4G Wireless Network Revolution

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***Abstract*—. In 4G mobile technology is the next step in this direction. 4G communication systems is the next generation of wireless networks that will totally replace 3G communication networks. 4G is the fourth generation of broadband cellular network technology, succeeding 3G. A 4G system must provide capabilities defined by ITU in IMT Advanced. It is supposed to provide its customers with better speed and all IP based multimedia services. 4G communication systems 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" in the world. 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 communication systems 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: TDMA, FDMA, GPS 4G, 3G, VoIP, Wi-Fi, Wi-Max, PoC, CDMA, GPRS,.

I. INTRODUCTION

New mobile generations have appeared about every ten years since the first move from 1981 analog (1G) to digital (2G) transmission in 1992. This was followed, in 2001, by 3G multi-media support, spread spectrum transmission and, at least, 200 kbit/s peak bit rate, in 2011/2012 to be followed by "real" 4G, which refers to all-Internet Protocol (IP) packet-switched networks giving mobile ultra-broadband (gigabit speed) access 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 (4^{th} 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. [1] 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 [2].

Systems .Fig.1 demonstrates the seamless connectivity of the networks.

Fig. 1. Seamless connections of networks[3].

II. BEFORE 4G

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

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 [3]. 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 it

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.

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	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. 2. Series of mobile generations and their features.

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 (ref. to fig. 2).

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.

Fig.3. Evolution of 4G technology

III. 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. [4].

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 [5].

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.4. 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 Internetand video services, could be set up in hours instead ofdays or even weeks required for restoration of wireline communications.

IV. CHALLENGES IN MIGRATION TO 4G

A. Multimode user terminals

With 4G there will be a need to design a single user terminal that can operate in different wireless networks and overcome the design problems such as limitations in size of the device, its cost and power consumption. This problem can be solved by using software radio approach i.e. user terminal adapts itself to the wireless interfaces of the network.

B. Selection among various wireless systems.

Every wireless system has its unique characteristics and roles. The proliferation of wireless technologies complicates the selection of most suitable technology for a particular service at a particular place and time. This can be handled by making the selection according to the best possible fit of user QoS requirements and available network resources [6].

C. Security

Heterogeneity of wireless networks complicates the security issue. Dynamic reconfigurable, adaptive and lightweight security mechanisms should be developed [6].

D. Network infrastructure and QoS support

Integrating the existing non-IP and IP-based systems and providing QoS guarantee for end -to-end services that involve different systems is also a big challenge.

E. Charging/ billing

It is troublesome to collect, manage and store the customers' accounts information from multiple service providers. Similarly, billing customers with simple but information is not an easy task.

F. Attacks on application level

4G cellular wireless devices will be known for software applications which will provide innovative feature to the user but will introduce new holes, leading to more attacks at the application level.

G. Jamming and spoofing

Spoofing refers to fake GPS signals being sent out, in which case the GPS receiver thinks that the signals comes from a satellite and calculates the wrong co-ordinates. Criminals can use such techniques to interfere with police work. Jamming happens when a transmitter sending out signals at the same frequency displaces a GPS signal.

H. Data encription

If a GPS receiver has to communicate with the central transmitter then the communication link between these two components is not hard to break and there is a need of using encrypted data.

V. WAR BETWEEN WIMAX AND LTE

WiMAX and LTE are the two technologies which are considered as the part of pre-4G. Operators are trying to decide on the best standard to invest in the long run and there is a continuous debate between WiMAX and LTE. LTE has the following advantages:

- It is quite fast with data rates of 100Mbps (download) and 50Mbps (upload).
- It can heal the GSM/CDMA rift that has divided the industry.
- LTE will have lower latency, which makes real-time interaction on high band-width applications using mobiles possible.

3GPP LTE, one of the most advanced mobile communication technologies to date, is currently undergoing 4G technology standardization by the 3GPP. This is the most likely technology to become the 4G standard, as many of the world's major operators and telecommunications companies are members of LTE/SAE (Long Term Evolution/System Architecture Evolution). These companies include operators, such as Vodafone, Orange, T-Mobile, NTT DoCoMo, China Mobile and Telecom Italia and vendors, Ericsson, Nortel, Alcatel-Lucent, Nokia Siemens and LG Electronics.

WiMAX has certain advantages mainly over the Fiber to the home (FTTH) technology. When bundled with broadband internet access and IPTV, a WiMAX triple play becomes very attractive to residential subscribers. Given the QoS, security and reliability mechanisms built into WiMAX, the users will find WiMAX VoIP as good as or even better than voice services from the telephone company [11].

VI. 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.
- Universal Mobile Telecommunications System (UMTS), standardized by 3GPP.
- 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 [11].

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.

VII. CONCLUSION

This paper provided an an informatuion about 4G evolution and technologies. 4G communication will certainly add perceived benefit to an ordinary person's life over 3G. 4G communication 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. Since 4G is a collection of wireless standards, the final form of a 4G device will constitute various standards. This can be efficiently realized using SDR technology, which is categorized to the area of the radio convergence.

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] Jawad Ibrahim, "4G Features" Bechtel Telecommunications Technical Journal, December 2002.

[4] K.R.Santhi, Prof.V.K.Srivastava, G.SenthilKumaran, "Goals of True Broad band's Wireless Next Wave (4G-5G)" 0-7803-7954-3/03/2003 IEEE.

[5] Simone Frattasi, Hanane Fathi, Frank H.P Fitzek, and Ramjee Prasad, Aalborg University, Marcos D. Katz, Samsung Electronics, "Defining 4G Technology from the User's Perspective", IEEE Network • January/February 2006.

[6] Suk Yu Hui and Kai Hau Yeung, City university of Hong Kong, "Challenges in the Migration to 4G Mobile Systems".