up with them. As a result, scientists in both the academic and business sectors have been working hard to make 5G networks a reality in the not-too-distant future [1].

There has been tremendous development in the field of telecommunications during the last several years. Current mobile communication networks will need to evolve in some ways to meet the expectations and challenges of the future. While development on 4G mobile networks continues, some in the telecom industry have begun looking forward to the next generation of technology and services. Research and development in the field of wireless communications have yielded substantial growth and advancements throughout the years. The name for this cutting-edge innovation is "5G." The 5G system, which stands for "fifth generation wireless," is the current standard for wireless networking. When compared to the existing 4G standard, this is the next big step for mobile communications [2].

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1.1.5G Network Structure:

The advent of the fifth-generation mobile network in 2020 will change the face of the world of communications. The concept of fifth-generation (5G) mobile networks is entirely IP-based. An innovative perspective in the design of 5G mobile networks is to place user terminals at the center of the focus. Because of its position, the terminal may access many wireless technologies at once and combine their features. In the 5G mobile communication network, the phone or terminal intelligently responds to a user's choice of a forceful plan of wireless to enter wireless networks, making the user's experience seamless regardless of location [3]. Cells in 5G networks will be segmented into sectors, and data will be sent by radio waves, much as in traditional cellular networks. Each cell has its own wired or wireless link to the network's main hub. 5G may utilize the same unlicensed frequencies as Wi-Fi to send and receive data. It claims to be able to make networks smarter, quicker, and more efficient. The purpose of 5G is to vastly improve upon 4G in terms of access speeds, capacity per sector, and latency. The cell is segmented into micro and pico cells to improve network performance.

2. DISCUSSION

Since the introduction of the first 1G system in 1981, cellular wireless networks have seen significant development, with a new mobile generation coming about every 10 years. Figure 1 depicts how the mobile phone industry has evolved and revolutionized over the last 30 years, with the introduction of each successive generation of mobile networking technology from 1G to 4G. We now have mobile telephony for the masses owing to 1G technology. SMS texting and worldwide interoperability in mobile telephony were made feasible with the advent of 2G networks. With 3G, we could now download large files quickly from the internet. Since 4G vastly improved data capacity and speed, it has become possible for more people to use online tools and take advantage of high-speed mobile internet services. With 5G technology, cellular wireless networks will have unprecedented power, unlimited call capacity, and unlimited data broadcast range [4].

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 5, May 2022

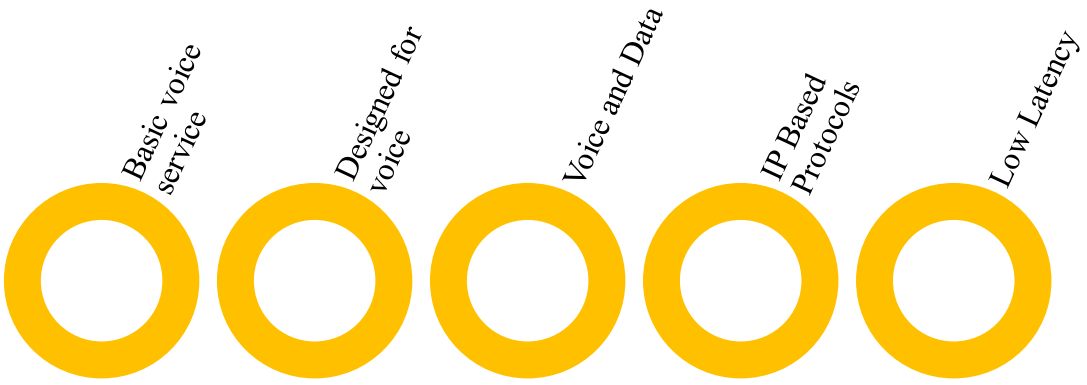

Figure 1: Displays The Development Of Wireless And Portable Communication.

In comparison to 4G wireless networks, 5G networks are more cost-effective, use less power, and have reduced speed. It's because 5G uses Ultra-Wide Band (UWB) networks, which have greater bandwidth at lower levels of energy. The total bandwidth of the network is 4000 Mbps, making it 400 times faster than 4G LTE mobile networks. Hundreds of billions of interconnections, enormous machine communications, and ultra-high-speed mobile broadband are all possible thanks to 5G communication networks. Furthermore, 5G provides 10 Gbps maximum data rate transmission rates, 10 Tb mobile data capacity, and ultra-low latency of 1 ms [5].

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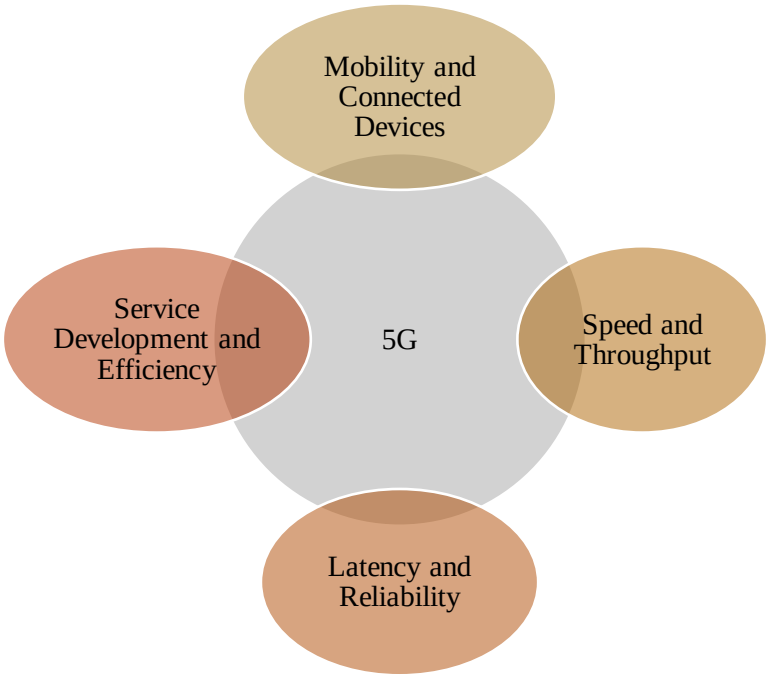

Figure 2: Shows the capabilities of 5G networks.

Support for machine-to-machine communication is enhanced by 5G networks, which seek to be more cost-effective, use less power, and have lower latency than their 4G predecessors. Ultra-Wide Band (UWB) systems are used for 5G because of their broadband and low energy consumption. A bandwidth of 4000 Mbps is 400 times faster than current 4G wireless networks as seen in Figure 2. Hundreds of billions of connections, huge machine communication, and ultra-high speed mobile broadband are all possible thanks to 5G communication networks. 5G also boasts a mobile data capacity of 10 Tb, 10 Gbps peak data rate transmission rates, 99.9 percent ultra-reliability, and a 1-millisecond latency [6].

5G mobile networks' all-IP approach for both wireless and cellular network interoperability is included in the system concept. A computer terminal (critical to the existing setup) and many autonomous radio system technologies make up the architecture. Because of an IP connection to the outside world through the internet, any of the radio approach techniques may be seen in any terminal. The mobile device's internal Radio Access Technology (RAT) implementation necessitates a separate network interface [7].

2.1.The Benefits of Fifth Generation Mobile Networks:

2.1.1. Rapid data transmission (Gigabytes in instants):

The 5G network will be characterized by its high-speed internet and intelligent networks. A full-length movie downloaded at 4G speeds takes around eight minutes; with 5G, that time would be cut to less than five. Network throughput may facilitate several technological developments, including but not limited to high resolution, multimedia television, social networking sites, and sophisticated production, autonomous cars, robotics, and 3D content augmented reality. Data communication between the billions of linked computers need not occur simultaneously for most uses. Some networks need real-time interaction, while others may be shared at low-traffic times.

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The advent of networks capable of continuous traffic management and instantaneous decision-making is crucial to the 5G era. By the end of 2020, the 5G network is expected to provide accessibility to 44 zettabytes (ZB) of data, while serving 50 billion mobile devices and 212 billion mobile sensors. It includes not only mobile phones and tablets, but also wearables, cars, computers, tools, and even remote controls [8].

2.1.2. 4K Streaming:

The proliferation of cutting-edge smartphone technology like 4K video streaming, multiplayer online role-playing games, and augmented and virtual reality applications has led to a meteoric rise in the demand for mobile networks. By implementing the 5G vision, we may expect to see a maximum bandwidth of 20 GB/s per device, a peak throughput of 1 GB/s per user, or latencies of less than 1ms. It is expected that when 5G networks are gradually phased out over the world, people will start utilizing eMBB applications on their mobile devices. These technologies, such as 4K and 8K video sharing and virtual or augmented reality devices, provide far more immersive virtual worlds but need a considerably larger data rate to be deployed seamlessly to users' devices. Maintaining the quality of experience (QoE) for users of these applications in high-stakes, complicated network environments is a top priority for 5G eMBB. A new development in 5G networks is the use of satellite connections [9].

2.1.3. Smart Mobility Using 5G:

In the future, researchers want to combine the MIH framework with DMM techniques in the context of 5G heterogeneous networks, particularly vehicle networks. Further criteria, like chance of failure to product, latency, vehicle speed, and the network size, should be carefully examined in this sort of network characterized by a high agility environment. Mobility innovations in 5G range from traditional road/ route optimization to innovative autonomous vehicle systems (connected cars) and increased smart transport sharing. Pollution reduction, price reduction, fuel conservation, incident prevention, safe navigation, and road management are all benefits of mobility solutions. This then honed in on smart connectivity that goes beyond the scope of SCOs, to highlight its primary outcomes and difficulties in the workplace. To further improve vehicle-to-vehicle communication, it also suggested a system that prioritizes the usage of 4G and, most crucially, 5G cell networking infrastructures [10].

2.1.4. Augmented Reality on 5G:

Recent years have seen a rise in the use of streaming video technologies and mobile networks to enhance augmented and virtual reality. However, constraints like as latency and bandwidth hinder us from realising high-fidelity videoconferencing as well as integrated active and augmented reality applications. Luckily, designers and developers are aware of these difficulties and have built 5G networks to prepare for the transition into the next era of software packages. The Internet of Things (IoT) and wireless Internet are the two key demand impacts that are contributing to the potential expansion of wireless connectivity, which should offer a wide range of chances for 5G. In the era of 5G, there will be a wide variety of use cases, some examples of which are augmented reality, virtual reality, wireless computing, electronic health care systems, and driving a vehicle [11].

2.2.Positive Impacts of 5G Technology:

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The most significant benefits of 5G are an increase in transmission speed, a decrease in latency, which results in an increase in the capacity for remote execution, an increase in the number of connected devices, and the possibility of implementing virtual networks (network slicing), which provides connectivity that is better tailored to specific requirements. Transmission speeds of up to 15 or 20 Gbps are possible. Because of the improved speed, we can now quickly and easily access data, software, and even distant applications. There will be less of a need for a high number of processors to be installed on certain items, since processing can be done in the Cloud, and all devices (phones, laptops, etc.) will rely more on the cloud's storage capacity rather than their own. Millions more gadgets per square kilometer will be able to connect to the network with the advent of 5G. In a world where everything is always online and sharing data in real-time, the internet of things promises to revolutionize the way we live. This works in favor of the Internet of Things. Typically, a typical household will have one hundred connected gadgets that are constantly exchanging data with one another. People in the manufacturing sector talk about thousands of interconnected devices. The development of smart cities and autonomous vehicles is dependent on the proliferation of linked gadgets [12].

2.3. Negative Impacts of 5G Technology:

One of 5G's biggest drawbacks is that it isn't accessible everywhere now. As a result, the 5G network is most useful in urban regions, and rural areas may not have access to it for some time. In addition, compared to other networks, the costs associated with erecting tower stations are rather expensive. Unlike 4G, the range of 5G devices is limited, even though they can operate at much higher speeds. Furthermore, obstructions like tall buildings and trees may cause interference with the 5G network. As a result, increasing coverage involves erecting more towers, a process that is labor-intensive and costly. Rain may also interfere with 5G coverage, therefore it's important to take extra precautions in these situations. Through the deployment of 5G technology, mobile phone users may guarantee rapid data transfer rates. However, unlike 4G, upload rates do not exceed 100 Mbps. Better battery technology is also required for mobile phones to support 5G connections. As 5G rolls out, several users report that their phones are much hotter than usual. The vulnerability of 5G networks to cyberattacks is one of the technology's downsides. With more available bandwidth, hackers may now easily take the database. Even worse, it relies on software that leaves it open to assaults. The prevalence of assaults will increase dramatically as 5G links more gadgets. Thus, organizations should spend more money on a security operations center to safeguard their infrastructure.

3. CONCLUSION

5G could have been more intelligent and effective in servicing enormous quantities of radio spectrum, from a basic detector to a complicated self-driving automobile, from wearable sensors in all sorts of hardware to autonomous autos, from aeroplanes to smart enterprises and municipalities. In compared to the current network, the 5G network has far more internet bandwidth, lower latency, and significantly greater frequencies. The fifth generation of wireless technology is set to be reevaluated. Professionals are still developing this cutting-edge 5 technology. The development of technologies such as millimeter waves, tiny cells, enormous Mimo, Beamforming, and full duplex is ongoing. Some cutting-edge electronics would be included as well. It would be difficult to make this whole system operate together. 5G services may be available within the next five years if experts can figure it out.

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