Best VoIP Codecs Selection for VoIP Conversation over Wireless Carriers Network

Mohd Nazri Ismail
Department of MIIT, University of Kuala Lumpur (UniKL), Malaysia

ABSTRACT: In this study, we propose to evaluate VoIP performance over wireless carriers network. Today, the deployment of VoIP occurs in various platform for example, VoIP over LAN, VoIP over WAN and VoIP over VPN. Therefore, this study is to define which VoIP codec selection can provide better VoIP performance over ISPs wireless network. We use softphone as our medium communication between two parties. The results show that VoIP over wireless WAN can degrade performance compare to VoIP over LAN but using the appropriate codecs selection able to increase VoIP performance over wireless WAN. In our experiment, it shows that GSM is the best codec to improve and provide better VoIP quality during conversation over wireless WAN and LAN.
KEYWORDS: GSM, VoIP, Wireless, WAN, Quality

Introduction

The objectives of this study are to: i) make comparison between several codecs selection that can produce better VoIP performance quality; and ii) evaluate VoIP performance over wireless WAN. We will study the performance of VoIP on diversity codecs selection such as G.711, G.726, GSM, G.722 and SPEEX. Codec is an algorithm used to encode and decode the voice conversation.

1. Related works

Voice over IP is a reality nowadays, every day more and more people use this system to phone around the world. There are many common programmes which make it easy to use VoIP: Skype, MSN messenger,

VoIPcheap, VoIP-buster etc. [RG06]. Today, many research concentrate on wireless technology implementation on VoIP service. In the digital era, the increase of network bandwidth and the ubiquitous wireless access facilitates the creation of more and more innovative network services. Among these services, Voice over Internet Protocol (VoIP) is surely one of the most popular and successful real-time multimedia services on the Internet [WW08].

Today, many organizations are using WLANs as a medium for communication, so it is important to investigate how VoIP over WLAN performs based on previous study [SA07]. Wireless VoIP applications make the very inefficient use of WLAN resources. Due to the large overhead involved in transmitting small packets in an 802.11 WLAN, the bandwidth available for VoIP traffic is far less than its maximal 11Mbps data rate it currently supports [ND06].

There has been much activity in the area of WLAN performance analysis in the last few years. The most relevant related works are highlighted here. Bianchi did their work in this area by developing the analytical model [Bia00] to compute the saturation throughput of the *Distributed Coordination Function* (DCF) scheme. Other 802.11 related researches have focused on approaches to adapting system parameters [HMM05].

2. Methodology

We have test a real wireless network environment to analyze and measure VoIP performance over WAN. This study posits several research questions: i) what is the VoIP performance level between two ISPs wireless provider? and ii) which codecs are able to provide better improvement of VoIP conversation over wireless network provider?

Figure 2.1 and Figure 2.2 show the flow of VoIP packets between source and destination call. We measure our voice quality using human perception. Mean Opinion Score (MOS) technique is the best approach to measure and validate voice quality between two ISPs wireless network provider. Figure 2.2 shows the measurement of VoIP performance over wireless WAN network cloud. We also test on different codecs selection such G.711, G.726, G.722, GSM, and SPEEX.

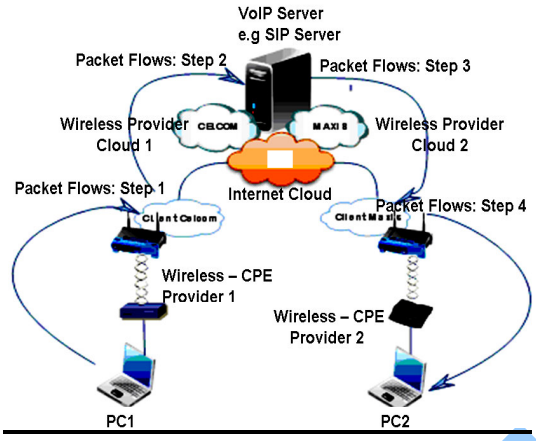

Figure 2.1: Wireless WAN Network Architecture

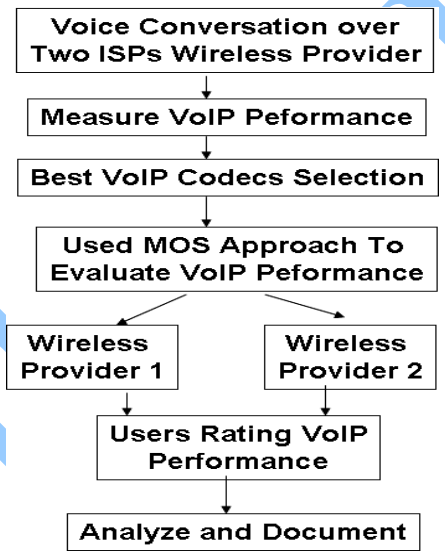

Figure 2.2: VoIP Performance Measurement Approach

3. Analysis and results

This section measures and compares VoIP performance using differences codecs selection. In voice communication, quality usually dictates whether the experience is a good or bad one. Besides the qualitative description we hear, like 'quite good' or 'very bad', there is a numerical method of expressing voice quality. It is called Mean Opinion Score (MOS). MOS can be tested using: i) human perception; ii) simulation model; and iii)

automated system [M+07, MO01, CR01]. MOS is expressed in one number, from 1 to 5, 1 being the worst and 5 the best. MOS is quite subjective; as it is based figures that result from what is perceived by people during tests (refer to Table 3.1). We will select five different users to evaluate and rate the VoIP performance over wireless WAN. Call quality is a function of packet loss rate, delay, and jitter is typically represented as a MOS [CR01, DG03].

Table 3.1: Mean Opinion Score (MOS) Ratings

Mean Opinion Score (MOS) Ratings	
Rate	5 (Perfect. Like face-to-face conversation or radio reception)
Good	4 (Fair. Imperfections can be perceived, but sound still clear. This is (supposedly) the range for cell phones)
Fair	3 (Annoying)
Poor	2 (Very annoying. Nearly impossible to communicate)
Bad	1 (Impossible to communicate)

3.1. VoIP over wireless LAN

Most of the users agreed and rates VoIP quality using GSM codec able to achieve better performance via wireless LAN medium (refer to Figure 3.1). Most of the users give 4 to 5 rating. The next experiment, we tested VoIP performance over wireless LAN using speex codec. The result shows that most of the users have rated 1 to 2. Speex codec unable to generate high quality VoIP performance over wireless LAN (refer to Figure 3.2). We conclude and summarize all the VoIP codecs performance, the results show that G.711 and GSM are the best codecs selection using wireless LAN (refer to Table 3.1 and Figure 3.3).

Table 3.1 Average of Mean opinion score (MOS) for wireless connection (LAN)

Codec	**G.711**	**G.722**	**G.726**	**GSM**	**Speex**
Average	4	2	3	4	1

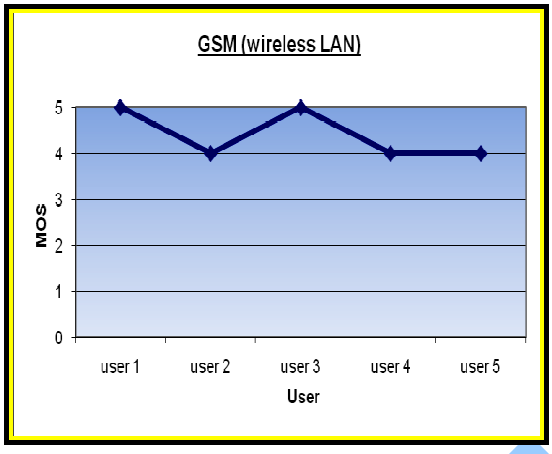

Figure 3.1: User Rating Using MOS Technique - GSM Codec over Wireless LAN

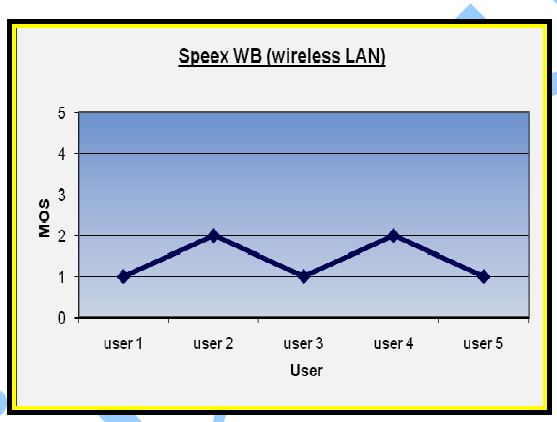

Figure 3.2: User Rating Using MOS Technique - Speex Codec over Wireless LAN

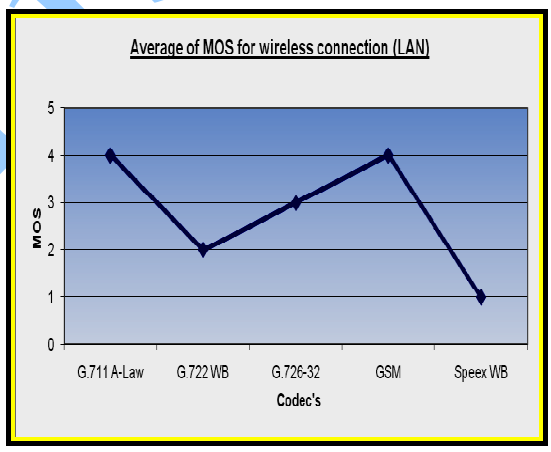

Figure 3.3: Average of Mean opinion score (MOS) for wireless connection (LAN) – Codecs Selection

3.2. VoIP over wireless WAN

Our next experiment, we will conduct and test VoIP performance over wireless WAN. Most of the users agreed and rates this VoIP performance using GSM codec will also provide high quality for VoIP transmission over wireless WAN (refer to Figure 3.4). Other users agreed and rates VoIP performance has achieved one rating for Speex codecs over wireless WAN (refer to Figure 3.5). Figure 3.6 shows the average MOS score for VoIP conversation performance over wireless WAN and the result confirm that GSM is the best codec selection to improve VoIP quality over wireless transmission (refer to Table 3.2).

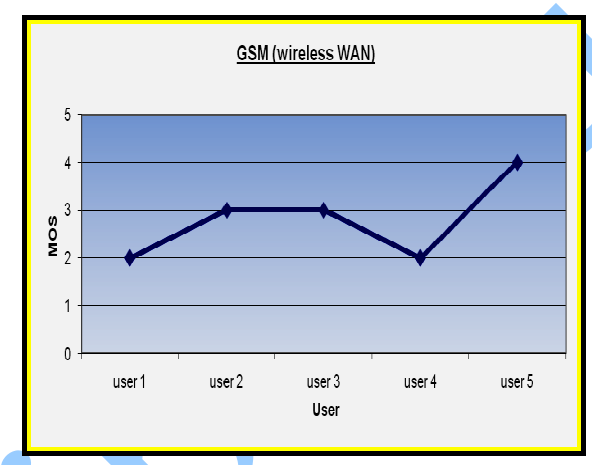

Figure 3.4: User Rating Using MOS Technique- GSM Codec over Wireless WAN

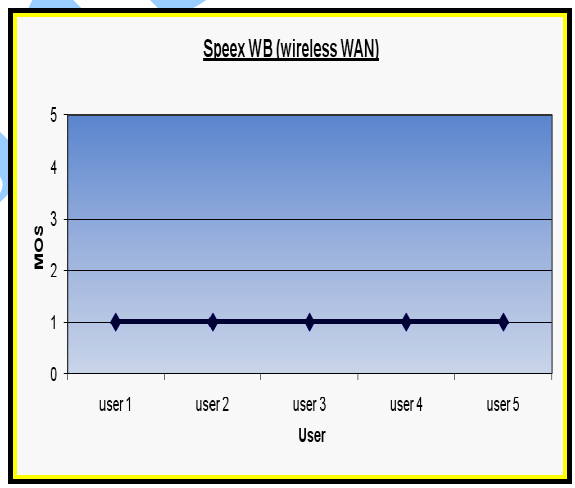

Figure 3.5: User Rating Using MOS Technique - Speex Codec over Wireless WAN

Table 3.2 Average of Mean opinion score (MOS) for wireless connection (WAN)

Codec	G.711	G.722	G.726	GSM	Speex
Average	1	1	2	3	1

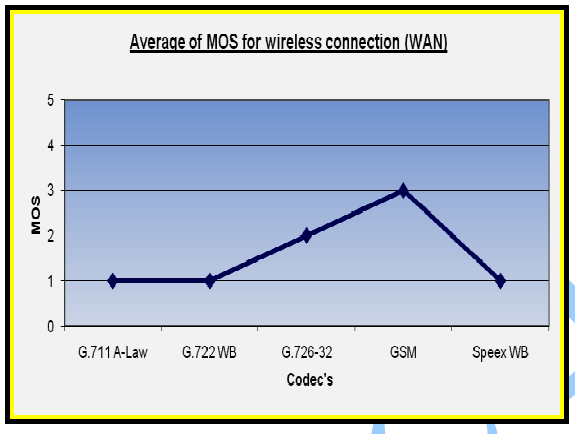

Figure 3.6: Average of Mean opinion score (MOS) for wireless connection (WAN) – Codecs Selection

3.3. Overall results

Finally, overall results can be summarized as follows: i) Figure 3.7 shows the comparison between wireless LAN and wireless WAN. The result show that VoIP transmission over wireless WAN will reduce the quality of VoIP conversation compare to wireless LAN. Most of the users agreed that VoIP over wireless LAN able to give better quality. There are several factors that can degrade VoIP quality transmission over wireless WAN such as: a) queuing delay; b) serialization delay; c) propagation delay; d) transmission delay; and e) codec delay; ii) Figure 3.8 shows the comparison of the VoIP codecs performance over wireless WAN. The best VoIP codec over wireless WAN is GSM.

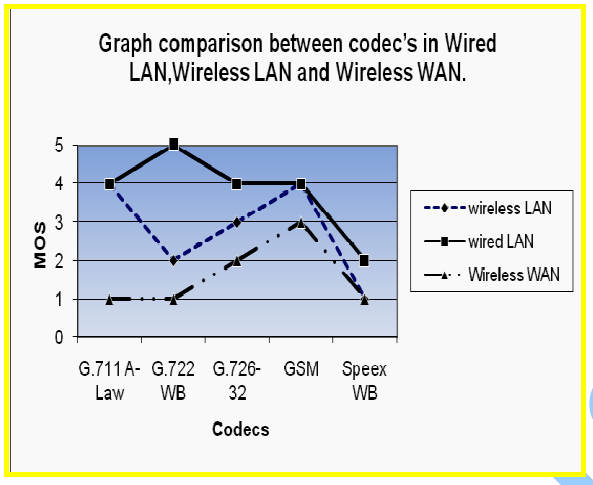

Figure 3.7: Comparison between Wireless LAN and WAN Performance

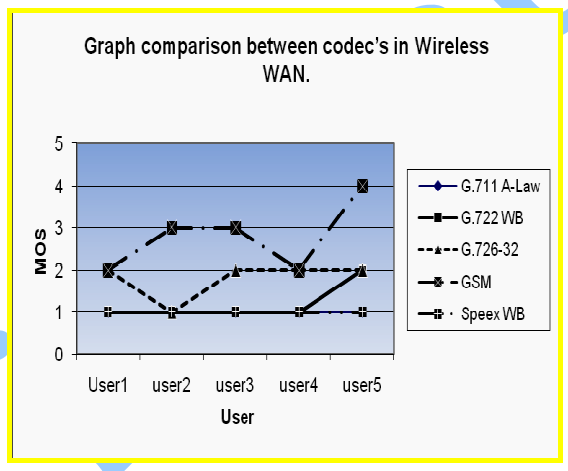

Figure 3.8: Comparison between VoIP Codecs Selection Performance

Conclusion and future work

Based on the results, using G.711, G.722, Speex and G.726 codec are not able to generate high quality of VoIP conversation over wireless WAN cloud. The result shows that GSM codecs is able to increase VoIP conversation performance over wireless WAN. For VoIP over LAN, the voice quality is more better than VoIP over WAN. From the result, we can conclude that VoIP over WAN has produce a lot of inteferences compare to VoIP over LAN. Since the manual/human MOS tests are quite subjective

and less than productive in many ways, there are nowadays a number of software tools that carry out automated MOS testing in a VoIP deployment. Although they lack the human touch, the good thing with these tests is that they take into account all the network dependency conditions that could influence voice quality. Some examples are AppareNet Voice, Brix VoIP Measurement Suite, NetAlly, PsyVoIP and VQmon/EP. Future work, we will extend our experiment on mesh wireless equipment in campus environment.

References

[Bia00] G. Bianchi - *Performance Analysis of the IEEE 802.11 Distributed Coordination Function*, IEEE Journal on Selected Areas in Communications, Vol. 18(3), pp. 35-547, 2000

[CR01] R. G. Cole, J. H. Rosenbluth - *Voice over IP performance monitoring*, ACM SIGCOMM Computer Communication Review Vol. 31(2), pp. 9-24, 2001.

[DG03] L. Ding, R. Goubran - *Speech Quality Prediction in VoIP Using the Extended e-Model,* Global Telecommunication Conference, GLOBECOM '03. IEEE, Vol. 7, pp. 3974-3978, 2003.

[HMM05] Gráinne Hanley, Seán Murphy, Liam Murphy - *Adapting WLAN MAC parameters to enhance VoIP call capacity*, International Workshop on Modeling Analysis and Simulation of Wireless and Mobile Systems, simulation of wireless and mobile systems, Montréal, Quebec, Canada, pp. 250 – 254, 2005

[MO01] M. Masuda, K. Ori - *Delay Variation Metrics for Speech Quality Estimation of VoIP,* Institute of Electronics, Information and Communication Engineers (IEIC) Technical Report, Vol. 101(11), pp. 101-106, 2001.

[M+07] N.T. Moura, B.A. Vianna, C.V.N. Albuquergue, V.E.F. Rebello, C. Boeres - *MOS-Based Rate Adaption for VoIP Sources*, IEEE International Conference on Communication, pp. 628-633, 2007.

[ND06] Miroslaw Narbutt, Mark Davis - *Gauging VoIP Call Quality from 802.11 WLAN*, Proceedings of the 2006 International Symposium on on World of Wireless, Mobile and Multimedia Networks, pp. 315 – 324, 2006

[RG06] Ángel Cuevas Rumín, Eur Ing Chris Guy - *Establishing how many VoIP calls a wireless LAN can support without performance degradation*, International Workshop on Modeling Analysis and Simulation of Wireless and Mobile Systems, Terromolinos, Spain, pp. 61 – 66, 2006.

[SA07] Patrick Stuedi, Gustavo Alonso - *Wireless ad hoc VoIP*, Proceedings of the 2007 Workshop on Middleware for next-generation converged networks and applications, Port Beach, California, pp. 8, 2007

[WW08] Jiayu Wang, Quincy Wu - *Porting VoIP applications to DCCP,* International Conference On Mobile Technology, Applications, And Systems, Yilan, Taiwan , pp. 8, 2008.