

A Review of Wireless Mobile Technology

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Abstract: *Wireless mobile technology is developing very fast speed with advanced techniques. It is developing extremely fast in present times and deals with all the fields of mobile and wireless communications. It is an emerging technology in all the fields of mobile communication such as internet access, location based services, video conferencing system, mobile financial services, mobile entertainment services etc. The users can use these applications at anytime and anywhere through mobile communication. Wireless communication is the transfer of information over a distance without the use of "wires". The distances involved may be short or long. In the past few decades; mobile wireless technologies have experience 4 or 5 generations of technology revolution and evolution, namely from 0G to 4G. Current research in mobile wireless technology concentrates on advance implementation of 4G technology and 5G technology. In this paper I shall throw light on the evolution and development of various generations of mobile wireless technology along with their significance and advantages of one over the other.*

Keyword: 1G, 2G, 3G, 4G (LTE), 5G

1. Introduction

Wireless Communication is the process of transmitting radio waves or micro waves over a distance between the two points without any physical wire attachment. It encompasses various types of devices such as Bluetooth, remote control, Hand-held walkie-talkies, personal digital assistant, wireless computer mice and so on.

Mobile wireless industry was started its technology creation, revolution and evolution since early 1970s. Zero Generation, First Generation, Second Generation, Third Generation, Fourth Generation and Fifth Generation are comes under wireless mobile network. 0G is also known as Mobile Radio Telephone system this system was analog in nature i.e. analog signals were used as carriers. Generally Mobile Radio Telephone system provides half duplex communications. The First Generation was referred as cellular and which was later abbreviated to "cell".

Cell phone signals were analog in nature. 1G device was comparatively less heavy and expensive. (2G) Second Generation mobile phones used GSM (Global System for Mobile) technology that uses digital modulation and it improves voice quality with limited data service. (3G) Third Generation allowed mobile telephone customers to use voice, graphics and video applications. (4G) Fourth Generation is for cell phones or/and hand held devices. (5G) Fifth generation wireless 5G development is based upon 4G, which at present is struggling to meet its performance goals. Most important advantages of 5G network is providing myriads of services to end users.

COMPARISON OF 1G, 2G, 3G, 4G, 5G

COMPARISON OF ALL GENERATIONS OF MOBILE TECHNOLOGIES (1G-5G)

Generation	1G	2G	2.5G	3G	3.5G	4G	5G
Start	1970-1980	1990-2000	2001-2004	2004-2005	2006-2010	2011-Present	Soon (2020)
Data Rate	2 Kbps	64 Kbps	144 Kbps	2 Mbps	More than 2 Mbps	1 Gbps	more than 1 Gbps
Technology	Analog Cellular	Digital Cellular	GPRS, EDGE, CDMA	CDMA 2000 (1xEV, EVDO), UMTS, EDGE	EDGE, Wi-Fi	WiMax, LTE, Wi-Fi	www
Service	Voice	Digital Voice, SMS, Higher Capacity, Packet Size Data	SMS, MMS	Integrated High Quality Audio, Video & Data	Integrated High Quality Audio, Video & Data	Dynamic Information access, Wearable Devices	Dynamic Information access, Wearable Devices with AI Capabilities
Multiplexing	FDMA	TDMA, CDMA	CDMA	CDMA	CDMA	CDMA	CDMA
Switching	Circuit	Circuit, Packet	Packet	Packet	All Packet	All Packet	All Packet
Core Network	PSTN	PSTN	PSTN	Packet N/W	Internet	Internet	Internet
Handoff	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal & Vertical	Horizontal & Vertical

Figure 1: Comparison of All Generations

The First Generation (1G) mobile phone networks uses analog signals to transmit the voice calls only between the two transmitters. Second Generation (2G) mobile network is the next stage in the development of wireless technology to overcome the limitations of 1G by primarily focusing on transmission of voice and data with digital signals. Third Generation (3G) was arrived because of low speed and incompatible technologies used on previous generations. The main features of 3G is that it allows higher data transmission rates and increased capacity for traditional voice call and high speed data applications such as Global Roaming, internet, mobile, video conferencing, video calls and 3D gaming. 4G is known as beyond 3G, stands as an acronym for fourth generation communication system which describes the next step in wireless communication. 4G is called as MAGIC because the users can use the mobile multimedia at anytime anywhere with global mobility support on integrated wireless solution and customized personal service at higher data rates than previous generations. Fifth Generation (5G) is a packet switched wireless mobile communication system with extensive area coverage and high through put. Hence it is called as Real World Wireless or wireless World Wide Web (WWW)[7].

2. 0G Wireless mobile technology

0G (Zero Generation) is also known as Mobile Radio Telephone system. As this generation was invented prior to cellular system it was mentioned as pre cellular system. This system was analog in nature i.e. analog signals were used as carriers. Generally Mobile Radio Telephone system provides half duplex communications i.e. only one person will speak and other should hear. Mobile Radio Telephone system (Zero generation) consists of various technologies such as Advanced Mobile Telephone System (AMTS), Mobile Telephone System (MTS), MTD (Mobile telephony system D), OLT (Offentlig Landmobile Telefoni or Public Land Mobile Telephony), Push to Talk (PTT) and Improved Mobile Telephone Service (IMTS).



Figure 1: A mobile radio telephone [8].

These mobile telephones were placed in vehicles (truck, cars etc). The mobile telephone instrument had two main parts those were transceiver (transmitter – receiver) and head (instrument which had display and dial keys). Transceiver (transmitter – receiver) was fixed in the vehicle trunk; head was fixed near the driver seat and both head and transceiver were connected to each other with wire. The device (telephone) would connect to local telephone network only if it is in the range of 20 Kms. Each city had a central antenna tower with 25 channels. This means that mobile transceiver should have a powerful transmitter with a transmitting range of 50-70 Kms. Only few people were able to use this device as only 25 channels were available. Roaming facility was not supported in this generation of analog cellular Mobile Radio telephone system. Mobile Radio telephone system was a commercial service under public switched telephone network with unique telephone numbers. Zero generation had seen different variants of two way radio telephones. Large number of limitations in this generation led to the advent of new generation [2].

3. 1G Wireless mobile technology

The First generation of wireless telecommunication technology is known as 1G was introduced in 1980. The main difference between then existing systems and 1G was invent of cellular technology and hence it is also known as First generation of analog cellular telephone. In 1G or First generation of wireless telecommunication technology the network contains many cells (Land area was divided into small sectors, each sector is known as cell, a cell is covered by a radio network with one transceiver) and so same frequency can be reused many times which results in great spectrum usage and thus increased the system capacity i.e. large number of users could be accommodated easily.

Use of cellular system in 1G or First generation of wireless telecommunication technology resulted in great spectrum usage. The First generation of wireless telecommunication technology used analog transmission techniques which were basically used for transmitting voice signals. 1G or first generation of wireless telecommunication technology also consist of various standards among which most popular were Advance Mobile Phone Service (AMPS), Nordic Mobile Telephone (NMT), Total Access Communication System (TACS). All of the standards in 1G use frequency modulation techniques for voice signals and all the handover decisions were taken at the Base Stations (BS). The spectrum within cell was divided into number of channels and every call is allotted a dedicated pair of channels. Data transmission between the wire part of connection and PSTN

(Packet Switched Telephone Network) was done using packet-switched network.

Use of Analog signals for data (in this case voice) transmission led to many problems those are:

1. Analog Signals does not allow advance encryption methods hence there is no security of data i.e. anybody could listen to the conversation easily by simple techniques. The user identification number could be stolen easily and which could be used to make any call and the user whose identification number was stolen had to pay the call charges. 2. Analog signals can easily be affected by interference and the call quality decreases.

4. 2G Wireless mobile technology

2G (Second Generation) System of wireless systems is based on digital system. 2G was started at 1980's and completed at 1990's which were mainly for voice transmission with digital signals and the speed up to 64 kbps. When compared to 1G, 2G was step ahead by providing services such as short message services, picture message services and Multi Media Message services (MMS). It provides a facility of SMS (Short Message Service). 2G mobiles used GSM technology in 1990s. It provides a good voice quality but limited data services. 2G also offered some additional services like faxes, text message and voice mail. It uses GPRS (General Packet Radio Services) which delivers packet switched data to existing GSM network.

GSM provides many more services than original network as following:

- 1) GSM (Global System For Mobile Communication):- 2G(GSM) network is capable of providing all the services such as data service and speech. GSM network is extension of fixed telephone network.
- 2) GSM AND VAS (Value Added Services): - This is advancement in GSM technology which is combination of two platforms. VMS (Voice Mail System) +SMSC (Short Message Service Centre).
- 3) GSM AND GPRS (General Packet Radio Services): - This enables the air interface for sending the data. This enables wireless access to the internet. The bit rate is reaching up to 150kbps in optimum conditions.
- 4) GSM ND EDGE (Enhanced Data Rate for Global Evolution): - Under this technology, increase in data rate up to 384kbps. EDGE is superset of GPRS and function in any network with GPRS.

Limitations of 2G

- 1) Strong digital signals are required to make the mobile phones work.
- 2) Digital signals would be weak if there is no proper network coverage in the specified area.
- 3) Difficult to handle complex data such as video etc.

5. 3G Wireless mobile technology

The third generation mobile technology is based on wide band wireless network and fulfilling the International Mobile Telecommunications 2000 (IMT-2000)

specifications. 3G Mobile Communication System was introduced in the year 2000. The speed of 3G technology is from 125Kbps-2Mbps. 3G uses packet-switching technology systems, but it requires a changed infrastructure to the 2G systems. Because of greater data rate and bandwidth 3G mobile phones offers multimedia applications and mobile internet access[1]. 3G offering faster data transfer rates and are the first to enable video calls. This makes them especially suitable for use in modern smartphones, which require constant high-speed internet connection for many of their applications. 3G delivers more new features such as Web browsing, e-mail, TV streaming, video conferencing, paging, 11sec-1.5min time to download a 3min Mp3 song, fax and navigational maps.

Limitations of 3G are

- Requires higher bandwidth.
- Cost for the 3G mobile phone is high.
- Size of the phone is large.
- Difficult to build the infrastructure for 3G.
- The amount is high for 3G Licenses Services.

6. 4G Wireless mobile technology

4G denotes the fourth generation of mobile communication system which was introduced in the year 2010. It is a successor of the 3G and provides ultra-broadband internet access for mobile devices. The high data transfer rates make 4G networks suitable for use in USB wireless modems for laptops and even home internet access[6].

The fourth generation (4G) is a conceptual framework and provides high speed wireless network that can transmit multimedia, data. 4G can support 100 Mbps peak rates in full-mobility wide area coverage and 1Gbps in low-mobility local area coverage [3, 4]. 4G is the IP-based mobile system that provides access through a collection of radio interfaces. It has the capability to provide speed of 100 Mbps – 1Gbps and has high QoS (Quality of service) and security[4]. The significant features of 4G technology are video conferencing, location based services, tele-medicine, high security, speed, capacity and low cost per bit. The term MAGIC used for 4G that indicates in 4G as M= mobile multimedia A= any time any where G= global mobility support I= integrated wireless solution C= customized personal service[5].

A 4G system must provide capabilities defined by ITU in IMT Advanced. In March 2008, the International Telecommunications Union-Radio communications sector (ITU-R) specified a set of requirements for 4G standards, named the International Mobile

Telecommunications Advanced (IMT-Advanced) specification, setting peak speed requirements for 4G service at 100 megabits per second (Mbit/s) for high mobility communication (such as from trains and cars) and 1 gigabit per second (Gbit/s) for low mobility communication (such as pedestrians and stationary users)[8]. LTE (Long Term Evolution) and Wi-MAX (Worldwide Interoperability for Microwave Access) technologies are used for fourth generation.

Long-Term Evolution (LTE) is a standard for high-speed wireless communication for mobile phones and data terminals. It is based on the GSM/EDGE and UMTS/HSPA network technologies, increasing the capacity and speed using a different radio interface together with core network improvements[8].

WiMAX (Worldwide Interoperability for Microwave Access) is a family of wireless communication standards based on the IEEE 802.16 set of standards, which provide multiple physical layer (PHY) and Media Access Control (MAC) options. HTC announced the first WiMAX enabled mobile phone, the Max 4G, on November 12, 2008. The device was only available to certain markets in Russia on the Yota network[8].

There are few limitations in 4G:

- The usage of battery in 4G mobile phone is more.
- Implementation of hardware is difficult.
- Complicated hardware less mobile technology.

7. 5G Wireless Mobile Technology

Fifth generation is a upcoming technology. Some sources suggest that 5G technology will come approximately in 2020. 5G has speeds beyond what the current 4G can offer. The 5G is called as Real world wireless or www (worldwide wireless web) because it does not require limitations. 5th generation mobile networks or 5th generation wireless systems, abbreviated 5G, are the proposed next telecommunications standards beyond the current 4G/IMT-Advanced standards. Rather than faster peak Internet connection speeds, 5G planning aims at higher capacity than current 4G, allowing higher number of mobile broadband users per area unit, and allowing consumption of higher or unlimited data quantities in gigabyte per month and user. This would make it feasible for a large portion of the population to stream high-definition media many hours per day with their mobile devices, when out of reach of wifi hotspots[8]

5G research and development also aims at improved support of machine to machine communication, also known as the Internet of things, aiming at lower cost, lower battery consumption and lower latency than 4G equipment [8]

The 5G terminals will have software defined radios and modulation schemes and new error-control schemes which can be downloaded from the Internet. The development is towards the user terminals as a focus of the 5G mobile networks. The terminals will have access to different wireless technologies at the same time as well as the terminal will be able to combine different flows from different technologies. In 5G, all networks will be responsible for handling user-mobility [9], while the terminal will make the final choice among different wireless or mobile access network providers for a given service. Such choice will be based on open intelligent middleware in the mobile phone.

There is currently no standard for 5G deployments. The Next Generation Mobile Networks Alliance defines the following requirements that a 5G standard should fulfill[8].

- Data rates of tens of megabits per second for tens of thousands of users.
- Data rates of 100 megabits per second for metropolitan areas
- 1 Gb per second simultaneously to many workers on the same office floor
- Several hundreds of thousands of simultaneous connections for massive wireless sensor network
- Spectral efficiency significantly enhanced compared to 4G
- Coverage improved
- Signalling efficiency enhanced
- 1ms Latency
- Latency reduced significantly compared to LTE.



Figure: All Generations Mobiles

8. Conclusion

During this paper, we examine that mobiles have become very essential part of our everyday life; performance of the earlier wireless communication systems. In this paper we reviewed the various generations of mobile wireless technology, their portals, performance, advantages and disadvantages of one generation over other. In this review paper, it was discovered that some problems are still unable to solve such as unending problems of communications with poor coverage, bad interconnectivity and poor quality of service. The advent of 5G will change the field of communication domain, bringing wireless experience to a completely new level. It will provide wealth of features. The mobile terminals of the 5G have more processing power and more memory on board. It is expected that the initial Internet idea of keeping the network simple as possible as well as giving more functionalities to the end nodes. It will become a reality in the fifth generation

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