

WIRELESS IMPLEMENTATION SELECTION IN HIGHER INSTITUTION LEARNING ENVIRONMENT

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ABSTRACT

The limitation of WiFi coverage and free frequency create problems as well as weaken security and degrade quality of services. Therefore, a complementary wireless technology, WiMAX, is required. WiMAX and WiFi are chosen as both technology are the most highly popular by wireless network protocols usage in Iraq. Simulation on both of the network environments will be used to imitate the real situation in Tikrit University. This study provides a comprehensive field survey on wireless networking in Tikrit University of Iraq. Suitable wireless protocol, expanding coverage, performance of network will be included after the application of this study. The major benefits that have achieved as the outcome of this study are packet delivery ratio and throughput. Both WiFi scenarios achieved packet delivery ratios of 97.2% and 96.012% respectively, while WiMAX scenario scored 98.0% on packet delivery ratio. On the other hand, the throughput was found to produce interesting results and increased with packet size. WiMAX throughput had been discovered to be increasing linearly to the throughput. The maximum throughput achieved by WiMAX was 22.12 Mbps while the WiFi obtained throughputs of 22.46 Kbps and 11.61 Kbps for the different scenarios.

Keywords: *WiFi, WiMAX, Interference, expand coverage.*

1. INTRODUCTION

The weather condition of Iraq is harsh with hot and dusty in the summer and almost devoid of rain with dry cold in the winter. Iraq has more than 54 universities which cut across all the provinces and control by private organizations and government. Wireless network works proper within a short period of time to integrate infrastructures [1-3]. It's recommendation depends on verify networks resources so that when Wireless networks are augmented with (Ethernets and Fiber optics) networks, there will be increase in reliability and performance, and resisting harsh environments in order to act as core networks regarding the main purpose that have been fishbone. From an unpublished observation 85% of Iraq depends on wireless networks for exchange information. Most of these networks engage many types of equipment in order to establish these data transfer in unwired media. The selected environment is a Tikrit University which is one of Iraq universities and finance by the Ministry of Higher Education and Scientific Research of Iraq. The WiMAX new

technology is the most suitable technology for this environment because it is the higher institution that depends on the type and specification of the problems that already exist in Tikrit University and require enumeration, not as narrative in the geographic natures, harsh weather, scattered campuses which belong to the university. Both WiFi and WiMAX technologies that adopted to be used in this study is a recent generation of WiFi. The new default Wireless-Standards have been adopted by the demands for ever higher data throughput, greater range and to meet increasing demand for security, since there are no signs that a weakening of the current "Wireless - boom" would be suggested. Quiet in 2005, new wireless technologies are in the starting blocks as they sometimes supplement WiFi, bluetooth, infrared and WiMAX[4, 5]. Wireless takes the air as media in transmission packets, thus the wireless lacks in-security. There are many established approaches to enhance wireless security with various WiFi devices due to its wider subscribers. When comparing Wireless technologies, protocols, and standards which have been initiated at hand and

considered as a good clue, the technology becomes desiring and wanted. There are many standards enacted by IEEE which are 802.11a, 802.11b, 802.11g and 802.11n. Each of these protocols belong to WiFi family with different specification [4]. Wireless networks are classified as three different types such as fixed networks, mobile access networks and ad-hoc networks "wireless mesh networks". The mobile access networks are divided into three types; circuit multiplexing (Global System for Mobile Communication (GSM) cellular networks), centralized statistical multiplexing (Code division multiple access (CDMA) cellular network). The earlier version of CDMA was Interim Standard (IS95) and is the first CDMA based digital cellular standard by Qualcomm. The brand name for IS-95 is CDMA One and known as TIA-EIA-95. The later generation is CDMA 2000 and 2- Wideband Code Division Multiple Access (WCDMA) IEEE 802.16 WIMAX networks [6]. The third type of mobile access network is distributed statistical multiplexing, while the example is IEEE 802.11 WLANs or WiFi. It is also known as an ad-hoc network which consists of wireless internet and sensor network [3, 7]. The new technology of wireless network was approved in June 2004 [7], while the sustainability does not belong to WiFi family but to centralized statistical multiplexing with WiFi at mobile access networks. This new technology is known as WiMAX and the most important classification of wireless network is shown in Figure 1-1.

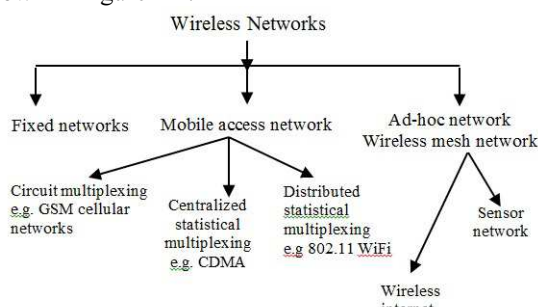


Figure 1 Wireless Networks Classification [6].

The Worldwide Interoperability for Microwave Access (WIMAX) takes the IEEE 802.16 standard due to the specification of WIMAX and has decisive change for telecommunications because of features that distinguish it from other members of wireless network especially WiFi. These include bitrates of throughput, coverage area, high level of

security, quality of service "QoS". It has capacity to cover a long distance of coverage area, high rate of throughput, mobility movement regarding end users that able to cover with center tower that known as base station, while other lead to WIMAX focus of attention and interest of Internet service provider (ISP) [7-11].

2. WIFI AND WIMAX ATTITUDE

No doubt that wireless technology might be considered as emerging branch of networking field due to its struggling as long as the past decades ago thought that witness most important steps of development, Adheres to the same principles however under same regulation which might change during that period the transmission which depended on two major activities sent and receives by using radio waves or radio frequency which in turn belong to spread spectrum at the same time it's part from electromagnetic waves the radio waves has a wavelength higher than infrared waves, radio waves uses an air as a media for transmission while sender and receiver have to use same channel to prescribed exchange process [12-15]. Radio waves applied within many fields and so many applications depend on it such as TV, Radio, cellular communications in addition to the navigation which also in contact astronauts, the wavelength of radio waves starts from little centimeters reach till few hundreds of meters this variety in both wavelength and frequency give its own special features of spreading. Many shapes of implementation the radio wave may be taken like amplitude modulation, frequency modulation and phase modulation AM/FM and PM these modulations till few early period using analog the another kind is the digital implementation, with AM is most familiar radio frequency often used by broadcast radio station but AM unfortunately suffered from interference from outdoor spruces like lightning from thunderstorm unlike FM, sometimes not generally used for data transfer, television video uses AM, television sound uses FM as well as the color information uses PM to be transferred [4, 6, 16-19].

2.1 WIFI Architectures

The methods used to link one or more electronic devices that are unwired are called wireless connections. These devices use special equipment's to establish connection for sending and receiving data through an air which used as a media and has to install peripherals on both or among

communication sides. This will be defined to the same behaviors between two nodes or among more nodes in order to be defined by all. The manufactures, developers and even end-users required to legislate and measured. Because of these two important reasons, manufactures and developers followed standers and regulations of IEEE and FCC [1, 4, 5, 7, 8, 13]. WiFi has 802.11 as a standard had been enacted by IEEE in order to befriend among interested. WiFi using radio waves for transmission for which the air uses it as intermediary carrier. WiFi defines three different wireless LAN configurations as listed below:

- Basic Service Set (BSS).
- External Service Set (ESS).
- Independent Service Set (ISS).

IEEE has divided the Data Link layer into two sub layers as shown in Figure 2. The sub layers are the Logical Link Control (LLC) sub layer, which provides common interfaces, reliability, and flow control, and the Media Access Control (MAC) sub layers, which append physical address to the frame. The reason for this change was to allow higher-level protocols working separately, such as those operations hold on network layer, to interacting with data link layer without affected up to physical layer characteristic.

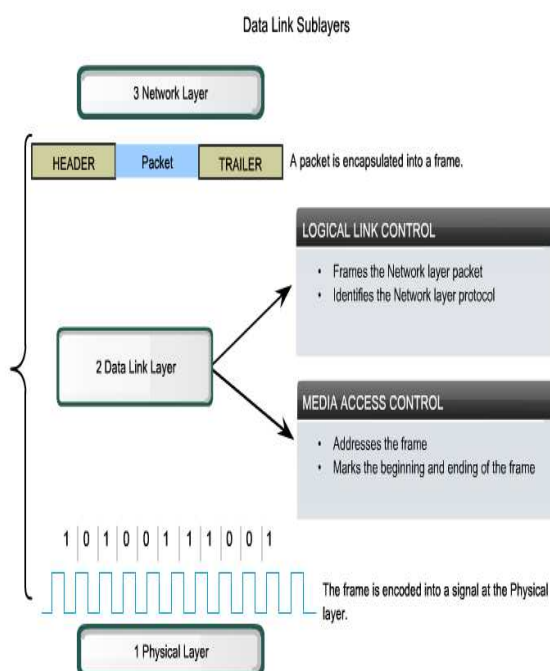


Figure 2 Data Link Sub Layers As Listed In[20].

Likewise, the IEEE has subdivided they physical layer which called abbreviated (PHY) for WLANs in to sub layers. Physical Medium Dependent (PMD) sub layer and Physical Layer Convergence Procedure (PLCP), sub layer about PMD sub layer, makes up the standards for both the characteristics of the wireless medium such as direct sequence spread spectrum DSSS or Orthogonal Frequency Division Multiplexing OFDM and define the method for transmitting and receiving data through that medium. On the other hand the PLCP sub layer achieve two basic tasks: it reassemble or reformats the data which received from MAC layer when transmitting into frame that the PMD sub layer can transmit, also listens to the medium to determine when the data can be sent as explained in [21-23].

WiFi has clarified use the radio transmission techniques which it operate on the unlicensed frequency or free 2.4-GHz range, which known ISM [3, 7]. Wi-Fi has 802.11 standard from IEEE so that defriended among interested. Wi-Fi using radio waves to transmission which the air its own media usually Wi-Fi using signals service set identifier SSID while a possibility of occurring reflecting in signals to be connect will be highly among signals broadcasting to use same equipment's so as to used signal identifier the device assigned for this task known by Access point whose linking end users should have special receiving devices known by WLAN's by transfer signal to connect them locally or work as a repeater to another AP[9, 14, 17, 19, 24, 25].

2.2 WIMAX Architectures

Worldwide Interoperability for Microwave Access (WiMAX is an integral part of the family of IEEE 802 to start. WiMAX is a wireless transmission technology (wireless) access to broadband and has the ability, as well as other wireless technologies, used in many types of surfaces WiMAX systems can be use from urban country environments). Mainly created to try to increase the access rate (nominal data rate) allowed by the WiFi and wants to expand the reach of the service. It also created some critical aspects of WiFi to improve, in particular:

- Help to manage the Quality of Service (QoS).
- Rising to increase network security, confidentiality of information exchanged.

The band of WiMAX is at higher frequencies than the WiFi and this leads to a better use of the network, but the downside is the fact that they

reduce the mobility of users. In essence created to serve metropolitan areas and is often referred to as a wireless living [26-28]. The secret of WiMAX that got attention is the big amount of applications which work with WiMAX smoothly. It is not only login broadband internet backbone but WiMAX improve alternative success that need to be applied instead of DSL, such as E1/T1 WiMAX evidence that has presented in more than one occasion. WiMAX also provides point to point and point to multipoint (striking feature). The point to point (P2P) has its range 30 miles 50KM with throughput approximately 72Mbps. However, it supplies non line sight with coverage of 4 miles 6.4 KM within point to multipoint (PMP). This distribution is able to deliver any to any which is N of bandwidth to M of users or end-terminals, where N and M equal to any and credence on user bandwidth and network design. The non-line of sight (NLOS) or point to multi point (PMP) with end points non straight direction from base station of WiMAX as explained below in Figure 3. The (P2P) is used for one base station to another or among neighboring city while PMP or NLOS is used for suburban and exurban users [27, 29-31].

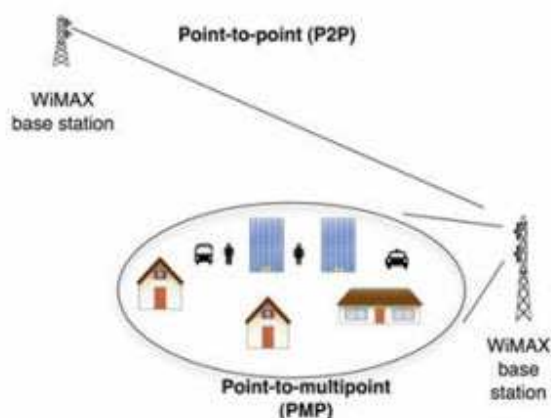


Figure 3 Differences Point To Point Or Light Of Sight Los From Nlos [28].

3. EXPLORE APPROACH

The methodology which deployed ascends this study functioned simulation environment application, actually the researcher, developers and even interesting peoples selected simulation application as concerning to implement proposed related work. [9]. Due to many reasons, such as a simulation provide accepted level of availability in terms of measurement, so it can give convenient way to predict the performance, even if a network hardware are available in terms of hardware

availability and rest infrastructures available for measurement. Simulation a bit preferred according to opportunities, which grant the user in evaluation phase of performance under a various wide workbench and network status. Simulation permits the analysis performance found adaptive compare several alternative architectures under identical and repeatable network conditions. Furthermore, simulation can incorporate more details than analytical modeling thus. More often can produce that is closer reality. Finally, researchers often use simulation environments to validate analytical results. A turning between analytical results with simulation results gives confidence for the use and creates a comprehensive vision. This study generally depends on two phases first phase is the network phase implementation and second is the evaluation phase; phase of network implementation consists from six steps while phase of evaluation deploys on two steps so that in total its eight steps as explained in Figure 4.

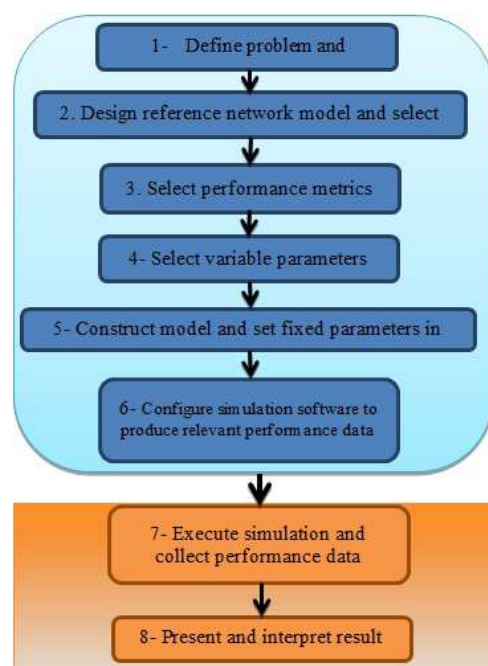


Figure 4 Phases Of Methodology [9].

3.1 Network phase include the first five steps:

- Define problem and objective: determining the use to frequency spectrum, fixing coverage boundaries, defining number of users.

- Design reference network model and select fixed parameters: Integration both technology and working Isolated, adapter bridge for switch and Established by star topology.
- Select performance metrics: Throughput and Packet Delivery ratio.
- Select variable parameters: Nailed both of channels and Fixed point (LOS) of subscribers
- Construct model and set fixed parameters in simulation software: Install NS2, Determining both scenarios Augmented suitable infrastructures
- Configure simulation software to produce relevant performance data: Implementing NS2 scripts regarding facts collected for WiFi and WiMAX.

3.2 Evaluation Phase Contains Two Steps:

- Execute simulation and Collect performance
Data: Execute both TCL scripts for WiFi, WiMAX in NS2 terminal and fetch information from trace file.
- Present and interpret data: Figure out the results after a verification and validation.

4. OBSERVING RESULTS

The results regarding both WiFi and WiMAX models after each of which executed in NS2, the various parameters setting which have been used inside each scenario code as a TCL script, in per se pose flavor in relation between WiFi and WiMAX scenarios.

Figure 5 illustrate the throughput of WiFi behavior.

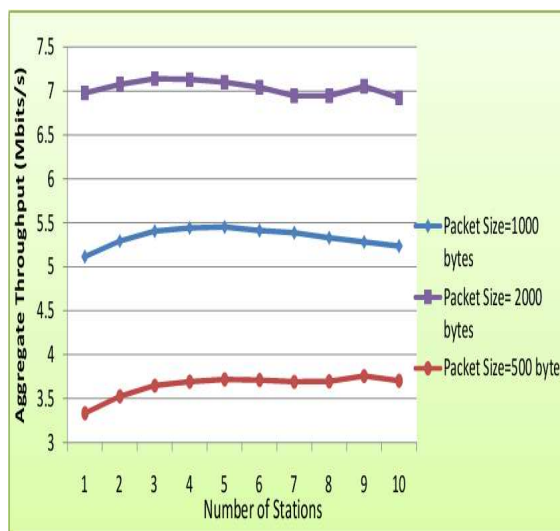


Figure 5 Throughputs Increasing With Packet Size.

The aggregate throughput is inversely related to the packet size, the aggregate throughput is the sum of all the throughputs by all the SSs to the access point. $S \propto E[P]$ where S is the aggregate throughput and E[P] is the fixed payload size [7, 18].

Throughput in bits/second = Packet size * 8 * (Packets Received) / simulation time [6, 9, 14].

On another hand WiMAX achieved following throughput values, which Figure 6 spotlight over it.

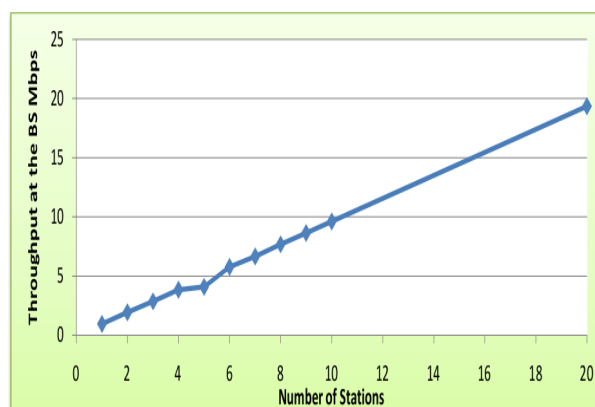


Figure 6 Total Throughputs At Base Station In Wimax.

Though this value is increasing linearly it is expected to level at the maximum data rate, it can notice that as the number of subscribers increase the aggregate throughput increases.

Regarding the Packet delivery ratio:

Packet Delivery Ratio (PDR) came from the percentage result of dividing total number packet receive on total number packet sent, hence the equation for calculate the PDR is

$$PDR = (\text{Number of receiving packets} / \text{Number of sending packets}) \% [4, 18].$$

Both WiFi scenarios and WiMAX score they following results respectively in Table 1.

Table 1 Wifi Scenarios And Wimax

Scenario	Description	value
WiFi	Scene 1	97.2%
WiFi	Scene 2 *	96.012%
WiMAX	Scene 1	98%

*Packet size=512byte plus no. of connections=10 while Scene1 higher than Scene2.

5. NS2 CHALLENGING

This study have faced set of difficulties through phases of process as a contribution for whom interests with Wireless network which get an implemented by using NS2, below notifications with most important that might be help.

- NS2 as an open source application it works on Linux open operating system distributions , while Linux have been selected as an platform it pose as obstacle has been faced most of researchers, developers and interested because Linux still not familiar for most users around the world Figure 7 shown percentages of operating system users for last five years.

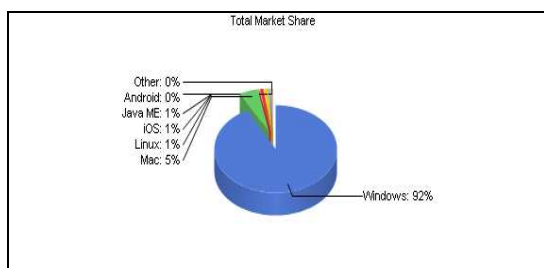


Figure 7 Percentage Of Users For The Operating Systems In Last Five Years Cited By Net Market Share.

- Choosing NS2 packages actually according to which the network models desired simulation, by another meaning

for routing protocols there is suitable package of NS which produced with suitable libraries, the same for TCP or UDP protocols.

Respecting wireless implementation on NS after have been test following packages

2.28, 2.29, 2.31, 2.34 and 3.12 the installable package, suitable selection and wireless library could be indulging in it was 2.31 with one struggle at all attached WiMAX library inside NS2.31, have to mentioned 2.31 installed successfully on Centos 5.6 and Ubuntu 10.04 LTS, important tips regarding Ubuntu it's recommended selected LTS as most stable distribution with few bugs also have to update packages inside Linux OS before establish NS2 installation process.

The default output with NS is trace file this is does not mean it is the only there are also NAM animation output for scenario created also Gnu plot draw the output in figures, Trace file take as extension but with two formats old and new format, so have to know trace file comes out by which format so can extract information because the shape varies in place and organization of parameters usually output of NS2.31 old fashion even while implemented new trace parameter inside tcl script the output have been in old format.

This is not only regarding WiMAX trace file it's taken varies extension res, both trace files of WiFi and WiMAX need to analysis and measured for fetching information through this huge lines it total of the trace files.

- Analysis and extract data from trace file which come out after tcl script file executed with NS take various format as mentioned above, so each format in fact requires special technique for fetch information, useful tools might help, command grep it's Unix command work with trace file but analysis and extracting way seems manually calculation, in case compared with awk script file ,Python and Perl so all of them could be useful tools for extract information first, then calculates whatever of performance metrics or print out total number of packets sent, received, forwarded and drop beside performance , also there are another technique by export trace file as text extension then imported in office access so

could extract information according what performance metric or information wanted.

Seeking up trace file appears complicated because of have to know which format belonging to, which useful tools for extract information by depending which tools and the big size of trace file just exceeding thousand for small scenario.

- Draw output figures in chart as mentioned some models required plotting points, thus needs install special application working with NS synonymously one of this application is Gnu plot which accept the post extracted information through trace file, usually print out Gnu plot the diagram as image which it's to implemented .

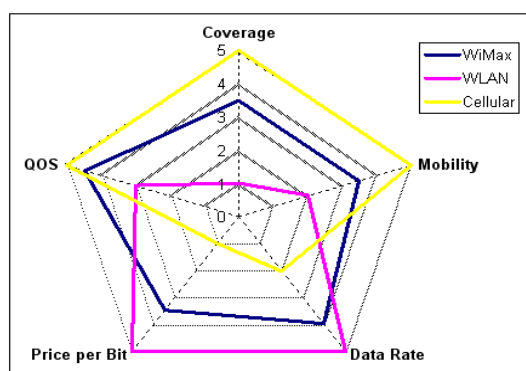


Figure 8 Wimax Vs Wifi And Cellular.

6. CONCLUSIONS

In a WiFi system if all stations are transmitting the at same packet size, the larger the packet size the better the aggregate throughput. For a limited number of SSs in WiFi in a fixed packet size network, the aggregate throughput is almost constant. In an 802.16e network the aggregate throughput gradually increases as the number of SSs increase, though expected to saturate at the maximum data rate.

Unlike 802.11, in 802.16 systems the throughput per SS remains almost constant even when several SSs are in the network (assuming no saturated aggregate throughput).

7. FUTURE WORK

WiFi as mentioned in this study previously take 2.4GHz and 5.0GHz as core band using in modulation packet through the air as known radio

frequency working concept, in addition this frequency belong to ISM rather than WiMAX which operate special frequency categorize as a licensed band this certainly non-free usability regarding that WiMAX still costly. Integration between both WiFi and WiMAX require exchange at PHY layer especially if it preferred use wireless instead of adapter of wire between both technologies. In addition, hyper technology which can act as arch between WiFi side and WiMAX on another side, factually most struggle part combining PHY layer inside this hyper technology able to detect ISM frequency and WiMAX unique frequency this including modulation, demodulation respectively this augmented with disparity between bandwidth between both WiFi and WiMAX it should be wide to accommodate multiple the input and output in multiple channels and beyond the problem of the bottleneck that led to congestions because the stream of wireless already extremely implying. There are also promises technology could also provide significant impacting in wireless network communications in case of WiMAX integration with Mobile Broadband Wireless Access MBWA 802.20.

REFERENCE

- [1] (Sandy), A., et al., DakNet: Rethinking Connectivity in Developing Nations. IEEE, 2004.
- [2] Choi, B.S.C. and M. Gerla. Wireless Interrupt: Inter-Device Signaling in Next Generation Wireless Networks. 2010. IEEE.
- [3] KAWASUMI, Y., Deployment of WiFi for Rural Communities in Japan and ITU's Initiative for Pilot Projects. IEEE, 2004.
- [4] Ciampa, M., CWNA guide to wireless LANs. 2005: Course Technology Ptr.
- [5] Cooklev, T., Wireless Communication Standards: A Study of IEEE 802.11, 802.15, and 802.16. IEEE, 2004.
- [6] Kumar, A., D. Manjunath, and J. Kuri, Wireless networking. 2008: Morgan Kaufmann.
- [7] Kartsakli, E., et al. Multiuser MAC protocols for 802.11 n wireless networks. 2009. IEEE.
- [8] Gracias, M., V. Knezevic, and A. Esmailpour. Interoperability between WiMAX and WiFi in a testbed environment. 2011. IEEE.
- [9] Hassan, M. and R. Jain, High performance TCP/IP networking. 2004: Pearson Prentice Hall.
- [10] Ibikunle, F.A. Security Issues in Mobile WiMAX (802.16 e). 2009. IEEE.

- [11] Intel, C.-a.b.M.a., WiMAX and WiFi Together: Deployment Models and User Scenarios. 2011.
- [12] Durreesi, A. and M. Denko, Advances in wireless networks. Mobile Information Systems, 2009. 5(1): p. 1-3.
- [13] Garg, V.K., Wireless communications and networking. 2007: Morgan Kaufmann.
- [14] Hu, J., et al. A Distributed QoS Provision Scheme in IEEE802. 16 Mesh Networks with Directional Antennas. 2010. IEEE.
- [15] Hui-Tang Lin, Y.-Y.L., Wang-Rong Chang, and Rung-Shiang Cheng, An Integrated WiMAX/WiFi Architecture with QoS Consistency over Broadband Wireless Networks IEEE, 2009.
- [16] Feng, J., Wireless networks 2011.
- [17] Miyahara, Y. Next-generation wireless technologies trends for ultra low energy. 2011. IEEE Press.
- [18] Price, R., Fundamentals of wireless networking. 2006: McGraw-Hill, Inc.
- [19] Ihab Ahmed Najm, M.I., Ghasan Akram Abed, HIGH-PERFORMANCE MOBILE TECHNOLOGY LTE-A USING THE STREAM CONTROL TRANSMISSION PROTOCOL: A SYSTEMATIC REVIEW AND HANDS-ON ANALYSIS. Journal of Applied Sciences, 2014. 14(19): p. 25.
- [20] Dhawan, S. Analogy of promising wireless technologies on different frequencies: Bluetooth, wifi, and wimax. 2007. IEEE.
- [21] Khan, A. and N. Zaman. Comparative analysis of broadband wireless access from Wi-Fi to WiMax. 2009. IEEE.
- [22] Lai, Y.C. and Y.H. Chen. Designing and Implementing an IEEE 802.16 Network Simulator for Performance Evaluation of Bandwidth Allocation Algorithms. 2009. IEEE.
- [23] Li, Y.M. and J.H. Jhang-Li, Integration of WiMAX and WiFi Services: Bandwidth Sharing and Channel Collaboration. 2010.
- [24] Ibanez, S.R., et al. Hybrid wifi-wimax network routing protocol. 2008. IEEE.
- [25] Ng, M.C., et al. From WiFi to WiMAX: Techniques for high-level IP reuse across Different OFDM protocols. 2007. IEEE Computer Society.
- [26] Ahson, S. and M. Ilyas, The WiMAX handbook. 2008: CRC Press.
- [27] Andrews, J.G., A. Ghosh, and R. Muhamed, Fundamentals of WiMAX: understanding broadband wireless networking. 2007: Prentice Hall PTR.
- [28] Ohrtman, F., WiMAX handbook. 2005: McGraw-Hill.
- [29] Abate, Z., WiMax RF systems engineering. 2009: Artech House Publishers.
- [30] fourm, W. WiMAX 2 Collaboration Initiative. 2011.
- [31] Ganan, I.A.O., Performance Evaluation of OFDM and Modulation Techniques in Mobile WiMAX (IEEE 802.16e) in IT faculty -CAS 2010, Universiti Utara Malaysia.