

COMPARISON BETWEEN NETWORKS LTE AND WIMAX

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ABSTRACT

With the development of high-speed mobile broadband access technology, there are two emerging technologies: Long Term Evolution (LTE) and WiMAX. Both of them have similar goals, specifically to provide high data rate wireless network connection for cell phones, laptops. WiMax and LTE technologies are the main competitors in the mobile communication domain, there are lots of technical similarities between the two technologies in architecture and targets. Both uses OFDMA with flat-IP architecture. This paper presents the network architecture and Quality of Service (QoS) and Security For both technologies, In addition this paper illustrates the comparison of these two technologies using Riverbed Modeler 18.5 network simulator. The evaluation of the network performance for two technologies is done on the basis of analyze the transmission rates(voice traffic send / resaved), the simulation results obtained, show that the performance of the LTE network is better than WiMAX network.

Keywords: Wireless Communication, WiMAX, LTE, 4G .

1. INTRODUCTION

In the last two decades the growth of subscribers in telecommunication networks has been exponential. First approaches of wireless telecommunications networks in 1980s were analog (1G) and have been replaced by digital approaches. The digital wireless telecommunication networks (2G) started with a circuit-switched (CS) approach called GSM (Global System for Mobile Communication). The CS approach was well known from the fixed telephony system and allowed the compatibility of both systems. As the Internet and the Mobile Services emerged and the

performance of Embedded Systems increased new services were available [1]. The continuous growth of subscribers lead to several GSM extensions and lead finally to UMTS (Universe Mobile Telecommunications System, also known as 3G) which was standardized by 3GPP (3rd Generation Partnership Project). Wireless industry continues to change at very high speeds, tending to use the equipment more easily and safely and with a connection speed that tends to be higher and higher. Users of 3G wireless networks are looking forward to the launch of the new 4G standard. WiMax and LTE technologies are the main competitors in the mobile communication domain. 4G is an integrated system based entirely on IP technology, able to provide users with data, voice and multimedia services anywhere and anytime, with transfer rates up to 1Gb/s with high security and quality [2]. The developing of the standard has as its main goals: meeting the need for broadband of the users of mobile broadband services; multimedia messaging services; digital video; HDTV and VOD; transfer rate between any two points in the world of 100Mb/s; interoperability with the existing mobile standards 2G, 3G, 3.5G . During November 2004, 3GPP launched the LTE project, which focuses on enhancing Universal Terrestrial Radio Access (UTRA) and optimizing 3GPP's radio access architecture in order to compete with WiMAX. . WiMAX (worldwide interoperability for microwave access) was created by the WiMAX Forum based upon the IEEE, 802.16 standard. WiMAX can provide high data rate wireless Internet access and telephony services for the users [3]. The forum describes WiMAX as "a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL". [2] While

LTE has focused on the needs of the current mobile operators . The rest of this paper is organized as follows, the next section show system architecture, Section 3 explains Quality of Service (QoS) and Security to both technologies, Section 4 describe the simulation platform of the two systems (LTE and WiMAX) using OPNET modeler , Section 5 include the simulation results and analysis of results, Section 6 will conclude the paper.

2. SYSTEM ARCHITECTURE

LTE and WiMAX system architectures are optimized for packet data in order to support the increasing amounts of data traffic. Compared with existing wide area cellular system's architectures, they provide improved respond times and both of these are all-IP backbone.

a. WiMAX SYSTEM

The WiMAX network model consists of the following entities: the subscriber station (SS), the access service network (ASN) which comprises the base station (BS) and the Access Service Network (ASN) gateway and the connectivity service network (CSN) which consists of visited network service provider and home network service provider. Fig.1 shows the WiMAX network reference model.

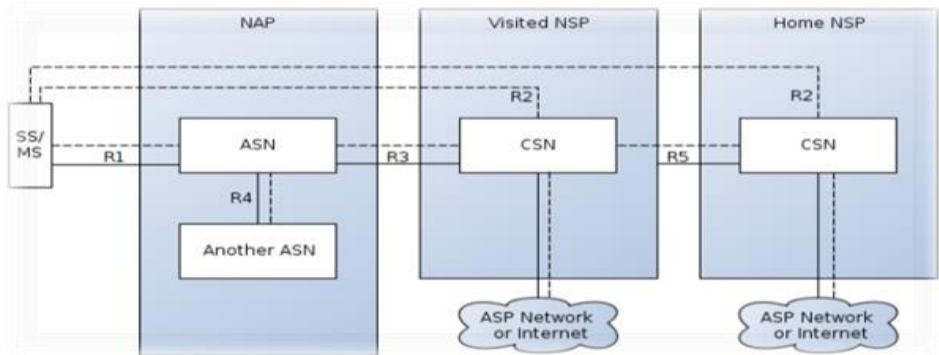


Figure 1. WiMAX Network Reference Model,[4]

- Mobile Station(MS)/SS: The Mobile is mobile equipment that provides wireless connectivity of one or more hosts to the WiMAX network. may be mobile or fixed and may be located
- ASN (Access Service Network): This is the area of the WiMAX network that forms the radio access network at the edge and it comprises one or more base stations and one or more ASN gateways.
- CSN Connectivity Service Network Another: This part of the WiMAX network provides the IP connectivity and all the IP core network functions. It is what may be termed the core network in cellular parlance. Main functions of the CSN:
 1. Establish the connections between subscribers and assign IP addresses for the
 2. Perform the Internet access.
 3. Use the AAA agent or server.

4. Control the user system parameters-based QoS and license.
 5. Establish and manage tunnels between the ASN and the CSN.
 6. Perform the subscriber accounting and settlement.
 7. Perform the inter-ASN mobility management.
- Base Station (BS): It is responsible for providing the air interface to the subscriber and mobile stations. It provides additional functionality in terms of micro-mobility management functions, such as handoff triggering and tunnel establishment
 - Reference Points: The reference points (R1-R5), as shown in figure 1, Those RPs introduce interoperability points between equipments from different vendors. In the scope of the Release 1 WiMAX network architecture, there are six mandatory RPs (R1 to R6) and two informative RPs (R7 and R8).

b. LTE ARCHITECTURE

Wireless operators are rapidly expanding their LTE networks to take advantage of additional efficiency, lower latency and the ability to handle ever-increasing data traffic. The core technologies have moved from circuit-switching to the all IP evolved packet core, As prior telecommunication networks LTE divides these nodes into two different planes. The SAE GW (System Architecture Evolution Gateway) operates in the user plane (UP), whereas the MME (Mobility Management Entity) is used in the control plane (CP), the LTE architecture consists of 4 different domains, as figure 2 shows.

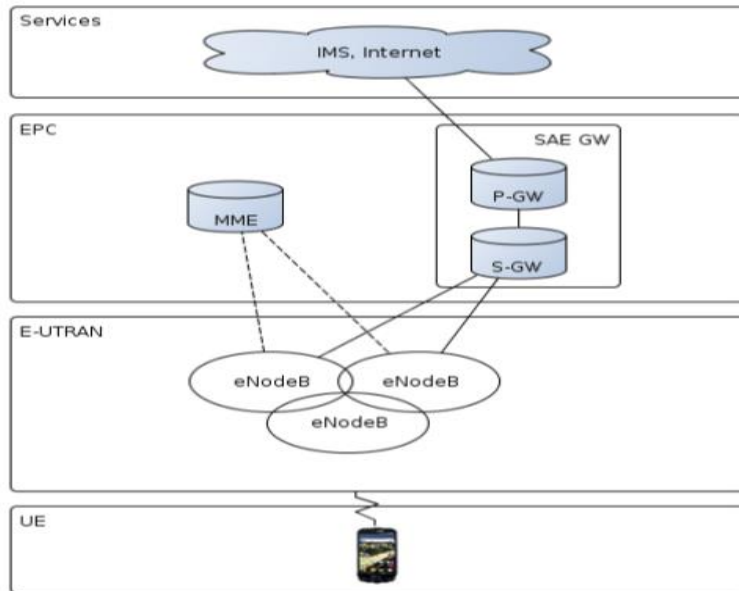


Figure 2. LTE System Architecture for E-UTRAN only, adapted from [5]

- User Equipment Domain: The user equipment domain contains the UE (User Equipment) which is the device that connects the end user to the access network. The UE is usually a mobile device or a data modem.
 - E-UTRAN Domain: E-UTRAN (Evolved Universal Terrestrial Radio Access Network) is the access network of LTE. It contains the eNodeB (E-UTRAN NodeB) which is an enhanced base station. The eNodeB is a key entity with multiple roles in the LTE network.
- I. **Mobility Management Entity (MME):** The MME is the main control entity in the 3GPP LTE network. Furthermore, the MME is basically responsible for three functions, which are Authentication and Security, Mobility Management and Subscription Profile and

Service Connectivity Management. Authentication and Security: The UE is authenticated by the MME, to assure that it is who it claims to be. In this procedure the permanent identity of the UE is detected.

II. System Architecture Evolution Gateway (SAE GW): Another very important entity in the LTE network is the SAE GW, which operates in the user plane. The key function of the System Architecture Evolution Gateway is the transfer of the actual user data through the network. This includes data packets for VOIP, messaging or other Internet services.

- Serving Gateway (S-GW): Basically the S-GW is responsible for the tunnel management and switching and is directly connected to the eNodeB. It controls only its own resources and allocates them upon request of the MME or the P-GW. The S-GW plays a major role in the active handover when the UE is in connected mode. The MME commands the S-GW a tunnel switch from one eNodeB to another. For idle mode the S-GW terminates the downlink (DL) data path and triggers the paging when DL data arrives.

- Packet Data Network Gateway (P-GW): The P-GW is the connectivity point for the UE to external data packet networks. It provides highest level mobility support when a UE switches the S-GW. The Packet Data Network Gateway is also responsible for performing policy enforcement, gating and packet filtering.

- Services Domain: The services domain covers all services such as IMS (IP Multimedia Subsystem) or the Internet that are connected to the EPC Base Station and Mobility Configurations .

3. QUALITY OF SERVICE (QOS) AND SECURITY

a. Quality of Service (QoS)

The wimax mac layer has a connection-oriented architecture that is designed to support a variety of applications, including voice and multimedia services. wimax supports five types of qos: ugs (unsolicited grant service), rtps (real time polling service), ertps (extended real-time polling service), nrtps (non-real-time polling service and be (best effort service). the unsolicited grant service (ugs) is designed to support real-time service flows that generate fixed-size data packets on a periodic basis, such as t1/e1 and voice over ip without silence suppression. wimax mac is designed to support a large number of users, with multiple connections per terminal, each with its own qos requirement [6].

LTE supports "End-to-End" QoS, meaning that bearer characteristic are defined and controlled throughout the duration of a session between the mobile device (UE) and the P-GW. QoS is characterized by an index, QCI (QoS Class Identifier), and the parameter ARP (Allocation and Retention Priority). Bearer types belong to two main classes with guaranteed and non-guaranteed rates and LABELs specify in more detail what values of packet delay and loss can be tolerated for any given bearer [7].

b. Security

LTE specifies a new layering of security and the enforcement of a clearer separation of control plane security and user plane security providing strong security features. LTE has support for UEA1, UIA1, UEA2 (SNOW algorithm supporting 256 bits of keys) and UIA2. Signaling at UPE and MME relocation allows the transfer of algorithm information to target UPE, MME and UE [8].

WiMAX supports strong encryption, using Advanced Encryption Standard (AES), and has a robust privacy and key-management protocol. It supports Privacy and Key Management - PKMv1 RSA, HMAC, AES-CCM and PKMv2 – EAP, CMAC, AES-CTR, MBS Security. The AES and the 3DES are mandatory features and new high-performance coding schemes, such as TC and Low Density Parity Check (LDPC) are included. The system also offers very flexible authentication architecture based on Extensible Authentication Protocol (EAP), which allows for a variety of user credentials, including username/password, digital certificates, and smart cards .

4. SIMULATION ENVIRONMENT

Scenarios have been simulated for both WiMAX and LTE. We implement WiMAX and LTE networks on Riverbed Modeler 18.5, in the proposed simulation all scenarios have the same structure and topology, Note that the application segment size for mobile station is 64000, therefore, the speed of traffic sent is 64 kbps, Each scenario was run for 30 min (simulation time), analyze the handovers and data transmission rates(voice traffic send /

resaved) of WiMAX and LTE, and compare the performance of WiMAX and LTE. The network topology shown in Figure 3,4 consists of two WiMAX cells, an MS, a server, and a backbone router. The MS migrates from BS1 to BS2 based on trajectory, Table 1 shows Simulation Parameters used in simulation.

TABLE 1: SUMMARY OF FORMATTING REQUIREMENT FOR THE CONFERENCE PAPERS

Description	Value
Simulation Time	30 min
Number of eNodeBs	2
Number of BS	2
Number of MS	1
Application	VoIP

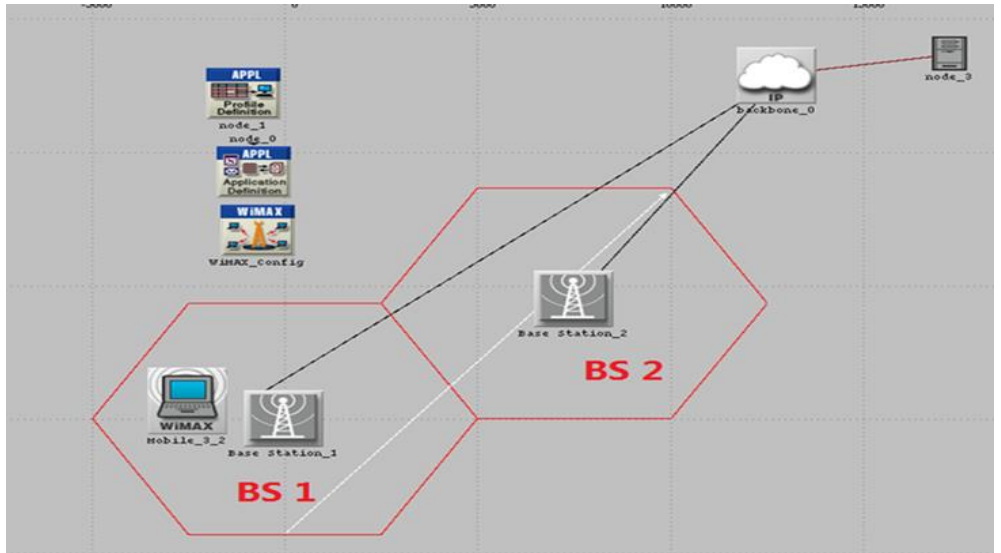


Figure 3. WiMAX Scenario 1.

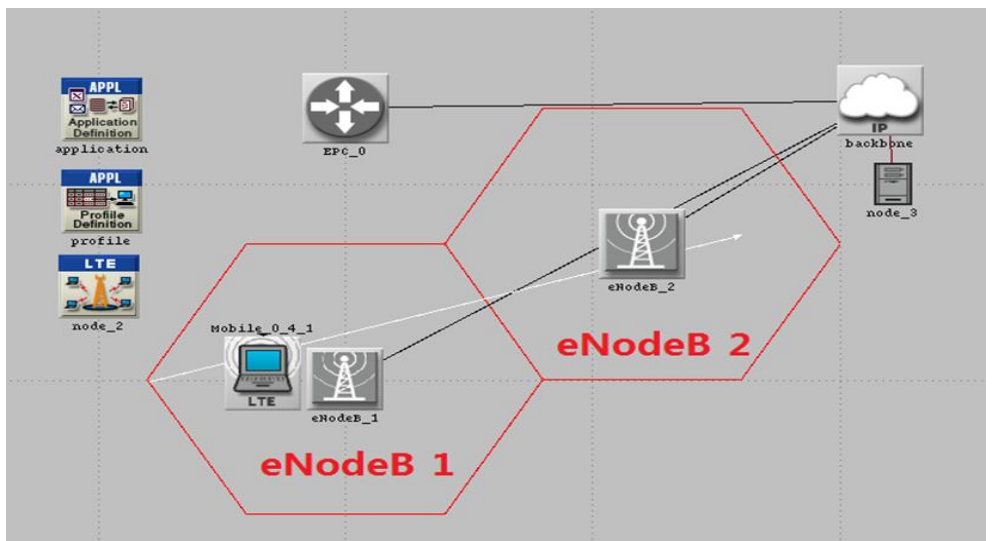


Figure 4. LTE Scenario 2

5. SIMULATION RESULTS AND DISCUSSION

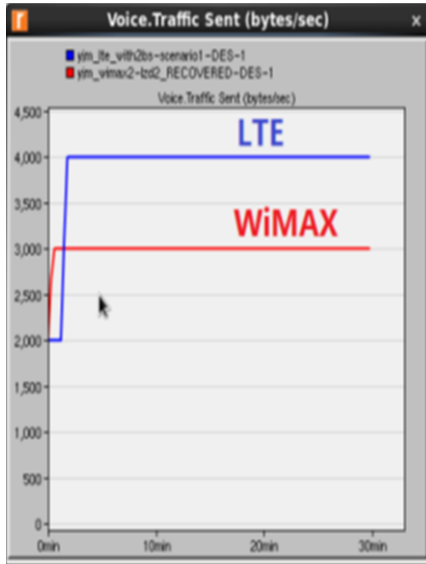
In this section, the results are obtained after implementing the WIMAX and LTE network simulation and the statistics are collected by using Riverbed Modeler 18.5, under two scenarios. The collected statistics from the simulation include, transmission rates(voice traffic send / resaved), Application and profile configurations, trajectory, traffic type, segment size (64000 bits/segment), and speed (10 m/s) are identical in WiAMX and LTEsimulations.

Fig 5 shows Comparison results of traffic transmission rate between WiMAX and LTE for Scenarios. Fig (5.a) show Voice traffic send for bothnetworks. value traffic send for wimax is 300 bytes/sec and LTE is 400 bytes/sec. Figure (5.b) illustrates the obtained results between Voice traffic received and simulation time, . The results indicate that LTE outperforms WiMAX in the presence of voice traffic sent, received, as shown in Table 2.

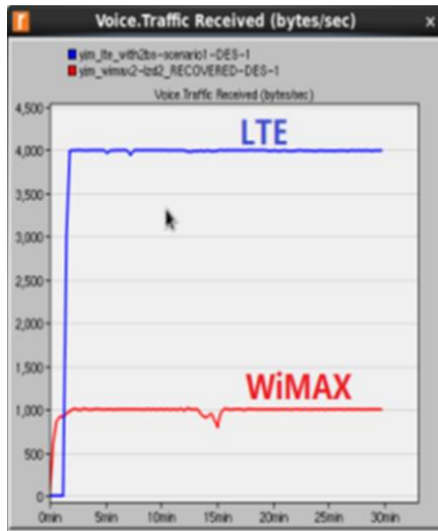
TABLE 2: RESULTS OF WIMAX AND LTE FOR SCENARIOS

Voice traffic sent (bytes/sec)	WiMAX	LTE
	3000	4000
Voice traffic received (bytes/sec)	1000	4000

In LTE network there was no loss of data sent. While in WiMAX network there is a large loss of data, where data sent was 3000 byte/sec and received 1000 byte/sec.



(a) Voice traffic sent.



(b) Voice traffic received.

Figure 5. Comparison of traffic transmission rate between WiMAX and LTE for Scenario.

6. CONCLUSION

4G networks are capable of providing faster data rates with lesser resource consumptions, In this paper illustrates the performance comparison of these two technologies WiMAX and LTE network using Riverbed Modeler 18.5 network simulator. We conclude that the system architecture of LTE and WiMAX network is quite similar in functionality. They both consist of radio access network and core network so that the subscribers can communicate with the Internet via these parts. Both systems are based on an all-IP network design, As shown in the discussion in section 3 . the discussion shows that Mobile WiMAX is superior to LTE in terms of security aspects in mobile enterprise networks. Additionally, The obtained results show that the LTE technologies are better from WiMAX technologies for voice traffic received.

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