

**PERFORMANCE ANALYSIS ON THE EFFECT OF G.711 and SPEEX  
SPEECH CODEC  
ON 802.11n draft 2.0 WIRELESS LOCAL AREA NETWORK**

**MARZIATUL AKHTAR BT SALEH  
(2006209676)**

**Thesis submitted in partial fulfillment of the requirements for the  
Degree of Master of Science (Computer Networking)  
November 2009**

**FACULTY OF INFORMATION TECHNOLOGY AND  
QUANTITATIVE SCIENCES  
UNIVERSITI TEKNOLOGI MARA  
SHAH ALAM**

# ACKNOWLEDGEMENT

Assalamualaikum w.b.t

*“In the name of ALLAH, the most Gracious and most Merciful”*

First and foremost, I would like to thank ALLAH the All Mighty for all the strength that has been given to me to complete this thesis. I would like to dedicate my utmost appreciation to all people that involved throughout the completion of my thesis.

Special thanks to Puan Rozita Yunos who has helped me along the way by giving a lot of thoughtful ideas, comments, suggestions and guidelines to me in order to complete this thesis. She has always been kind to me, guided me and encouraged me to understand the problems while doing my thesis.

Not to forget to my friend from CS778, Imran Edzerei who has given me the idea of starting out this thesis and has helped me to accomplish this project accordingly. Thank you for all the contributions, motivations and reminders that success can be achieve with constant efforts.

Finally, to my beloved husband, Amir Fairuz a gazillion thank you to him for supporting me throughout this semester to complete my thesis and also to my family especially my parents for keeps on encouraging me to finish my Masters degree. Thanks for the non-stop support, love, encouragement, supports and prayers all this time.

Thank you.

Marziatul Akhtar Saleh

# TABLE OF CONTENT

ABSTRACT.....	1
CHAPTER 1 .....	1
INTRODUCTION.....	2
<b>1.0 INTRODUCTION</b> .....	2
<i>1.0.1 802.11n Wireless Technology</i> .....	4
<b>1.1 PROBLEM STATEMENT</b> .....	6
<b>1.2 RESEARCH QUESTION</b> .....	7
<b>1.3 RESEARCH OBJECTIVES</b> .....	7
<b>1.4 SIGNIFICANCE OF RESEARCH</b> .....	8
<b>1.5 SCOPE OF RESEARCH</b> .....	8
CHAPTER 2 .....	9
LITERATURE REVIEW.....	9
<b>2.0 INTRODUCTION</b> .....	9
<i>2.0.1 How does VoIP Works?</i> .....	9
<i>2.0.2 VoIP on Wireless System</i> .....	10
<b>2.1 VOIP PROTOCOLS</b> .....	12
<i>2.1.1 Session Initiation Protocol</i> .....	12
<i>2.1.2 H.323</i> .....	13
<b>2.2 SPEECH CODEC</b> .....	14
<i>2.2.1 G.711</i> .....	15
<i>2.2.2 G.729</i> .....	16
<i>2.2.3 Speex</i> .....	16
<i>2.2.4 GSM</i> .....	16
<i>2.2.5 iLBC</i> .....	17
<b>2.3 WHAT IMPACTS VOIP PERFORMANCE?</b> .....	17
<i>2.3.1 Packet Loss</i> .....	18
<i>2.3.2 Jitter</i> .....	18
<i>2.3.3 Codec Quality</i> .....	18
<i>2.3.4 Sequence Errors</i> .....	19
<b>2.4 ASSESSING THE VOICE QUALITY</b> .....	19
<i>2.4.1 MOS (Mean of Opinion Score)</i> .....	20
<i>2.4.2 Signal to noise ratio (SNR)</i> .....	20
<i>2.4.3 R-factor</i> .....	22
<b>2.5 QoS CHALLENGE</b> .....	24
<i>2.5.1 Why is QoS Necessary in VoIP Communication?</i> .....	25

<b>2.6 WLAN 802.11N-2009 STANDARD .....</b>	<b>26</b>
2.6.1 Data encoding .....	27
2.6.2 Number of antennas.....	27
2.6.3 Data Rates .....	28
2.6.4 Frame aggregation.....	28
2.6.5 Backward compatibility.....	28
<b>2.7 SUMMARY .....</b>	<b>29</b>
<b>CHAPTER 3 .....</b>	<b>30</b>
<b>RESEARCH METHODOLOGY.....</b>	<b>30</b>
<b>3.0 INTRODUCTION .....</b>	<b>30</b>
<b>3.1 OVERVIEW OF RESEARCH METHODS.....</b>	<b>32</b>
3.1.1 Study Phase .....	32
3.1.2 Planning Phase .....	32
3.1.3 Design Phase.....	33
3.1.4 Testing Phase .....	34
3.1.5 Data Analysis Phase.....	34
<b>3.2 RESEARCH EXPERIMENTS.....</b>	<b>35</b>
3.2.1 Experimental Setup .....	35
3.2.2 Related Software .....	37
3.2.3 Experimental parameters and procedures .....	40
<b>3.3 SUMMARY .....</b>	<b>47</b>
<b>CHAPTER 4 .....</b>	<b>48</b>
<b>EXPERIMENTAL ASSESSMENT.....</b>	<b>48</b>
<b>4.0 INTRODUCTION .....</b>	<b>48</b>
<b>4.1 EXPERIMENT T1 TEST SCENARIO: “CLIENT 1” TALKING AND “CLIENT 2” SILENT .....</b>	<b>49</b>
4.1.1 Experiment T1 findings: Packet jitter comparison.....	49
4.1.2 Experiment T1 findings: Packet loss comparison .....	51
4.1.3 Experiment T1 findings: R-Factor comparison.....	52
4.1.4 Experiment T1 findings: MOS Score comparison.....	54
<b>4.2 EXPERIMENT T2 SCENARIO: “CLIENT 1” SILENT AND “CLIENT 2” TALKING ..</b>	<b>55</b>
4.2.1 Experiment T2 findings: Packet jitter comparison.....	55
4.2.2 Experiment T2 findings: Packet loss comparison .....	56
4.2.3 Experiment T2 findings: R-Factor comparison.....	58
4.2.4 Experiment T2 findings: MOS Score comparison .....	59
<b>4.3 EXPERIMENT T3 SCENARIO: “CLIENT 1” TALKING AND “CLIENT 2” TALKING</b>	<b>61</b>
4.3.1 Experiment T3 findings: Packet jitter comparison.....	61

# **ABSTRACT**

## **Performance analysis of G.711 and Speex speech codec On 802.11n draft wireless local area network**

**Key Words: G.711, Speex, VoIP, 802.11n draft, SNR**

Voice over Internet Protocol (VoIP) communication over Wireless LAN (WLAN) is the fastest growing technology in this era of globalization. This is due to its cost efficiency and its high resource utilization. The latest wireless standard specification endorsed by IEEE is 802.11n-2009 has been said that can increase reliability and promotes higher data rates compare to previous standard such as 802.11g. However, despite the powerful 802.11n standard deployment, VoWLAN still imposes drawbacks especially in term of its quality of services (QoS). In this thesis, we will analyze the performance of two speech codec namely G.711 as per ITU-T recommended speech codec and Speex as an open source codec in 802.11n draft wireless environment. The performance analysis will be focusing on the QoS parameters such as packet jitter, loss, R-factor and MOS Score. The experimental procedure is based on Markov method and divided into three experiments; Experiment 1: Client 1 talks, Client 2 silent; Experiment 2: Client 1 silent, Client 2 talks and Experiment 3: Client 1 and Client 2 talks. After obtaining the result, we will analyze the result and compare it accordingly based on our research objectives that have been outlined in Chapter 1.