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Throughput of VoIP over WiMax

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Abstract
The aim of this paper is to evaluate the throughput performance of VOIP over fixed and mobile WIMAX networks, the performance comparisons have been done between different types of nodes for three and five cells. Different scenarios have been created using OPNET simulator to measure the throughput of VOIP over WIMAX
.
Keyword: *WiMax, VoIP, OPNET, QoS.*

I. Introduction

WiMAX (Worldwide Interoperability for Microwave Access) is a technology based on the IEEE 802.16 standards and aims at enabling the development of wireless broadband systems. The IEEE 802.16 defines the physical (PHY) and medium access control (MAC) layers. The MAC layer is responsible for the most important features of the standard, such as Quality of Service (QoS) implementation. The IEEE 802.16-2004 standard defines four classes of service: Unsolicited Grant Service (UGS), Real-Time Polling Service (RTPS), Non-Real Time Polling Service (NRTPS) and Best Effort (BE). The IEEE 802.16e-2005 extends the classes of service supported by introducing the Extended Real-Time Polling Service (ERTPS) class of service. [1]

VoIP uses Internet Protocol for transmission of voice as packets over IP networks. The process takes arranged steps start with digitization of voice, isolate unwanted noise signals and then the compression of the voice signal using compression algorithms/codecs. After that voice is packetized to send over an IP network, The signaling protocols are add for each packet destination address ,sequence number and data for error checking. When a voice packet arrives at the destination, the reverse operation will start. Synchronization and delay management is important issue for real time application so Jitter buffer is used to store un arranged packets when arrive through different routers to wait for the other packet [2].

There have been recent studies focusing on performance evaluation of VOIP over WIMAX network. V. Rangel, L. Ortiz, J. Gomez, M. Lopez-Guerrero and Raul Aquino made paper to examine VOIP over WIMAX based network and evaluate the performance. They applied two different codes (G711, G723) and two modulations have been made for each code: QPSK with convolutional coding = ½ (QPSK1/2) and 64-QAM with convolutional coding = ¾ (64-QAM3/4). They Found 64- QAM has higher throughput in two codes. [3] Rohit Talwalkar was designed WIMAX network and applied the VOIP on it. G.711 code was applied on WIMAX services and compared between the different service flows, the throughput result for UGS flow was the highest among the BE, RTBS. [4 S. Alshomrani, S. Qamar, S. Jan, I. Khan and I. A. Shah evaluated the performance of different VOIP codes (G.711,G.723,G.729) over the WIMAX network using OPNET software .The result showed that VOIP performed best under the G.711 compared to the G.723 and G.729 [5] Priyanka, Jyoteesh Malhotra, Kuldeep Sharma in their paper different VOIP codes have been evaluated using OPNET. They found that G.7231 was highest delay because it uses coding rate of 6.3 kbps and when number of packet increase the delay will increase according to the congestion in the network. [6] Sandhya Kulkarni, H. J. Thontadharya, J.T. Devaraju evaluated the performance of VOIP over WIMAX network using OPNET by measuring the throughput for G711,G723,G729 codes ,they found that G711 gave the higher throughput than others.[7]

The objective of this paper is to simulate, evaluate and analyse the performance of voice over IP over WIMAX using OPNET software program, the throughput was considered as QoS performance in this paper.

2. Description Analysis

Using OPNET modeler 14.5, we have designed WIMAX scenarios and evaluated the performance of VOIP over WIMAX with network size of [20*20 km] in campus with variable number of nodes 5, 10, 15 for fixed and mobile nodes and different transmitted power values. The Simulation has been run for 3 minutes.

3. Modelling

Network throughput is the average data rate of successful message delivery through Communication channels. Throughput is a measure of the date rate (bits per second).The throughput can be calculated using the following formula:

Throughput = $\frac{\sum_i packetsizei}{packet\ arriveln - packet\ start0}$

Where Packet Sizei is the packet size of the packet reaching the destination, Packet Start0 is the time when the first packet left the source and Packet Arrivaln is the time when the last packet arrived.

4. Computer Modelling

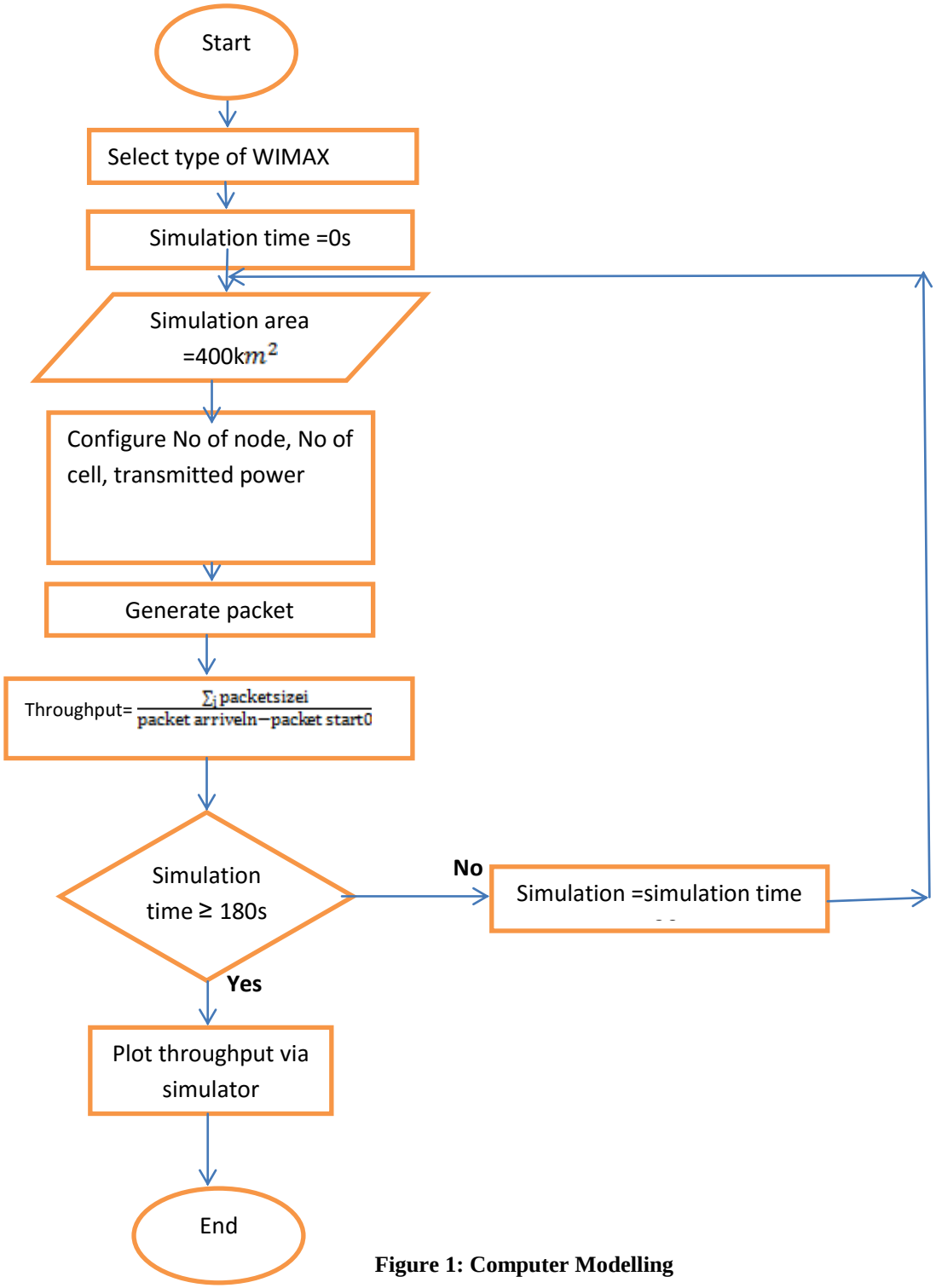

Figure 1: Computer Modelling

5. Simulation Parameter

Table 1: Simulation Parameter

Parameter	Value
WIMAX Network	Fixed ,mobility
Application	VoIP
Nodes	5,10,15
Simulation time	3 minutes
Number of cell	3,5
Coding	G7.11
Transmitted Power	0.5,1w

6. Simulation

Different scenarios have been made using OPNET software to simulate and evaluate the performance of VOIP over fixed and mobile WIMAX networks.

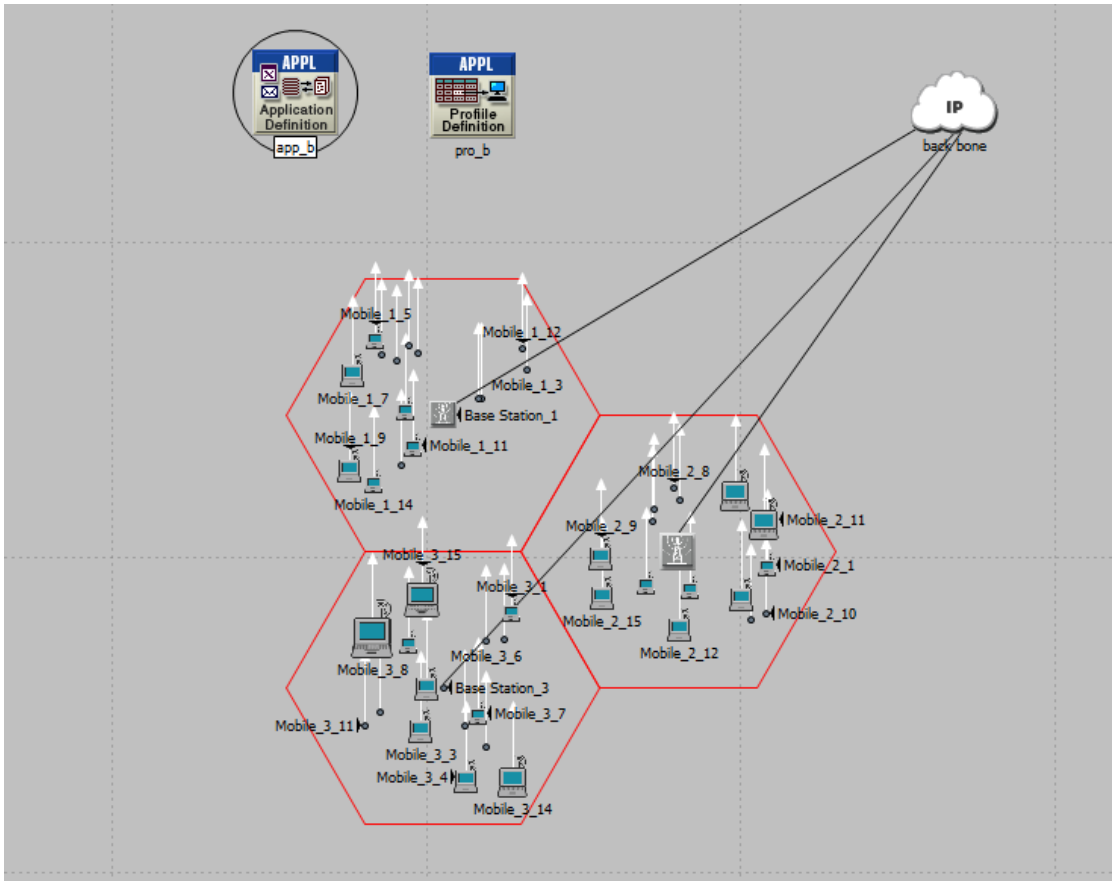

Figure 2: Three Cells with Mobile Nodes

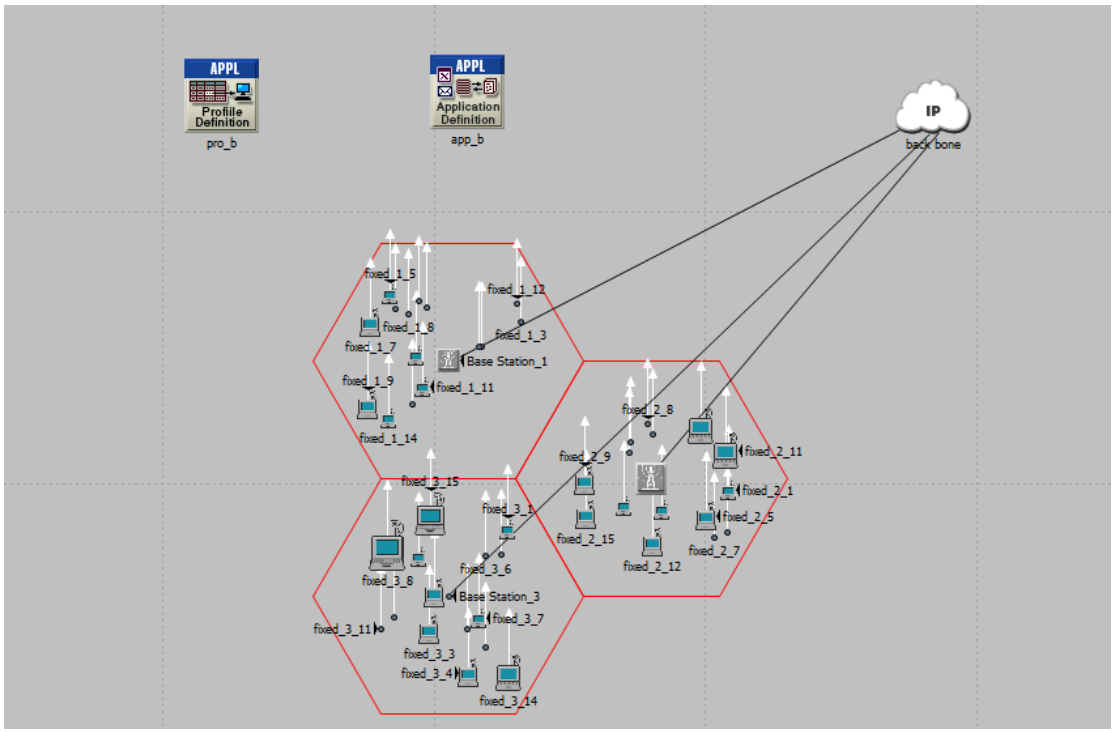

Figure 3: Three Cells with Fixed Nodes

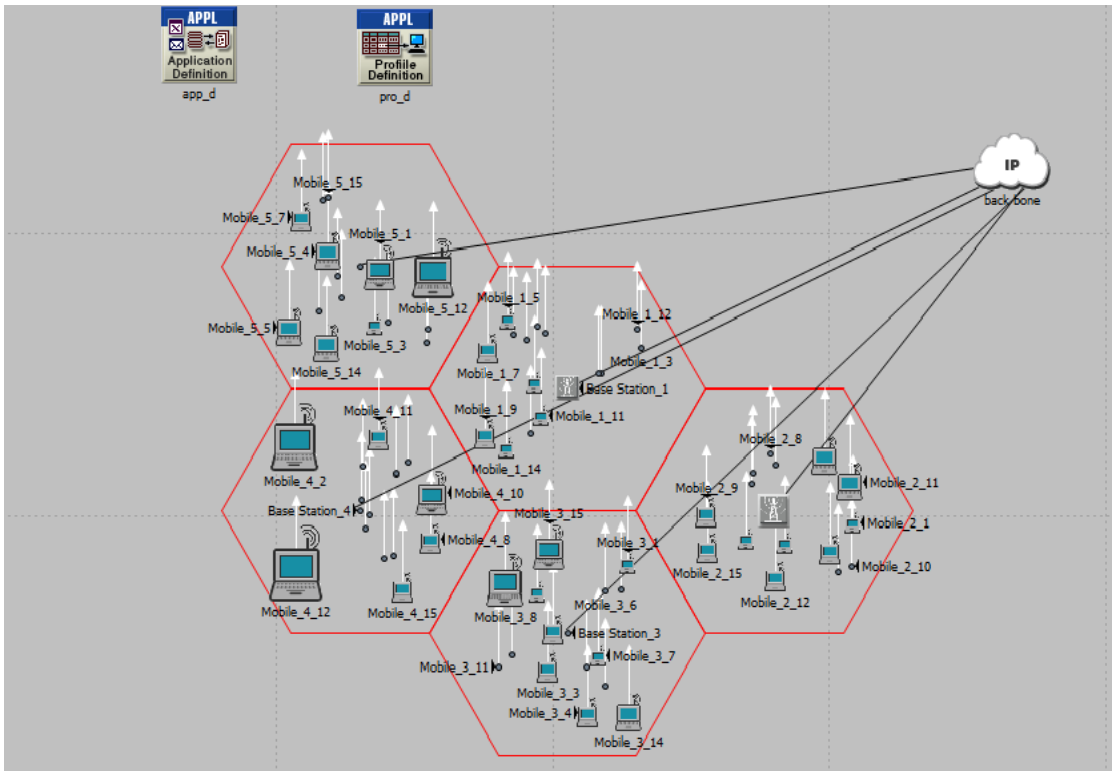

Figure 4: Five Cells with Mobile Nodes

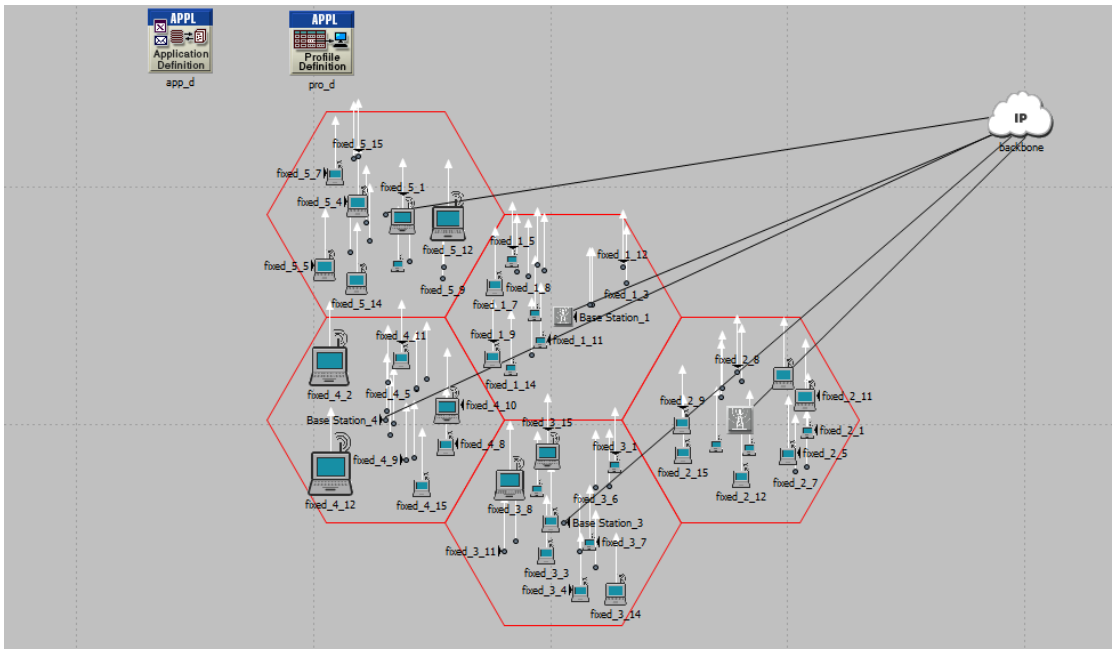

Figure 5: Five Cells with Fixed Nodes

7. Result

The simulation was implemented and we get the following results:

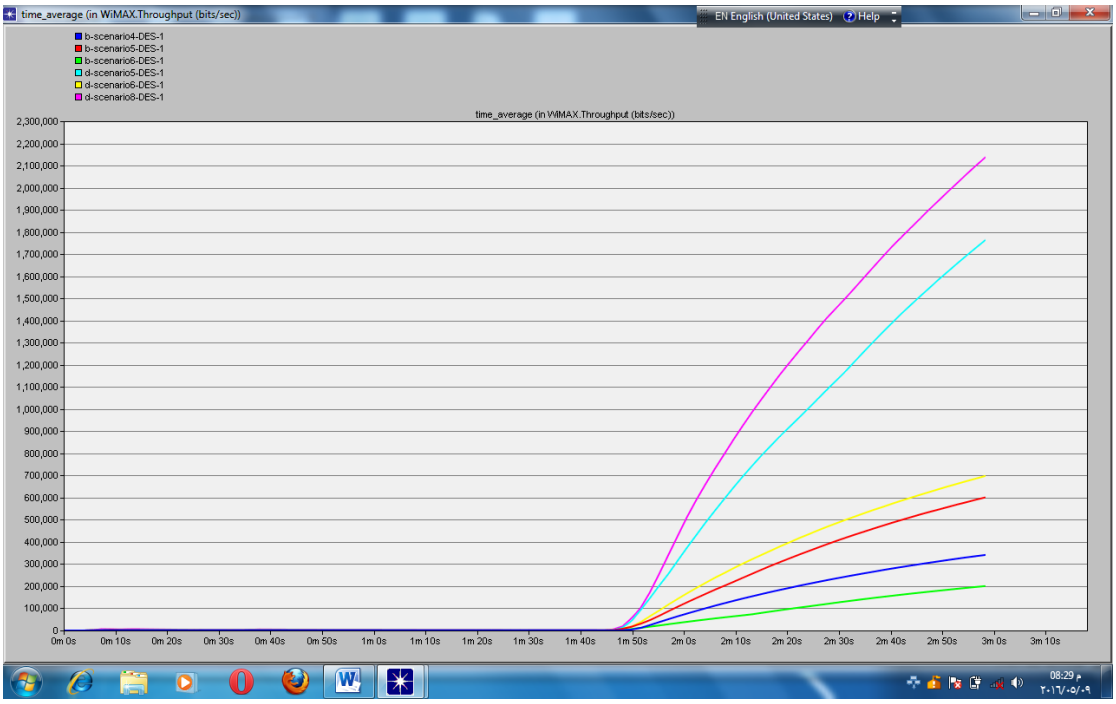

Figure 6: Average Throughput for Mobile Nodes with Variable Number of Node (5, 10, 15) and Power Value 0.5w

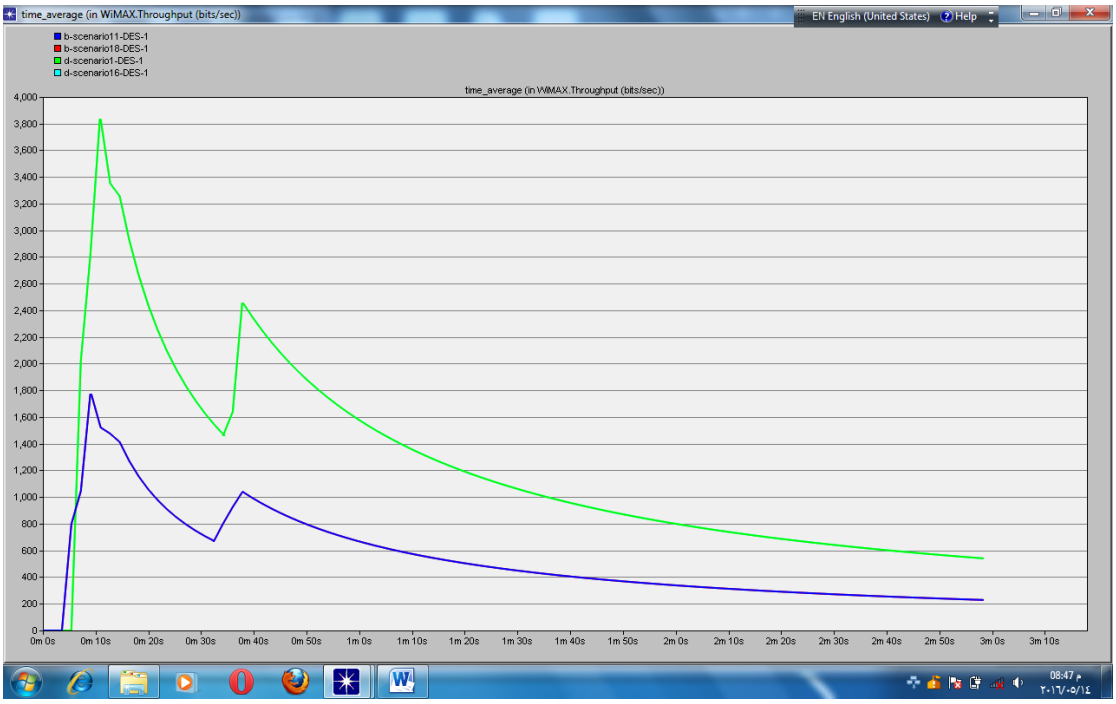

Figure 7: Average Throughput for Fixed Nodes with Variable Power Values (0. 5, 1) w and 5 Nodes

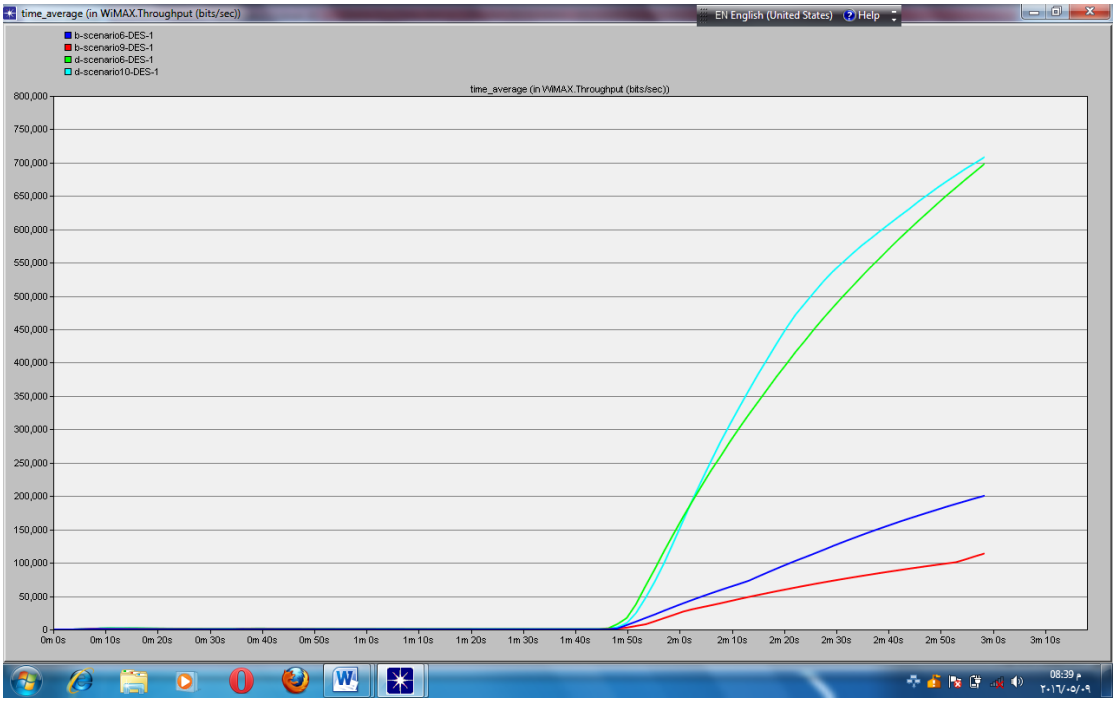

Figure 8: Average Throughput for Mobile Nodes with Power Values (0.5, 1) w and 5 Nodes

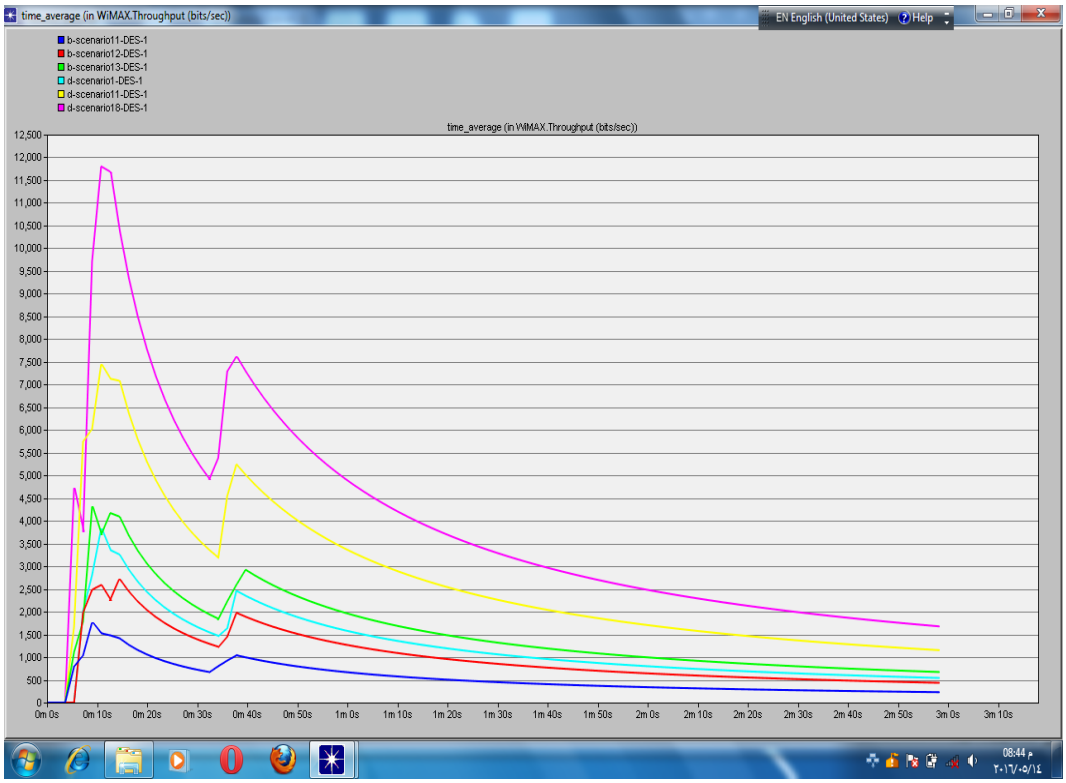

Figure 9: Average Throughput for Fixed Nodes with Variable Number of Node (5, 10, 15) and Power Value 0.5w

8. Result analysis

The figures above were showed that in mobile and fixed nodes when number of node increase the throughput will increase, when number of node was 5 the average throughput for three cells with mobile nodes was 41.95 while it was 542.2 for fixed nodes and it was 159.09 for five cells with mobile nodes while it was 1.22 for fixed nodes, When number of node was 10 the average throughput for three cells with mobile nodes was 76.95 while it was 993.8 for fixed nodes and it was 380.09 for five cells with mobile nodes while it was 2.66 for fixed nodes. We observed that the throughput decrease when transmitted power increase from (0.5 to 1) w in mobile nodes but it was constant in fixed nodes, when it was 0.5w the average throughput for three cells with mobile nodes was 41.95 and changed to 24.43 when the power was 1w, while it was 542.2 for three cells with fixed nodes for both power values. When power was 0.5w the average throughput for five cells with mobile nodes was 169 and changed to 159 when the power increase but it was constant for fixed nodes in both power values and it was 1.22

9. Conclusion

The evaluation and performance analyses for VOIP over fixed and mobile WIMAX networks have been done by measuring the throughput for different scenarios using OPNET software.

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