

# A Literature Review On: Wireless Technologies From 0G to 7G

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**Abstract-** *Wireless technology is evolving in all areas of mobile and wireless communications and it is one of the fastest growing sectors. In the last decade, there has been a huge increase in wireless technology. The evolution of wireless technology now a day has been reached at 7.5 Generation (G). This paper focus on the literature survey to discuss the most popular wireless technologies with their features of several generations which are being commonly consider as 0G,1G, 2G, 3G, 4G, 5G, 6G & 7G. We focus on the evolution and development of different generations of mobile wireless technology and their importance and benefits among others.*

**Indexed Terms-** *Mobile technology, Wireless technology, Generation, 7.5G.*

## I. INTRODUCTION

In recent years, mobile wireless communication systems have undergone significant changes. Mobile Wireless Generation (G) suggests adjusting to the concepts of framework, speed, technology, frequency, data capacity, delay, etc. Each generation has certain standards, different abilities, new techniques and new features that make them different from the past [1]. Wireless communication is the transfer of information over long distances without the use of wires that is wireless. Over the past few decades, mobile wireless technology has evolution from 0G to 4G. Advance implementation of 5G technology built on the development of the World Wide Web (www). Each generation has some standards, capabilities, techniques and new features that make them different from previous generations. Due to these new features, the number of mobile phone subscribers is increasing rapidly. Bell's laboratory with cellular systems was the result of the evolution of wireless communication in the 1960s-70s for the development of highly reliable, microscopic, solid state RF hardware [2].

## A. ZERO GENERATION (0G – 0.5G)

At 1940's, Pre-cell phone mobile telephony technology was introduced which is the first radio telephone service known as radio telephones. It was devised in cars to the public land-line supported telephone network & only voice Communication is possible. These mobile telephones were built up in cars or trucks. Military Communication was used by mobile radio telephones. In this radio telephony, large transmitter (Single) is placed on peak of a tall building and the channel (Single) used for transferring and getting the data. For Enabled transmission and disabled reception, user pushed a button to talk from one end to another end. This is known as push to talk or press to transmit (PTT) in 1950. Technology was used by CB-radio, taxis, police cars. Bell Systems launched a system in 1960 which is called Improved Mobile Telephone Service (IMTS). A few improvements like direct dialing and more bandwidth can be done. In the late 60s and early 70s the very first analog systems were based upon IMTS were formed which was used 23 channels from 150 MHz to 450 MHz [3].

## B. 1ST GENERATION TECHNOLOGY OR 1G

In 1974, the mobile communication system introduced the first generation or a new generation called 1G which was completed in 1984. At an earlier stage, it was developed primarily to communicate with mobile phones through a network of distributed transceivers. This generation is commonly referred to as the generation of wireless telecommunication technology that is popularly known as cell phones. The 1G mobile wireless communication systems is an analog frequency modulation system and the technology that forms the basis for this generation is NMT (Nordic Mobile Telephony), AMPS (Advanced Mobile Phone Service) and CDPD (Cellular Digital Packet Data) [4].

Table 1: Features of 1<sup>st</sup>Generation [2]

Generations	1G
Starts from	1970-84
Frequency	800-900 MHZ
Data capacity	2KBPS
Technology	Analog wireless
Standard	AMPS
Multiplexing	FDMA
switching	Circuit
Service	Voice only
Main network	PSTN
Hand off	Horizontal

The limitations that exist in the 1G generation are listed here:

- a) Low-capacity incredible handoff, bad voice links,
- b) The data has no security because it does not allow advance encryption methods resulting in the user's identification number being used to call another user,
- c) Global roaming services are not available,
- d) A single channel exists to carry data from source (caller) to destination (second caller) and as a result two callers cannot hear each other at the same time and
- e) Voice signals are not converted to digital signals. These disadvantages have led scientists and researchers to develop new communication generation system 2G which is described in the next section [4].

### C. 2<sup>ND</sup> GENERATION TECHNOLOGY OR 2G

It is based on GSM or in other words global system Mobile communication. It started in Finland Year 1991. It was the first digital cellular network; there were many obvious advantages over analog networks. They were flexible: improved sound quality, better Security etc. [5]. 2G technology has replaced analog technology with digital communication by providing services such as text messaging, picture messaging and MMS. All text messages are digitally encrypted in this technology. This digital encryption allows data to be transferred in a way that only the recipient can receive and read. 3 different types of 3G mobile

technology (FDMA, TDMA / GSM, and CDMA) are designed with different working methods, and features [6].

Table 2: Features of 2G, 2.5G and 2.75G [2]

Generations	2G	2.5	2.75
Starts from	1990	2000	2003
Frequency	850-1900 MHz(GSM) 825-849MHz(CDMA)	850-1900 MHz	850-1900 MHz
Data capacity	10KBPS	200 KBPS	473 KBPS
Technology	Digital wireless	GPRS	EDGE
Standard	CDMA TDMA GSM	Supported TDMA/ GSM	GSM CDMA
Multiplexing	TDMA CDMA	TDMA CDMA	TDMA CDMA
Switching	Circuit Packet	Packet	Packet
Service	Voice data	MMS internet	
Main network	PSTN	GSM TDMA	WCDMA
Hand off	Horizontal		

#### A. FDMA Technology:

It acts like a radio system by dividing the frequency into equal spectra and affecting the sound quality. FDMA is an analog system with 2G digital modules in a still limited area in 2G mobile technology. Instead of splitting the frequency now cellular based technology that does not have frequencies in geographical areas and improves service [6, 7].

#### B. GSM/TDMA Technology

It helps to establish international roaming. This enabled mobile customer to use their mobile phones based on digital signals in the world. GSM enables users to use Short Message Services (SMS) anytime on any mobile network. SMS is a simple and easy way to send a message to anyone except voice calls or conferencing. This technology is beneficial for both network operators and end users at the same time. Another use of this technology is the availability of international emergency numbers, which can be used by international users at any time without knowing the local emergency number [8].

#### C. CDMA Technology

With the help of code, CDMA works using the entire band. CDMA is based on a wide spectrum as many

calls were made identify each other based on unique code [6, 7].

- Features of CDMA based technologies:
  - a) CDMA gives a separate code to each phone,
  - b) Increase the frequency band space by assigning code in sequence,
  - c) Both senders and receivers are able to use a full band with the help of using their codes,
  - d) Contrast to one analog call, nearly dozen calls can be channelized at the same time [6].

**D. THIRDDGENERATIONTECHNOLOGY (3G–3.75G)**

The third generation of the mobile system provides 144 kbps and the highest high speed data transmission. It is having high-speed transmission, advanced multimedia and access and global roaming. 3G is used with mobile phones or handsets to connect the phone to the internet or other IP networks for making voice and video calls, downloading and uploading data and surfing the net. 3G will support multimedia applications like full-motion video, video conferencing and internet access. Data is sent through a technology which is called as packet switching. Voice call is interpreted by circuit switching. This is the most sophisticated form of communication in the last decade [8].

Table 3: Features of 3G. 3.5G and 3.75G [2]

Generations	3G	3.5	3.75
Starts from	2001	2003	2003
Frequency	1.6-2.5GHz	1.6-2.5GHz	1.6-2.5GHz
Data Capacity	384Kbps	2Mbps	30Mbps
Technology	Broad band /IP technology FDD TDD	GSM/ 3GPP	
Standard	CDMA/WCDMA/ UMTS/CDMA2000	HSDPA/HS UPA	1xEVDO
Multiplexing	CDMA	CDMA	CDMA
Switching	Circuit, Packet	Packet	Packet
Service	High speed voice/data/video	High speed voice/data/video	High speed internet/multimedia
Main network	Packet network	GSM TDMA	
Hand off	Horizontal	Horizontal	Horizontal

**E. FOURTH GENERATION TECHNOLOGY (4G)**

The fourth generation of mobile communications is expected to upgrade existing communication networks and provide a comprehensive and secure IP-based solution where features like voice, data and streaming multimedia will be provided to the user on "anytime, anywhere" basis and much higher data rates than previous generations [6]. The term MAGIC is used to explain the 4G technology, which means M for mobile multimedia, A for any time anywhere, G for global mobility support, I for integrated wireless solution for customized personal service. ITU-advanced features they should be able to provide 1 Gbps speed and at least 100 Mbps for low mobility for high mobility. Emerging 4G technologies such as WiMAX and LTE are stronger than Wi-Fi [9].

Table 4: Features of 4G [2]

Generations	4G
Starts from	2010
Frequency	2-8GHz
Data capacity	200Mbps-to- 1Gbps
Technology	LTE, Wi MAX
Standard	IP-broadband LAN/WAN/PAN
Multiplexing	MC-CDMA, OFAM
switching	Packet
Main network	Internet
Hand off	Horizontal &Vertical

**F. FIFTH GENERATION TECHNOLOGY (5G)**

5G technology has millimeter-wave technology that uses frequency in the release of the frequency spectrum. Also offers the possibility of more spectrum and much wider channel bandwidth with a frequency of 1 - 2 and above [10]. 5G is a new technology that will provide all possible applications using just one universal device and interconnecting with already existing communication basics. It will have software defined radio modulation schemes. In this technology terminals have to access different wireless technologies simultaneously which combine different streams of different technologies [7].

Table 5: Features of 5G [2]

Generations	5G
Starts from	2015
Data capacity	Higher than 1Gbps
Technology	IP v6
Standard	IP-broadband LAN/WAN/PAN&WWWW
Multiplexing	CDMA
Switching	All packet
Service	Dynamic Information access, wearable devices with AI Capabilities
Main network	Internet
Hand off	Horizontal & Vertical

Table 6: Comparison from 0G to 5G [14]

	1G	2G	3G	4G	5G
Period	1980 to 1990	1990 to 2000	2000 to 2010	2010 to 2020	2020 to 2030
Bandwidth	150/900 MHz	900MHz	100MHz	100MHz	1000x BW per unit area
Frequency	Analog signal (30 KHz)	Digital signal (1.8GHz)	1.6 to 2.0 GHz	2 to 8 GHz	3 to 300 GHz
Data rate	2 kbps	64 kbps	144 kbps to 2 Mbps	100 Mbps to 1Gbps	1Gbps <
Characteristic	First wireless communication	Digital communication	Digital broadband, increased speed	High speed, all IP	
Technology	Analog cellular	Digital cellular (GSM)	CDMA, UMTS, EDGE	LTE, Wi-Fi	WWW

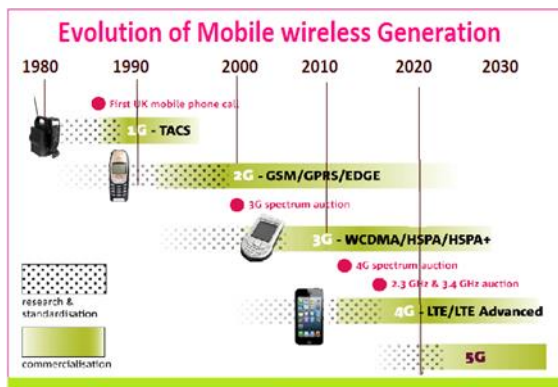


Figure 1: Evolution of mobile wireless generation

Figure 1 shows that the evolution of mobile wireless generation with respective decade of years. It also shows that how communication technologies changed as per hardware part is changed.

G. SIXTH GENERATION (6G)

The sixth-generation technology uses the latest combination of radio and fiber optics technology. We deliver through the lens so we don't have to rely on copper cables or bases. The 6G mobile system will integrate 5G wireless mobile systems and satellite networks for global coverage. Telecommunications satellite is used for voice, data, internet and video transmission. Earth imaging satellite network is for the collection of weather and environmental information and the Navigational Satellite Network for Global Positioning System (GPS) [6, 11]. It is believed that 6G will make the speed of 1GB data more beneficial transfers which can integrate 6G mobile communication networks, 5G for satellite communication network and global coverage [12]. There are four different countries developing these satellite systems- GPS by USA, Compass system developed by China, Galileo system developed by EU and GLONASS system developed by Russia. Handoff and roaming in 6G will be a big problem as these satellite systems are different networks. 6G has four different standards namely Pico cell, micro cell, macro cell, satellite cell. So, these four networks must have handoffs and roaming but how that will happen is not yet answered [13].

H. SEVENTH GENERATION TECHNOLOGY (7G)

7G will be the most advanced generation in mobile communication network. It is similar to 6G for global coverage but it will also define satellite functions for mobile communications. But 7G will do some research on things like the need to use mobile phones when moving from one country to another, as satellites are also constantly orbiting at specific speeds and specific orbits, from cellular to satellite system standards and protocols and from satellite-to-satellite communication systems. The dream of 7G can only come true when all the standards and protocols are defined. Maybe in the next generation this is possible after 7G and named as 7.5G. Another way is to broadcast HD video live to gather news. This may be the best price solution for the lower-level user [7].

Generation 7.5 provides high speed of peak download and peak upload of data rate. In this space time block codes are used to see the high definition of video transmission. We can download five movies with 20 GB files in one second and upload 1 GB files or any data. It therefore navigates to satellite network techniques using the OFDM method and FEC to speed up the communication process. This is a possible technique while achieving high bandwidth and improves satellite cell sensitivity with its signal reliability. Although the benefits of 7.5G are in the middle of the ocean, they can easily communicate with others [6].

### CONCLUSION

The world of wireless telecommunications is evolving rapidly. The wireless industry has seen unprecedented growth in the last few years. Different generations are the result of current development. In this paper we review the various generations & features of mobile wireless technology. The first generation (1G) has completed basic mobile voice, whereas the second generation (2G) has introduced capabilities and coverage. This is followed by the third generation (3G), which is literally trying to get data faster to open the gates for the "mobile broadband" experience, which the next fourth generation (4G) will realize. The 5G mobile network will focus on the development of the user's terminal which has to access different wireless technologies simultaneously. Satellite Network 6G Mobile Communication System will be used thereafter. The cost of mobile calls in 6G will be relatively high but in 7G this problem will be rectified and the cost of calls will be reduced and it will benefit the lower-level user.

### FUTURE SCOPES

The main aim of 7.5 G is to provide the very high speed of peak download and peak upload of data rate. In this space time block codes are used to view the high definition of video broadcasting. Within a second we can download 20 GB files and upload the 15 GB files easily. It also navigates the satellite networks techniques, hence using the OFDM (Orthogonal Frequency Division Multiplexing) methodology and FEC (Forward error correction) for the speed of communication process. It is possible only when we

achieve the higher bandwidth and improves the satellite cell sensitivity. The benefits of 7.5 G can easily communicate to the other even they are in the center of the sea.

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