

Analysis and Survey on Past, Present and Future Generation in Mobile communication

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Abstract: From past year wireless technology makes enormous growth. Evolution of wireless technology is reached at 7.5G. Wireless technology FG (Future generation) mobile communications will have higher data transmission rates in 6G and 7G. Wireless technology is continuously one of the hottest areas that are developing at a high speed, with advanced techniques emerging in all the fields of mobile and wireless communications. Current times are just the beginning for deploying 5G mobile communication systems. At present we have many technologies each capable of performing functions like supporting voice traffic using voice over IP (VoIP), broadband data access in mobile environment etc., but there is a great need of deploying such technologies that can integrate all these systems into a single unified system. 8G presents a solution of this problem as it is all about seamlessly integrating the terminals, networks and applications. Our aim is to empower the community with world class broadband capabilities, establishing a future-proof groundwork for new ideas and opportunities to build on. The Communications Revolution starts here.

Keywords-OFDMA, WiMAX, SDR, MIMO, STBC, 0G, 1G, 2G, 3G, 4G, 5G, 6G, 7G, CDMA, TDMA, FDMA, GSM

I. INTRODUCTION

The mobile communication systems and the wireless communication technologies have been proving very fast day by day. Wireless communication is the transfer of information over a distance without the use of enhanced electrical conductors or "wires" When the context is clear, the term is often shortened to "wireless". It encompasses various types of fixed, mobile, and portable two-way radios, cellular telephones, Personal Digital Assistants (PDAs), and wireless networking. In the past few decades, the mobile wireless technologies have experience of various generations of technology revolution & evolution, namely from 0G to 4G. An advance implementation of 8G technology which are being made on the development of World Wide Web (WWW).

Consumers are demanding more advanced and useful applications. 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.

Hence, there is need of capacity improvements in wireless communications. The term 8G is used broadly to include several types of broadband wireless access communication systems, not only cellular telephone systems. One of the terms used to describe 8G is MAGIC—Mobile multimedia, anytime anywhere, Global mobility support, integrated wireless solution, and customized personal service. 8G will be a fully IP-based and satellite based integrated system. 8G will be capable of providing between 100 Mbit/s and 1 Gbit/s speeds both indoors and outdoors, with premium quality and high security [1]. Fourth generation networks are likely to use a combination of WiMAX and Wi-Fi technologies [2]. 5G is intended to provide high speed, high capacity, low cost per bit, IP based services. The goal is to have data rates up to 20 Mbps, even when used in such scenarios as a vehicle traveling 200 kilometers per hour. Fifth Generation (5G) mobile devices and services will transform wireless communications into on-line, real-time connectivity. The 5G systems not only will support the next generation of mobile service, but also will support the fixed wireless networks.

II. PAST WIRELESS GENERATION

A. 1G (First generation): The process began with the designs in the 1970s that have become known as 1G. Almost all of the systems from this generation were analog systems where voice was considered to be the main traffic. The first generation wireless standards used plain TDMA and FDMA. These systems could often be listened to by third parties. Some of the standards are NMT, AMPS, Hicap, CDPD, Mobitex, DataTac, TACS and ETACS. [3] The unique feature of 1G is the use of cellular technology that is building of hexagonal cells. But 1G has some downfalls regarding overall connection quality. It has low capacity unreliable handoff, poor

voice links, and no security since voice calls were played back in radio towers, making these calls susceptible to unwanted dropping or interference by third party.[4]

B. 2G (Second generation): The 2G (second generation) systems designed in the 1980s were still used mainly for voice applications but were based on digital technology, including digital signal processing techniques. These 2G systems provided circuit switched data communication services at a low speed [3]. All the standards belonging to this generation were commercial centric and they were digital in form. 2G system became popular due its high quality speech services. The second generation standards are GSM, iDEN, D-AMPS, IS-95, PDC, CSD, PHS, GPRS, HSCSD, and WiDEN.

Table: 1. Evolution of computer generation

Technology feature	1G	2G	3G	4G	5G
Start deployment	1970-1980	1990-2004	2004-2010	Now	Soon
Technology	2kbps	64kbps	2mbps	1Gbps	Higher than 1 Gbps
Service	Analog cellular tech.	Digital cellular tech.	CDMA2000	Wi-Fi	WWW
Multiplexing	Mobile M/C	Packetized data	High quality data	Wearable data	All with AI capabilities
Switching	Circuit	Circuit, packet	Packet	All packet	All packet
Core network	PSTN	PSTN	Packet N/W	Internet	Internet

2.5G: 2.5G is the intermediate generation between 2G and 3G cellular wireless technologies. This term is used to describe 2G-systems that have implemented a packet switched domain in addition to the circuit switched domain. 2.5G is not an officially defined term rather it was invented for marketing purpose. 2.5G provides some of the benefits of 3G (e.g. it is packet-switched) and can use some of the existing 2G infrastructure in GSM and CDMA networks.

D. 3G (Third generation) To meet the growing demands in network capacity, rates required for high speed data transfer and multimedia applications, 3G standards started evolving. Third generation of mobile telecommunication also known as Tri-band 3G. This technology is based on very high capacity broadband data. It supports greater voice and data capacity and high data transmission at low-cost. 3G mobiles can operate on 2G and 3G technologies. It supports greater voice and data capacity and high data transmission at low-cost. 3G mobiles can operate on 2G and 3G technologies. This technology provides localized services for accessing traffic and weather updates. Video calls and video conference is another major feature in 3G mobile technology. These features reduce the communication barriers between people, that were not sacked even with mobile phones. Data transfer rates are high and can support even live TV channels over phone. Online media is another exciting feature in 3G mobiles. 3G mobiles highly attract the music listeners as they can listen to music and watch videos online and can download huge files with in less time. It supports peak upload rate of 5Mbps and peak download rate is 100 Mbps. It supports frequency band of 1.8-2.5GHz. It does not support virtual presence. It supports standards like CDMA 2000, UMTS, EDGE, 1XRTT, EVDO.

III. PRESENT WIRELESS GENERATION

E. 4G (Fourth Generation): Fourth generation wireless system is a packet switched wireless system with wide area coverage and high throughput. It is designed to be cost effective and to provide high spectral efficiency. The 4G wireless uses Orthogonal Frequency Division Multiplexing (OFDM), Ultra Wide Radio Band (UWB), and Millimeter wireless. Data rate of 20 mbps is employed. Mobile speed will be up to 200km/hr. The high performance is achieved by the use of long term channel prediction, in both time and frequency, scheduling among users and smart antennas combined with adaptive modulation and power control. Frequency band is 2-8 GHz. It gives the ability for world wide roaming to access cell anywhere. Wireless mobile communications systems are uniquely identified by "generation designations.

Features of 4G Wireless Systems:

- The bandwidth is much wider than 2G and 3G networks-100MHz

- It supports for interactive multimedia, voice, streaming video, internet and other broadband services.
- It supports IP based Mobile System.
- It supports user friendliness.
- It supports high speed ,high capacity and low cost per bit
- It supports global access, service portability and scalable mobile service.
- Seamless switching and variety of quality service driven service
- It has Better spectrum Efficiency is 20MHz
- Its Peak upload speed may be up to 500 Mbps [5]
- Its Peak download speed may be up to 1Gbps.
- It supports packet as well as message switching.
- It has core network as Internet
- WiMAX, LTE technologies are part of 4G.
- Handsets are provided with Wi-Fi, Bluetooth, internet etc.
- Very much capable in taking multiple parties simultaneously.
- Its network architecture is integration of wireless LAN and wide area network.
- It has frequency of 2-8 GHz.
- It supports terminal heterogeneity and network heterogeneity.
- It provides HD video access to the users.
- In 4G, Virtual presence is also possible.
- It provides virtual navigation.

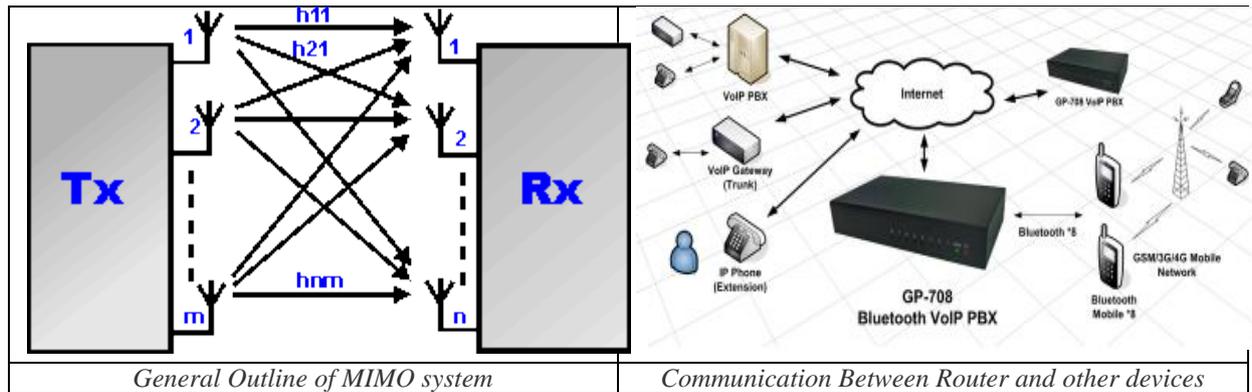
a) TECHNOLOGY USED IN 4G:

1] OFDMA [orthogonal frequency division multiplexing].

It is the method of encoding digital data on multiple carrier frequencies.[6]. This technology has been around for some time and has been used in ADSL, Wi-Fi (802.11a/g), DVB-H and other high-speed digital transmission systems. It is not surprising that the first foray of OFDM into the cellular wireless world was fixed-access WiMAX 802.16d. This wireless standard has been used to provide high-speed internet access either as a replacement for other access technologies like ADSL or cable, or to provide service in regions where the other access technologies were not deployed. In OFDM, usable bandwidth is divided into a large number of smaller bandwidths that are mathematically orthogonal using fast Fourier transforms (FFTs). Reconstruction of the band is performed by the inverse fast Fourier transform (IFFT). FFTs and IFFTs are well-defined algorithms that can be implemented very efficiently when sized as powers of 2. Typical FFT sizes for OFDM systems are 512, 1024 and 2048, with the smaller 128 and 256 sizes also possibilities. Among the bandwidths that will be supported are 5, 10 and 20 MHz One beneficial feature of this technique is the ease of adaptation to different bandwidths. The smaller bandwidth unit can remain fixed, even as the total bandwidth utilization is changed. For example, a 10-MHz bandwidth allocation may be divided into 1,024 smaller bands, whereas a 5-MHz allocation would be divided into 512 smaller bands. These smaller bands are referred to as subcarriers and are typically on the order of 10 kHz.

2] MIMO [Multiple input Multiple output]

MIMO is a technique that uses multiple antennas both for the transmission and reception. It can be used for two purposes: signal quality enhancement by transmitting identical signal through multiple antennas and channel capacity enhancement by transmitting different signals on multiple antennas. Space time block codes (STBC) is a popular MIMO technique for the signal quality enhancement and the vertical Bell Laboratories layered space-time (V-BLAST) technique is popular for channel capacity enhancement. The basic concept of MIMO is used to improve the performance of the system. MIMO is an essential part of wireless communication. It utilizes the multipath signal propagation that is present in all terrestrial communications. .The transmitter and receiver have more than one antenna and using the processing power available at either end of the link, they are able to utilize the different paths that exist between the two entities to provide improvements in data rate of signal to noise.



3] Software defined Radio (SDR):

The basic concept of the SDR software radio is that the radio can be totally configured or defined by the software so that a common platform can be used across a number of areas and the software used to change the configuration of the radio for the function required at a given time. SDR benefits from today's high processing power to develop multi-band, multi-standard base stations and terminals. In future the terminals will adapt the air interface to the available radio access technology, at present this is done by the infrastructure.[5]

4] IPV6:

The most significant characteristic of IPv6 is that it substitutes 32-bit IP version 4 (IPv4) addresses with 128-bit addresses. It supports large quality of service, security and mobility. IPv6 eliminates the need of private IP address spaces and Network Address Translators (NAT) due to its huge IP address space, i.e. every terminal can be allocated one or even several global IPv6 addresses. Thus, with IPv6 we can get rid of NAT and private address space maintenance.[6]

5] Voice over IP

Voice over IP (VoIP) is a group of technologies to perform voice communications and multimedia sessions over Internet Protocol (IP) networks. By using VoIP we can use service like voice, fax, SMS over the internet.[7]

6] WIMAX :(Worldwide Interoperability for Microwave Access)

WIMAX is belongs to a family of wireless communication and initially designed to provide 30 to 40 Mbps data speed. [8]. It is alternative to the Cable and DSL. It is similar to the WI-FI but it can enable usage at much greater distance. WIMAX can operate at home or mobile for internet access across cities or country. WIMAX is used IEEE 802.16 standard. WIMAX can provide long range for communication for the smart grid. WIMAX range 50km for fixed station and 5km for mobile station.

IV. FUTURE WIRELESS GENERATION

F. 5G (Fifth Generation): 5G mobile technology has changed the means to use cell phone with very high bandwidth. User never experienced ever before high value technology. 5G include all the type of advance feature which makes 5G mobile technology most powerful and huge demand in future. 5G technology is hand held phone offering more power and feature at least 1000 lunar modules. 5G technology cell phone with their laptop to get broadband internet access. 5G technology including camera, MP3 recording, Video player, large phone memory, dialing speed, audio player and much more.

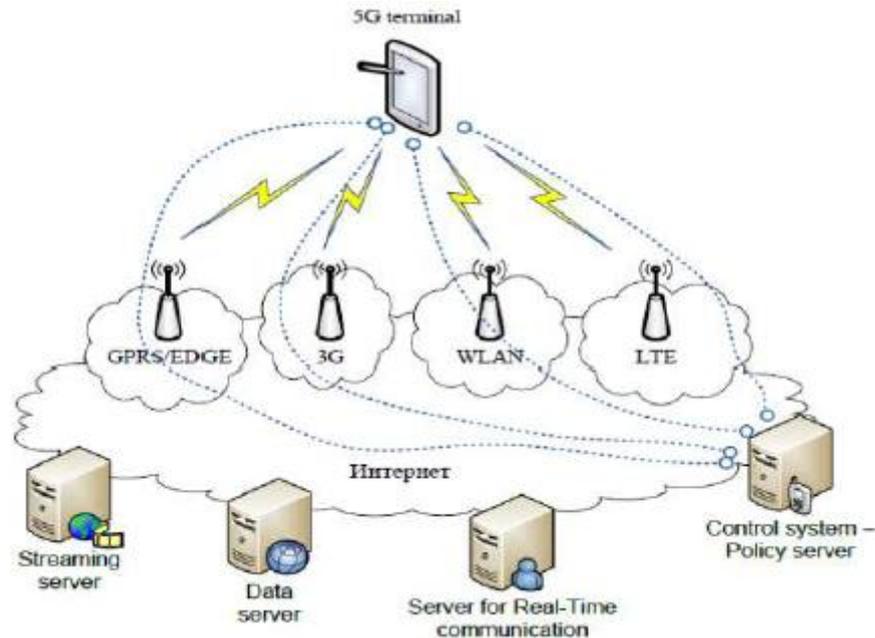
New Concept in 5G technology:

- **Pervasive networks:** This technology being considered for 5G cellular systems is where a user can concurrently be connected to several wireless access technologies and seamlessly move between them.
- **Group cooperative relay:** This is a technique that is being considered to make the high data rates available over a wider area of the cell. Currently data rates fall towards the cell edge where interference levels are higher and signal levels lower.
- **Cognitive radio technology:** If cognitive radio technology was used for 5th generation, 5G cellular systems, then it would enable the user equipment / handset to look at the radio landscape in which it is located and choose the optimum radio access network, modulation scheme and other parameters to configure itself to gain the best connection and optimum performance.

- **Wireless mesh networking and dynamic ad-hoc networking:** With the variety of different access schemes it will be possible to link to others nearby to provide ad-hoc wireless networks for much speedier data flows.
- **Smart antennas:** Another major element of any 5G cellular system will be that of smart antennas. Using these it will be possible to alter the beam direction to enable more direct communications and limit interference and increase overall cell capacity.

Architecture of 5G:

As shown in the following image, the system model of 5G is entirely **IP** based model designed for the wireless and mobile networks.



The system comprising of a main user terminal and then a number of independent and autonomous radios access technologies. Each of the radio technologies is considered as the IP link for the outside internet world. The IP technology is designed exclusively to ensure sufficient control data for appropriate routing of IP packets related to a certain application connections i.e. sessions between client applications and servers somewhere on the Internet. Moreover, to make accessible routing of packets should be fixed in accordance with the given policies of the user (as shown in the image given below).

5G requirements:

The following set of 5G requirements is as follows.

- 1-10Gbps connections to end points in the field (i.e. not theoretical maximum)
- 1 millisecond end-to-end round trip delay - latency
- 1000x bandwidth per unit area
- 10-100x number of connected devices
- Perception of 99.999% availability
- Perception of 100% coverage
- 90% reduction in network energy usage
- Up to ten year battery life for low power, machine-type devices

Advantages of 5G

There are several advantages of 5G technology, some of the advantages have been shown in the above *Ericsson* image, and many others are described below –

- High resolution and bi-directional large bandwidth shaping.
- Technology to gather all networks on one platform.
- More effective and efficient.
- Technology to facilitate subscriber supervision tools for the quick action.

- Most likely, will provide a huge broadcasting data (in Gigabit), which will support more than 60,000 connections.
- Easily manageable with the previous generations.
- Technological sound to support heterogeneous services (including private network).
- Possible to provide uniform, uninterrupted, and consistent connectivity across the world.

Disadvantages of 5G Technology

- Technology is still under process and research on its viability is going on.
- The speed, this technology is claiming seems difficult to achieve (in future, it might be) because of the incompetent technological support in most parts of the world.



- Many of the old devices would not be competent to 5G, hence, all of them need to be replaced with new one — expensive deal.
- Developing infrastructure needs high cost.
- Security and privacy issue yet to be solved.

G. 6G TECHNOLOGY:The Sixth Generation or 6G Mobile and Wireless Communication Network is a revolutionary technology aiming to provide unbelievably high data rates or very fast Internet speed access on air through wireless and mobile devices possibly up to 11 Gbps. its main backbone is thought to be based on 5G technology. It is imaginary to provide user/customer on the fly high Internet access rates without any fluctuations even if a user is traveling or in a remote location. Specially designed Nano Antennas will be implemented at different geographical locations or positions along roadsides, villages, malls, airports, hospitals etc to broadcast such high speed electromagnetic signals. The globe will be decorated by fly sensors with the help of 6G technology. These fly sensors will provide information to their remote observer stations; further these stations will check any activity upon a special area such as the activity of terrorists, intruders etc. The point to point wireless communication networks that transmit super fast broadband signals through the air will be assisted by high speed optical fibers lines. The air fiber combination will be the best method to broadcast much secured information from transmitters to destinations. The radio over fiber system is already in running state, but with the advent of this 6G technology the earth's mankind will be much closer to any extraterrestrial civilization in our universe.

Features/Advantages of 6G Technology:

- Ultra fast access of Internet.
- Data rates will be up to 10-11 Gbps.
- Home automation and other related applications.
- Smart Homes, Cities and Villages.
- May be used in the production of Energy from galactic world.
- Space technology, Defense applications will be modified with 6G networks.
- Home based ATM systems.
- Satellite to Satellite Communication for the development of mankind.
- Natural Calamities will be controlled with 6G networks.

- Sea to Space Communication.
- Mind to Mind Communication may be possible.

G.7G TECHNOLOGY: The 7G will be the most advance generation in mobile communication network. It is like the 6G for global coverage but it will also define the satellite functions for mobile communication. But in 7G, 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. There is another way, is direct HD video broad casting for news gathering likewise. This can be the best solution of cost on lower level user X.

V. CONCLUSION

The concept of wireless mobile generation is currently attracting a great deal of interest, not least because it may offer a genuine and efficient alternative to radio and IP based wireless. As a growing number of people and their devices access wireless internet, the air waves are becoming increasingly clogged, making it more and more difficult to get a reliable, high-speed signal. So advance mobile generation has a bright future. Proposed 6G and 7G systems offer this promise of a standard that can be accept worldwide through its key concept of integration. Future wireless networks will need to support diverse IP multimedia applications to allow sharing of resources among multiple users.

VI. ACKNOWLEDGEMENT

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