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A Research based study on Evolution of Cellular Generations (5G)

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Abstract: The manifesto of this paper is paramount deviation in the mobile computing philosophy with respect to end user correlated to prevailing 3G connectivity and almost on the verge of entering 4G mobile network technology and this superfast technology is known here- the 5G. We are all aware of wireless and mobile networks which have made extraordinary development in the past twenty years. At present, 3G mobile phone systems are sustaining IP connections worldwide for all real and non-real time operations. Subsequently, the platform of 4G is formerly deliberated and it is sure that 4G comprises heterogeneous standards under a same umbrella, as in 3G but there is one exception of IEEE 802.XX wireless network connection which is present in this network from the initial progress phase. Our future minds are eagerly waiting for fifth generation technology which is based on user centric concept means user is the topmost priority of system. Each network in 5g mobile phones will capable to handle user mobility. There will be new and advance error prevention methods which are inbuilt in nature and protects network from malign attacks. As a whole, advancement in technology reaches our lives to a forward step ahead.

I. INTRODUCTION

We are all aware of massive transformation of mobile industry from past few years. The number of subscribers triples in every million of second. A survey shows that the number of subscribers crossed the one billion strokes with respect to higher economy countries such as the United States, Japan, Europe etc. which have the highest number of end users. The astounding development of mobile industry in the 21st century is the outcome of modernized fundamentals in mobile networks paradigm. Our diversity of culture also plays a crucial role for this tremendous growth of mobile technology as they adopted this technology in a friendly manner [1]. The reliable way of communication over mobile phones includes heterogeneous voice and data services such as e-mails, voice and text messages and the most innovative one is internet which works on wireless technology. Today mobile phones are being used as 'ten tasks in one minute concurrently' like we play games, download files, chatting with friends, taking pictures while hanging out with dear ones. Teenagers get the mobile devices in their early stage of life so they are highly advanced in technology. Today mobile phones are being used as 'ten tasks in one minute concurrently' like we play games, download files, chatting with friends, taking pictures while hanging with dear ones. Growth in mobile phone users worldwide from 2012to 2017 is shown in figure 1. Teenagers get the mobile devices in their early stage of life so they are highly advanced in technology.

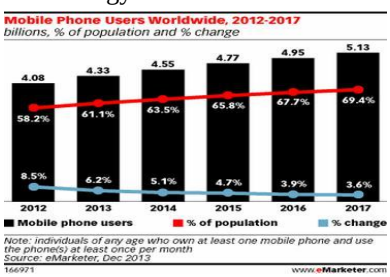

Fig 1: Growth of Mobile Users Worldwide

This research paper will render the evolution of cellular standards multiplied over the years. Starting from the 1G cellular network generation to the future 5G connectivity is being explored in this paper review.

The motivation of this research paper is that how rapid speed of emerging technology changed our lives in a short span of time. Till today researchers are using 4G technology in mobile networks and future generations and even we are eagerly waiting for 5G. What will be the key objectives and challenges in the evolution of 5G that is discussed in this paper in an effective manner?

The outline of this research paper comprises of 4 sections. As we have already seen, section 1 gives introduction of emergence of mobile industry, role of technology in our lives and discussed motivation of this paper. Section 2 proposed brief idea of all cellular Generation up to 4G with examples. The main domain of this research paper i.e., the key objectives, challenges, scope of 5G is discussed in section 3. Section 4 describes future prospective of 5G. Then, all these sections followed by conclusion and references.

II. EVOLUTION OF NETWORK GENERATIONS

By the 2010, there were over five times more mobile subscribers than obsolete telephone lines. Mobile interaction models reformate the method in which people communicate. At present, emergence of wireless network technologies is about to attain its fourth generation [4].

The wireless access generation (G) formerly describes a step ahead in the isolated nature of network services. Looking back, these technologies have implied variable emergence routes hoped at magnificent result related to efficiency in the environment of mobile networks. New cellular generation has been evolved in every 10 years -

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starting from 1981. Both the users and mobile operators recognized the importance of cellular networks with highly efficient designs. It resulted into optimization based services taking a sharp vision [3]. The fig. 2 and following section demonstrates the evolution of generations- 1G to 5G.

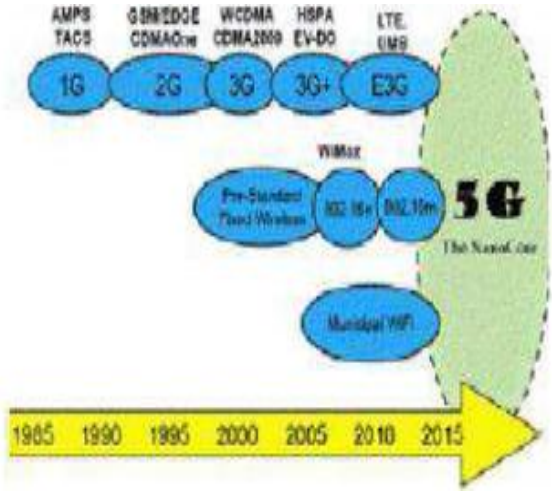

Fig 2: Evolution of Mobile Technologies

1G Cellular Network:

1G mobile network used analog system for communication of speech services. Mobile telecommunication in 1G first introduced in 1980s and continued till 1990. Analog Mobile Phone Systems (AMPS) was first established in USA in mobile networks. It has simple voice only cellular telephone parameters. The first generation of analog mobile phones has speed up to 2.4 Kbps. It allows end users to make voice calls only within 1 country [6, 8]. 1G had limited advantages but major drawbacks such as poor voice quality, handoff reliability, and battery life, large size of phones, no security mechanism alike many more.

Fig. 3 IG Mobile Phones

2G Cellular Network:

2G wireless technologies are based on Gsm and use digital signals. The main difference between 1G and 2G is that former uses analog signals where latter uses digital signals. These 2G telecom networks were launched on GSM standard in Finland by Radiolinja in 1991. This technology holds efficient security mechanisms for the sender and receiver. It enabled various high level services such as messages, images, text sms etc. 2g mobile network technologies are whether time division multiple access (TDMA) or code division multiple access(CDMA). Both CDMA & TDMA have different platforms and access mechanisms. Consequently, when compared with 1G network, efficient data access services, good quality and capacity higher spectrum is found. These networks have data speed up to 64Kbps. 2G communications is formerly linked with the isolate system for GSM services [7]. 2G invented the concept of short messages services (SMS) which is very cheap and fast way to talk with other person at anytime. It proves to be beneficial for end users and mobile operators at same time. There exist some drawbacks of 2G i.e. it demands strong digital signals to assist connections of mobile phones, unable to hold complex data such as videos.

Fig. 4 2G Mobile Phones

3G Cellular Network:

3G technology refers to 3rd cellular generation established in 2000s [9]. This network has highest speed as compared with 1G and 2G i.e. 144Kbps-2Mbps. It is also known as International Mobile Telecommunications-2000. It is able to transfer packet switch data at higher and better bandwidth. It offers technically advanced services to end users. There is extraordinary clarity in voice calls services. There have been found some advance features of 3G technology as it provides faster communication, large broadband capabilities, video conferencing, 3D gaming, high speed web, more security methods like many more. There exist also some drawbacks like expensive fees for 3G Licenses Services, big size of mobile phones, expensive in nature, higher bandwidth requirements etc.

Fig. 5 3G Mobile Phones

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4G Cellular Networks:

The location knowledge and bandwidth available in 3G devices gives emergence of 4G mobile phones [18]. The next generation of mobile technology gives higher data access rates and can enlarge multimedia processing services. The 1st successful field attempt for 4th generation networks was performed in Tokyo, Japan on June 23rd, 2005. It is capable of transmitting 100mbps-1gbps speed.

There is one basic phrase used to elaborate meaning of 4G network is MAGIC. This cellular generation of network can provide any sort of service to remote users at anytime as per specification everywhere [11]. Highly marvelous features include low cost in roaming network, high speed and high capacity. Up till now only US, Sprint Nextel, Germany, Spain, China, Japan and England have 4G mobile sets and services. 4G is a point of acquaintance to meet future needs of a reliable speed wireless network. Few drawbacks of 4G are as it needs complicated hardware, high battery power, hard to access and has expensive equipment needed to implement next generation network.

Fig. 6 4G Mobile Phones [2]

Difference between Different Generations:

The comparison of different heterogeneous generation has been shown in Table 1.

Technology-Feature	1G	2G	3G	4G	5G
Start/Deployment	1970-1980	1990-2004	2004-2010	Now	Soon
Data Bandwidth	2kbps	64kbps	2Mbps	1Gbps	Higher than 1Gbps
Technology	Analog Cellular Tech.	Digital Cellular Technology	CDMA 2000	Wi-Fi	WWWW
Service	Mobile M/C	Packetized Data	High Quality Data	Wearable Devices	All with AI Capabilities
Multiplexing	FDMA	TDMA, CDMA	CDMA	CDMA	CDMA
Switching	Circuit	Circuit, Packet	Packet	All Packet	All Packet
Core Network	PSTN	PSTN	Packet N/W	Internet	Internet

Table 1: Comparison of All Generations [10]

III. THE ULTIMATE INNOVATION- 5G

The 5th cellular generation of wireless network will be a highly remarkable communication system with no limitations. 5G is a broadband network innovated technology that has undergone in the development phase and likely to be hit in the market five to six years from now [19]. According to developers of 5G, they are assuming that this network has capabilities to answer and handle 15,000 more calls and data access traffic rates from end users as compared with 3G and 4G. But there are still many questions unanswered to user about 5g as what is 5g? What would a typical 5g experience be like? Will 5g works on the same platform that 3g and 4g run on? When will users be able to use this 5g? Will 3g and 4g mobile phones run 5g networks? And are there any inbuilt weaknesses in 5g? For this time being, it is not possible to answer all these tag questions but we can give a brief overview of 5g revolution through our following section of this paper.

What is 5G Technology?

This technology is fifth generation of wireless mobile network which was begun in late 2010s. It has almost no limitation which makes it isolated or completed wireless communication. Mobile users not had experience of such a highly advance technology [14]. An end user can also connect their 5G mobile phones with their desktops to have internet connection. It totally supported World Wide Wireless Web (WWWW). This communication technology merges all enhanced benefits of mobile phones like dialing speed, MP3 recording, cloud storage, HD downloading in instant of seconds and much more that you had never imagined [12].

Working Concepts of 5G Networks

As stated earlier, 5G will be completely user centric i.e. nothing is hidden from user. It will have new error prevention schemes that can be installed through internet anytime and have modulation methods and software defined radios [8]. 5G will be a collaboration of networks and individual network handle user mobility. This network will be based on Open Wireless Architectures as it has Physical Access Control Layer i.e. OSI Layer.

Application Layer	Application (Services)
Presentation Layer	
Session Layer	Open Transport Protocol
Transport Layer	
Network Layer	Upper Network Layer
	Lower Network Layer
Data Link Layer	Open Wireless Architecture
Physical Layer	

Table 2: OSI Layers in 5G Terminal Design [13]

Features of 5G:

The following are the features of 5G that makes it extraordinary phone:

(i) Faster data transfer rate as compared with last generations.
(ii) Huge memory, fast dialling speed.
(iii) HD quality picture.
(iv) More attractive and more effective.
(v) Peak uploading and downloading speed.
(vi) Remote diagnostics.
(vii) Up to 25 Mbps connection speed.
(viii) High quality services to avoid errors.
(ix) Bi-directional large bandwidth.

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These all features will be most likely found in 5G mobile phones and figure 7 gives you a idea picture of these phones.

Fig. 7 Expected 5G Mobile Phone [4]

Future Prospective of 5G Technology:

5G mobile phones have bright future in the era of development and technology. At present, each desktop or laptop has assigned an individual IP address to track the flow of data traffic but in future 5G mobile phones will have permanent care of address and "Home" IP address associated which tells actual location without any error. Once a computer is connected to internet, then it can easily connect with mobile phone as computer sends a data packet to IP address of mobile set and as a result, server present on IP address send acknowledgement packet to real location through message forwarding mechanism [8]. 5G will use cloud computing mechanism in their mobile phones i.e. it is a technology that uses central data repository and internet connection to maintain applications. At present, operators are going through training of clod computing technology and in future they implied tremendous opportunities of cloud in 5G wireless networks. The most effective and attractive feature of 5G will be its advanced billing interfaces.

IV. CONCLUSION

This paper gives brief of individual cellular generation of mobile wireless technology. This revolution had started from 1G and emerging up to 5G. These technology has Personal Data Access to be whole office is in your finger tips. 5G will prove to be the reason for India considered to be developed. It will encourage the idea of Super Core that will connect all operators globally under same framework or core and same infrastructure regardless of their access methods.

At last I want to conclude that advance technology make things good and can be bad. So it is all up to users that take charge of using these wirelesses generation of mobile technology.

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