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Future Prospects of Wireless Generations in Mobile Communication

Jasmeen Gill and Shaminder Singh
Assistant Professor, RIMT-IET, Mandi Gobindgarh, India
Assistant Professor, GGI, Khanna,India
E-mail: er.jasmeengill@gmail.com, er_shaminder@yahoo.co.in

Abstract **- In today's world, wireless mobile communication plays a vital role in information exchange which demands high speed data transfers, users' fast access to data, secure and reliable network protocols that too at low costs. Moreover, the ability to connect instantly and anywhere, made them more popular and successful. However, wireless is not a recent technology. Several wireless technologies are available with their own advantages and disadvantages. This research article presents a review of several generations which are being used viz. 0G, 1G, 2G, 3G, 4G and 5G, along with the future generations which are under research like 6G, 7G and 7.5G.**
Keywords:**Wireless Technology; Mobile Technology; 0G; 1G; 2G; 3G; 4G; 5G; 6G; 7G.**

I. INTRODUCTION

Wireless Technology helps in transferring information over a distance without the use of wires. The distance can be short or it can be of thousands of kilometers. A new subscriber signs up after every 2.5 seconds [3].With the increasing demands in the field of mobile and data communications, the sole aim is to connect users as fast as possible. In this paper the birth of different generations of mobile wireless technology with their advantages and significance are presented. In past few years, mobile wireless communication has experienced different generations of technology mainly from 0G to 4G. A snapshot of future technologies such as 5G, 6G and 7G has also been shown providing immense scope for innovative research and development [2].

II. ZERO GENERATION (0G – 0.5G)

Wireless telephone started with what you might call 0G if you remember back that far. In those pre-cell days, you had a mobile operator to set up the calls and there were only a handful of channels available. 0G refers to pre-cell phone mobile telephony technology, such as radio telephones that some had in cars before the advent of cell phones. Mobile radio telephone systems preceded were the predecessors of the first generation of cellular telephones; these systems are called 0G (zero generation) systems. These early mobile telephone systems can be distinguished from earlier closed radiotelephone systems in that they were available as a commercial service that was part of the public switched telephone network, with their own telephone numbers, rather than part of a closed network such as a police radio or taxi dispatch system. These mobile telephones were usually mounted in cars or trucks, though briefcase models were also made [10].

III. FIRST GENERATION (1G)

The first generation of cellular systems used analog radio technology. Analog cellular systems consist of three basic elements: a mobile telephone (mobile radio), cell sites, and a mobile switching center (MSC). A mobile telephone communicates by radio signals to the cell site within a radio coverage area. The cell site s base station (BS) converts these radio signals for transfer to the MSC via wired (landline) or wireless (microwave) communications links. The MSC routes the call to another mobile telephone in the system or the appropriate landline facility. These three elements are integrated to form a ubiquitous coverage radio system that can connect to the public switched telephone network (PSTN). It support speed up to 2.4kbps. Major contributors were AMPS (Advance mobile phone system) was first launched by the US, NMT, and TACS [1].

IV. SECOND GENERATION (2G)

It is based on GSM or in other words global system for mobile communication. It was launched in Finland in the year 1991. It was the first digital cellular networks, which had a number of obvious benefits over the analog networks they were supplanting: improved sound quality, better security, etc. [1]. 2G technologies have replaced the analogy technology by digital communication by providing services such as text message, picture message and MMS. All text messages are digitally encrypted in 2G technology. This digital encryption allows for the transfer of data in such a way that only the intended receiver can receive and read it. There are 3 different types (FDMA, TDMA/GSM, and CDMA) of 2G mobile technologies are designed with different working methods, properties and specifications [11].

A. FDMA Technology

It works like a radio system by separating the frequency into equal spectrum but affecting the quality of voice. FDMA is an analog system still exists in 2G mobile technology with the digital module of 2G in limited area. Instead of frequency division now cellular based technology which divide geographical areas not frequency and improve the service [11]. There are some features of FDMA based technologies:

a) This technology is first used in 1G mobile as an analog system, introduced in 2G with the increase in its frequency with the help of cellular technology.
b) Able to carry digital transmission but digital transmission is not quality wise as good as in case of analog system.
c) Facilitate with the feature of analogue system by enabling the accessibility of call [13].

B. GSM/TDMA Technology

It was the first one to help establish international roaming. This enabled the mobile subscribers to use their mobile phone a connection in many different countries of the worlds is based on digital signals. GSM has enabled the users to make use of the short message services (SMS) to any mobile network at any time. SMS is a cheap and easy way to send a message to anyone, other than the voice call or conference. This technology is beneficial to both the network operators and the ultimate users at the same time. Another use of this technology is the availability of international emergency numbers, which can be used by international users anytime without having to know the local emergency numbers [1]. There are some features of GSM/TDMA based technologies:

- On 2G platform, digitals systems are designed for low power consumption and this makes the handset and equipment less expensive.
- Digital signals are considered environment friendly.
- The use of digital data service assists mobile network operators to introduce short message service over the cellular phones.
- Digital encryption has provided secrecy and safety to the data and voice calls.
- Since it uses digital multiplexing, more calls can be accommodated into same amount of bandwidth.

C. CDMA Technology

CDMA works using the entire band with the help of code. CDMA is based on a wide spectrum as many calls laid over each other identifying on the basis of unique code [11].There are some features of CDMA based technologies:

a) CDMA gives a separate code to a separate 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 [13].

V. THIRD GENERATION (3G)

The third generation of mobile systems provides high-speed data transmissions of 144kbps and higher. It comes with enhancements over previous wireless technologies, like high-speed transmission, advanced multimedia access and global roaming. 3G is mostly used with mobile phones and handsets as a means to connect the phone to the Internet or other IP networks in order to make voice and video calls, to download and upload data and to surf the net. 3G will support multimedia applications such as full-motion video, video conferencing and Internet access. The data are sent through the technology called Packet Switching .Voice calls are interpreted through Circuit Switching. It is a highly sophisticated form of communication that has come up in the last decade [1]. The following are the key features of 3G technologies:

- Several times higher data speed.
- Multiple mobile applications and clarity of digital signals.
- Enhanced audio and video streaming;
- Video-conferencing support;
- Web and WAP browsing at higher speeds;
- IPTV (TV through the Internet) support.

TABLE I COMPARISON OF 3G WITH 1G AND 2G

Parameters	Technologies		
	1G	2G	3G
Data Capacity	2.4 Kbps	10 Kbps	144 Kbps or Higher
Technology	Analog Wireless	Digital Wireless	Broad-band/IP
Standard	AMPS	CDMA,FDMA,TDMA	CDMA, WCDMA, UMTS
Multiplexing	FDMA	TDMA, CDMA	CDMA
Switching	Circuit	Circuit	Packet, Circuit
Service	Voice Only	Voice and Data	High Speed Data, Voice, And Video
Network Type		PSTN	Packet
Frequency	800-900 MHz	950-1950 MHz	1.6-2.5 GHz

VI. FOURTH GENERATION (4G)

The Fourth Generation of mobile communication upgrade existing communication networks and is expected to provide a comprehensive and secure IP based solution where facilities such as voice, data and streamed multimedia will be provided to users on an "Anytime, Anywhere" basis and at much higher data rates compared to previous generations[1]. The term MAGIC is used to explain the 4G technology, which means

M = mobile multimedia
A = any time any where
G = global mobility support
I = integrated wireless solution
C = customized personal service

ITU-Advanced specifications state that it should be able to provide 1Gbps speed for low mobility and at least 100Mbps for high mobility. The emergent 4G technologies such as WiMAX and LTE are stronger as compared to Wi-Fi [5].

A. Long Term Evolution(LTE)

LTE stands for “Long Term Evolution”. It was developed by a telecommunication body known as Third Group Partnership Project (3GPP) in the year 2004.SAE(System Architecture Evolution) is the corresponding evolution of the GPRS/3G packet core network evolution . The word LTE includes both LTE and SAE technology .4G is aimed to provide high date rate, adjustable bandwidth and low latency [6].

Data Speed of LTE is

Peak Download =100 MBit/s,
Peak Upload =50 MBit/s

B.Mobile WiMAX(IEEE 802.16e)

The Mobile WiMAX (IEEE 802.16e) mobile wireless broadband access (MWBA)standard (also known as WiBro in South Korea) is sometimes branded 4G, and offers peak data rates of 128 MBit/s downlink and 56 MBit/s uplink over 20 MHz wide channels. Data Speed of WiMAX

Peak Download 128 MBit/s
Peak Upload 56 MBit/s

Applications such as wireless broadband access, Multimedia Messaging Service (MMS), video chat, mobile TV, HDTV content and Digital Video Broadcasting (DVB) are being developed to use a 4G network [1]. 4G is a research item for next-generation wide-area cellular radio and having features like

- 4G is a conceptual framework and a discussion point to address future needs of a high speed wireless network.
- These offer both cellular and broadband multimedia services.
- Theoretically, 4G is set to deliver 100Mbps to a roaming mobile device globally, and up to 1Gbps to a stationary device.
- 4G will bring almost perfect real world wireless or called ―WWWW: World Wide Wireless Web.

So 4G provides the wonderful features to the users but also has some challenges like [2]:

Security: The first step in analyzing cellular wireless security is to identify the security objectives. The goals that the security policy and corresponding technology should achieve are to ensure that information generated by or relating to a user is adequately protected against misuse or misappropriation. It is to be ensured that the level of protection afforded to users and providers of services is considered to be better than that provided in contemporary fixed and mobile networks.

Hand off Delay: Handoff delay poses another important QoS-related issue in 4G wireless networks. During the handoff process, the user may experience a significant drop in QoS that will affect the performance of both upper-layer protocols and applications. Deploying a priority-based algorithm and using location-aware adaptive applications can reduce both handoff delay and QoS variability.

4G supportive devices showing less Battery Backup: In 4G supportive Devices due to presence of large number of Transmitters & Receivers, the battery of the device runs off quite quickly. With technological developments the devices are getting smaller in size due to Large Scale Integration and micro architecture. Hence in 4G devices if we want to enhance the battery life by designing a much powerful Li-on Battery ,then the backup would increase no doubt but also the size o the device would increase i.e. not highly recommended.

VII. FIFTH GENERATION (5G)

In 5G, researches are related to the development of World Wide Wireless Web (WWWW), Dynamic adhoc Wireless Networks (DAWN) and Real Wireless Communication. The most important technologies for 5G technologies are 802.11 Wireless Local Area Networks (WLAN) and 802.16 Wireless Metropolitan Area Networks (WMAN), Ad-hoc Wireless Personal Area Network (WPAN) and Wireless networks for digital Communication [4]. Some features of 5G Technology are given below:

- 5G is a completed wireless communication with almost no limitation; somehow people called it REAL wireless world
- Additional features such as Multimedia Newspapers, also to watch T.V programs with the clarity as to that of an HD T.V.
- We can send Data much faster than that of the previous generations.

- 5G will bring almost perfect real world wireless or called “WWWW: World Wide Wireless Web
- Wearable devices with AI capabilities.
- Internet protocol version 6 (IPv6), where a visiting care-of mobile IP address is assigned according to location and the connected network.

TABLE II COMPARISON BETWEEN 4G AND 5G

Parameters	Technologies	
	4G	5G
Data Bandwidth	2Mbps to 1Gbps	1Gbps and higher as per need
Frequency Band	2 to 8 GHz	3 to 300 GHz
Standards	Al access convergence including OFDMA,MC-CDMA, network-LMPS	CDMA and BDMA
Technologies	Integration of broadband LAN/WAN/PAN and WLAN	Integration of broadband LAN/WAN/PAN/ WLAN and advanced technologies based on OFDM modulation
Service	Dynamic information access, wearable devices, HD streaming, global roaming	Dynamic information access, wearable devices, HD streaming, any demand of users
Multiple Access	CDMA	CDMA,BDMA
Core network	All IP network	Flatter IP network
Initiation from	year-2010	year-2015

The 5G technologies are viewed to provide following applications [1].

- It will be able to charge your mobile using your own heartbeat.
- It will perceive your grandmother sugar level with your mobile.
- It will know the exact time of your child birth that too in nano seconds.

VIII. SIXTH GENERATION (6G)

Sixth Generation technologies use a combination of the latest in radio and fiber optics technology. We deliver through via line of sight which means we don’t have to rely on the copper cable or base. The 6G mobile system for the global coverage will integrate 5G wireless mobile system and satellite network. The telecommunication satellite is used for voice, data, internet, and video broadcasting; the earth imaging satellite networks is for weather and environmental information collection; and the navigational satellite network is for global positional system (GPS) [8].

It is assumed that 6G will proffer the speed of 1GB data transfer. 6G mobile communication networks can integrate satellite communication networks and 5G to make global coverage [2]. The four different countries which developed these satellite systems are; the GPS by USA, the COMPASS system developed by China, the Galileo system developed by EU and the GLONASS system by Russia. Handoff and roaming will be the big issues in 6G because these satellite systems are different networks. 6G has four different standards namely Pico cell, Micro cell, Macro cell, satellite cell. So the handoff and roaming must take place between these four networks but how it will occur is still to be to be answered [8].

IX. SEVENTH GENERATION (7G)

These mobile networks are like the 6G for global coverage but it will also define the satellite functions for mobile communication. In satellite system, the telecommunication satellite will be for voice and multimedia communication; navigational satellite will be for global positional system (GPS) and earth image satellite for some extra information like weather update. The 6G mobile wireless networks will

support local voice coverage and other services. The 7G will be the most advance generation in mobile communication but there will be some research on demanding issues like the use of mobile phone during moving condition from one country to another country, because satellite is also moving in constant speed and in specific orbit, the standards and protocols for cellular to satellite system and for satellite to satellite communication system. The dream of 7G can only be true when all standards and protocols are defined. The major factor here will be cost of phone call and other services. It provides seamless movement of mobile phone from one country to the other. This will be major benefits for frequent international travelers [7].

Generation 7.5: It provides the very high speed of peak download and peak upload of data rate. Here space time block codes are used to view the high definition of video broadcasting. Within a second we can download the five films that are 20 GB files and upload the 15 GB files or any datum. Therefore it also navigates the satellite networks techniques, hence using the OFDM methodology and FEC for the speed of communication process. It is possible technique only when achieve the higher bandwidth and improves the satellite cell sensitivity with its signal fidelity. The benefits of 7.5 G can easily communicate to the other even they are in the centre of the sea [1].

X.CONCLUSION

In this paper we have discussed the existing (0G-4G) and future (5G -7.5G) wireless mobile communication generations. The first generation (1G) has fulfilled the basic mobile voice, while the second generation (2G) has introduced capacity and coverage. This is followed by the third generation (3G), which has quest for data at higher speeds to open the gates for truly "mobile broadband" experience. Moreover, the demanding requirements in terms of QoS, were realized by the fourth generation (4G). The 5G mobile networks will focus on the development of the user terminal where we can watch an HD TV channel in our mobile phones without any disturbance. 5G technology offers high resolution for passionate mobile phone consumer. Satellite network will be used from 6G mobile communication systems and onwards. In 6G the cost of mobile call will be relatively high but in 7G this problem will be improved and the cost of call will be reduced which will benefit the low level user. The authors hope that this study besides helping people in their research, will also promote future concepts of mobile communication and internet services.

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