BORANG PENGESAHAN STATUS TESIS

JUDUL: **A COMPARATIVE ANALYSIS OF QOS FOR DATA TRANSMISSION OVER WIRELESS NETWORK**

Sesi pengajian: **2010/2011**

Saya **SUZI IRYANTI BINTI FADILAH** mengaku membenarkan tesis sarjana ini disimpan di perpustakaan Fakulti Teknologi Maklumat dan Komunikasi dengan syarat-syarat seperti berikut:

1. Tesis dan projek adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan Fakulti Teknologi Maklumat dan Komunikasi dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan Fakulti Teknologi Maklumat dan Komunikasi dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. ** Sila tandakan (/)

_____	SULIT	(mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
_____	TERHAD	(mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan di jalankan
_____	TIDAK TERHAD	

(TANDATANGAN PENULIS)

(TANDATANGAN PENYELIA)

Alamat Tetap: SUZI IRYANTI BINTI FADILAH
PETI SURAT 47, BT 32,
KG PT SELANGOR, JLN JOHOR,
82000, PONTIAN
JOHOR DARUL TAKZIM.

DR. ABDUL SAMAD B. SHIBGHATULLAH

Tarikh : 15 NOVEMBER 2010

Tarikh : 15 NOVEMBER 2010

A COMPARATIVE ANALYSIS OF QOS FOR DATA TRANSMISSION OVER WIRELESS NETWORK

SUZI IRYANTI BINTI FADILAH

This report is submitted in partial fulfilment of the requirements for Master of Computer Science (Internetworking Technology)

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2010

DECLARATION

I hereby declare that this project report entitle **"A COMPARATIVE ANALYSIS OF QOS FOR DATA TRANSMISSION OVER WIRELESS NETWORK"** is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of other degrees.

Signature: .....

Name: SUZI IRYANTI BINTI FADILAH

Date: 10 November 2010

APPROVAL

I hereby declare that i have read through this project report and in my opinion this project report is sufficient in terms of scope and quality for the award of the degree of master of Computer Science (Internetworking Technology).

Signature:.....

Supervisor: DR. ABDUL SAMAD SHIBGHATULLAH

Date: 15 NOVEMBER 2010

DEDICATION

Fadilah Abd Karim & Misraton Ahmad
Wan Muhammad Mukhlis Wan Sallehuddin

For my family and friends
For their love and support throughout my life

ACKNOWLEDGEMENT

By the name of Allah, the Most Gracious and the Most Merciful, many thanks for His blessing in giving me the opportunity to finish my research successfully. I would like to express my gratitude to Kementerian Pengajian Tinggi (KPT) for the sponsorship throughout the whole master degree's semesters.

I must first and foremost thank my thesis supervisor Dr. Abdul Samad Shibghatullah, who was most responsible for helping me make this work a success. His encouragement and guidance combined with a superior, in-depth knowledge of the wireless field have enabled me to complete this thesis. Dr. Samad's patience and kindness have made him not only an excellent advisor, but also a friend. Thanks also to both evaluators, Dr. Zul Azri Muhamad Noh as well for his contribution by assisting me in the early stages of this project, sharing ideas and insight on the project.

I would also want to show my deepest thanks to beloved my parent whom had given me moral, guidance and financial support throughout the research. I hope that with the knowledge and experienced that I gain from this research will be useful in a future.

From the bottom of my heart, I thank you all for your undying support.

ABSTRACT

A wireless network is admired because it strikes a good balance between speed, cost and simple installation. There are some other issues that contribute of this comparative analysis, which is confusion surrounding the capabilities and status of the IEEE standard especially the new 802.11n WLAN standard, the performance in real environmental test like in a controlled lab may not be reproducible since its affected by the same or similar environmental factors, the IEEE reaffirmation process involves the review of an existing standard to determine if it is still useful, valid, or requires updating. It involves the creation of a standards committee working group who is tasked to review, advice and either modify or reject the standard and the future guidance for any IEEE or WLAN development integration, step by step in choosing technology in related field and benefits to the power users or users in comparing and choosing the suitable technology based on their requirements. The wireless data communications system depends on a number of variables which are throughput, distance, interference and power consumption. The main result is a comparing wireless standard and analyzing the problem of influence various factors on the rate of data transmission in Wireless networks. Yet the purpose specific work of different equipment from two different IEEE 802.11 standards was experimentally researched by using proper software and standards of a wireless network for providing suitable service was analyzed. The aim of this thesis is to provide detailed investigation and analysis of main performance issues related to wireless networks based on the IEEE 802.11g and IEEE 802.11n. A comparison of these standard wirelesses IEEE 802.11 will lead better understanding among the user in a future.

ABSTRAK

Sebuah rangkaian tanpa wayar digemari kerana keseimbangan yang baik antara kelajuan, kos dan pemasangan sederhana. Namun, ada beberapa isu lain yang memberikan sumbangan kepada analisis komparatif ini antaranya keraguan kemampuan dan status daripada piawaian *IEEE* terutamanya piawaian terbaru 802.11n, hasil kajian makmal terkawal tidak sama dengan persekitaran sebenar akibat dipengaruhi oleh faktor-faktor persekitaran sebenar, proses naik taraf piawaian *IEEE* melibatkan analisa perbandingan suatu piawaian yang sedia ada untuk menentukan sama ada ia diperlukan atau memerlukan perubahan dan analisa ini relevan pada masa depan untuk pembangunan piawaian *IEEE* yang baru, malah bermanfaat bagi pengguna untuk membandingkan dan memilih teknologi yang sesuai. Analisa komparatif ini melibatkan *throughput*, jarak, gangguan dan pengambilan kuasa. Keputusan utama adalah membandingkan piawaian rangkaian tanpa wayar dan menganalisis masalah pelbagai faktor yang mempengaruhi tahap penghantaran data dalam menggunakan perkakasan dan perisian yang tepat dan standard rangkaian wayarles untuk menyediakan perkhidmatan yang sesuai dianalisis. Sekaligus memberikan penyiasatan terperinci dan analisis antara *IEEE 802.11g* dan *IEEE* 802.11n Suatu perbandingan dari standard *IEEE* 802.11 akan membawa pemahaman yang lebih baik di kalangan pengguna di masa depan.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AFH	Adaptive Frequency-Hopping Spread Spectrum
AP	Access Point
ARS	Adaptive (or Automatic) Rate Selection
ASCII	American Standard Code for Information Interchange
ASK	Amplitude-Shift Keying
ATM	Asynchronous Transfer Mode
BSD	Berkeley Software Distribution
B	Byte
BPSK	Binary Phase-Shift Keying
CCK	Complementary Code Keying
dBM /dBmW	decibels
DAST	Distributed Applications Support Team
DBPSK	Differential Binary Phase-Shift Keying
DPSK	Differential Phase-Shift Keying
DQPSK	Differential Quadrature Phase-Shift Keying
DSSS	Direct-sequence spread spectrum
DRS	Dynamic Rate Shifting
DPSK	Differential Phase-Shift Keying
EBCDIC	Extended Binary Coded Decimal Interchange Code
FHSS	Frequency Hopping Spread Spectrum
FSK	Frequency-Shift Keying
FTP	File Transfer Protocol

GB	Gigabyte
GFSK	Gaussian Frequency-Shift Keying
GHz	Gigahertz
HTTP	Hypertext Transfer Protocol
HT	High Throughput
IBM	International Business Machines
IEEE	Institute of Electrical and Electronics Engineers
ISM	Industrial, scientific and medical
KB	Kilobyte
Kbps	Kilobit per second
Kbyte	Kilobyte
LAN	Local Area Network
MAC	Media Access COntrol
MAN	Metropolitan Area Network
Mbit/s	Megabit per second
MB	Megabyte/Megabit
Mbyte	Megabyte
Mbps	Megabyte per second
MIMO	Multiple input multiple output
NDM	Network Data Mover
NLANR	National Laboratory for Applied Network Research
OFDM	Orthogonal frequency division multiplexing
OS	Operating System
OQPSK	Offset Quadrature Phase-Shift Keying
PC	Personal Computer
PHY	Physical layer
PSK	Phase-Shift Keying

PSSS	Parallel-Sequence Spread Spectrum
QAM	Quadrature Amplitude Modulation
QoS	Quality of service
QPSK	Quadrature Phase-Shift Keying
RAM	Random access memory
RF	Radio frequency
8DPSK	8 Phase Differential Phase-Shift Keying
SONET	Synchronous Optical Networking
SMTP	Simple Mail Transfer Protocol
SNR	Signal-to-noise ratio
SS	Spread Spectrum
STBC	Alamouti Space-Time Block Coding
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
U-NII	Unique Ingredient Identifier
USB	Universal Serial Bus
VPN	virtual private network
WAN	wide area network
WLAN	wireless local area network
WEP	Wired Equivalent Privacy
WPA	Wi-Fi Protected Access
Wi-Fi	Wireless Fidelity
4-DQPSK	4 Rotated Differential Quadrature Phase-Shift Keying

CHAPTER 1

INTRODUCTION

1.1 Background of the study

As wireless networking has proliferated homes and offices around the world, and network vendors keep releasing with new devices on a regular basis, thus data transmission over wireless has been increasingly deployed too. Following the success of cellular telephone services in the 1990s, the technical community has turned its attention to data transmission (Richard J. Lavery, 2001) However, data transmission techniques are primarily designed for wired networks and can perform poorly over wireless networks. The research focuses on the impact of a wireless connection on the performance of data transmission over wireless. Supporting data transmission in wireless networks is receiving more attention from the research community. WLAN (wireless local area network) is one of the most popular networking technologies today.

The standard IEEE 802.11 has been developed by the IEEE LAN/MAN Standards Committee (IEEE 802) for WLANs operating in the 2.4 GHz and 5 GHz

ISM bands. IEEE 802.11 has many family members but 802.11 (a/b/g/e) are the most popular ones. Recently a new standard naming 802.11n is being drafted by the IEEE which will increase the throughput to over 100 Mbps (Roger B. Marks, Ian C. Gifford, and Bob O'Hara, 2001). The benefits of WLANs include mobility, productivity, ease of deployment, simplicity, flexibility, less cost and etc. The disadvantages include concerns over security, low delivery rates, high error rates due to media characteristics, and contention between stations to access the medium.

Wireless networks are noisy and unreliable communication environments. Data transmission over wireless network is an exciting and active area of research. It is predicted to be one of the highest revenue generating technologies in near future. Unlike in wired networks where data losses are mainly caused by traffic congestions, losses in wireless networks are due to both traffic congestions and transmission errors. This is due to the fact that wireless links have low bit rate and high error rate compared to wired networks. If traffic congestions are somewhat predictable, transmission errors are subject to the variation of the wireless propagation environment, and therefore much harder to predict and control. As a result, providing Quality of Service (QoS) in wireless networks is more challenging.

1.0 Background of the research problem

Today's enterprises face a choice when selecting a vendor of wireless LAN infrastructure for their organization. While there are many standards to choose from in competency manifests itself in disparities in performance specifically, in throughput, wireless LAN coverage, and capacity. Essentially, IEEE 802.11g is designed to improve 802.11a/b while IEEE 802.11n is designed to enable wireless networks to do more, faster and over a larger area. The use of wireless communications is on the rise. It is often more practical and less expensive than

hard-wired solutions, but is not as reliable. The situation is further complicated by an increasing number of wireless standards such as, 802.11, 802.11a, 802.11b, 802.11g, 802.11n and other new standards soon.

There are four main obstacles in data transmission over wireless. First, the consumption of battery power is another issue of wireless standards today. Thus, the purpose of this research is to experimentally evaluate this by determining the major contributions to energy consumption. We investigate the rate of battery power consumption in wireless devices (laptops) under different scenarios such as with and without transmission over WLAN, at different standard.

Second, voice of frequency band, 802.11b and g equipment may occasionally suffer interference from microwave ovens, cordless telephones and Bluetooth devices. 802.11b and 802.11g control their interference and susceptibility to interference by using direct-sequence spread spectrum (DSSS) and orthogonal frequency-division multiplexing (OFDM) signaling methods, respectively. 802.11a uses the 5 GHz U-NII band, which, for much of the world, offers at least 19 non-overlapping channels rather than the 3 offered in the 2.4 GHz ISM frequency band. Better or worse performance with higher or lower frequencies (channels) may be realized, depending on the environment, making it susceptible to the same interference as other 802.11 standards. Also, as this band is narrower than the 2.4 GHz band, signal is more easily absorbed or reflected by environmental obstacles

Third, WLAN throughput falls off more or less rapidly the farther a client device moves from an access point. The drop depends on how much metal, wood, concrete, and other construction material is between the two devices. In addition, in almost every case today, an access point is a shared medium: whatever throughput it can deliver is divvied up among however many users connect to that one access point. Unless users are sitting right under the access point, they just don't get the maximum throughput

Fourth, Quality of the transmission depends on distance and other factors. The further a device is from its access point, the weaker the signal it can send and receive and the lower the physical rate that it can reliably achieve because the frame error rate increases as the distance increases. A high frame error rate will negate any speed advantages of a high data rate by causing too many retransmissions, 802.11 devices constantly monitor the quality of the signals received from devices with which they communicate

Wireless communications are affected by environmental variables much more than wired networking. The performance of data transmission depends on the quality of service (QoS) assigned to a particular application. Today, there is still a lot of confusion surrounding the capabilities and status of the IEEE standard especially the new 802.11n WLAN standard which also contribute to this analysis development. The confusion is understandable since the standard is very broad and has been slow to develop, and even slower to finalize. Full ratification for 802.11n was on September, 2009.

There are some other issues that contribute of this comparative analysis. There were many factors affecting actual performance analysis such as structures, latency, network traffic, etc. Wireless signals suffer loss and quality degradation as they move through space, especially inside buildings where walls, furniture, human bodies and other obstacles cause absorptions, reflections and refractions, they are also susceptible to interference from other wireless devices such as electrical equipment, microwave ovens and even other wireless devices on the same network that are competing for the same wireless frequency resources. Delivering data over the wireless is an important issue for many Internet applications. Transmission of data has bandwidth, delay, and loss requirements. Because these factors were out of our control and testing was not done in a controlled lab the exact results may not be reproducible. The tests were designed to be objective by ensuring that each test configuration was affected by the same or similar environmental factors.

Besides that, since IEEE more than 400 standards under development, hope that this comparative analysis could be one of the useful references for further analyzing in the future. This is because, every so often, IEEE (Institute of Electrical and Electronics Engineers) standards must be reaffirmed. The reaffirmation process involves the review of an existing standard to determine if it is still useful, valid, or requires updating. It involves the creation of a standards committee working group who is tasked to review, advice and either modify or reject the standard. (Howard W. Penrose, PhD, CMRP)

This comparative analysis is also developed because of there's lots of research more to the common issues like wireless speed, coverage and etc. There's some more on research comparison between different IEEE standards like comparison 802.11a/b/g only, or research on IEEE 802.11n only and there's quite less research on comparison between IEEE 802.11g and IEEE 802.11n in detail and specifically on the issues of interference, throughput, power consumption and distance whereas the testing result is based on real environment.

Yet, this analysis development is actually could be one of the future guidance for any IEEE or WLAN development integration, step by step in choosing technology in related field and benefits to the power users or users in comparing and choosing the suitable technology based on their requirements.

1.3 Limitations of Current Research Approaches

Supporting efficient and reliable data transmission over wireless networks has been subject of continuous research over the last decade (Rawat, K.S.; Massiha, G.H.; 2003). Wireless transmission has arrived in providing clear and significant

advantages. Yet the market research reports about wireless analysis are still one of the most interests.

There is lots of wireless analysis nowadays. Thus this thesis purpose is only focuses on to analyze the performance of QoS management for data transmission delivery over WLAN for IEEE 802.11 g and IEEE 802.11n, with the metrics used were throughput, interference, distance and power consumption.

Various experiments were conducted to measure and analyze the performance of transmission of data transmission with a notebook as a mobile host over an infrastructure network. The test-bed network consists of the infrastructure network integrating a wireless net.

There will be four samples of tests that will be run with different variables and different IEEE standard. Then, each test will be repeated at least three times to ensure the accuracy and the average result will be taken for generating graph and elaborating comparison and analysis.

The main comparison regarding this analysis is about comparing the throughput between both IEEE 802.11g and 802.11n. This is because different wireless standard will produce different throughput result in data transmission rate. The other variable that will be tested and compared via this thesis is distance. This is because distance affects the wireless performance in term of the farther the distance, the lower the throughput value and the lower the data transfer rate. The distance between transmitter and receiver is proportional with the data transmission rate. The interference also one of the main variable in this research whereas both IEEE standards 802.11g and 802.11n operate at the same frequencies of microwave, cordless phones and Bluetooth which is 2.4GHz. This contribute to interference that effect both wireless performances. Last but not least, the power consumptions issue whereby having built-in wireless means users got a little chip inside notebook that's