UNIVERSITI MALAYSIA SARAWAK
UNIMAS

Faculty of Engineering

PERFORMANCES ANALYSIS OF VOIP OVER 802.11B AND 802.11E WLANS USING DIFFERENT VOIP CODECS

Yu Ka Chai

TK
5105.5865
Y94
2010

Bachelor of Engineering with Honours
(Electronics and Telecommunications Engineering)
2010

Pusat Khidmat Maklumat Akademik
UNIVERSITI MALAYSIA SARAWAK

Performances analysis of VoIP over 802.11b and 802.11e WLANs using different VoIP CODECs

YU KA CHAI

This project is submitted in partial fulfillment of
The requirements for the degree of Bachelor of Engineering with Honors
(Electronics and Telecommunications Engineering)

Faculty of Engineering
UNIVERSITI MALAYSIA SARAWAK
2009/2010

UNIVERSITI MALAYSIA SARAWAK

R13a

BORANG PENGESAHAN STATUS TESIS

Judul: **PERFORMANCES ANALYSIS OF VOIP OVER 802.11B AND 802.11E WLANS USING DIFFERENT VOIP CODECS**

SESI PENGAJIAN: 2009/2010

Saya **YU KA CHAI**
(HURUF BESAR)

mengaku membenarkan tesis * ini disimpan di Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hakmilik Universiti Malaysia Sarawak.
2. Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Membuat pendigitan untuk membangunkan Pangkalan Data Kandungan Tempatan.
4. Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
5. ** Sila tandakan (✓) di kotak yang berkenaan

[ ]	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 dijalankan).
[✓]	TIDAK TERHAD	

Disahkan oleh

(TANDATANGAN PENULIS) | (TANDATANGAN PENYELIA)

Alamat tetap: No. 1A,
JALAN OLD OYA, 96000 SIBU

MDM. ADE SYAHEDA WANI bt MARZUKI
Nama Penyelia

Tarikh: 14 MAY 2010 | Tarikh: 14 MAY 2010

CATATAN

* Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah, Sarjana dan Sarjana Muda.

** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT dan TERHAD.

This Final Year Project attached here:

Title	: Performances analysis of VoIP over 802.11b and 802.11e WLANs using different VoIP CODECs
Student Name	: Yu Ka Chai
Matric No	: 17593

has been read and approved by:

:e Syaheda Wani bt Marzuki
Pensyarah
Fakulti Kejuruteraan
UNIVERSITI MALAYSIA SARAWAK

Mdm. Ade Syaheda Wani bt Marzuki

(Supervisor)

Date 17 MAY 2010

"I declare that this thesis entitled Performance analysis of VoIP over 802.11b and 802.11e WLANs using different VoIP CODECs is the results of my own research except as cited in the references. This thesis has not been accepted for any degree and is not concurrently submitted in candidate of any degree."

Signature : .....

Name of candidate : Yu Ka Chai

Date : 14 May 2010

Dedicated to my beloved family and friends

ACKNOWLEDGEMENT

This project has been made possible as a result of the co-operation and support rendered by several individuals. While it is impossible to list down all of them, I am very grateful for their assistance.

Firstly, I would like to thank my supervisor, Mdm. Ade Syaheda Wani bt Marzuki. Her comments support, and guidance has helped me throughout the course our project. Without her cooperation and dedicated work in keeping the project on track, I would not be able to complete the project on time.

Secondly, I would like to thank my second supervisor, Dr Hushairi Zen. He had helped me a lot in the project. He shared his knowledge to me. He also gave advice to me on solving problem and developed the project.

Thankfulness would like to give to all my friends and family who give full supports to me either morally or financially. They had helped me in sailing through the many hard days in lives and studies all these while.

Finally, special thanks to Lee Liang Wee, Ivan Chan and Punitha.

ABSTRAK

Projek berbentuk simulasi ini bertujuan mengkaji suara melalui protokol internet (VoIP) menggunakan IEEE 802.11b dan 802.11e rangkaian kawasan setempat (WLAN) dengan pengekod-penyahkod (CODEC) yang berbeza dengan menggunakan perisisan Network Simulator-2. Objektif-objektif utama projek ini adalah untuk menganalisis VoIP berdasarkan jumlah purata mata pendapatan (MOS), kelewatan hujung-ke-hujung, daya pemprosesan dan kadar kejatuhan pakej. Simulasi dijalankan menggunakan CODEC yang berbeza (G.711, G.729A dan G.723.1) dan disimulasikan dengan tanpa dan adanya lalu lintas latar belakang (data). Dengan menggunakan VoIP CODEC yang berbeza dan jumlah panggilan VoIP, pretasi VoIP boleh diperhatikan dan kesan lalu lintas latar belakang dapat diperolehi sepanjang simulasi. Simulasi dalan projek ini menggunakan 1 nodus terdawai dan 1 titik akses dihubungkan dengan nodus bergerak. Semua nodus ini dihubungkan secara hierarkikal. Nodus bergerak akan menghantar panggilan VoIP untuk nodus terdawai melalui titik akses serentak. Daripada hasil simulasi, dapat disimpulkan bahawa VoIP memanggil melalui CODEC G.711 menyediakan kualiti terbaik. Bagaimanapun, CODEC G.723.1 menyediakan kemudahan sokongan paling banyak panggilan VoIP dengan kualiti servis yang boleh diterima. Selain itu, ciri pengutamaan yang ada pada 802.11e membolehkan VoIP menghasilkan audio yang sangat berkualiti.

ABSTRACT

This project is to simulate the Voice over Internet Protocol (VoIP) over IEEE 802.11b and 802.11e WLANs (Wireless Local Area Network) with different Coder-Decoder (CODECs) by using Network Simulator-2. The main objectives of this project are to analyze the VoIP of Mean Opinion Score (MOS), end-to-end delay, throughput and packet drop rate. The simulation is conducted using different CODECs (G.711, G.729A and G.723.1) and simulated with and without background traffic (data). By using different VoIP CODECs and number of VoIP calls, the performance of VoIP can be observed and the effect of background traffic is obtained from this simulation. The simulation in this project is using 1 wired node and 1 access point connected with mobile nodes in hierarchy. The mobile nodes will send VoIP calls to wired node through access point simultaneously. From the project, it is found that the CODEC G.711 provides the best quality of VoIP calls. However, CODEC G.723.1 can support the most VoIP calls with acceptable quality. In addition, with the first priority given by 802.11e to the VoIP, it can provide a very good perceived audio quality.

Pusat Khidmat Maklumat Akademik
UNIVERSITI MALAYSIA SARAWAK

TABLE OF CONTENTS

APPENDIX

LISTS OF TABLE

LISTS OF FIGURES

LIST OF ABBREVIATIONS

ACK	-	Acknowledgment
ADC	-	Analog-to-Digital Converter
AIFS	-	Arbitration Inter Frame Space
AP	-	Access Point
APC	-	Adaptive Priority Control
ATICAC	-	Adapting Transmitting Interval Call Admission Control
BI	-	Back-off time Initial
BS	-	Base Station
BSS	-	Basic Service Set
CAC	-	Call Admission Control
CBR	-	Constant Bit Rate
CCK	-	Complementary Code Keying
CFP	-	Contention-Free Period
CODEC	-	Coder/Decoder Technology
CP	-	Contention Period
CS-ACELP	-	Conjugate-Structure Algebraic Code Excited Linear Prediction
CSMA/CA	-	Carrier Sense Multiple Access with Collision Avoidance
CW	-	Contention Window
DCF	-	Distributed Coordination Function
DIFS	-	DCF InterFrame Space
DSSS	-	Direct Sequence Spread Spectrum

EDCA	-	Enhanced Distributed Channel Access
ETSI	-	European Telecommunications Standards Institute
FHSS	-	Frequency Hopping Spread Spectrum
FTP	-	File Transfer Protocol
HC	-	Hybrid Coordinator
HCCA	-	HCF Controlled Channel Access
HCF	-	Hybrid Coordination Function
IEEE	-	Institute of Electrical and Electronics Engineers
IP	-	Internet Protocol
IR	-	Infrared
ITU–T	-	International Telecommunication Union –Telecommunication
LLC	-	Logical Link Control
MAC	-	Media Access Control
MN	-	Mobile Node
MPC-MLQ	-	Multipulse LPC with Maximum Likelihood Quantization
MOS	-	Mean Opinion Score
MSS	-	Maximum Segment Size
NS-2	-	Network Simulator
OSI	-	Open System Interconnection
PBX	-	Private Branch Exchange
PCF	-	Point Coordination Function
PCM	-	Pulse Code Modulation
PF	-	Persistence Factor
PHY	-	Physical

PLCP	-	Physical Layer Convergence Procedure
PSTN	-	Public Switched Telephone Network
QAP	-	QoS Access Point
QBSS	-	QoS supporting BSS
QoS	-	Quality of Service
QPSK	-	Quadrature Phase Shift Keying
QSTA	-	QoS Station
RF	-	Radio Frequency
RTP	-	Real Time Protocol
SIFS	-	Short InterFrame Space
SIP	-	Session Initiation Protocol
STA	-	Station
RTS	-	Request To Sent
TIA	-	Telecommunication Industry Association
TXOP	-	Transmission Opportunities
UDP	-	User Datagram Protocol
VoIP	-	Voice over Internet Protocol
WDB	-	Waiting-Time Dependent Back-off
WLAN	-	Wireless Local Area Network
WT	-	Waiting Time

CHAPTER 1

INTRODUCTION

1.1 Wireless Local Area Network

A wireless local area network (WLAN) is a data transmission system designed to provide location-independent network access between computing devices by using radio waves rather than a cable infrastructure [1]. This system enables multiple computer users to communicate or share resources with each other. Instead of using coaxial, twisted-pair or fiber-optic cable, WLANS uses Infrared Light (IR) or radio frequency (RF) as a transmission medium. By using RF technology, WLANs can transmit and receive data over the air without wired connections. However, wireless system is not a completely wireless. These systems are designed and constructed by using standard microprocessors and digital circuits which are connected to traditional wired LAN systems [2]. So, wireless devices are just a part of wired LAN.

The growing popularity of WLANs has helped to simplify networking by enabling multiple computer users to simultaneously communicate with each other and sharing resources without wired connections. With WLANs, users can access resources without looking for a place to plug in the LAN cable, and network managers can easily set up without installing wires.

The widespread reliance on networking and the fast growth of the internet and online services, WLANs are commonly used by everyone. It is because with the WLAN, the lower speeds are adequate to support application and user needs [3]. WLANs provide the advantages; convenience, mobility, productivity, speed of deployment, cost, WLAN voice service and scalability.

1.2 802.11 Standards

The 802.11 is a wireless standard that specifies connectivity for fixed, portable, and moving stations (STAs) within a LAN. The first 802.11 Standards for WLANs are introduced in 1997. This first version of 802.11 only provides 1 to 2 Mbps data rate which is consider relatively slow. Recognizing the critical need to support higher data-transmission rates, the Institute of Electrical and Electronics Engineering (IEEE) has ratified new several 802.11X Standards for higher transmissions.

As any 802.X Standards, 802.11 Standard focuses on the lower-layer (Data Link layer and PHY layer) standards of the Open System Interconnection (OSI) reference model. So, the 802.11 standard is officially called IEEE Standard for WLAN Media Access Control (MAC) and Physical (PHY) specifications [1]. The 802.11 Standard defines a single MAC which interacts with three PHYs (Frequency Hopping Spread Spectrum or FHSS, Direct Sequence Spread Spectrum or DSSS, and Infrared or IR) and Logical Link Control (LLC) 802.2 as shown in Figure 1.1. However, this project is carried out to study the performance of Voice over Internet Protocol (VoIP) over 802.11b and 802.11e on MAC. So, in the following section will briefly discuss on 802.11b and 802.11e.

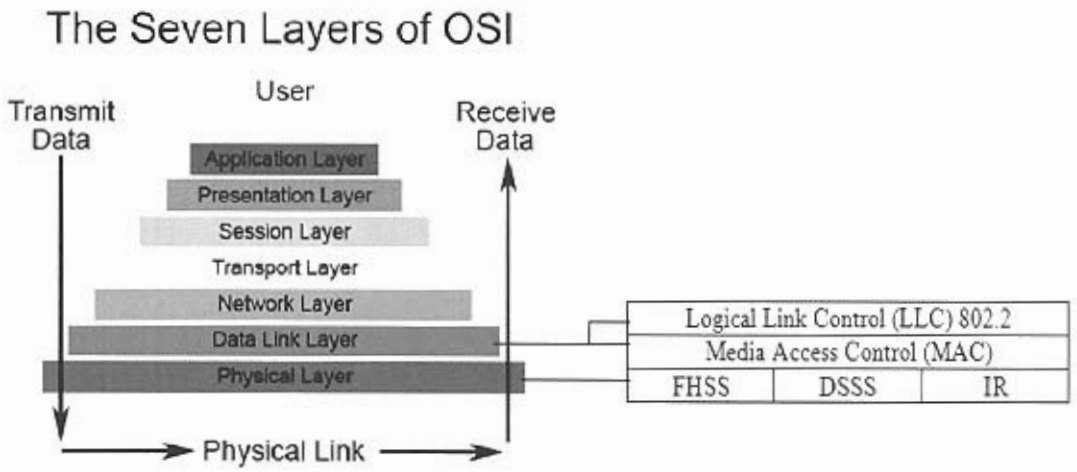

Figure 1.1: IEEE 802.11 Protocols in Seven Layers of OSI [Modified from 4]

1.2.1 IEEE 802.11b

IEEE 802.11b is an amendment to the IEEE 802.11 specification that extended throughput up to 11 Mbps using the same 2.4 GHz radio band. This specification under the marketing name of Wi-Fi has been implemented all over the world. The amendment has been incorporated into the published IEEE 802.11-2007 standard [5]. 802.11b has a maximum raw data rate of 11 Mbps and uses the same Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) media access method defined in the original standard.

802.11b products appeared on the market in early 2001 [6], since there is an enhancement on the 802.11 PHY layer. 802.11b is a direct extension of the DSSS modulation technique defined in the original standard. To increase the data rate in the 802.11 Standard, 802.11b have specifies Complementary Code Keying