

# Mobile Wireless Communication - The expansion to the 5G Revolution

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**Abstract**—After the roll-out of 5G technology, the evolution of mobile wireless communication broadly has acquired a purpose in recent years. This progressive journey encompasses numerous generations, commences with 1G, following 2G, 3G, 4G, and the yet-being-researched 5G. The advancement of remote access gadgets will facilitate 5G mobile systems, who require a premium on strengthening client stations anywhere it has stations. The internet of things (IOT) technologies that are scheduled to be invented in the fifth era shall represent an increasingly knowledgeable invention that directions society as a whole. The article examines various kinds of data transmission prices, challenges, techniques, features, and applications hired to present a snapshot of the emergence of mobile generations.

**Keywords**—IOT; LTE; 4G; 5G; Wireless;

### Introduction

The discipline of Mobile Wireless Communication Networks (MWCN) continues to be increasing swiftly as of late. Many billions of people now use cellular telephone technology, which became attainable by the invention of several subsequent eras of wireless communication [1], [2]. Multiple types of mobile wireless communication have existed created while the 1G first generation, and that was mainly utilised for voice calls yet formed the starting point for Each cell phone generation [3, 4]. The 2G second generation brought text messaging and a new perform and made digital phone conversation possible. afterwards the arrival of Third generation 3G, which encourages multimedia techniques, the rate of information transmission has increased [5], [6]. As opposed to 3G, the 4G fourth generation is more swift and more reliable, which is an improvement that eliminates 3G's

restrictions and additionally improves QoS. The data transfer capacity is boosted with service) [7], [8]. that time 2010 right through to this moment, 4G users and support have grew more common. The Wireless World Wide Web (WWW) has a new generation that is referred to as 5G. given that new features and techniques are supported in every generation. The mobile phone companies and the number of mobile users increase as the consequence of this growing [9], [10]. The remote Businesses has been undergoing explosive development due to of both ranged innovation and its backers [11], [12], and [13]. Particularly since the period's turn, there has been an obvious change in fixed to portable communications [14]. Before the passing of 2010, there were more adaptable cell phone customers than fixed phone lines. Network planning and improvement-related administrations jumped into existence as a consequence of this. the sharp core [15], [2]. The 3G and 4G networks that's presently present are not suited for Internet of Things (IOT) in multiple ways. Since 5G has yet to be publicly in use, it could enhance services such e-commerce, e-transactions, while e-management [19]. The phrase "Internet of Things" (IOT) depicts an online community of gadgets with connectivity that work together to monitor and enhance daily living. The Internet of Things (IOT) is an offer trend and a future direction in technology [8], [9]. Nearly all that was needed. Such gigantic devices need to be able to speak to other machines to be able to connect to the internet through high-speed internet [44], [11]. Future 5G cell phones will be heavily exploited to help with the huge IOT deployment that will include billions of attributed smart goods and sensors [12], [13]. The significant amount of data has been taken into account when designing 5G. Connectivity to billions of technology and future advances is made possible by the internet of things [14]. wireless and mobileEase of Use Connectivity in communication between the five generations will increase; traffic volume will impact

all aspects of daily life and create an all-dimensional atmosphere. which has to adjust to these obstacles by adding fantastic features to boost capacity and enhance energy, spectrum, and cost efficiency [25].

## 2. Evolution of Mobile Wireless Communication through Five Generations

The article analyses each technology and analyses the mobile wireless communication generations from the initial one to the fifth. It is important to go over past wireless mobile communications generations, and Figure 1 shows the highlights of those generations. With 5G technology still according to study and creation, it could bring about another revolution by responding to fresh technologies with fast data rates.

### 2.1 First Generation (1G)

The very first mobile network, or 1G, originated as an analogue system built during the 1980s. It hires an analogue radio signal with a frequency of 150 MHz, only does voice transmission and call modulation, like mobile phone systems, and uses a recurrence balance FM system to multiplex radio communication traffic into an FDMA (Frequency Division Multiple Access) recurrence division various access system [6]. It is unreliable for this generation, without security. In any event, 1G innovation has a number of shortcomings. AMPS (Advanced Mobile Phone System) and TACS (Total Access Communications System) are widely used and recently issued. It could be as quickly as 2.4Kbps [2].

### 2.2 SECOND GENERATION (2G)

Through 1991, Finland's 2G mobile network travelled application below the GSM (Global System for Mobile Communication) the mean. Computer chats tend to be clearer and 2G calls could be jumbled. Some of its key features enabled users to share voice and image messages (MMS), text messages (SMS), and image interactions via their phones [8]. As opposed to an analogue signal, it utilised a digital one. It put the CDMA Code Division Multiple Access idea into effect. CDMA supplies everybody with a unique code for indicating the closing of several physical channels. FDMA, TDMA, and CDMA are a few of the access methods that are utilised for communication with a growing amount of customers. After 2G opened in 1995, 2.5G followed, combining voice and data in a process the fact improved GSM Evolution (EDGE)'s data rate. In addition, GPRS (General Packet Radio Service), which featured packet switching and was appropriate for the internet, emerged. The transfer of data at 64 Kbps [9].

### 2.3 Third Generation (3G)

For it accomplish a data transmission rate of at least 2 Mbps, 3G requires utilises huge trademark wireless networks with enhanced system support abilities. It was first released in 2000 and includes high-speed data transfer and security. The 3GPP (3rd Generation Partnership Project), a company created to aid in the construction of the 3G network, has advanced the project by providing an open

design that complies with an IMT 2000 guideline. The Universal Mobile Telecommunication Systems, also known as Universal Terrestrial Mobiles Systems, were known in Europe. that ITU T term of a three-era framework by way of CDMA and transport technology enhanced data GSM environment, which forms part of the ETSI ambitious International Mobile Telecom IMT2000. A 3G digital network is EDGE [33]. raised information transmission powers of 3G, that have numerous times speedier than those of 2G. The abilities have been extended to include speech, video files, finishing IP (like Skype), and bandwidth and data transfer rates. Peak data speeds vary from 100 to 300 Mbps [15].

### 2.4 Fourth Generation (4G)

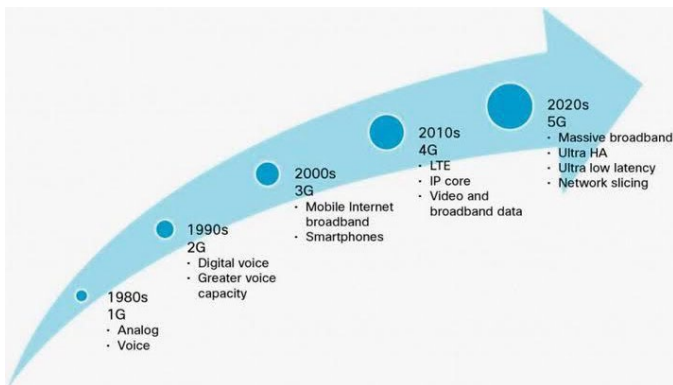
An important advance in this generation is the affordability of higher security, larger bandwidth, and a quicker internet access. Long Period Evolution (LTE) is the basis for this generation. The LTE standard was created by the 3G Partnership Project (3GPP) for 4G distant exchange. The 4G will continue to bring steadily enhanced versions of the same innovations promised by 3G (such as improved multimedia, streaming of videos, global access, and around-the-world getting around through a broad range of gadgets). An array of systems. The International Telecommunication Union (ITU) has chosen 100 Mbps as the permitted speed [43]. implementing a Long Term Evolution (LTE) 4G typical, the 4G began to be communicated in Stockholm before moving to Oslo, Norway when 2009. Therefore, 4G offers quick mobile web browsing (up to one Gb per second for stationary clients), encouraging gaming, regulates HD recordings, and promotes HQ video conferencing for many customers. This was presented all over the world complete high quality streaming of movies [37].

### 2.5 5G Revolution and Application

The fifth generation of wireless mobile broadband technology is right now ready. Higher speed, less latency, ability of supporting many devices at once, and conservation of energy are a few of the key rewards. Nowadays, projects must support 5G strength in order to fit multiple services due to the obstacles of modern technology. The World Wide Wireless Web (WWW) is a real wireless while 5G development is still underway. 5<sup>th</sup> Wireless System for Dynamic Operating Mega Communication (WISDOM), an original concept for a new wireless communication, is the cornerstone of the generation communication network [1]. According to communication theory, the 5G has a high speed for data transmission while the short frequency and broad bandwidth are more effective. network. This frequency range, which has been assigned to 5G, enables communication over short distances and with the ability deeper than 1Gbps [13].

The world's mobile communications have become overloaded due to the rise in customer appetite for data and the need to offer new services. Therefore, 5G networks are developed for the challenges of new technology, such as machine communication, and the growing demand for data from industrial users. Furthermore, as the total number of

internet-connected devices rises, 5G wireless technologies for consumer devices (such as smart watches, smart metres, technology and sensors utilised by business). When related these devices use Internet of Things (IoT) capabilities. With regard to mobile communications services, which are used between people and objects, the IoT has widened this focus. The explosive growth of IoT applications will be driven by future IoT applications such mobile health, internet devices in autos, connected homes, industrial control, and environmental monitoring. Additionally, the cloud will be used for storage and processing of the big data produced by IoT applications. All industries is going to see a change thanks to the 5G network. Through the year 2020, when there will be an estimated 20 billion linked devices [4]. The future of the Mobile Broadband (MBB) service and Internet of Things (IoT) is represented by the roll out of wireless mobile 5G applications in society's day-to-day activities. Some of the contemporary uses offered by 5G include charging mobile devices using our own the heartbeat, knowing the precise time of our job in nanoseconds, and real-time video software. Augmented AR and VR services, smart cities, networked buildings, and city services, autopilot applications in education, autonomous vehicles, industrial automation, and health applications are a few instances of emerging technologies [37]. An enormous quantity of gigabit-scale data may be transmitted, and 5G offers private virtual networks. 25Mbps related rates with data capacity more than 1Gb are also offered. 5G has unprecedented upload and download rates [26].



**Figure 1.** Evaluation of Wireless Mobile Generations.

### 3. Literature Review

Plenty of research on the growth of mobile communication and the fifth generation trend have been performed by researchers in recent years. Several major research projects conducted in the mobile generations will be studied in this section of the paper: In 2016, Gopal and P. G [7] proposed examining the speed, frequency range, switching design the basis and forward error correction of 4G and 5G wireless protocols. Likewise they discussed about how 5G will soon replace 4G and mentioned some new 5G applications. In 2017, Yadav, M., et al. [8] looked at the mobile communication generation that has developed thus far and

will remain in the future for the next generation. After the advent of 6G technology, which will offer high-speed internet access up to 11 Gbps, there are no hindrances to the progress of mobile communication. The 6G will bring together satellite networks and the 5G wireless mobile system. Furthermore, they discussed about how the 7G generation is dependent on satellite functions for mobile communication. Satellite-based 7.5 Gbps super high-speed connectivity and top download network methods. In 2017, Pavia, L., et al. [29] released an analysis of the 2G, 3G, and 4G security features. The second (2G), third (3G), and fourth (4G) versions of mobile communications networks employ the Global System for Mobile Communications (GSM), Universal Mobile Telecommunication System (UMTS), and Long Term Evolution (LTE) innovations, accordingly. Furthermore, new security systems that automate and monitor security using artificial intelligence and machine learning algorithms have been introduced for 5G and IoT applications. The Authors arrived to the idea that new avenues need to be established for device attack prevention and protection. In 2018, Alsulami and Akkari [14] proposed that 5G wireless networks play the primary role in acting and addressing the IoT's high communication requirements. 5G was created for running IoT applications. The authors analysed 3G, 4G, and 5G relationship alternatives for the Internet of Things. Furthermore, several 5G IoT enabling technologies have received consideration, involving D2D, MWT, Relays, WSDN, and NFV. In 2018, Neumann, G., et al. [11] described three strategies for combining industrial Ethernet and 5G mobile networks onto a hybrid design. The first extends the second conduct by a far-flung production site, the second is a virtualized controller, and the third is connected homogenous, which is an island. They employed a mechanism for merging 3GPP 5G with TSN/Industrial Ethernet. Bendale and Prasad [42] suggested a plan in 2018 to boost the security of the 5G mobile network through the addition of new features. This study provided some basic information on 5G wireless networks. The many innovations, notably IOT, MIMO, D2D and SDN, HetNet and IDS, that may be used with 5G wireless. Rashid and Razak [23] touched about the challenges that come with big data analytics in 5G in 2019. A billion devices are anticipated to be connected to 5G, increasing bandwidth interest and data size. They supplied a flow model for 5G that incorporates several machine learning methods to deal with huge and different quantity of data. The flow model demonstrated that big data analytics tools may be used to enhance 5G networks. In Furthermore, they came to the decision that a 5G wireless system will be essential for supporting various applications, such as big data. Botir S., et al. [14] provided a thorough overview of mobile wireless generations in 2019. They compared alterations happening with generations of mobile wireless communication. They looked examined characteristics of several generations, included bandwidth, core connections, multiplexing, and switching. They came to the conclusion that 5G is more reliable as it transmits large amounts of data quickly. They found that 5G delivers unique characteristics that are consistent with contemporary supported by LAS-CDMA, OFDM, MCCDMA, Network-LMDS, and UWB



advances in technology. They expected that five generations will be finished and in support by the year 2020.

In 2019, Manam, V., et al. [35] discussed and outlined the evolution of mobile wireless generations. They compared the pace, technique employed, and specific aspects of electronic devices from all generations. Instead of discussing both the advantages and negatives of the 1, 2, 3, 4, and 5 generations. Abidin, I., et al. [26] described the characteristics of 5G in 2020. The five generations will be addressed with a focus on 5G. They focussed on employing the WISDOM approach in 5G as a justification for quicker data transmission as compared to 4G LTE techniques. In their opinion, 5G is a a 4G and WISDOM approach concoction. The 0G, 1G, 2G, 3G, 4G, and 5G mobile generations were outlined by AHMAD et al. [37] in 2020. Furthermore, the author compared the various features of each of the first through fifth generations. The author mentioned how employing Millimetre Wave (mmWave) methodology in 5G delivers higher frequency that is between 30-300GHz with capability larger than 1Gbps for the quickest data transfer. Pawarand and Deshpande [8] presented their disapproval of the 5G network and fast expansion in 2020. rely on cognitive radio (CR) technology and spectrum sharing (SS) technologies. They recommended employing 5G's capabilities for offering a variety of services, including machine-to-machine communication, Internet of Things (IoT), increasing mobile broadband, and conquering several challenges faced by 5G technology.

4. Discussion and Comparison

Reviewing and analysing some of the major past research concerning the development of mobile wireless communication networks from 1G to 5G has been discussed in the sections before it. What we can infer is that Initially, 1G was only used for voice. Their phones use second generation 2G for phone calls and sending data like SMS and MMS messages. Third-generation 3G enables elevated information exchange features and multimedia services at speeds several times quicker than 2G. Additionally, the growth of new administrations like video conferencing was prompted by 2G. Fourth generation (4G), on the other hand, is the generation currently in use prior to the invention of 5G. Due to this, the fifth generation is not now in widespread availability, but according to the evaluated studies, it could potentially be in frequent use in 2020 with a bandwidth of more than 1 Gbps. Table 1 shows several kinds of investigation, each with a unique methodology that offers an overview of these five generations. So, based on past evaluations of generation type, deployment, system technologies, bandwidth, standards, and services, a comparison of them is produced.

In summary, the development of mobile wireless communication networks has progressed significantly from the initial 1G to the current 4G generation, with the upcoming 5G technology poised to make a significant impact in the near future. Each generation has brought with it advancements in features, speed, and services, from voice-only capabilities to high-speed internet and multimedia

services. The comparison of these generations is based on various factors, such as deployment, system technologies, bandwidth, standards, and services. Through analysis of past research, it is clear that each generation has built upon the previous one, and the progression has been significant in terms of technology, infrastructure, and services offered to users.

Table 1: comparison of different mobile technologies of the addressed previous researches

Ref. No.	Gen.	Deployment	Technologies system	Bandwidth	Techniques standards	Services and Applied
[49] 2019	5G	2020	-	-	MIMO, URLLC QOE	Big data analytics (FCN) application
[44] 2019	1G	1970-1980	Analog Cellular Technology	2kbps	FDMA	Mobile Technology (Voice)
	2G	1990-2004	Digital Cellular Technology	64kbps	TDMA, CDMA	Digital Voice, SMS, Higher Capacity
	3 G	2004-2010	CDMA, UMTS, EDGE	2Mbps	CDMA	High Quality Audio
	4 G	Now	Wimax, LTE	1Gbps	CDMA	Dynamic information Access
	5 G	Soon (Probably by 2020)	Unknown	More than 1Gbps	CDMA	Unknown
[45] 2019	1G	1970-1980	Analog Cellular	2kbps	AMPS, NMT, TACS	voice
	2G	1990	Digital Cellular	64kbps	TDMA, CDMA	Digital Voice, SMS, lower rate data
	3 G	2001	CDMA	2Mbps	CDMA/ IP	High Audio, video calls, mobile broadband
	4 G	2010	LTE - WIFI	1Gbps	Undefined IP, LAN, WAN	Wearable device , high data rate
	5 G	2020	Multi radio waves	Higher 1Gbps	-	Device-to device , IOT
[46] 2020	1G	Developed 1980	Analog Cellular	--	-	-
	2G	1990	Digital Cellular	-	-	-
	3 G	2001	CDMA	Network download 7.2 Mbps	--	high data transmission, video calls and video conference
	4 G	2009	LTE	100Mbps	OFDM	IP is used for networking
	5 G	2020	Integrated Radio Access Technology (RAT)	Higher 1Gbps	(WISDOM)	Support WWW, IOT
[47] 2020	1G	1970-1984	Analog Cellular	2kbps	AMPS	Mobile Telephony (Voice)
	2G	1980-1999	Digital Cellular	14-64kbps	TDMA, CDMA, GSM 2.5G: GPRS, EDGE, IxRTT	Digital Voice, SMS, high capacity
	3 G	1990-2001	Broadband CDMA, IP Technology	2Mbps	WCDMA, CDMA	Integrated high-quality audio, video and data
	4 G	2000/2010	Unified IP & seamless combination of broadband LAN/WAN/PAN & WLAN	200Mbps	Single Unified Standard	Dynamic Information access, wearable devices
	5 G	2014/2015	Unified IP & seamless combination of broadband LAN/WAN/ PAN, WLAN & www mm Wave	Higher 1Gbps	Single Unified Standard	Dynamic Information access, wearable devices with AI capability
[48] 2020	5G	2020	-	very large bandwidth	SS and CR	(IoT), Enhanced mobile broadband, ultra-reliable, low latency communication, massive machine communicate

5. Conclusion

After examining a number of investigations, we reached conclude that the development of mobile wireless communication networks from 1G to 3G only involved voice, message, and data communication. Different mobile transmissible types have been outlined, taking consideration how 5G wireless technology has further revolutionised the mobile businesses. Since it can handle the best advancements and supply an irreplaceable receiver to their clientele, 5G technology has a bright future. The 4th and 5th generations methods supply qualified assistance with lightning-fast data transmission and an obvious boost in the communication market. The unified-IP, seamless adoption of broadband implementing LAN/WAN/PAN was covered by 5G technology, none the less. Additionally, a single unified standard technique was dependent on dynamic information access and wearable devices with AI capabilities in addition to the more than 1Gbps of provided bandwidth.

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