4G Wireless Networks: Opportunities and challenges

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ABSTRACT

4G is the fourth generation of broadband cellular network technology, succeeding 3G. A 4G system must provide capabilities defined by ITU in IMT Advanced. Potential and current applications include amended mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing, and 3D television. The first-release Long Term Evolution (LTE) standard (a 4G candidate system) has been commercially deployed in Oslo, Norway, and Stockholm, Sweden since 2009 4G is still passing through research and therefore there are some problems that need to be fixed in order to benefit the users from it fully. In this report we discuss various challenges 4G is facing and solutions to those problems are discussed. We propose our own way of improving QoS in 4G by using combination of mobility protocol SMIP and SIP. We propose that by using such scheme we can achieve better QoS during the process of handover.

1. INTRODUCTION

Looking at the ecological process that mankind has passed through; it is quite evident that communication is one of the basic requirements. It is predicted that when humans came into existence on earth they did not know how to communicate with each other. They couldn‟t speak any language, they had no idea of the use of body language and it was even more difficult to communicate with people who were at some distance. Because of the fact that they couldn‟t communicate they had to face all the hardships individually.

But gradually as they started to learn techniques of communicating with each other their life started to improve and they started to discover new methods of communicating with distant members of the community. But it wasn‟t an easy task at all. Because they had no knowledge of any mean of communication, but something had to be done so the they started using different techniques such as lighting the fire, animal's skin, use of different color stones for different messages. That laid the basic ideas for the development in communication technology. Resulting in various communication environments these days. One of such environments is the Mobile communication.

.First generation of network came into use for the first time inJuly1978 inUSA.1Gconsisted of distributed transceivers that helped in communicating with mobile phone. The structure of the mobile phone was analogue and it could only be used for voice traffic. For the transmission of signals frequency modulation was in use. It is called the edge because it is the node furthest away from the core (wired network) and closest to the access (wireless part) node.

Figure 1. 3G applications

2. 4G

The mobile users demand for more and more sophisticated and compact devices, therefore the manufacturers are emphasizing on smaller devices with increased processing and high level security. Although current3Gdevices are good But still there exists room for improving image processing and speed of processor so that they can be used for high demanding 4G applications.The applications like 3D games, high definition camcorders and larger mega pixels cameras need efficient application processors . Fourth generation (4G) also called Next Generation Network (NGN) offers one platform for different wireless networks. These networks are connected through one IP core. 4G integrates the existing heterogeneous wireless technologies avoiding the need of new uniform standard for different wireless systems like World Wide Interoperability for Microwave Access (WiMAX), Universal Mobile Telecommunications System (UMTS), wireless local area network (WLAN)and General Packet Radio Service(GPRS). 4G networks will increase the data rates incredibly, by providing 100Mbps to 1Gbps in stationary and mobile environment respectively .In 4G the latency will be decreased considerably, because of all IP environments. 4Gcan be considered as a global network where users can find voice, data and video streaming at anytime and anywhere around the globe. In

4Gthe integration of network and its applications is seamless therefore there is no risk of delay. While implementing4G the cost issue needs to be taken into consideration so that users can benefit from this technological development fully.

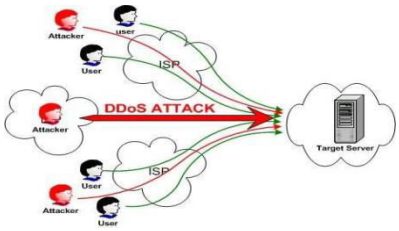

Figure: 2.4G network

3. Security in 4G

Humans have been striving for security right from the beginning of the universe or the human life. It has changed its nature through different phases humans have witnessed but in none of the phase its utmost importance can be denied. Either it is security for life, wealth, land or any other type; it is always one of the priorities humans have. Security is applicable to all the areas of human life, its scope cannot be modified to some particular area. No matter how much humans work on improving security but the threat is always there and there always exists room for improvement.

Security in digital world means to protect the digital systems from criminal and unauthorized usage. In terms of computers and mobile communications the need for security has increased overwhelmingly with the improvement in technology. Some decades ago when first generation of mobile networks were in use the concept of security was not so much in practice or we can say that awareness was not that much highlighted. But as technology kept on improving and new advents were introduced the need of security kept on creeping. These days no one likes to be insecure digitally. Because of the heavy dependence on digital media for the use of private, sensitive, financial and important communication. There can be many attacks on digital data some of them are eavesdropping, man in the middle attack, denial of service (DOS) attack, spoofing and lot more.

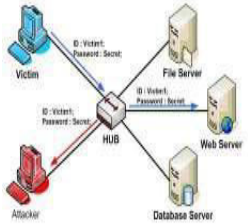

Figure 3 Eavesdropping

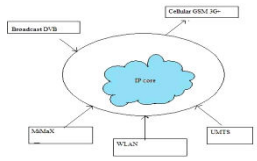

Figure 4. Denial of Service

Traditionally network security is considered to secure network edges from external attacks. Unfortunately this is not sufficient as attackers look for breaches in network protocols, operating systems and applications. Therefore we need a comprehensive security mechanism that can protect the whole network
downlink.

4. Security architecture

IP Multimedia Subsystem (IMS) is independent of the access technologies, therefore 4G security can be observed under lights of IMS security. Like IMS4G security is based on access view security where the first hop is secured to access the network, 4G core view security and interconnecting view security. As 4G is mixture of heterogeneous networks therefore it supports many business roles that range from regional network operators to service providers. The interoperations interfaces that can be prone to security attacks .In order to provide protection against this aspect of attack 4G introduce security gateways (SEGs) which facilitates security between domains

5. ITUTX.805

International Telecommunication Union developed X.805 model based on BellLab Security Model. X.805 works on modular approach and provides security against all possible threats for end system network security. There are eight security dimensions that further increase the resistance to vulnerabilities.

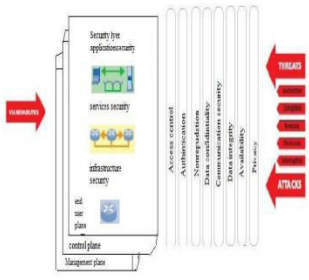

Figure 5. X.805 security model

4G LTE = IMT-A = LTE-A: Is the new 4G technology. As shown in the table below, LTE-A can provide as

much as 10x the speed (both uplink and downlink) of LTE. In addition, latency is also lower.

	WCDMA (UMTS)	HSPA HSDPA / HSUPA	HSPA+	LTE	LTE ADVANCED (IMT ADVANCED)
Max downlink speed bps	384 k	14 M	28 M	100M	1G
Max uplink speed bps	128 k	5.7 M	11 M	50 M	500 M
Latency round trip time approx	150 ms	100 ms	50ms (max)	~10 ms	less than 5 ms
3GPP releases	Rel 99/4	Rel 5 / 6	Rel 7	Rel 8	Rel 10
Approx years of initial roll out	2003 / 4	2005 / 6 HSDPA 2007 / 8 HSUPA	2008 / 9	2009 / 10	
Access methodology	CDMA	CDMA	CDMA	OFDMA / SC-FDMA	OFDMA / SC-FDMA

WiMax is the other alternative to LTE-A, but WiMax is less appealing compared to LTE-A. LTE-A will use OFDMA and MIMO technologies, with more antenna additions. LTE-A utilizes carrier aggregation technique to boost transmission capacity. IMT-A sets the maximum channel bandwidth as 100MHz.

LTE-CoMP: LTE-A includes LTE-CoMP (co-ordinated multipoint) which turns inter-cell interference into useful signal. LTE-CoMP refers to the dynamic coordination of transmission and reception among different base stations.

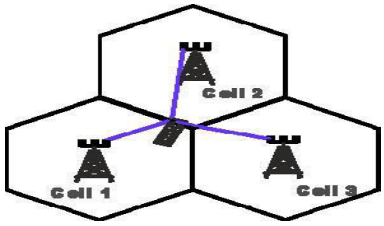

Figure:6 LTE-CoMP allows multiple eNBs coordination

LTE-CoMP allows the mobile at the edge of a cell to be served by 2 or more eNBs to improve signal transmission and reception thereby increasing throughput especially under cell edge situations. Intelligence is added to LTE-CoMP such that multiple simultaneous transmission of user data from multiple eNBs to a single mobile station and the dynamic cell selection with data transmission from a single eBN.

LTE-A Relaying: Its purpose is to enhance wireless coverage and capacity. One of the hard issues is dealing with poor signal conditions at cell edges. LTE relays actually demodulate and decode the received signal, apply any necessary error correction and then retransmit an entirely new signal. This "relay" provides a clean signal to be propagated out again. A mobile station actually talks to the relay node, which in turn communicates with an eNB, hence the term "relay". Relay nodes are fixed elements, they do not move unlike the mobile station.

4G LTE Coverage & Services: We will now look at the 4G LTE providers in the USA, i.e., VERIZON and AT&T. Verizon claims that its' 4G LTE coverage include over 175 cities and supports over 186 million users in the USA. Verizon identifies several applications of 4G LTE, such as transportation, emergencies, distribution, health care, utility industries, construction sector, financial services, manufacturing, etc. For mobile broadband devices, Verizon charges $30/month for 2GB. Verizon LTE smart phones operate at the LTE 700 MHz band, with CDMA 1xEVDO/3G at 800 and 1900 MHz band.

most 4G markets are targeted at the east coast of USA, in particular, major cities where population concentration is important. Also, Verizon 3G coverage has been predominantly covering the whole of USA, with the exception of some rural areas.

6. CONCLUSION

4G wireless networks not only enable more efficient, scalable, and reliable wireless services but also provides wider variety of services. These opportunities come with a need for rethinking our security, privacy, architect and billing technologies have been used for previous generations. We believe, however, that future research will overcome these challenges and integrate newly developed services to 4G networks.

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