ISSN (Print) :2320 – 9798
ISSN (Online): 2320 – 9801

International Journal of Innovative Research in Computer and Communication Engineering
Vol. 1, Issue 3, May 2013

Comprehensive Study of Mobile Networks

Jitender Singh

Assistant Professor, Dept of ECE, Somany (PG) Institute Of Tech & Mgt, Rewari, India

ABSTRACT: In telecommunication a Wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor .Wireless operations permit services, such as long-range communications, that are impossible or impractical to implement with the use of wires. The term is commonly used in the telecommunications industry to refer to telecommunications systems which use some form of energy to transfer information without the use of wires. Information is transferred in this manner over both short and long distances. In this paper we are reviewing different wireless technologies and discussing about the future of wireless technologies used for cellular or mobile networks.

Keywords: Mobile wireless communication networks. Mobile broad band, 1G, 2G, 2.75G, AMPS, GPRS, EDGE, 3G, LTE, WiMAX, 4G

I. INTRODUCTION

Wireless communication is the one of the most vibrant area in communication field .While it has been a topic of study since 1960's due to confluence of several factors. First there has been a explosive increase in demand tether less connectivity. Second the dramatic progress in VLSI technology has enabled small area and low power implementation of sophisticated signal processing algorithm and coding techniques [1]. Third is success of second generation (2G) digital wireless standards. Over the years, there have been consistent improvements in the design of cellular networks as shown in fig 1. The advancement is necessary in order to cope with increasing number of users, increasing level of traffic (voice, data, etc.,), and increasing level of sophisticated but useful applications on mobile devices. The quest for higher bandwidth, faster connection times, and seamless handoffs, a scalable solution prompted engineers to seek better solutions. Various standardization organizations have taken efforts to work on specific agenda, providing an open forum for ideas, contributions, and convergence to agreed technical specifications.

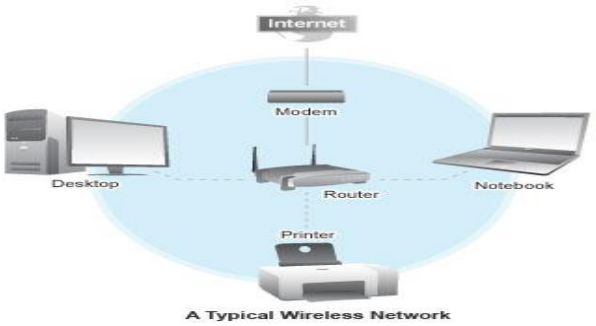

Fig 1-Wireless communication Network

II. WIRELESS TECHNOLOGIES

In wireless communication we have different technologies which came in knowledge after a regular study of wireless systems and network. Wireless technologies can be divided in different type based on their generation like as 1st Generation(1G),2nd generation(2G), 3rd generation(3G), 4th generation(4G) and in recent years we are working on a new generation which is named as 5G.

A. First Generation (1G)

1G refers to the first-generation of wireless telephone technology, mobile telecommunication these are the analog telecommunications standards. The main difference between two succeeding mobile telephone systems, 1G and 2G, is that the radio signals that 1G networks use are analog, while 2G networks are digital. Although both systems use digital signalling to connect the radio towers to the rest of the telephone system, the voice itself during a call is encoded to digital signals in 2G whereas 1G is only modulated to higher frequency, typically 150 MHz and up.1G speeds vary between that of a 28k modem (28kbit/s) and 56K modem (56kbit/s) means actual download speeds of 2.9KBytes/s to 5.6KBytes/s[2]. Then after the first generation digital wireless came to know which is known 2G.

ISSN (Print) :2320 – 9798
ISSN (Online): 2320 – 9801

International Journal of Innovative Research in Computer and Communication Engineering
Vol. 1, Issue 3, May 2013

B. Second Generation (2G)

2-G is second-generation wireless telephone technology Second generation 2G cellular telecom networks were commercially launched on the GSM standard. Three primary benefits of 2G networks over their predecessors were that phone conversations were digitally encrypted; 2G systems were significantly more difficult on the spectrum allowing for far greater mobile phone penetration levels; and 2G introduced data services for mobile, starting with SMS text messages. 2G technologies can be divided into Time Division Multiple Access (TDMA)-based and Code Division Multiple Access (CDMA)-based standards depending on the type of multiplexing used. The main 2G standards in fig 2 are GSM (Global System Mobile), which supports eight time slotted users for each 200 kHz radio channels. The most popular second generation standards include three TDMA standards and one CDMA standards which are compared as given in fig 2. The 2G standards represent the first set of wireless interface standards to rely on digital modulation and sophisticated digital signal processing in the handset and the base stations [2].

	IS-54	GSM	JDC	IS-95
Multiple Access	TDMA	TDMA	TDMA	CDMA
Tx. Freq. MHz Base/Mobile	869-894/ 824-849	935-960/ 890-915	810-826/ 940-956	869-894/ 824-849
Duplexing	FDD	FDD	FDD	FDD
Channel Spacing (KHz)	30	200	25	1250
Modulation	π/4 QPSK	GMSK	π/4 QPSK	BPSK/ QPSK

Fig 2-Comparison between different standards

C.Third Generation (3G)

3G is the 3rd generation of mobile telecommunications technology. Also called Tri-Band 3G. 3G telecommunication networks support services that provide an information transfer rate of at least 200 Kbit/s. However, many services advertised as 3G provide higher speed than the minimum technical requirements for a 3G service. Recent 3G releases [3], often denoted 3.5G and 3.75G, also provide Mobile broadband access of several Mbit/s to smart phones and mobile modems in laptop computers.3G finds application in wireless voice telephony mobile Internet access, fixed wireless Internet video calls and mobile TV. Both 3GPP and 3GPP2 are working on extensions to 3G standard that are based on an all-IP network infrastructure and using advanced wireless technologies such as MIMO. These specifications already display features characteristic for IMT-Advanced (4G) the successor of 3G.3GPP plans to meet the 4G goals with LTE Advanced, whereas Qualcomm has halted development of UMB in favour of the LTE family. A complete evolution of 3G is shown in fig 3.

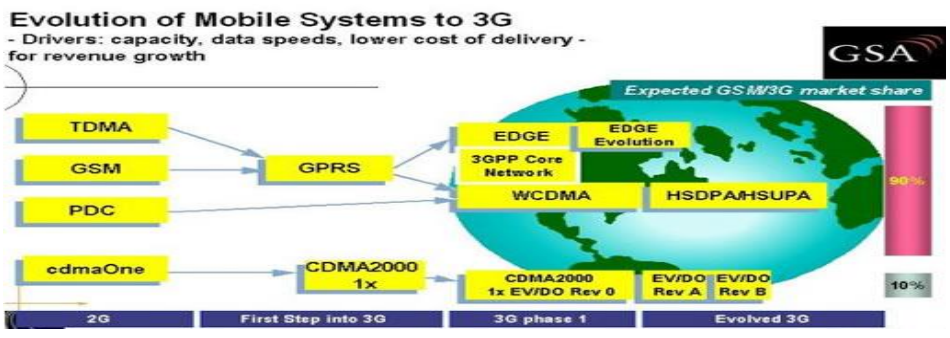

Fig 3-Evolution of mobile system to 3G

D.Features of Third Generation (3G)

High Bandwidth- The measure of transmission capacity is one of the selling points of 3G. This allows you quick and easy access to all of your favourite online multimedia and Internet tools, just like you were at home on a computer. You can pay bills, book dinner reservations, update social networking pages and check emails, all on the-go.

Higher Speed- With 3G technology, you get to enjoy data transmission speed leading up to 2Mbps, considering that you have a phone in stationary mode. It also gives you high degree of connectivity and higher networking, plus resistance to noise[4]. The technology has enhanced the bit rate, allowing service providers to give high speed internet facilities, higher call volumes and host of the multimedia applications that can be given to the customers. All the

ISSN (Print) :2320 – 9798
ISSN (Online): 2320 – 9801

International Journal of Innovative Research in Computer and Communication Engineering
Vol. 1, Issue 3, May 2013

services can be given to the customers based on the data quantity transmitted and not on the time used for the service. The services rendered to clients are cheaper overall.

On Price- Despite the new speeds and features of 3G technology, the prices of handsets and mobile units are relatively the same. The most recent models, however, may be priced higher compared to those featuring 2.5G.

Always-Online Devices- Another feature of 3G technology is that it can utilize packet-based Internet protocol connectivity. This means your mobile device will always be online and ready for Internet access. However, you will not actually pay for the connection until you start sending or receiving data packets, such as sending an email or looking at a webpage.

Power Requirements- In addition to being more expensive, 3G handsets also require more power than most 2G models.

III. FOURTH GENERATION (4G)

4G is the fourth generation of mobile phones communications standards. It is a successor of the third generation (3G) standards as shown in evolution diagram in fig 4. 4G system provides mobile ultra broadband Internet access, for example to laptops with USB wireless modem, to Smartphone's, and to other mobile devices. Conceivable applications include amended mobile web access, IP technology gaming services, high definition mobile TV video conferencing, 3D Television and cloud computing. Two 4G candidate systems are commercially deployed: the Mobile WiMAX standards and Long Term Evolution (LTE) standard. Smartphone's have been available since 2010, and LTE Smartphone's since 2011. When a standard definition of 4G is accepted, it will encompass all existing generations of fixed and mobile wireless technologies with major improvements in performance and capabilities. Fundamentally, 4G intends to alter the paradigm of user-network communication via a single device connected to a (mostly) single network. Since 4G is expected Ito be more than 3G phone service, it allows all sorts of portable devices onto "the" network. Embedding broadband in all types of consumer devices is a goal of 4G. The World Wireless Research Forum anticipates some 17 trillion devices connected for seven billion people by the year 2017[5]. If the scale is matched, 4G will do for portable consumer devices what 3G is predicted to do for individual phones and laptops in terms of advances in connectivity and productivity, published by the ITU, depicts the IMT-A vision of various access systems ("network") interconnected to provide services in a cooperating manner.

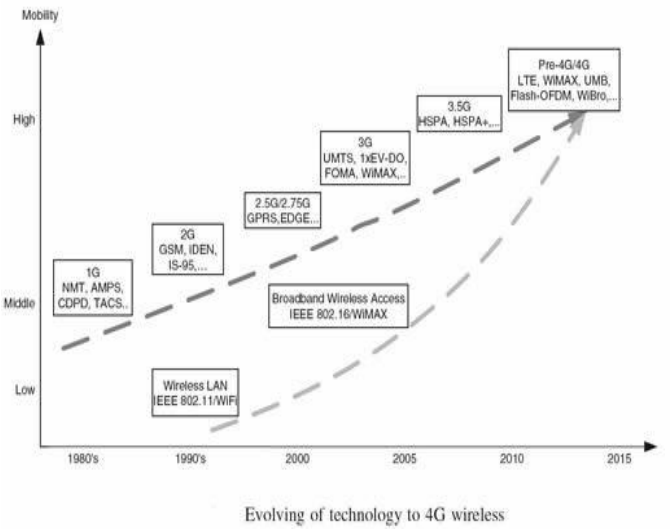

Fig-4 Evolution of 4G Wireless technology

A.WiMAX

WiMAX (Worldwide Interoperability for Microwave Access) is a wireless communications standard designed to provide 30 to 40 megabit-per-second data rates with the 2011 update providing up to 1 Gbit/s for fixed stations. WiMAX refers to interoperable implementations of the IEEE 802.16 family of wireless-networks standards ratified by

ISSN (Print) :2320 – 9798
ISSN (Online): 2320 – 9801

International Journal of Innovative Research in Computer and Communication Engineering
Vol. 1, Issue 3, May 2013

the WiMAX Forum. WiMAX is sometimes referred to as "Wi-Fi on steroids" and can be used for a number of applications including broadband connections, cellular backhaul, hotspots, etc. It is similar to Wi-Fi, but it can enable usage at much greater distances. It is used for Providing portable mobile broadband connectivity across cities and countries through a variety of devices and providing data, telecommunications (VoIP) and IPTV services (triple play).It is also useful in providing a source of Internet connectivity as part of a business continuity plan &Smart grids and metering. The WiMAX Forum has proposed an architecture that defines how a WiMAX network can be connected with an IP based core network, which is typically chosen by operators that serve as Internet Service Providers (ISP); Nevertheless the WiMAX BS provide seamless integration capabilities with other types of architectures as with packet switched Mobile Networks. IEEE developed the IEEE 802.16 standards, which include notably IEEE 802.16-2004, the first major WiMAX standard for fixed access. This was superseded by IEEE 802.16e-2005, known as Mobile WiMAX, which provides both fixed and mobile access [6].

B.Long Transmission Emission (LTE)

LTE, an initialize of long-term evolution, marketed as 4G LTE, is a standard for wireless communication of high-speed data 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. LTE is the natural upgrade path for both carriers with GSM/UMTS networks and for CDMA holdouts such as Verizon Wireless, who launched the first large-scale LTE network in North America in 2010.LTE is a standard for wireless data communications technology and an evolution of the GSM/UMTS standards. The goal of LTE was to increase the capacity and speed of wireless data networks using new DSP (digital signal processing) techniques and modulations that were developed around the turn of the millennium. 3GPP's LTE standard evolved from the High-speed Packet Access cellular standards. The LTE standard is officially known as "document 3GPP Release 8." LTE Release 8 almost achieves full compliance with IMT-Advanced requirements [7], so some call it 3.9G. In September 2009, 3GPP submitted its LTE-Advanced proposal for IMT-Advanced, officially called "document 3GPP Release 10."In December 2009, Swedish telecom operator Telia Sonera launched the first commercial deployments of LTE in Stockholm, Sweden and Oslo, Norway.5,6 Stockholm's network was supplied by Ericsson while Oslo's network was supplied by Huawei. The modems were supplied by Samsung.

C.Features of 4G

Peak download rates up to 299.6 Mbit/s and upload rates up to 75.4 Mbit/s depending on the user equipment category. Low data transfer latencies (sub-5 ms latency for small IP packets in optimal conditions), lower latencies for handover and connection setup time than with previous radio access technologies. Improved support for mobility, exemplified by support for terminals moving at up to 350 km/h (220 mph) or 500 km/h (310 mph) depending on the frequency band .Increased spectrum flexibility: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz and 20 MHz wide cells are standardized. Support for cell sizes from tens of meters radius (femto and picocells) up to 100 km (62 miles) radius macrocells [8]. It is easy to say, based on the developing trends of Mobile communication, that 4G will have broader bandwidth, higher data rate, smoother and quicker handoff, wider mobile area, more various service, lower cost, etc. Obviously these ideas do not make too much sense as such. Other than the words "more", "any" and/or "all" are preferred over expressions used by some others, e.g. anyone can communicate with anyone else, anywhere and anytime, or enjoy any service of any network operator, through any network of any network service provider. These sentences are truly attractive from a subscriber's viewpoint, and they sound quite like advertisements or word games [9].

IV. RESULTS & CONCLUSION

The last few years have witnessed a phenomenal growth in the wireless industry. The ever increasing demands of users have triggered researchers and industries to come up with a comprehensive manifestation of the up-coming fourth generation (4G) mobile communication system. As the history of mobile communications shows, attempts have been made to reduce a number of Technologies to a single global standard. The first generation (1G) has fulfilled the basic mobile voice, while the second generation (2G) has introduced capacity and coverage. The 4G network will encompass all systems from various networks, public to private; operator-driven broadband networks to personal areas; and ad hoc networks. The 4G systems will interoperate with 2G and 3G systems, as well as with digital (broadband) broadcasting systems. In addition, 4G systems will be fully IP-based wireless Internet which will provide access to wide range of telecommunication services, including advanced mobile services, supported by mobile and fixed networks, which are increasingly packet based, along with a support for low to high mobility applications and wide range of data rates, in accordance with service demands in multiuser environment. The three charts below quickly compare the differences

ISSN (Print) :2320 – 9798
ISSN (Online): 2320 – 9801

International Journal of Innovative Research in Computer and Communication Engineering
Vol. 1, Issue 3, May 2013

between the generations of wireless telecommunications. Each chart covers a different aspect of the standards: Technology in Use (fig 5), Speeds , Frequencies and Carriers.

	Technology			
1G	Analog	**CMRT**		**AMPS**
2G	Digital Circuit Switched	**D-AMPS**	**GSM**	**CDMA**
2.5G	Digital Packet Switched	**GPRS**		**EDGE**
3G	Digital Packet Switched	**UMTS**	**W-CDMA**	**CDMA2000**
4G	Digital Broadband	**802.11**		

Fig 5- Comparison chart of Technology in Use

When we compare all these wireless technologies based on their standards we found that all these are different in their characteristics. In case of technologies standards 1G use analogy methodology in which CMRT & AMPS are main standards. In case of 2G the technology is Digital circuit switched and the standards are GSM & CDMA.

		Frequency	Carrier
1G		800 MHz	30 kHz
2G	**D-AMPS**	800 MHz or 1.9 GHz	30 kHz
	GSM	800 MHz or 1.9 GHz	200 kHz
	IS95A/B	800 MHz or 1.9 GHz	1.25 MHz
2.5G		800 MHz or 1.9 GHz	200 kHz
3G	**UMTS**	2 GHz	5 MHz
	WCDMA	2 GHz	5 MHz
	CDMA2000	2 GHz	1.25 MHz / 3.75 MHz
4G		1.8-2.5 GHz	5-20 MHz

Fig 6-Comparison chart of frequencies and carriers of different generations

Whereas in 3G we use technology of digital packet switched network and the standards are UMTS, CDMA200 which are different from the standards of 2.5G which are GPRS & EDGE. In last when we see the technology used in 4G is Digital broadband and the standards is 802.11. In fig 6 here we gave a comparison chart of frequency and carriers used in different technologies. In 1G the frequency range was up to 800 MHz and the carrier frequency was 30 kHz, whether in the next generation to 1G the frequency is 800 MHz to 1.9 GHz and the carrier frequency was 1.25 MHz and in 2.5G the carrier frequency is 200 KHz.In 3G frequency range is 2GHz and the carrier frequency is 1.25 MHz to 5 MHz at the same time in 4G the frequency is 1.8-2.5GHz and the carrier is 5-20MHz.

		Data Rate
1G		9.6 Kbps to 14.4 Kbps
2G	**D-AMPS**	9.6 Kbps to 14.4 Kbps

ISSN (Print) :2320 – 9798
ISSN (Online): 2320 – 9801

International Journal of Innovative Research in Computer and Communication Engineering
Vol. 1, Issue 3, May 2013

	GSM	9.6 Kbps to 14.4 Kbps
	IS95A	9.6 Kbps to 14.4 Kbps
	IS95B	115 Kbps
2.5G		56 Kbps to 144 Kbps
3G	**UMTS**	2+ Mbps, up to 384 Kbps
	WCDMA	384 Kbps (wide area access), 2 Mbps (local area access)
	CDMA2000	614 Kbps
4G		20-40 Mbps

Fig 7-Comparison chart of speed/Data rate of different Generations

So we can compare all these generations and can conclude that 4G is best technology than other three. Like as technologies & frequency when we compare all these technologies based on Data rate as in fig 7. We see the data rate speed of 1G is lies between 9.6 Kbps to 14.4 Kbps. In 2G the data rate of speed is 9.6 Kbps to 115 Kbps. In 2.5 G the data rate 56 Kbps to 144 Kbps, Whether in 3G the data rate is very high and it gives a speed of 2Mbps. In present when 4Gis in use and it gives us the speed of 20Mbps to 40Mbps. Same like as the technology and speed, frequency spectrum is also differing for each of them. We see This paper provides a comprehensive overview of the evolution of Mobile Wireless Communication Networks from 1G to 4G.In now a days we can say 4G is the best technology in which the data rate , speed , reliability are best.

REFRENCES

[1] K. Kumaravel, Assistant Professor Dept. of Computer Science, Dr. N.G.P. Arts and Science College, Coimbatore, "Comparative Study of 3G and 4G in Mobile Technology", IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 5, No 3,ISSN (Online): 1694-0814 ,www.IJCSI.org September 2011

[2] C. S. Patil1, R. R. Karhe2, M. A. Aher3 Department of E & TC,S.G.D College of Engg. , Jalgaon, Maharashtra, INDIA, "Review on Generations in Mobile Cellular Technology, International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, Volume 2, Issue 10, October 2012).

[3] Tim Masson UK Regional Specialist, "Third Generation (3G) Basics CDMA-2000 & 3GPP W-CDMA" Dec 2000.

[4] Amit K. Mogal Department of Computer Science, CMCS College, "Wireless Mobile Communication - A Study of 3G Technology" Int. J. Advanced Networking and Applications Volume: 03 Issue: 05 Pages:01-06 (2012) Special Issue of NCETCSIT 2011 – Held in Bapurao Deshmukh College of Engineering, Sevagram on 16-17 Dec, 2011 .

[5] Ishan Shah Institute of Technology Nirma University, Shiv Shukla Institute of Technology Nirma University, "Comparative Study of 4G Technology, Applications and Compatibility in Prevailing Networks" International Journal of Electronics Communication and Computer Technology (IJECCT)Volume 2 Issue 6 (November 2012).

[6] Z. Abichar, Y. Peng, and J.M. Chang, "WiMAX: The Emergence of Wireless Broadband," IT Professional, July/Aug. pp. 44–48, 2006 .

[7] Zakhia Abichar and J. Morris Chang, Iowa State University Chau-Yun Hsu, Tatung University, Taiwan, "WiMAX vs. LTE: Who Will Lead the Broadband Mobile Internet?" 1520-9202/10/$26.00 © 2010 IEEE, IT Pro May/June 2010.

[8] Batch Babu Muvva, Rajkumar Maipaksana, and M. Narasimha Reddy, 4G and Its Future Impact: Indian Scenario, International Journal of Information and Electronics Engineering, Vol. 2, No. 4, July 2012.

[9] Jun-Zhao Sun, Jaakko Sauvola, and Douglas Howie MediaTeam, Machine Vision and Media Processing Unit, Infotech Oulu University of Oulu, Finland Tutkijantie 2 B, FIN-90570 University of Oulu, Finland, "Features in Future: 4G Visions From a Technical Perspective" 0-7803-7208-5/01/$17.00 (C) 2001 IEEE.

[10] http://en.wikipedia.org/wiki/4g.

[11] Sangram Gayal and Dr. S. A. Vetha Manickam, Comparative analysis Of GSM and CDMA technologies "A Security Perspective" Network Security Solutions Ltd. Pune.

[12] "WiMAX and the IEEE 802.16m Air Interface Standard". WiMax Forum. 4 April 2010. Retrieved 2012-02-07.

BIOGRAPHY

Jitender Singh received BE in Electronics & Communication from M.D.University Rohtak India in the year 2008 and M.Tech in Communication Systems from Manav Rachna International University, Faridabad Deemed University in the year 2012. He is working with the Department of ECE in S (PG) Institute of Technology & Management, Rewari (Haryana), affiliated to the M.D.University, Rohtak His main areas of interest are Spatial Diversity, MIMO & wireless network technologies.