

Review of Transformation of Mobile Wireless for Next Generation Communication Networks

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Abstract: *The wireless mobile communication network connects the entire world. People need it to be omnipotent. This network has developed through a series of evolution. It all began with a simple voice transmission in the early years using the analog systems for first generation like Advanced Mobile Phone Service -AMPS, Nordic Mobile Telephones -NMT and Total Access Communication System -TACS and then referred as 1G. The technology improvisation offered birth to the next generation with the ability to send SMS using digital systems for example, GSM - Global System for Mobile Communication, D-AMPS - Digital-Advanced Mobile Phone Service, IS-95, GPRS-General Packet Radio Services (2.5G) and EDGE-Enhanced Data GSM Environment 2G. The WCDMA-Wideband Code Division Multiple Access, CDMA- Code-Division Multiple Access and TD-SCDMA-Time Division- Synchronous CDMA emerged into the next generation 3G with enhanced data rates. The Long Term Evolution (LTE) of 3G resulted in 4G with a theoretical data rate of 1Gbps. The thirst for rather new is taking the technology towards the next level with a data rate estimation of 10,000Mbps, which is to be evolved as 'The FIFTH generation-5G'. 5G should be a more smart technology that interrelates the entire world. This article provides a high level review on evolution of this new technology and next-generation mobile broadband with worldwide interoperability.*

Keywords: Mobile communication, GSM, GPRS, EDGE, WCDMA, TD-SCDMA, CDMA, LTE, 1G, 2G, 3G, 4G, 5G.

I. INTRODUCTION

Communication technology become the bloodline of the developing world. The air which we once thought to be empty has become the eyes and ears of the world. The wireless technology of data transfer has now become a major means of communication. Beginning from the push to talk systems in 1946 to the online shopping today, evolution of technology is well evident. Keen study on this evolution will enable the creation of an enhanced future where the world would be in our palms. The first generation 1G transmitted voice using analog signals whereas the 2G was a digital system with SMS services. 3G offered multimedia features with high data transmission rates. Increased bandwidth and reduced cost integrated with 3G resulted in the long term evolution (LTE), the 4G. Evolution occurred by the attempt to overcome the disadvantages faced during the generations 1G, 2G, 3G and 4G. In the view of providing a better communication environment to the corporates and the common people

having all the advances in technology with extreme superiority in function is expected to be seen in the next generation, 5G.

II. TRANSFORMATION OF TECHNOLOGY

A. First Generation (1G)

Communication through car based telephone systems in 1946 was the preliminary step. This was then referred to as 0G. The first generation phones were deployed in 1980's with a speed limit of 2.4 kbps. The technology was first launched by the AMPS- Advanced Mobile Phone System in US which uses analog signals followed by the TACS- Total Access Communication System and NMT-Nordic Mobile Telephone in Europe and J-TACS in Japan. These are constructed on simple FDMA-frequency division multiple access, that permitting consumers to sort the voice calls within a nation.

B. Factors that paved way to the next generation

As 1G used analog signals, the communication was less secure and no data roaming is provided. The signals were weak and hence easily prone to noise. Long distance transmission is not possible and speed are low. Reduced voice quality with deprived the phone battery life. Size of mobile phones are vast with frequent call drops and poor handoff reliability and speed up to 2.4Kbps. The frequency range is 150 MHz and above. Fig 1. Shows the 1G wireless technology

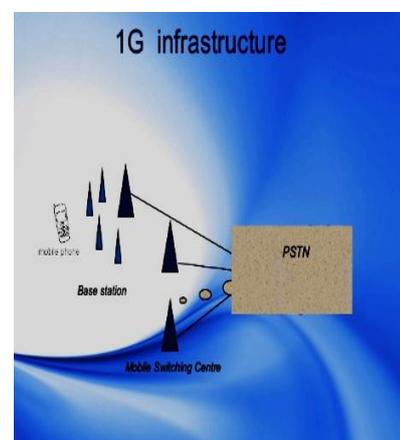


Fig. 1 1G Wireless Technology

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III. SECOND GENERATION (2G)

In early 1990's, the second generation wireless mobile networks - 2G are created on digital skills. In 1991 2G technology have been launched in Finland and provided facilities like script message, image messages and Multimedia message. These networks are superior safety for both sender and receiver. Second Generation system practices Digital Mobile Access like Time Division Multiple Access- and Code Division Multiple Access. GSM, PDC, IS-136 are different TDMA tools. The first 2G system has originated from Europe as GSM. The utmost appreciated standard, among the mobile technologies is GSM which is used in around 212 nations, in the biosphere. In the 900 and 1800 MHz band groups, GSM measures TDMA upto 8 calls per channel. GSM distributes circuit switching data and voice with the speed of 14.4kbps. To enhance this technology, 2.5 generation (2.5G) systems has been developed with an advanced GSM system.

A. General Packet Radio Service- 2.5G GPRS

To enhance data rates, support and the volume of launching the packet based services, the early 2G network have been upgraded as General Packet Radio Service. The technologies such as HSCSD, GPRS and EDGE technologies with various databases such as HLR, VLR, EIR and AUC, offers the range data rate from 56 kbps to 384kbps. The GPRS network provides or supports services such as Wireless Application Protocol -WAP, Multimedia Messaging Service -MMS, Short Message Service -SMS, mobile games, search directory and well internet access.

B. Enhanced Data Rates for GSM Evolution -2.75G EDGE

The EDGE networks are progression of GPRS networks using the overview of QPSK encoding. The retrograde - attuned mobile technology with digital has Enhanced Data rates for GSM evolution. The improved data transmission rates and best standard are allowed in GSM Improved GPRS (EGPRS) or IMT Single Carrier (IMT - SC). By Cingular (now AT&T) in the United States, it has organized on GSM networks beginning in the early 2003. EDGE provides threefold increase in capacity of GSM/GPRS networks. It agrees strong and profligate in data transmission and information. Owing to its tractability, EDGE technology has more advantages than GSM in carrying packet and circuit switching data.

C. Factors that paved way to the next generation

Digital signals are normally weak and possessed angular decay curve (jagged decay curve due to unfavorable conditions). It reduced range of sound. Upto 35 km site range, GSM has a fixed maximum cell which is enforced by some of limitations in technically. For a smart phone functions, 2G networks are less compatible and minimum data transmission speed. Fig 2. Shows network architecture of 2G.

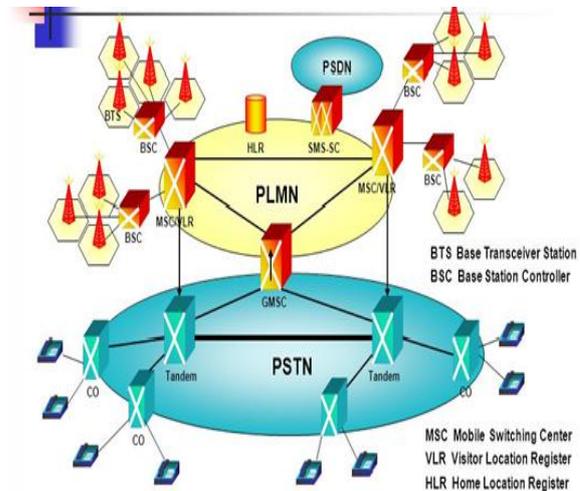


Fig. 2 Network Architecture Of 2G

IV. 3G -THIRD GENERATION

The 3rd generation -3G has high principles and expertise, following 2G and earlier 4G. The ITU-International Telecommunication Union formulated 3G plan and contrivance in international frequency in the 2000MHz band. International Mobile Telephone 2000-IMT 2000 standard which supports a single universal wireless communication standard for all nations throughout the world. To achieve greater network capacity and better spectral efficiency, this technology allows the network operators to offer a broader range of services with advanced system. The high data speed audio and video streaming and conferencing maintenance are enhanced in 3G and also provides higher speeds Web and WAP browsing and TV through the internet support.

A. High - Speed Downlink Packet Access: 3.5G HSDPA

A mobile telephony protocol with higher data transfer speeds is 3.5G HSDPA which offers a UMTS based 3G networks with smooth evolutionary path. It transmits data transmission up to 8-10 Mbit/s and 20Mbit/s for MIMO system over a 5MHz bandwidth in WCDMA downlink a packet based data service in WCDMA downlink. Fast cell search and advanced receiver design are implemented which includes Adaptive Modulation and Coding, Multiple Input Multiple output, Hybrid Automatic Request (HARQ) in this 3.5G.

B. 3.75G HSUPA : High Speed Uplink Packet Access -

The well defined 3G wireless /mobile technologies is 3.75G technologies. For advanced data rates such as mobile e-mail and real-time gaming, UMTS/WCDMA uplink evolution technology is needed for advanced one to one data applications. The enhanced uplink speed HSUPA, initially lift the UMTS WCDMA uplink upto 1.45Mbps and in later releases up to 5.8Mbps for benefit of old-fashioned business along with several customer applications.

C. Factors that paved way to the next generation

These of different handsets and cost of cellular infrastructure are very high for upgrading base stations. The requirement of closer base stations makes more expensive and also high power consumption. The roaming and data/voice work together are not implemented.

V. 4G-FOURTH GENERATION

The perception of inter-operability between dissimilar networks are implemented in 4G, which provides the transfer of great speed data such as 0-100 MBPS of the data receiver and the server. The download rate of data 100Mbps in access of mobile and less flexibility of 1GBps for indigenous access of wireless are enabled in 4G technology. A novel technology of OFCDMA is introduced in 4G with the conception of DMA with frequency domain equalization process symbolizes. To maintain the data access demand used by various services, the data transfer speed for 4G are amplified. High definition streaming supports increased portability, 4G technology is made possible in world wide roaming.

Factors that paved the way to next generation

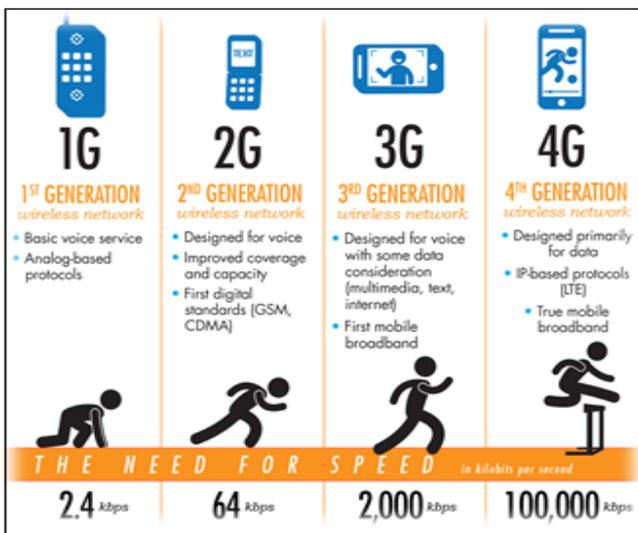


Fig. 3 1G to 4G Evolution

Features	1G	2G	3G	4G
Image				
Name	First Generation	2 nd Generation	3 rd Generation	4 th Generation
Introduced in the year	1980	1993	2001	2009
Location of first commercialization	USA	FINLAND	JAPAN	SOUTH KOREA
TECHNOLOGY	AMPS,N	GSM	DIT 2000,	LTE,

LOGY	MT, TACS		WCDMA	WMA X
Multiple address and Access system	FDMA	TDMA, CDMA	CDMA	CDMA
Switching type	Circuit Switching	Circuit Switching for voice and packet switching for Data	packet switching except air interface	packet switching
SPEED (data rates)	2.44 Kbps-14.4 Kbps	14.4 Kbps	3.1 Mbps	100 Mbps

Table 1.A Comparison Between The Generations Of Mobile Wireless Technology Networks

The 4G network helps to make possible of current equipment compatible. It consumes data very fast when in use. It has different network bands for different phones. Data prices for consumers were higher. Battery consumption is high which leads to heating of mobile phones. Fig.3 shows the evolution of 1G to 4G. Table 1 shows the comparison between the generations of mobile wireless technology networks.

VI. FIFTH GENERATION -5G

The 4G network invites more and more users online. The bandwidth from 3kHz to 3GHz is not sufficient due to the increased data demand. Hence, we come up with the next generation 5G. Currently, 5G includes the following technologies:

A. Millimeter waves

Millimeter waves are of high frequency and hence has the increased bandwidth of 3kHz to 300GHz. This reduces the crowding of the devices online. Their drawback is that they can't travel through buildings and get absorbed by plants and rain. In order to overcome this, the small cell networks are to be made in use.

B. Small cell Networks

Today, large towers are used to transfer data through large distances. The millimetre waves are prone to obstacles. Construction of small cell networks favours switching to new stations without data losses when the waves encounter such obstacles.

C. Massive MIMO

MIMO views for multiple input and multiple output which is possible in 5G. 4G towers have 12 ports to handle the traffic. 5G towers are planned to have 100 ports which increases the capacity by a factor of 22.



Efficiency to handle traffic is increased but the increased number of ports could lead to series interference of the waves from various networks. This is again overcome by beam forming. Beam forming is a method in which the traffic in the transmission of the signals and their interference is avoided by focusing the data in specific directions.

D. Full duplex

Data traffic makes transmission and reception simultaneously, slightly difficult. There are more possibilities for data loss. 5G is expected to overcome this hindrance.

E. Special features that are to be found in 5G

It is capable of handling 1000 times more traffic and several times quicker than the current 4G network. It would probably download a HD movie in one second. The theoretical download speed would be 10000 Mbps. It would give rise to the gigabyte smartphone. It provides greater bandwidth having high download speeds, able to run more complex mobile internet apps. 5G wifi is expected to be 3 times faster than 4G with a capacity of streaming 450 Mbps in a single stream, 900 Mbps in a dual stream and 1.3 Gbps in a triple stream. Fig 4 shows that the 5G architecture.

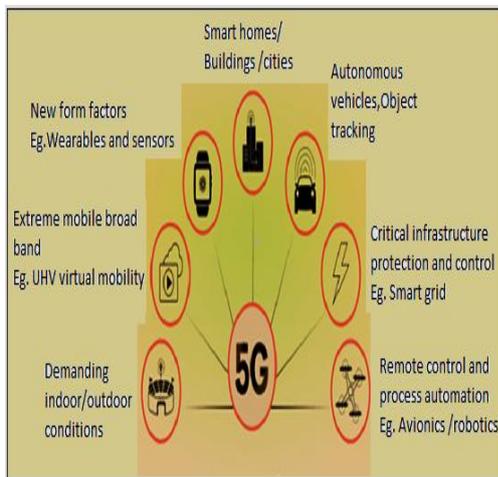


Fig.4 Enhancements In 5G

VII. CONCLUSION

The thirst for something new and better always paved way to a next level. This technology of wireless communication has boomed in such a way that in the near future, Google assistants in your phones could get an appointment for you anywhere, saving your time. The primary goal of serving the people has been achieved. This transformation of technology from 1G to 4G and 5G ensures prosperity of one, another and in turn the prosperity of the world. Not only the business classes but also the common people could explore the world sitting in the remote corners. Distance, now cannot deprive them from what they deserve. All these are possible today only because of the Wireless Networks.

REFERENCES

1. Amitkumar, Dr. Yaunfei Liu, Dr.JyotsnaSengupta and Divya. 2010 "Evolution of mobile wireless communication networks 1G to 4G."
2. SuneelkumarTarunAgarwal and Prashant Singh. International journal of future generation communication and networking.,2014 "A future communication technology – 5G."
3. Sucheta and Dr. K.P. Yadav 2008, 'International journal of advances in Engineering research. "A comparative study of 1G, 2G, 3G and 4G."
4. JiveshGovil, JivikaGovil. "5G : Functionalities development and analysis of Mobile wireless grid", IEEE wireless communications, April 2008.
5. M. Hata. "Fourth Generation Mobile Communication Systems beyond IMT-2000 Communications," Proc 5th Asia Pacific Conf.
6. M. Bhalla , A. Bhalla, "Generations of mobile wireless technology : A Survey" International journal of computer applications, Volume 5- No.4, August 2010.
7. T. Janevski, "5G mobile phone concept" – CCNC Conference in Las Vegas, 2009.
8. Sapna Singh, Pratapsingh. "Key concepts and network architecture for 5G mobile technology" International Journal of Scientific Research Engineering and Technology Volume 1 Issue 5 pp 165 – 170 August 2012.
9. Chen, Yue . "Soft handover issues in radio resource management for 3G WCDMA Networks." Queen Mary University of London, 2003.
10. Mishra, Ajay K. "Fundamentals of cellular Network Planning and Optimization, 2G/2.5G/3G.... Evolution of 4G" , John Wiley and Sons, 2004.