Comparison of 4G Wireless Technologies and Their Challenges

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***Abstract*—The wireless communication among people is increasing day-by-day. Mobile has made important impacts especially among youngsters. Wireless standards are introduced to improve this impact across the world. Like the generations of people the wireless phone have life of their own. Evolution of wireless standards now reached the fourth generation (4G). This paper covers the challenges that discourage 3G to jump into 4G and the comparative study between the different generations.**

Index Terms— Generations, Station, System, Service, Comparison

1. INTRODUCTION

Wireless communication is the transfer of information over a distance without the use of enhanced electrical conductors or "wires". The distances involved may be short or long. When the context is clear, the term is often shortened to "wireless"[1]. Cell phones and network systems are classified by generation of wireless technology.

The generation of wireless technologies as,
0G- Great-Grandparents
1G- Grandparents
2G–Parents
3G –Children

The first generation(1G) cellular phone is used to make only voice calls and is introduced in 1980's.The 1G grown into second generation(2G) phones are used to connect people digitally in late 1980's. The new technologies have been introduced to help 2G such as 2.5G and 2.75G. During the evolution from 2G to 3G, wireless systems such as GPRS(General Packet Radio Service), IMT-2000, Bluetooth, WLAN, and HiperLAN, have been developed[3]. 3G systems are introduced to help multimedia communication systems. It is originated in 2000. The different technologies have been used to make these generations work effectively.

4G wireless technologies are implemented in more than 45 countries[2]. 4G will be described simply as "MAGIC"(Mobile multimedia, Any-where, Global mobility solutions over, integrated wireless and Customized services) . It is considered to have data bandwidth of 200 Mbps. 3GPP LTE, one of the most advanced mobile communication technologies to date, is currently undergoing 4G technology standardization by the 3GPP[3]. The following figure represents the evolution of wireless technologies.

2. TECHNOLOGIES USED

The wireless technologies are developed using the various standards. The technologies will not work separately, but will offer some interconnectivity between them. The emerging 4G wireless technologies are

The pre-4G 3GPP Long Term Evolution (LTE) technology is often branded "4G-LTE", but the first LTE release does not fully comply with the IMT-Advanced requirements. LTE has a theoretical net bit rate capacity of up to 100 Mbit/s in the downlink and 50 Mbit/s in the uplink if a 20 MHz channel is used — and more if multiple-input multiple-output (MIMO), i.e. antenna arrays, are used. The physical radio interface was at an early stage named High Speed OFDM Packet Access (HSOPA), now named Evolved UMTS Terrestrial Radio Access (E-UTRA)[3].2.2. WiBro:

802.16 are better known as WiMAX (Worldwide Interoperability for Microwave Access) or WiBro (Wireless Broadband)**.** This technology supports speeds as high as 70Mbps and a range of up to 48 kilometres. The IEEE 802.16 standard is versatile enough to accommodate time division multiplexing (TDM) or frequency division duplexing (FDD) deployments and also allows for both full and half-duplex terminals. It uses microwave radio technology to connect computers to the Internet. The user within 3 to 5 miles of the base station will be able to establish a link using non line-of-sight (NLOS) technology with data rates as high as 75Mbps while user up to 30 miles away from the base station with an antenna mounted for line-of-sight (LOS) to the base station will be able to connect at data rates approaching 280Mbps[3,4].

3. PROBLEMS RAISED WHEN SWITCHING OVER 4G FROM 3G

The challenges may rise in 3 different ways when switching from 3G to 4G wireless technology. The following figure shows the challenges when migration[5].

Fig2. Challenges when migrating to 4G

3.1. STATION

3.1.1. Multimode user terminal

4G wireless systems have ability to work with several different networks to reduce operational, power consumption and simplify the style problems. The accessing of these networks in chorus creates a major issue. One of the solutions to solve this problem is to use multi-mode devices. This can be achieved by adapting the end-user terminal to various wireless interfaces of networks.

3.1.2. Searching of Wireless system

Owing to the heterogeneity of 4G networks, devices have the need to process signals from the available service providers and connect to applicable service providers. It may be incompatible to each other. One of the ways to solve the problem is system-initiated discoveries. Another approach to solve this problem is to connect using overlay network.

3.1.3. Selection of Wireless system

4G user terminal will have the support to select the accessible wireless network. Each network will have the selection pattern for applicable network that might optimize the system performance and resource usage. To solve this problem, information of the mobile network and location information is known to the node.

3.1.4. Uncomfortable roaming

The roaming cost and its frequencies have to be considered when the user is travelling. So the user has to return to the 3G network. To handle this, the cross-frequency chip-sets may be the possible solution.

3.2. SYSTEM

3.2.1. Terminal flexibility

As per the slogan "Any Time Any Where", 4G network should have the terminal mobility environment. It allows the clients to roam across the geographic countries. It also has 2 concerns. Location management involves information about roaming like QoS(Quality of Service), authentication information. Handoff management handles the ongoing communication in roaming. A binding between the home address and care-of address is said to home agent to support continuous communication. Many problems arose from this method like system load, packet losses, and system performance. Researchers are currently working on vertical and horizontal hand-off method.

3.2.2. Infrastructure

The existing wireless system may be differentiated by 2 types: non-IP based for voice delivery and IP-based system for data services. While integrating the 4G wireless system, QoS is considered importantly in time-sensitive and multimedia applications. 3GPP has proposed a complete QoS design for UMTS(Universal Mobile Telecommunication System). Although, it doesn't provide the guaranteed end-to-end QoS as a result non-UMTS are involved.

3.2.3. Safety issues

4G network is developed by reusing the existing features of 3G wireless network but still working on some quality and relinquishing measures. The heterogeneity of 4G network complicated the exchanging information by security and privacy issues. One approach is to change the existing security and privacy methods while another approach is to develop light-weight and dynamic reconfigurable mechanism.

3.3. SERVICE

3.3.1. Reality will come to true

Many countries implemented 4G wireless network successfully but not still it is not executed in various states like India. We hopefully expect in near future system.

3.3.2. Billing

Due to the heterogeneity and frequent interaction, 4G network unable to give the detailed information about charging. The research community addressed this concern and proposed several frameworks to handle the customers' billing and user account information [6, 7].

3.3.3. Personal Mobility

It concentrates on the travelling of users without altering the existing servers in heterogeneous system. In case of video message addressed to the mobile user, it will be send correctly. Mobile-agent-based infrastructure is one of the extensive solutions for this infrastructure. This agent will migrate according the movement of the users.

4. COMPARISON OF 4G WIRELESS TECHNOLOGY

A comparative study is provided for the wireless technology based on various factors. The table1 shows the comparative study.

Table 1. Comparative study of wireless technology

Technology / Factor	1G	2G/2.5G	3G	4G
Year of starting	1970	1980	1990	2000
Year of implementation	1982	1991	2002	2011
Purpose	Analog	Digital	Packet data	Broadband data
Running at	14.4 Kbps	14.4 Kbps/171.2 Kbps	3.1 Mbps	100-300Mbps
Bandwidth	2 Kbps	14-64 Kbps	2Mbps	200 Mbps

Technologies used	AMPS	TDMA, CDMA, GPRS, EDGE	CDMA 2000,UMTS, HSPA	LTE Advance, Wi-Max
Connection	PSTN	PSTN	Packet Network	Internet
Switching Technique	Circuit	Circuit	Packet (not air interface)	All Packet
Servicing	Voice	Voice and Data, SMS, MMS	Integrated high quality 2G services	Dynamic information access

5. CONCLUSION

This paper reviewed the concepts of various generations of wireless network. In the development of the generation, there are various challenges that may arise when we migrate to 4G. The comparison is made to give the overall representation of the generations. We all look forward for the future analysis of 4G network to overcome the challenges in migration and for the execution of the network at every time from everywhere and by everybody. We can expect grandchildren soon to all places.

Though there are many challenges in migration to 4G. Many countries have employed 4G technology and they are going for the implementation of 5G and so on. South Korea is building $1.5 billion 5G service that can download movies in second[8]. There is also scope for the future generations such as 6G, 7G…

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