

Emerging high speed technology in mobile communication: 4G

Shrikant R Tripathi¹ and Nitesh B Khandelwal²

¹tripathishrikant0@gmail.com, G.H.Raisoni Institute of Technology Nagpur (M.S.) India

²(Sarva Shiksha Abhiyan Zilla Parishad Gondia, Dist-Gondia (M.S.)) India

Abstract : 4G (Fourth generation) mobile communications will have higher data transmission rates than 3G i.e. 4G is 3 times faster speed than 3G technology. Mobile communication 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 3G 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. 4G presents a solution of this problem as it is all about seamlessly integrating the terminals, networks and applications.

Keywords - OFDMA, WiMAX, SDR, MIMO, STBC

I. INTRODUCTION

The mobile communication systems and the wireless communication technologies have been improving very fast day by day. Consumers are demanding more advanced and useful applications.

Hence, there is need of capacity improvements in wireless communications. The term 4G 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 4G is MAGIC—Mobile multimedia, anytime anywhere, Global mobility support, integrated wireless solution, and customized personal service. 4G will be a fully IP-based integrated system. 4G 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]. 4G 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. Fourth Generation (4G) mobile devices and services will transform wireless communications into on-line, real-time connectivity. The 4G systems not only will support the next generation of mobile service, but also will support the fixed wireless networks.

II. EVOLUTION OF 4G

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]

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 circuitswitched 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 become 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.

C. 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. The systems in this standard are

essentially a linear enhancement of 2G systems. They are based on two parallel backbone infrastructures, one consisting of circuit switched nodes, and one of packet oriented nodes.

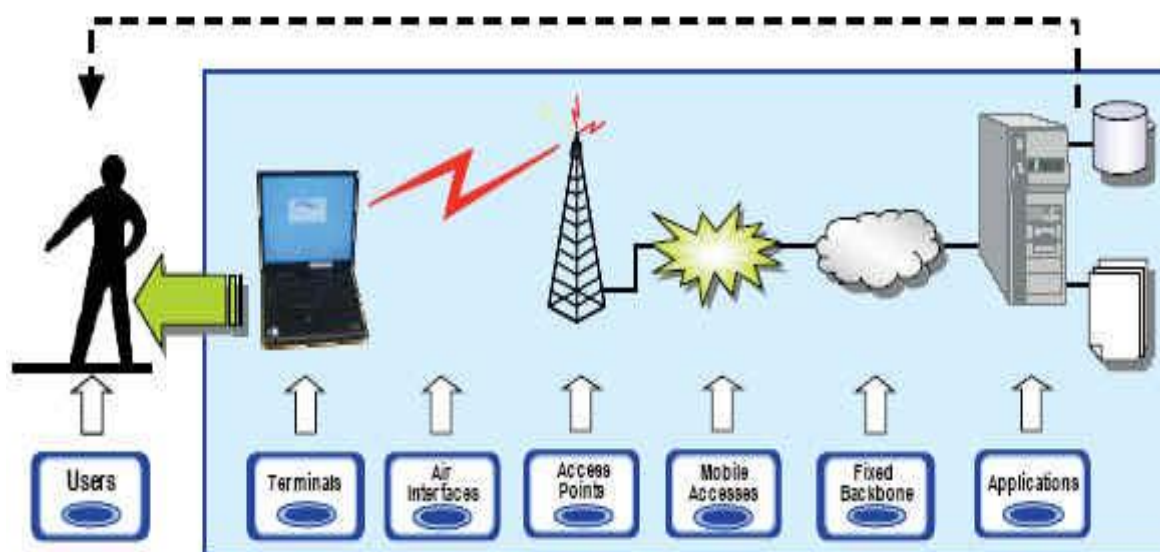
Technology	1G	2G	2.5G	3G	4G
Design Began	1970	1980	1985	1990	2000
Implementation	1984	1991	1999	2002	2010?
Services	Analog voice	Digital voice	Higher capacity, packetized data	Higher capacity, broadband data up to 2mbps.	Completely IP based, speed up to hundreds of MBs
Standards	NMT, AMPS, Hicap, CDPD, TACS, ETACS.	GSM, iDEN, D-MPS	GPRS, EDGE etc.	WCDMA, CDMA 2000.	Single standard
Data Bandwidth	1.9 kbps	14.4 kbps	384 kbps	2 Mbps	200 Mbps
Multiplexing	FDMA	TDMA, CDMA	TDMA, CDMA	CDMA	CDMA?
Core Network	PSTN	PSTN	PSTN, packet network	Packet network	Internet

Fig.1.Evolution of 4G

III. FEATURE OF 4G TECHNOLOGY

- 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.
- Band 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.

4G Mobile Communications

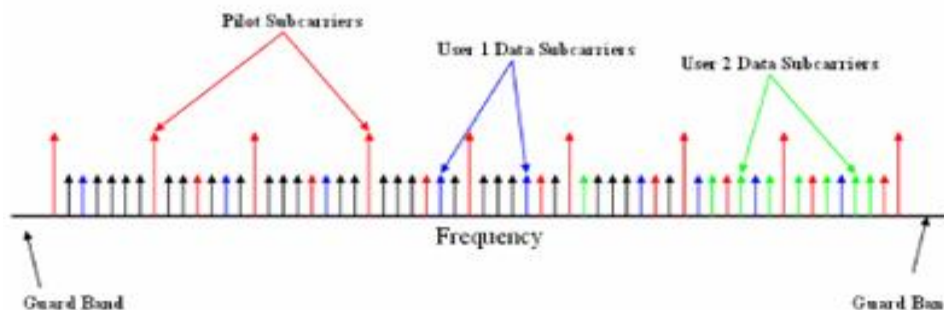


IV. TECHNOLOGY USED IN 4G:

A. 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.

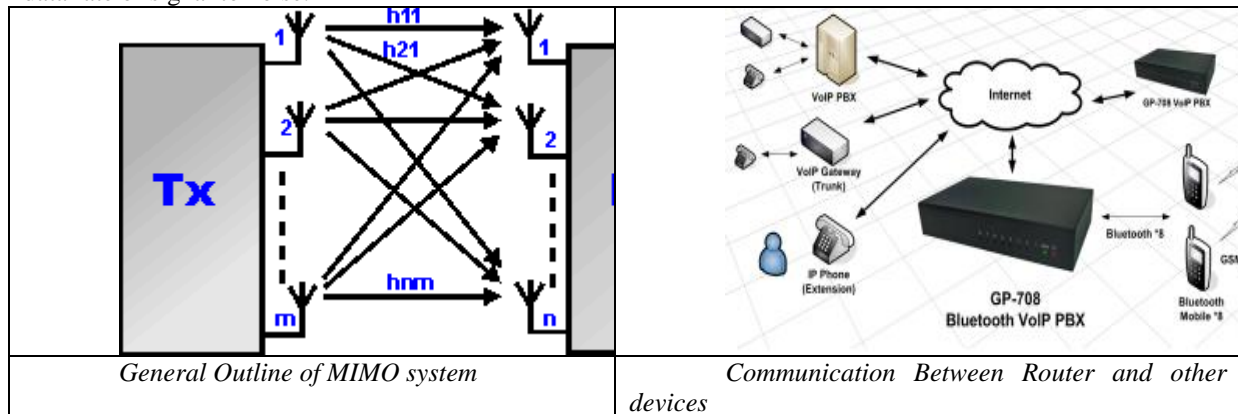
Figure 2: In OFDM, usable bandwidth is divided into a large number of smaller bandwidths, called subcarriers that are mathematically orthogonal.



B. 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.



C. 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.[8]

D. IPV6:

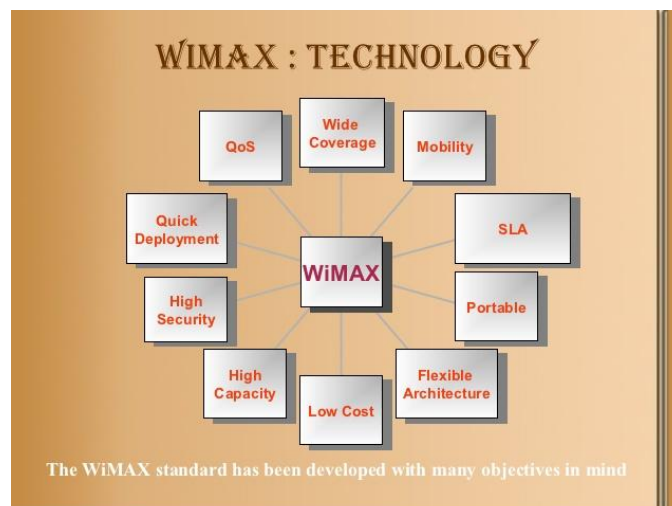
The most significant characteristic of IPv6 is that it substitutes 32-bit IP version 4 (IPv4) addresses with 128-bit addresses. It supports large quality of service, security and mobility. IPv6 eliminates the need of private IP address spaces and Network Address Translators (NAT) due to its huge IP address 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.[9]

E. 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.[10]

F. 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. [11]. 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.



V. DISADVANTAGES OF 4G

- 4G technology is very expensive.
- Battery uses are harder to implement.
- Need complicated hardware.
- It is impossible to make current equipment compatible with the 4G network

VI. RESULTS

4G will be an intelligent technology that will interconnect the entire world seamlessly.

VII. CONCLUSION

The concept of 4G is currently attracting a great deal of interest, not least because it may offer a genuine and efficient alternative to radio 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 4G has a bright future. Proposed 4G systems offer this promise of a standard that can be embraced 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.

VIII. ACKNOWLEDGEMENT

We are very much thankful to Mr. Dhiraj Rane, Assistant Professor, G. H. Raisoni Institute of Technology Nagpur for his valuable inputs, constant guidance and his extensive support and encouragement for this work.

REFERENCES

- [1] Young Kyun, Kim; Prasad, Ramjee. 4G Roadmap and Emerging Communication Technologies. Artech House 2006, pp 12-13. ISBN 1- 58053-931-9.
- [2] Jivesh Govil, Jivika Govil, "An Empirical Feasibility Study of 4G's Key Technologies", 978-1-4244-2030-8/08/ 2008 IEEE.
- [3] Afaq H. Khan, Mohammed A. Qadeer, Juned A. Ansari, Sariya Waheed," 4G as a Next Generation Wireless Network International Conference on Future Computer and Communication 2009 <http://www.seminaronly.com/Labels/4g-Technology-Features.php>
- [4] shipra Gupta, Supriya Shakya, Himanshu Tyagi," The 4G Technology V/S other G Technologies" IJARCSSE vol.3 2013 ISSN: 2277 128X
- [5] https://en.wikipedia.org/wiki/Orthogonal_frequency-division_multiplexing
- [6] <https://en.wikipedia.org/wiki/MIMO>
- [7] B.Vasavi,Mounika Marepalli, Leepika Gudur Evolution of 4G-Research Directions Towards Fourth Generation Wireless Communication IJCSIT Vol. 2 (3) , 2011, 1087-1095
- [8] Jari Valmiki , "Usage of IPv6 in Selected 3G and 4G Architectures"
- [9] https://en.wikipedia.org/wiki/Voice_over_IP
- [10] <https://en.wikipedia.org/wiki/WiMAX>