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Performance Evaluation of Wi-Fi and Wimax Using OPNET

Dafaalla Hamid Mohamad[1], Dr. Haala El Dawo[2]

Department of Communication Engineering, Al-Neelain University

Abstract: ***Wireless Fidelity (WiFi) network is based on the IEEE 802.11 standard. Worldwide Interoperability for Microwave Access (WiMAX), based on IEEE 802.16, is a standard with similar principles. The main advantage of WiMAX over WiFi is that it covers larger areas and has higher data rates. WiMAX network operators provide WiMAX subscriber units that enable connection to the metropolitan WiMAX network while WiFiunits are used for connecting local devices within homes or businesses. In this paper, we use OPNET Modeler to simulate and compare WiFi and WiMAX in a small area network and compare their performance in terms of mobility. Simulation results indicate that WiMAX may carry larger load and has better throughput.***

Keywords: wif ,wimax, ,simulation, OPNET and bandwidth

1. Introduction

Wireless Fidelity (WiFi) and Worldwide Interoperability for Microwave Access (WiMAX) are Wireless Local Area Network (WLANs) technologies. WiFi is based on the IEEE standard 802.11 while WIMAX operates based on IEEE 802.16. Both standards are designed for the Internet protocol applications. WiFi is optimized for a very high speed WLAN while WiMAX is intended for a high speed Wireless Wide Area Network (WWAN). WiFi has an operating range of a few hundred feet with speeds up to 54 Mbps while WiMAX may operate in the range of up to 40 miles with speeds of 70 Mbps and beyond. WiFi may cover an ofce or a campus area while WiMAX covers an entire city. In this paper, we describe a comparative performance analysis of WiFi and WiMAX technologies for a small area network. Two scenarios were designed to carry load and to compare the throughput.

2. Methodology

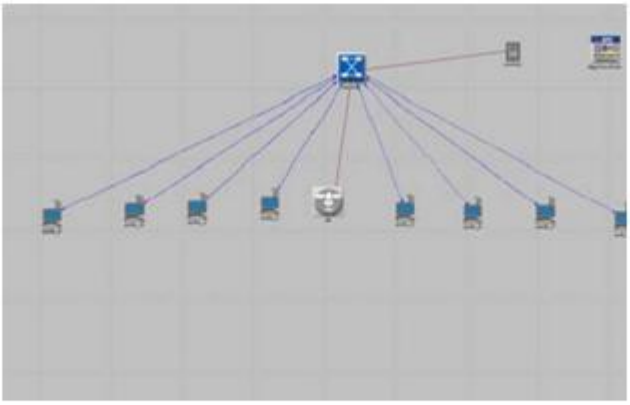

Figure 1: WiFi scenario with stationary workstations

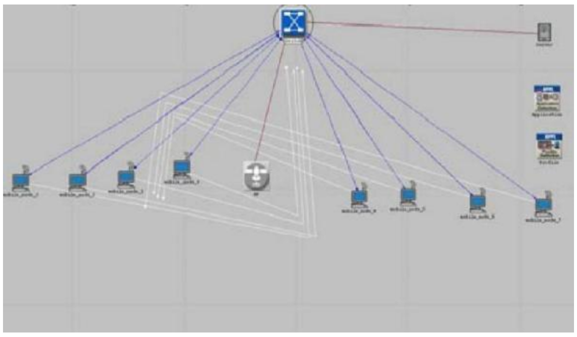

Figure 2: WiFi scenario with randomly located mobile stations.

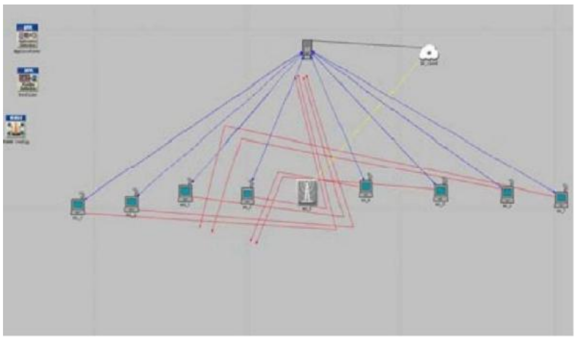

Figure 3: WiMAX scenarios with randomly located mobile stations

3. Parameters Setup

Table 1: Wireless LAN parameters for WiFi scenarios

BSS identifier	Auto assigned
Access point functionality	Enabled
Physical characteristics	Extended rate PHY(802.11g)
Data rate (bps)	24 Mbps
Transmit power (W)	2
Packet reception-power	-95
Short retry limit	7
Long retry limit	4
Buffer size (bits)	256,000

Table 2: Traffic characteristics

BSS identifier	Auto assigned
Access point functionality	Enabled
Physical characteristics	Extended rate PHY (802.1 lg)
Data rate (bps)	24 Mbps
Transmit power (W)	2.0
Packet reception-power threshold	-95
Short retry limit	7
Long retry limit	4
Buffer size (bits)	256,000

Table 3: Base station WiMAX parameters

Match property	IPToS
Match condition	Equals
Match value	Excellent effort

Table 4: Base station parameters

Antenna gain (dBi)	1 dBi
MAC address	1
Maximum transmission power (W)	2.0
PHY profile	Wireless OFDMA 5 MHz
PermBase	1
Receiver sensitivity	-200 dBm

Table 5: Base station parameters

Maximum number of SS nodes	100
Minimum power density	-100
Maximum power density	-60
Number of initial ranging codes	8
Number of HO ranging codes	8
Number of periodic ranging codes	8
Number of bandwidth request codes	8
Number of transmitters	SISC

4. Results and Discussion

Four applications are used in three scenarios to compare the network load and queuing delay. HTTP traffic sent and received is shown in Figures 4 and 5, respectively. The traffic sent by both mobile and fixed WiFi is identical to the traffic received, which implies no loss. There is also no loss in case of mobile WiMAX trafc sent and received. No loss occurring due to handoff because the WiFi network has only one AP and the WiMAX network has only one BS in each simulation scenario.

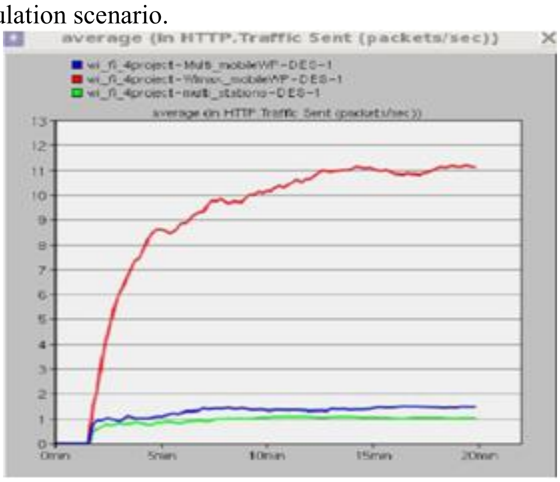

Figure 4: HTTP traffic sent by the server.

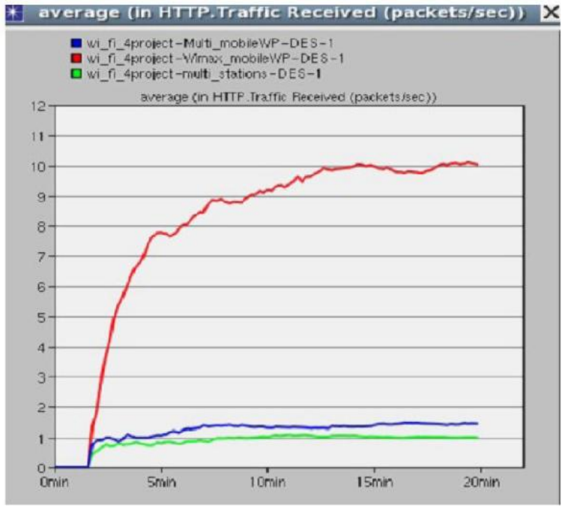

Figure 5: HTTP traffic received by the server

Average traffic in packets/s sent through the network by the FTP server is shown in Figure 6. FTP traffic received by the server is shown in Figure 7. As expected, fixed WiFi has the least amount of traffic sent compared to mobile WiFi. Mobile WiMAX has the highest average amount of traffic sent, almost seven times the traffic sent over the WiFi network. Since WiFi does not provide the broadband Internet services, WiMAX provides broadband service to carry additional load. Voice and video applications show similar results. Voice mean opinion score (MOS) is shown in Figure 8. MOS provides a numerical measurement of quality of voice signal transmitted. Mobile WiFi has higher MOS value than mobile WiMAX.

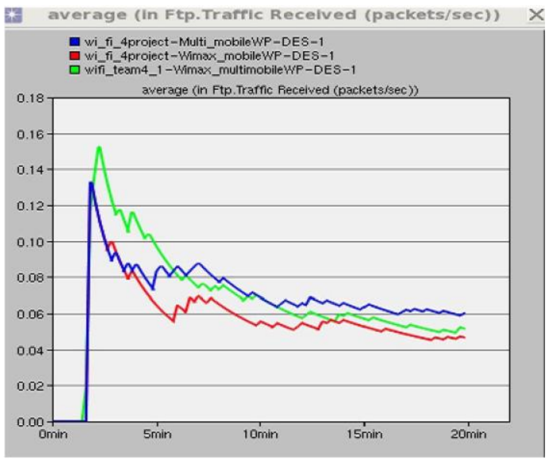

Figure 6: FTP traffic sent by the server

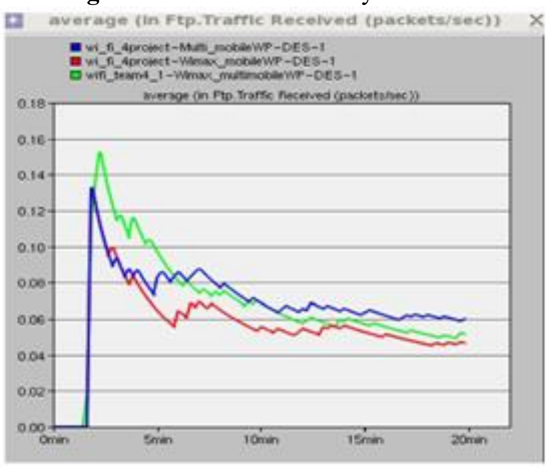

Figure 7: FTP traffic received by the server

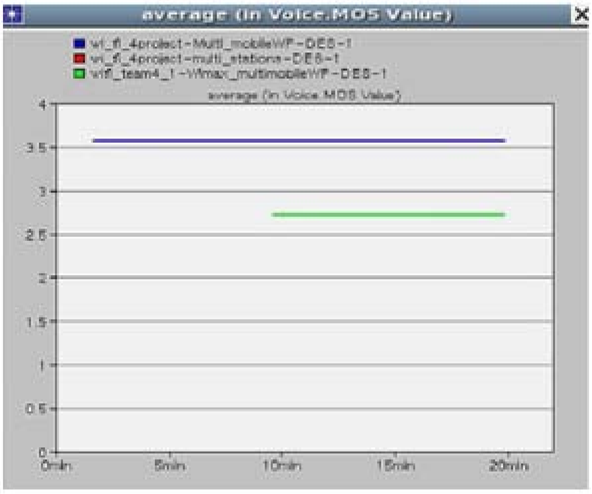

Figure 8: Mean opinion score (MOS) value

The average and overlaid point-to-point throughput of the inward link to the server and outward link from the server are shown in Figures 9 and 10, respectively. Point-to-point throughputs for fxed and mobile WiFi are as predicted. WiFi with moving stations has better throughput than fixed WiFi, which is due to the Stations moving closer to the AP. WiMAX has higher throughput compared to WiFi scenarios. The throughput of inward link to the server is much smaller compared to the outward link from the server, as seen in Figure 10. In WiFi mobile and WiMAX scenarios, the throughput of the WiMAX network link that carries load from the server has higher point-to-point throughput. WiMAX has better throughput because it is based on a broadband service.

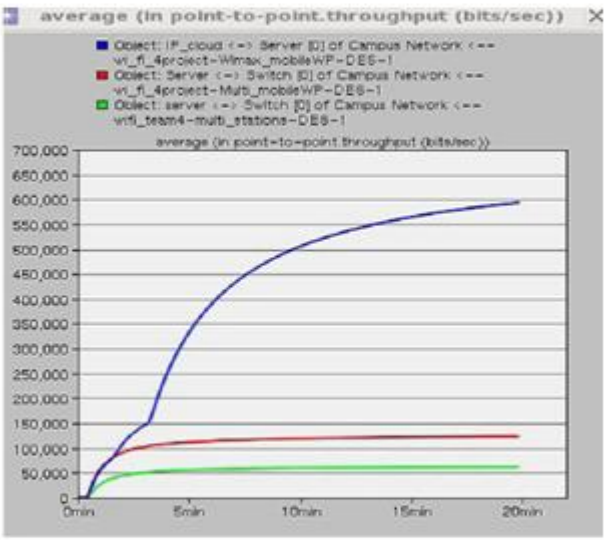

Figure 9: Throughput of the inward link to the server

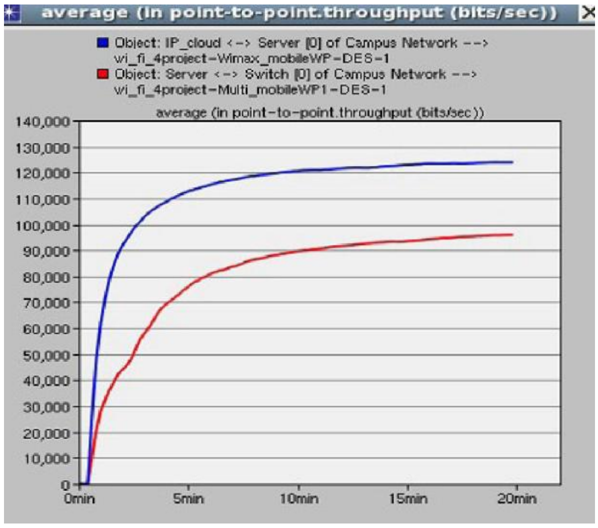

Figure 10: Throughput of the outward link from the server

5. Conclusions

In this paper, we simulated two WiFi and one WiMAX scenarios and compared their throughput and load. WiMAX throughput is higher in case of heavier traffic and wide area range. WiMAX may handle heavier load compared to WiFi. The simulation results show that the WiMAX queuing delay is smaller because WiMAX provides broadband service to carry heavier traffic load over the network. Queuing delays for both WiFi scenarios are identical.

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[7] W. Hrudey and Lj. Trajkovic, "Mobile WiMAX MAC and PHY layer Optimization for IPTV," Mathematical and Computer Modelling , Elsevier, vol. 53, pp. 2119–2135, Mar. 2011. Figure 16: Average queuing delay of the server to switch link in WiFi and the IP cloud to server link in WiMAX.

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