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# Evolution of Wireless Technology

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***Abstract— Nowadays, we use wireless technology, because easy communication with these technologies has become an integral part of life. Users always demands for reliable network & high data rate from the network provider. For faster data rate in new technology mmWave needs higher speed of data rate, low latency, less system complexity, etc. Here, we will see the step by step evolution of wireless communication. In this paper, we survey challenges on mmWave technology.***

***Keywords— Wireless, 0G, 1G, 4G, 5G***

## I. INTRODUCTION

Today's wireless networks have a difficult challenge, the number of users and the devices are consuming more data than ever before. Nevertheless, telecom carriers should be limited to the same radio spectrum frequency band they are often used to. That is, per user having access to limited bandwidth, which results in slower speed and disconnections. In wireless networks, if the connected user devices increase it leads to the shortage of spectrum. We keep on sharing a restricted data transfer capacity of a limited range. This bigly affects the client experience. In any case, millimetre wave innovation gives a functional answer for this issue. It is difficult to state that particular technology which plays an important role for the development of the 5G technology. 5g technology involves mmWave, beamforming, MultiUser-MIMO(MU-MIMO), etc[1]. There are some lacunas in previous generation that is in 4G for example offers low data rate contrast with wired systems, based on wireless standards data rates are varies, signal loss, low latency, high system complexity and computational complexity, etc., which need to overcome in next generation that is in 5G. To achieve this, it is necessary to design a set of completely new technologies. This technology will allow for 5G data transmission delays and peak data download speeds compared to 4G networks. Earlier Amplitude Modulation (AM) radio phones are to be used, named as walkie-talkie, which is used for military applications only not for civilians. Then for the civilians used car phones are introduced. Step by step go through all the mobile generations.

## II. ZERO GENERATION (0G)

The radio telephone technology was introduced in 1940[1]. As this technology was created before cell framework it was referenced as a pre-cellular system. Here, the system was analog in nature and analog carrier is used here. In this system only one way communication is held, that is one person speaks and at another end only one person listens to the voice, which is called half duplex system or technology. It is used in various applications like vehicular systems, for military applications, etc.

## III. FIRST GENERATION (1G)

The first generation (1G) was introduced in 1980 with analogue switching technology having 2.4 kbps speed. On 1 December 1979, in Tokyo, Japan, the principal business 1G versatile system on the planet was propelled by Nippon Telephone and

 

Telegraph Company (NTT). The first cell phone was created by Martin Cooper and produced by Motorola company which was presented simultaneously. The early vehicle telephones in the Japan NTT arrange later advanced into "shoulder telephones" in 1985 that can be carried on the shoulder like a sling sack. In 1G, a phone coordinate with 88 cell locales with base stations, or radio towers covering all regions, handover of the call between various cell locales was bolstered, where automated switching without the need for human switchboard operator was to be used. First generation was used for voice only. Handset is overwhelming[2]. It was utilized for corporate and official use, not for individual use. It was expensive, hence an image of luxuriousness and economic wellbeing. Key features of 1G were 800 MHZ frequency, 10MHZ Bandwidth, Frequency Division Multiple Access (FDMA) access technique is to be used. 1G faces low voice quality, unsecure system, distortion occurred in voice communication. Data communication speed is very slow, it's not user friendly due to bulkiness and higher cost.

## IV. SECOND GENERATION (2G)

In 1991, the 1G analog network replaced by the fully digital technology that is Second generation (2g) was introduced with 64Kbps speed. 2G and 3G have had fixed frequencies, however 4G doesn't observe such standards. 2G is generally run on 900Mhz or 1800Mhz around the world, aside from America where 2G is on 800Mhz/850Mhz/1900Mhz. In 2G Global System for Mobile (GSM) was used. Second era cellphone uses were either Code Division Multiple Access (CDMA) or Time Division Multiple Access (TDMA)[3]. It introduced e-mail, a Short Message Service (SMS), Multimedia Messages (MMS) and picture messages. To secure the user, the data encryption technique was used, which means the information signal or message or data from transmitting end was only received by the receiver end user. In 2G, the cell phone size is less than the first generation. The 2G enabled cellphone requires digital data which consumes less power due to which the battery lasts a long time. This system, overcomes some issues of previous generation, but it having its own drawbacks like, cell towers had limited coverage areas and 2G needs strong digital signals to uplink and downlink the data, so in rural areas or where there is a low cell tower coverage area, the 2G system is unable to work, that is, data dropout is there. 2G is a circuit exchanged, where the end frameworks are devoted for the whole cell., which causes insufficient utilization of data transfer capacity and assets. It was unable to handle the intricate information, like video.

## V. THIRD GENERATION (3G)

In 2001, a third generation (3G) was launched, with speed 3.1 MBPS. 3G is generally run on 900Mhz or 2100 MHz, once more, aside from America where 3G is on 850Mhz/ 1700Mhz/ 1900Mhz.First time mobile broadband introduced in 3G. This technology did bring numerous improvements over 2.5G. The 3G standard International Mobile Telecommunications IMT-2000, which is also called 3G. In 3G Universal Mobile Telecommunications System (UMTS) which uses as the main interface that is WideBand-Code Division Multiple Access (WCDMA)"[4]. The most extreme speed of 3G is evaluated to associate with 2 Mbps for stationary gadgets and 384 Kbps in moving vehicles. It introduced faster data transmission, video calling, live video conferencing, access to the internet for mobile and music, Television (TV) on mobile is possible due to the 3G. Users can enjoy cricket matches, news, users may not be able to watch the whole movie but able to watch small video clips, emails on mobile, banking facilities with the payment. Also, users can be able to use navigation tracking systems for cars or people, etc. There are some disadvantages like It requires 3G consistent handsets, the expense of moving up to 3G gadget is very costly, so users friendly, power utilization is high, due to which the mobile battery couldn't last a long time, For smooth operation 3G requires nearer base stations which is costly. The technology was improved from time to time, in 3.5G High-Speed Uplink Packet Access (HSUPA) and High-Speed Downlink Packet Access (HSDPA) these two technologies are used and which having higher information uplink speed 1.4 ,1.9 ,5.8 Mbps. and1.8 ,3.6 ,7.2 to 14 Mbps respectively. In 3.75G, High Speed Packet Access (HSPA) and High-Speed Downlink Packet Access (HSDPA) is used. HSPA is the blend of HSUPA and HSDPA that improves the exhibition of W-CDMA and can achieve speed from 21 Mbps to 28 Mbps and 1.8 ,3.6 ,7.2 to 14 Mbps, respectively.

## VI. FOURTH GENERATION (4G)

In late 2009, 4G was launched. It can do everything 3G can do, but just in a faster way. There was a need for 3G that may not be adequate to address issues of future elite applications like sight and sound, full-movement video, remote remotely coordinating. Multiple principles for 3G make it hard to meander and interoperate across systems. Requirement of a solitary broadband system with high information rates which coordinates remote LANs, Bluetooth, cell systems, and so on. 4G can likewise deal with HD portable TV, 3D TV, videoconferencing, gaming, cloud computing and other information escalated applications. On the off chance that you watch YouTube recordings, stream Spotify, and depend on a broad cluster of webs associated applications day by day, 4G is an undeniable essential.

4G – Also known as "Beyond 3G", 4G alludes to the fourth era of technology [5]. The organization of 4G systems ought to be in the 2010-2015-time allotment and will empower another jump in remote data rate and unearthly productivity. The International Telecommunication Union (ITU) has indicated IMT-A (IMT-Advanced) for 4G guidelines. 4G is about intermingling; union of wired and remote systems, remote advancements including GSM, remote LAN, and Bluetooth just as PCs, purchaser hardware, correspondence innovation and a few others. 4G is a Mobile sight and sound, whenever anyplace, Global portability support, incorporated remote arrangement, and modified individual assistance organized framework.

 

## VII. KEY TECHNOLOGIES IN 4G

First technology is MIMO – OFDM. Multiple Input Multiple Output (MIMO), as opposed to customary correspondence frameworks, exploits multipath spread to expand throughput, extend/inclusion, and dependability. MIMO (Multiple Input Multiple Output) frameworks utilize spatial multiplexing, wherein numerous transmitting radio wires and different receiving wires are utilized. It licenses parallel streams to be transmitted all the while by those radio wires. Since MIMO transmits numerous signs over the correspondence channel, the data rate is multiplied by the receiving antenna.

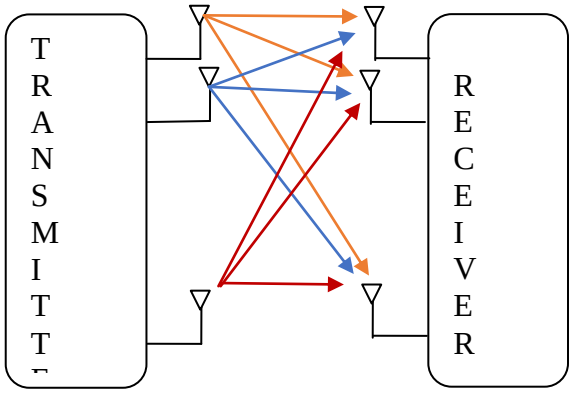


Figure 1: Transmission & Reception of data in MIMO

4G utilizes Orthogonal Frequency Division Multiple Access (OFDMA) and other new advancements like Single Carrier-Frequency Division Multiple Access (SC-FDMA), Interleaved Frequency Division Multiple Access and Multi-transporter Code Division Multiple Access rather than Code Division Multiple Access (CDMA), which is utilized by each of the 3-G frameworks. Universal Mobile Telecommunications Service (UMTS) Long Term Evolution (LTE) was presented in 3rd Generation Partnership Project (3GPP) Release & which bolsters 300 Mbps (4×4 MIMO) and up to 150 Mbps (2×2 MIMO) data rate in the downlink and up to 75 Mbps in the uplink. LTE is probably going to approach IMT-A, downlink upto 1 Gbps and uplink upto 500 Mbps [6]. The 4th generation overcomes the problems of the 3rd generation but it has its own disadvantages. Due to the increase in data transfer rate, it requires more power consumption, due to this battery drains faster. The hardware is also complex due to which hardware complexity has increased, which affects the hardware cost. Power consumption, hardware complexity and hardware cost are related to each other. The 4th generation is complex, costly and hard to implement. Due to the complexity of the hardware and software, the implementation cost, handset price, data price also affects, all these costs are higher, and which is not affordable to all consumers. To use 4th generation technology, we need to use 4G enabled handsets [7]. However, the consumers are increasing day by day and demand for the higher data rate is also increased, to fulfil the requirement new frequencies are to be used due to which the new components are needed to be used in cell towers which affects the cost.

## VIII. FIFTH GENERATION (5G)

5G systems are cell systems, in which the service region is partitioned into little geological zones called cells [8]. All 5G remote gadgets in a cell are associated with the Internet and phone arranged by radio waves through a nearby receiving wire in the cell. The fundamental preferred position of the new systems is that they will have more noteworthy transmission capacity, giving quicker download speeds, in the long run up to 10 Gbps. Due to the expanded transfer speed, it is normal that the new systems won't simply serve cell phones like existing cell systems, yet in addition be utilized as general web access suppliers for personal computers, contending with existing Internet Service Provider (ISPs), for example, digital web, and furthermore will make conceivable new applications in Internet of Things (IoT) and Machine - to -Machine (M2M) zones [9]. Current 4G cell phones won't have the option to utilize the new systems, which will require new 5G empowered remote gadgets. 5G uses Millimetre Wave (mmWave) for fastest data delivery, which is higher frequency that is from 30-300GHz. There are some features of 5G like it made innovation to accumulate all systems on one stage, High goals and bi-directional enormous data transfer capacity, increasingly successful and effective, effectively sensible with the past generation, Conceivable to give a uniform, continuous, and reliable network over the world. Like advantages there are some drawbacks of 5G. 5G innovation is still under procedure and research on its reasonability is going on [10]. The speed, this innovation is asserting appears to be hard to accomplish (in future, it may be). Hardware cost is more because the previous generation model is not compatible for 5G and need to replace the handset and obviously it is a costly deal. Creating a foundation for 5G needs significant expense. Security and protection issue yet to be unresolved.

We will see the comparison between all the generations with the different parameters. The comparison of all the generations with different parameters are shown in the above table, which is labeled as comparison of 1$^{st}$ generation to 5$^{th}$ generation.

 

| **Technology** | **1G** | **2G** | **3G** | **4G** | **5G** |
|---|---|---|---|---|---|
| **Year** | 1970/1984 | 1980/1999 | 1990/2002 | 2000/2010 | 2014/2015 |
| **Bandwidth** | 2Kbps | 14-64 Kbps | 2Mbps | 200Mbps | >1Gbps |
| **Standards** | AMPS | 2G: TDMA, CDMA, GSM 2.5G: GPRS, EDGE, 1xRTT | WCDMA, CDMA-2000 | Single Unified Standard | Single Unified Standard |
| **Technology** | Analog Cellular Technology | Digital Cellular Technology | Broadband CDMA, IP Technology | Unified Ip & seamless combination of broadband LAN/WAN/PAN & WLAN | Unified Ip & seamless combination of broadband LAN/WAN/ PAN, WLAN & wwww |
| **Service** | Mobile Telephony (Voice) | 2G: Digital voice, short messaging 2.5G: High capacity, packetized data | Integrated high-quality audio, video and data | Dynamic Information access, wearable devices | Dynamic Information access, wearable devices with AI capability |
| **Multiplexing** | FDMA | TDMA, CDMA | CDMA | CDMA | CDMA |

Table I: Comparison of 1st Generation to 5th Generation

## IX. FUTURE SCOPE

To join the satellite systems to make an accessible system position identifier, interactive media with internet network, administrations to the portable clients and climate data. At various geological areas exceptionally structured nano radio wires will be actualized. Fly sensors will be executed to give data to remote watched stations and to determine the issue of security and give the quick web at the accelerated to higher speed.

## X. CONCLUSION

In this paper we have summarized the overview of advancement of different wireless technologies and different generations that is 0G, 1G, 2G, 3G, 4G, 5G. This paper shows the advancement of wireless technology, and its systems, organization of required components, features precedence & downsides or drawbacks too. Among 5G gives a high information transfer rate. Advancement of Wireless innovation is the best aid to the media transmission area. Finally, I close remote innovation assists with supporting more grounded interfaces between individuals working in various fields making up and coming ideas of portable correspondence, web access, distributed computing and nanotechnology, IoT, M2M technology.

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