

# Future Generations of Mobile Communication Networks

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## Abstract:

The journey of development in mobile wireless communication is spread over few decades. This advancement in mobile communication consists of few generations and is still going on. In this paper we will present the study of several generations which are being used 1G, 2G, 3G, and 4G, and try to find some future generations which are under research like 5G, 6G, and 7G. The main propose of this study is to find the future picture of mobile communication.

**Keywords;** 1G,2G,3G,4G,5G,6G,7G, TDMA,CDMA,GSM.

**Paper type:** Research Paper

## Introduction

The growth in telecommunication industry is very sharp during last little decades. The main contribution in this growth of industry is wireless mobile communication industry. The growth of this industry has experienced several generations. These generations are 1G, 2G, 3G, and 4G. Each generation have some standards, capacities, techniques and new features which differentiate it from previous generations. Due to these new features, the number of mobile phone subscribers is increasing day by day.

The concept of cellular telephony was developed in AT&T's Bell labs in 1970s. The 1<sup>st</sup> commercial mobile was developed in Scandinavian country in 1981 with the name of Nordic mobile telephone (NMT) networks [1]. The first mobile communication trial was placed in Chicago in 1978. After that, this launch occurred in Chicago in 1983 commercially. Meanwhile, other parts of the world were making progress in mobile communication. In 1979 the mobile phone system was introduced in Japan. The European countries were also very active in mobile

communication; the first mobile system was launched in 1981 in Sweden, Norway, Denmark and Finland [2].

After this the development of generations for mobile wireless communication takes its start. Total numbers of mobile wireless communication generations which are being experienced are four.

## Literature Review

In literature review we will discuss mobile communication generations from 1G to 4G.

## 1G Mobile communication system

The 1G first generation mobile wireless communication system was analog system, which was based on a technology known as Advance Mobile Phone Service (AMPS). The AMPS system was frequency modulation radio system using frequency division multiple access (FDMA) with channel capacity of 30 KHz and frequency band was 824-894 MHz [3]. In 1988 10MHz additional bandwidth was allocated to AMPS which was developed in Chicago, with coverage area of 2100 square miles [4]. The first generation has some specifications which are as following.

Generatio n	Starts from	Data capacit y	Technolog y	Stander	Multiplexi ng	Switchin g	Servic e	Main networ k	Hand off	frequenc y
1G	1970- 84	2kbps	Analog wireless	AMPS	FDMA	Circuit	Voice only	PSTN	Horizont al	800-900 MHz

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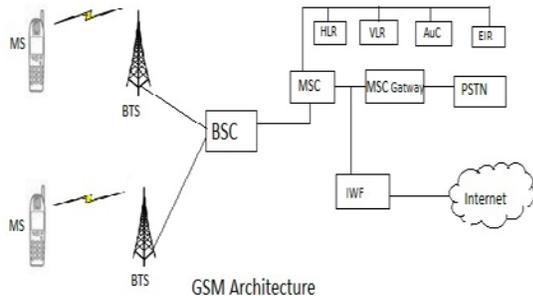
**2G Mobile communication system**

The 2G second generation mobile communication system is digital system. This system was commercially launched in Finland in 1991. This system is still mostly used in different parts of the world. This generation is for data and voice services. In this generation two digital modulation schemes are used; one is time division multiple access

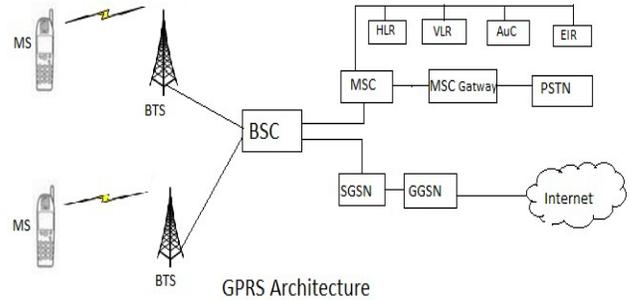
(TDMA) and the 2nd is code division multiple access (CDMA) [5]. The first digital system was introduced in 1991 in United States. Three types of developments took place in 2nd generation wireless communication system, IS-54 (TDMA) in 1991, IS-95 (CDMA) in 1993, and IS-136 in 1996 [6]. The family of this generation consists of 2G, 2.5G and 2.75G. The specifications of this family are shown in the table below.

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

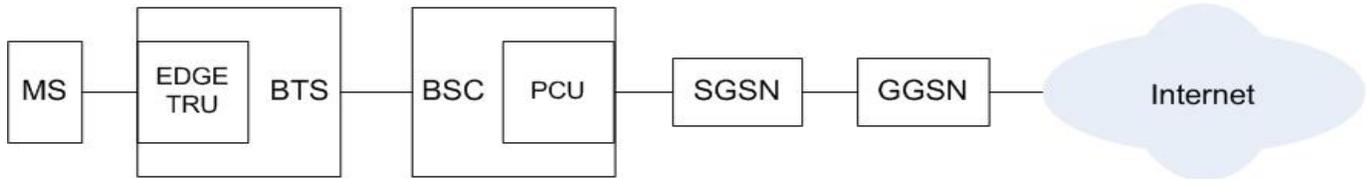
The network architecture of 2G GSM system is shown below.



The 2.5G GPRS architecture is shown below



The 2.75G EDGE architecture is shown below



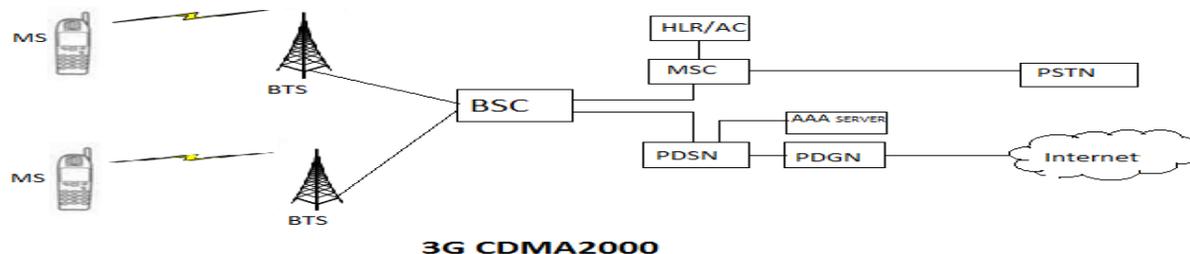
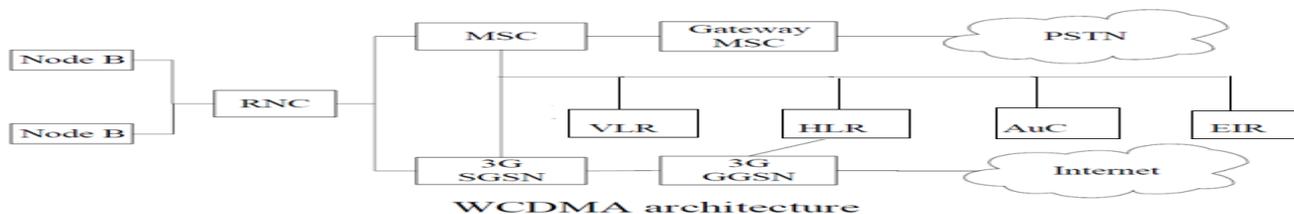
TRU: Transceiver Unit  
 PCU: Packet Control Unit

**3G Mobile communication system**

The evolution of GSM to 3G is about gradually adding more functionality, possibilities and value to the existing GSM network and business. In search of high speed, fast data rate capacity and good QoS, the evolution of mobile generation reached to 3rd generation mobile communication system. This system was adopted by Japan and South Korea in 2001 for the first time.

3G UMTS (universal mobile telephone service) is developed by ETSI with in ITU's IMT-2000 framework. 3G mobile system is equally available with all cellular standards like CDMA, GSM, and TDMA under one umbrella. The main features of 3G technology include wireless web base access, multimedia services, email, and video conferencing.

Generation	Starts from	Data capacity	Technology	Standard	Multiplexing	Switching	Service	Main network	Hand off	frequency
3G	2001	384Kbps	Broad band /IP technology FDD TDD	CDMA/ WCDMA/ UMTS/ CDMA 2000	CDMA	Packet & circuit	High speed voice/data/video	Packet network	Horizontal	1.6-2.5GHz
3.5G	2003	2Mbps	GSM/ 3GPP	HSDPA /HSUPA	CDMA	Packet	High speed voice/data/video	GSM TDMA	Horizontal	1.6-2.5GHz
3.75G	2003	30Mbps		1xEVDO	CDMA	packet	High speed internet /multimedia		Horizontal	1.6-2.5GHz



**4G Mobile communication system**

A huge increment in the mobile subscription has made the attention of researchers and industries to move the next generation of mobile wireless technology. The main aim of 4G technology is to provide high speed, high quality, high capacity and low cost services for example voice, multimedia and internet over IP. 4G is totally IP based

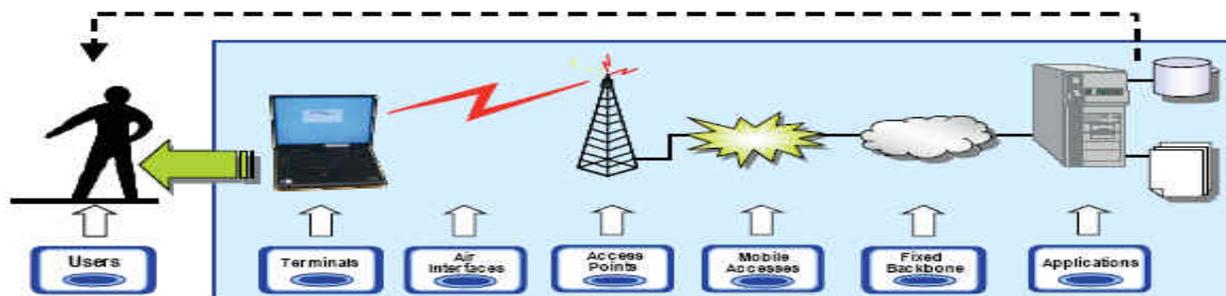
technology with the capability of 100Mbps and 1Gbps speed for both indoor and outdoor. This generation is in the under development stage. A term MAGIC is used to explain the 4G technology.[7]

- M= mobile multimedia
- A= any time any where
- G= global mobility support

I= integrated wireless solution

C= customized personal service

### 4G Mobile Communications



4G wireless technology should put together different presently existing and prospect wireless network technologies (e.g. OFDM, MC-CDMA, LAS-CDMA and Network- LMDS) to make sure that free movement and faultless roaming from one technology to another is achieved [8].

The technologies under the 4G umbrella are; one is LTE (Long term evolution) and second is Wi-MAX (Worldwide Interoperability for Microwave Access)

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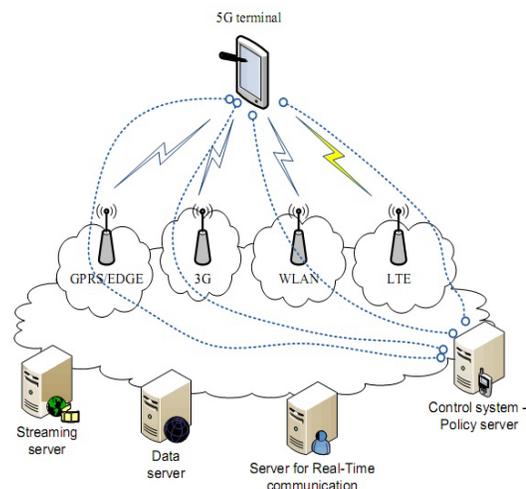
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Generation	Starts from	Data capacity	Technology	Stander	Multiplexing	Switching	Main network	Hand off	frequency
4G	2010	200Mbps-to-1Gbps	LTE Wi MAX	IP-broadband LAN/WAN/PAN	MC-CDMA OFAM	Packet	Internet	Horizontal & Vertical	2-8GHz

### Future Generations of Mobile communication

#### A- 5G Mobile communication system

The 5th generation of wireless mobile communication is wireless internet network which is supported by OFDM, MC-CDMA, LAS-CDMA, UWB, Network-LMDS and IPv6. The basic protocol for running on both 4G and 5G is IPv6[9]. The 5G is complete wireless communication system having no limitation and is called as Real world wireless or WWWW worldwide wireless web.



Application layer	Application (service)
Presentation layer	
Session layer	Open transport protocol
Transport layer	
Network layer	upper network layer
	lower network layer
Datalink layer	Open wireless Architecture
Physical layer	

In 5G wireless network physical layer and data link layer defines the wireless technology. The two layers define that the 5G wireless technology is like open wireless architecture (OWA).

Generation	Starts from	Data capacity	Technology	Stander	Multiplexing	Switching	Service	Main network	Hand off	frequency
5G	2015	Higher then 1Gbps	IP v6	IP-broadband LAN/WAN/PAN &www	CDMA	All packet	Dynamic Information access, wearable devices with AI capabilities	Internet	Horizontal & vertical	

**B- 6G Mobile communication system**

The 6G mobile system for the global coverage will integrate 5G wireless mobile system and satellite network. These satellite networks consist of telecommunication satellite network, Earth imaging satellite network and navigation satellite network [11]. 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) [12]. The four different countries which developed these satellite systems are; the GPS by USA, the COMPASS system developed by China. The Galileo system by EU, and the GLONASS system developed by Russia [13].

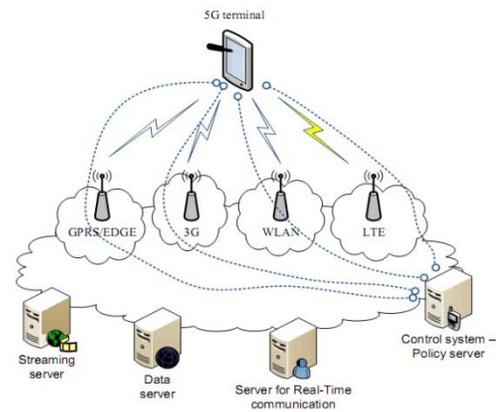
In 6G handoff and roaming will be the big issue because these satellite systems are different networks and 6G has four different standards. So the handoff and roaming must take place between these 4 networks but how it will occur is still a question.

The 5G technology mobile phone shall maintain virtual multi-wireless network. For this, the network layer should be divided into two sub layers. For mobile terminal, the upper network layer and for interface, the lower network layer. This is an initial design for internet, where all the routing will be based on IP addresses which should be different in each IP network world wide [10].

In wireless radio interface the higher bit rate is a big loss; in 5G this loss is controlled by using open transport protocol (OTP). The transport layer and session layer in 5G network sport this protocol.

The application layer is for quality of service management over different type of networks.

The important features of 5G technology includes bidirectional larger bandwidth, less traffic, equally availability of network across the world, 25Mbps connectivity speed, data bandwidth higher than 1GB and low-cost.



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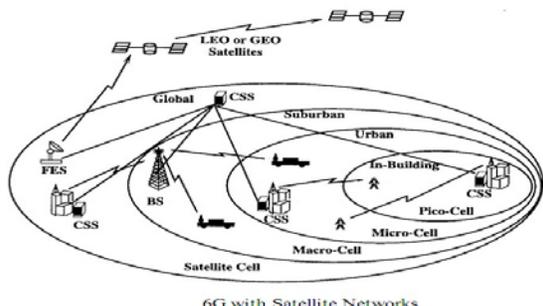
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**D- 7G Mobile communication system**

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7G mobile network is 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 [14]. The 6G mobile wireless network 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. May be this is possible in next generation after 7G and can be named as 7.5G.

**E- Issues of 7Generation**

When 7G will complete all its week points then there will be no issue of data capacity coverage and hand off left behind. At that time there will be only one demand from user which is the cost of mobile phone call and its services. This issue will again start evolutionally change in standard and technology and will also open new horizons for research. This new revolution in technology for cost of mobile phone call and services will be called as 7.5G or 8G.

F- There is another way to apply this generation for its utilization and that is direct HD video broadcasting for news gathering purpose likewise. This can be the best solution of cost on lower level user or you can say that

this generation is for specific HD direct video broadcast user.

### Conclusion

In this paper we have discussed the existing and future wireless mobile communication generations. Edge will contribute to a bright future for 3G and onwards generations, a vision shared by major analyst and industry groups. 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 and lower level user will benefit from it. Automobile and the television changed our lives but EDGE will change our lives by providing 3G, 4G, 5G, 6G, 7G services for the masses.

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