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QoS Comparison between UMTS 3G Network and WIMAX 4G Network

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Abstract: ***Year by year communication networks are in continuous grow in coverage areas and technologies because of the growing in user's needs and requirements. The purpose of this paper was to compare the QoS between UMTS 3G network and WiMAX 4G networks. Two network models were proposed has objective of studying a realistic approach: in UMTS model multiple users are placed in the network requesting some applications and then the network traffic measured and calculated.. Regarding the WIMAX model scenario, where several users perform different services, enabling the analysis of network performance by measuring several parameters.***

Keywords: 3G, 4G, UMTS, WIMAX, QoS, OFDMA, TDMA, WCDMA

1. Introduction

Human took advantage Over the ages of the growth of knowledge from the surrounding environment and the discovery of the different laws of nature, in the development of communication Starting with communicating directly between the two parties (audio, visual), but time and distance and natural obstacles were factors to prevent direct communications, So people Introduced and developed several means to transfer the content of these messages (mail, telegrams, telephones, etc.) .

This was followed by the emergence of the idea of wireless networks which was initially used to have voice conversations only then evolved to audio and text, images and even later to the video conversations and video conferencing in the current time.

The purpose of wireless communications based on a simple idea which is fully dispensed for "wire" and the provision of telecommunications services for different users everywhere. On the other hand, the provision of services and the same features offered by wired telecommunications, and cover larger geographical areas (city-level). Of course, the data transfer rate(Data Rate) in wireless networks, less than in wired networks, and also suffers from problems such as security and protection, and the problems of overlapping waves (Interference). This development occurred as a result of the growing in numbers of the users of these networks and their needs, which led to the multiplicity of purposes and reasons for such use.

1.1 Methodology

There are different types of network simulators. But some of the simulation tools are complicated some are difficult to learn or to use . In this case the OPNET Modeler 14.5 used whichis easy to learn because it has well defined user interface andvery efficient to use. OPNET Modeler has user friendly graphical interface that is easy to use. For these reasons I have chosen this simulation tool. In this simulation, have designed two network models for both 3Gnetwork(UMTS) and 4G networks (WIMAX) and measure the performance of some parameters such as throughput, jitter, queuing delay and delay as well as meet the goal to analysis the QoS in 3G an 4G wireless networks.

1.2 Previous Studies

The success of 3G/4G and next generations of wireless technologies depend on the users' satisfaction and affordability for different services. The real time applications such as voice and video conferencing are highly delay and loss sensitive. Implementation ofQoS in the UMTS and WIMAX networks has a great role in order to meet the bounded delay and packet loss for the real time applications [5]. A research trend which aims to integrate UMTS and Wireless Local Area Network (WLAN) to benefit the high data rate and low cost of WLAN has much attracted research community and standardization bodies for the last few years. Recently, the Worldwide Interoperability for Microwave Access (WIMAX), a common name associated to the IEEE 802.16a/d/e wireless MAN standard [9], which provides specifications for an air interface for fixed, portable and mobile broadband wireless access networks, has not only addressed the last mile problem but also supported the nomadic and mobile clients on the go over the extended coverage area of cellular network [1].

In the recent years, some related research works have been done in this area.

2. UMTS and WIMAX

From basis of the first generation until now , communication technology promising Substantial innovations in the future, There was an accelerated growth in using communication service and Take advantage of the available bandwidth with the rapid development in communication technologies. Now a days the most used communication technologies in the majority of countries in the world are 3G(UMTS) and 4G(WIMAX).

2.2 Universal Mobile Telecommunication System

Is one of the third generation of mobile communications technology, which is also being developed to fourth generation technology. The most common form of UMTS, uses WCDMA International mobile communications with direct spread (IMT) as a front air to overlap, but this system also includes a Time-Division Multiple Access -- and Asynchronize Access Time to Code Division Multiple Access includes all of IMT, CDMA and TDD.

2.3 Worldwide Interoperability Microwave Access WIMAX:

Emerged as a potential alternative to cellular technology for wide-area wireless networks. Based on Orthogonal Frequency Division Multiple Access (OFDMA) and approved by the International Telecommunication Union (ITU) as an IMT-2000 (3G technology) under the name OFDMA Time Division Duplex (TDD) Wireless Metropolitan Area Network (WMAN), mobile WiMAX gained its greatest traction in developing countries as a fixed wireless alternative to wireline deployment.

WiMAX employs many of the same mechanisms as HSPA to maximize throughput and spectral efficiency, including high-order modulation, efficient coding, adaptive modulation and coding as well as Hybrid Automatic Repeat Request (HARQ).The principal difference from HSPA is IEEE 802.16e-2005's use of OFDMA. In 5 to 10 MHz radio channels, there is no evidence indicating that WiMAX will have any performance advantage compared with HSPA+. With respect to spectral efficiency, WiMAX is comparable to HSPA+. As for data performance, HSPA+ in Release 8—with a peak rate of 42 Mbps—essentially matches mobile WiMAX in 10 MHz in TDD 3:1 DL:UL using 2X2 MIMO with a peak rate of 46 Mbps [10].

3. Simulation

3.1OPNET UMTS Model

a) General Model Description

Universal Mobile Telecommunications System (UMTS) is a Third Generation (3G) wireless protocol that is part of the International Telecommunications Union's IMT-2000 vision of a global family of 3G mobile communications systems. UMTS is expected to deliver low-cost, high-capacity mobile communications, offering data rates up to 2-Mbps. The UMTS model suite allows you to model UMTS networks to evaluate end-to-end service quality, throughput, drop rate, end-to-end delay, and delay jitter through the radio access network and core packet network

b) Proposed Model

The proposed model is measured for its performance by running data, voice and video traffic; hence the average delay, throughput, load, and received traffic are the performance metrics used in this work. In this case study a simulation scenario was built and run in order to obtain the desired results Table (1) to achieve the objective. Figure (1) below shown a UMTS network model a scheme:, displays the network topology of this case; Ftp, web browsing ,Email ,video conferencing and voice over ip applications are used ,throughput, delay, and traffic received metrics are used. The proposed topology of UMTS network model consists of Node_B's, RNC's, mobile nodes, routers, servers, and SGSN/GGSN nodes. The coverage area is 15 km* 10 km. A base Vector trajectory. The simulation time in all cases of this project is taken to be 15 minutes.

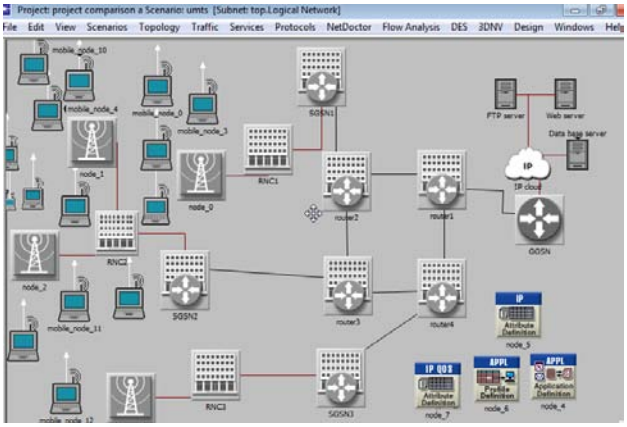

Figure 1: UMTS model scheme

Table 1

Time (minutes)	Delay (sec)	Jitter (m sec)	Queuing delay(m sec)	Throughput(Packet/sec)	
				Downlink	Uplink
0.0	0.0	0.0	0.03	0.00	0.00
2.5	2.5	3.8	15.00	0.00	0.00
5	1.9	4.0	19.00	30.06	107.24
7.5	1.7	4.7	20.00	47.52	128.29
10	1.6	6.0	20.00	52.56	135.37
12.5	1.6	6.9	21.00	50.77	140.00
15	1.6	7.1	21.00	51.43	140.33

3.2 OPNET WiMax Model

a) WiMAX (802.16e) Model

The WiMAX model suite includes a discrete event simulation model that lets you analyze network performance in wireless metropolitan area networks. The WiMAX model suite includes the features of the IEEE 802.16e standard. Note that the Wireless Module and a license for the WiMAX specialized model are needed to run simulations. The WiMAX license is also required for viewing or modifying WiMAX process models

b) Proposed Model

Proposed a scheme of the network topology of this case study as shown inFig(2) . WiMAX configuration and profile Configuration provide to define and attribute all the applications that are used in this network case study. Five different applications are used:, Email ,web browsing, FTP, Video Conferencing and Voice over IP. The proposed WiMAX network model consists of five Base Stations and cells; each cell has six mobile nodes to serve all applications types. A vector-based and Wimax_light_dens trajectory is used in this model. The simulation result in Table {2}.

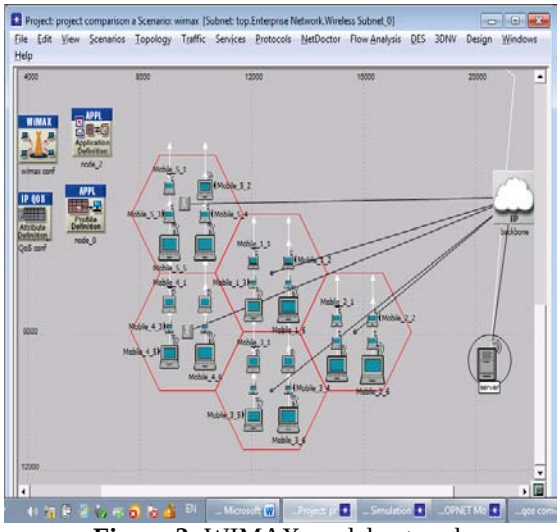

Figure 2: WIMAX model network

Table 2

Time (minutes)	Delay (sec)	Jitter (m sec)	Queuing Delay (m sec)	Throughput (Packet/sec)
0.0	0.00	0.0	2.5	0.0
2.5	0.95	0.0	0.49	155.0
5	1.2	0.0	0.49	345.0
7.5	1.3	0.0	0.49	400.0
10	1.3	0.0	0.49	440.0
12.5	1.3	0.0	0.49	455.0
15	1.3	0.0	0.49	475.0

4. UMTS and WIMAX Comparison

- **Delay**: Is the time of the sent packet it takes to arrive. Shown in **FIG(3)** UMTS model delay is more than WIMAX model delay
- **Throughput:** The rate of the sent data in packet per second. WIMAX throughput is higher than UMTS throughput in **FIG(4)**
- **Queuing Delay:** The time of the sent packet it waits to send. WIMAX has less queuing delay **Table{3}, FIG(5).**
- **Jitter:** Is the variation in arriving time of sent packets. WIMAX has no jitter **FIG(6).**

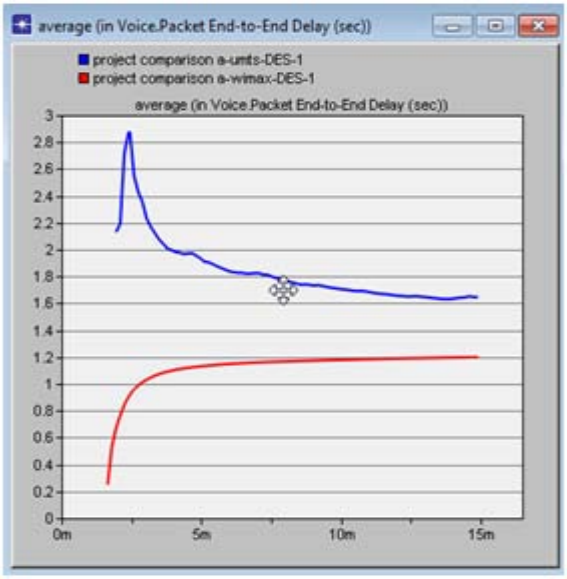

Figure 3

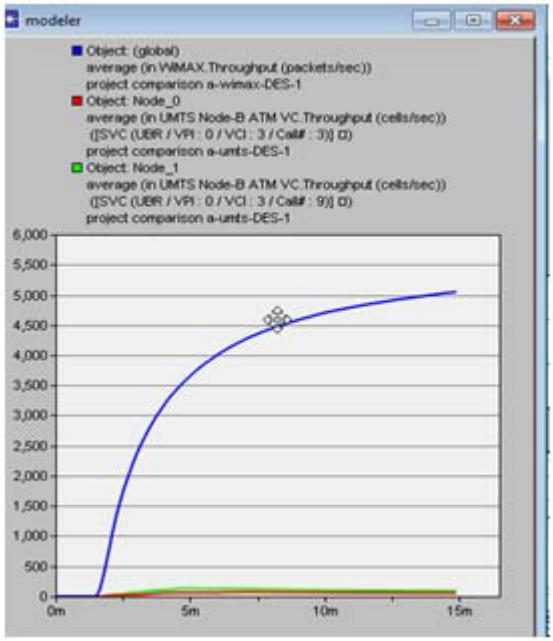

Figure 4

Table 3

Time(minutes)	*Queuing Delay(m sec)*	
	WIMAX	*UMTS*
0.0	2.5	00.03
2.5	0.49	15.00
5	0.49	19.00
7.5	0.49	20.00
10	0.49	20.00
12.5	0.49	21.00
15	0.49	21.00

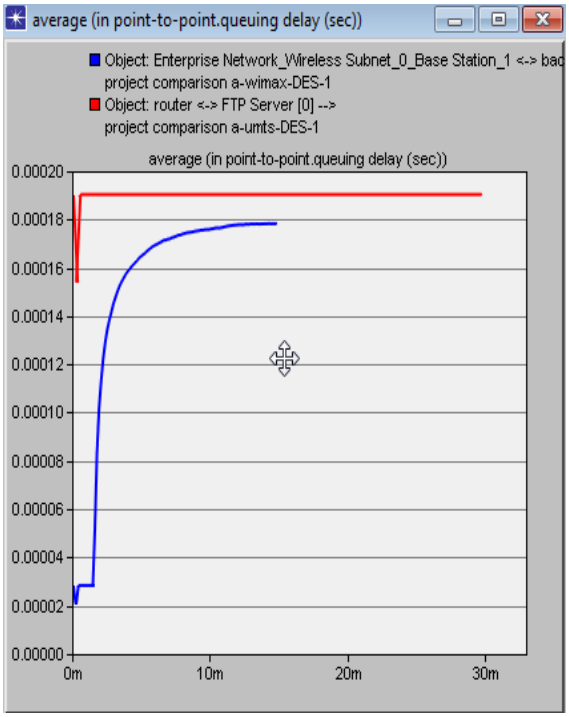

Figure 5

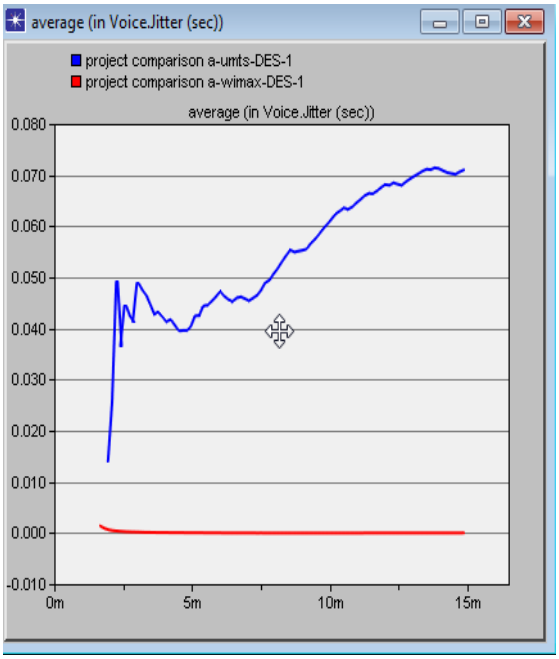

Figure 6

5. Conclusion

From the comparing of two network models and the observed result it is concluded that WIMAX is more efficient than UMTS. WIMAX network has high performance, which has showed by the measured and analyzed parameters, WiMax has higher throughput **FIG (4)**, and less delay **FIG(3)**also queuing delay time in UMTS is longer than WIMAX queuing delay time which caused more jitter in voice and RTP applications.

6. Recommendations

1. Study the analysis for UMTS and LTE networks
2. Applying the analysis for the other parameters.

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