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4G as a Next Generation Technology Network

Mr. Sachin Patil

Asst. Professor, KES's PIBM, Chinchwad-Pune

Patilsachin4u@gmail.com

Abstract- ***User requirements are growing faster than ever and the limitations of the current mobile communication systems have forced the researchers to come up with more advanced and efficient technologies. 4G mobile technology is the next step in this direction. 4G is the next generation technology networks that will totally replace 3G networks. It is supposed to provide its customers with better speed and all IP based multimedia services. 4G is all about an integrated, global network that will be able to provide a comprehensive IP solution where voice, data and streamed multimedia can be given to users on an "Anytime, Anywhere" basis. 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. The race to implement 4G is accelerating as well as quite challenging. The aim of this paper is to highlight the benefits, challenges in deployment and scope of 4G technologies.***

Keywords - ***4G, 3G, VoIP, Wi-Fi, Wi-Max, CDMA, GPRS, GPS***

I. INTRODUCTION

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4G, short for fourth generation, is the fourth generation of mobile telecommunications technology, succeeding 3G and preceding 5G. A 4G system, in addition to the usual voice and other services of 3G, provides mobile broadband Internet access, for example to laptops with wireless modems, to Smartphone's, and to other mobile devices. Potential and current applications include amended mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing, 3D television, and cloud computing.

With the deployment of 3G (3rd generation mobile communication systems) in process, the interest of many research bodies shifts towards future systems beyond 3G. Depending on the time such new systems are planned to be introduced and on the characteristic of improving or replacing existing systems they are called B3G (beyond 3G) or 4G (4th generation mobile communication system). There is no formal definition for what 4G is; however, there are certain objectives that are projected for 4G. These objectives include: that 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. The term 4G is used broadly to include several types of broadband wireless access communication systems, not only cellular telephone systems. While neither standards bodies nor carriers have concretely defined or agreed upon what exactly 4G will be, fourth generation networks are likely to use a combination of WiMAX and Wi-Fi technologies.

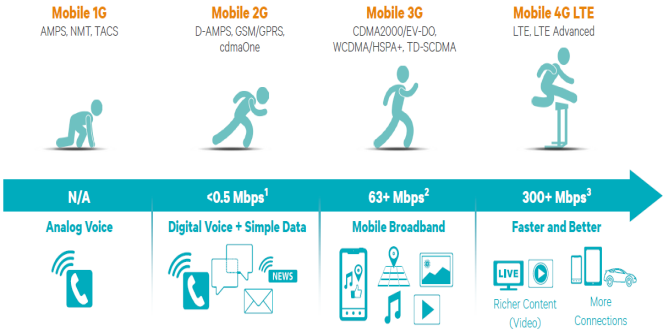

Fig.1.1 Evolving mobile technologies

Evolving Mobile Technologies

The history and evolution of mobile service from the 1G (First generation) to fourth generation is discussed in this section.

A. 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.

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. All the standards belonging to this generation were commercial centric and they were digital in form. The second generation of wireless mobile communication systems was a huge success story

because of its revolutionary technology and the services that brought to its users. Besides high-quality speech service, global mobility was a strong and convincing reason for users to buy 2G terminals. 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. The third generation (3G) has been launched in several parts of the world, but the success story of 2G is hard to repeat.

II. FEATURES OF FOURTH GENERATION TECHNOLOGY

There are several reasons which are sufficient to answer a simple question- why do we need to adopt 4G technology? Below are some of the features of 4G which make it an "above all" technology.

A. High performance:
Industry experts say that users will not be able to take advantages of rich multimedia content across wireless networks with 3G. In contrast to this 4G will feature extremely high quality video of quality comparable to HD (high definition) TV. Wireless downloads at speeds reaching 100 Mbps, i.e. 50 times of 3G, are possible with 4G.

B. Interoperability and easy roaming:
Multiple standards of 3G make it difficult to roam and interoperate across various networks, whereas 4G provides a global standard that provides global mobility. Various heterogeneous wireless access networks typically differ in terms of coverage, data rate, latency, and loss rate. Therefore, each of them is practically designed to support a different set of specific services and devices, 4G will encompass various types of terminals, which may have to provide common services independently of their capabilities. This concept is referred to as service personalization.

C. Fully converged services:
If a user want to be able to access the network from lots of different platforms: cell phones, laptops, PDAs he is free to do so in 4G which delivers connectivity intelligent and flexible enough to support streaming video, VoIP telephony, still or moving images, e-mail, Web browsing, e-commerce, and location-based services through a wide variety of devices. That means Freedom for consumers.

D. Low cost:
4G systems will prove far cheaper than 3G, since they can be built atop existing networks and won't require operators to completely retool and won't require carriers to purchase costly extra spectrum. In addition to being a lot more cost efficient, 4G is spectrally efficient, so carriers can do more with less

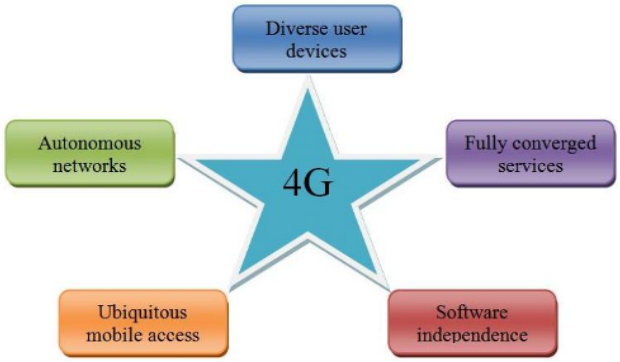

Fig 1.2 Key features of 4G

E. Devices: more user friendly interface:
4G devices are expected to be more visual and intuitive rather than today's text and menu based systems. They will be able to interact with the environment around it and act accordingly.

F. Enhanced GPS Services:
In addition to locating individuals, a 4G version of GPS tech might be able to let people be virtually present in a variety of places.

G. Scalability:
It is most challenging aspect of the mobile networks. It refers to ability to handle ever increasing number of users and services. Since an all IP core layer of 4G is easily scalable, it is ideally suited to meet this challenge.

H. Crisis-Management applications:
Natural disasters can affect the entire communications infrastructure is in disarray. Restoring communications quickly is essential. With wideband wireless mobile communications Internet and video services, could be set up in hours instead of days or even weeks required for restoration of wire line communications.

III. SCOPE IN 4G

There are several technologies suggested to deploy in the 4G and these may include:
• Software Defined Radio (SDR): is a radio communication system where components that have
typically been implemented in hardware (i.e. mixers, filters, amplifiers, modulators/demodulators, detectors. etc.) are instead implemented using software on a personal computer or other embedded computing devices.
• Orthogonal frequency-division multiplexing (OFDM): is a frequency-division multiplexing (FDM) scheme utilized as a digital multi-carrier modulation method.

• Multiple-input and multiple-output, or MIMO), is the use of multiple antennas at both the transmitter and receiver to improve communication performance.
• Time Division-Synchronous Code Division Multiple Access, or TD-SCDMA, is a 3G mobile telecommunications standard, being pursued in the People's Republic of China by the Chinese Academy of Telecommunications Technology All of these delivery methods are typified by high rates of data transmission and packet-switched transmission protocols. 3G technologies, by contrast, are a mix of packet and circuit-switched networks

With 4G, a range of new services and models will be available. These services and models need to be further examined for their interface with the design of 4G systems. The process of IPv4 address exhaustion is expected to be in its final stages by the time that 4G is deployed. Therefore, IPv6 support for 4G is essential in order to support a large no. of wireless- enabled devices. IPv6 removes the need for NAT (Network Address Translation) by increasing the no. of IP addresses. With the available address space and number of addressing bits in IPv6, many innovative coding schemes can be developed for 4g devices and applications that could help in the deployment of 4G network and services. The fourth generation promises to fulfil the goal of PCC (personal computing and communication) - a vision that affordably provides high data rates everywhere over a wireless network. In the future wireless networks there must be a low complexity of implementation and an efficient means of negotiation between the end users and the wireless infrastructure. The Internet is the driving force for higher data rates and high speed access for mobile wireless users. This will be the motivation for an all mobile IP based core network evolution.

IV. Conclusion

This paper provided an overview of the 4G evolution and technologies. 4G will certainly add perceived benefit to an ordinary person's life over 3G. 4G will be an intelligent technology that will interconnect the entire world seamlessly. Projected 4G mobile communication system will reduce number of different technologies to a single global standard. Technologies are evolving every day and night but the final success of 4G mobile communication will depend upon the new services and contents made available to users. These new applications must meet user expectations, and give added value over existing offers.

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