"I hereby declare that I have read this thesis and in my opinion, it is suitable in term of scope and quality for the purpose of awarding a Bachelor Degree in Electronic Engineering (Computer Engineering)."

Signature :
Supervisor : Zahariah binti Manap
Date : 5/5/06

THE PROTOCOL AND IMPLEMENTATION OF VOICE OVER IP (VOIP)
IN MALAYSIA: A CASE STUDY.

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This Report is Submitted in Partial Fulfillment of Requirements for the Bachelor Degree of Electronic Engineering (Computer Engineering)

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"I admit that this is done by myself except the discussion and extracts taken from other sources that I explained each in detail."

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**Dedicated to abah and mama**

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## ABSTRACT

Over the past decade, the telecommunications industry has witnessed rapid changes in the way people and organizations communicate. Many of these changes spring from the explosive growth of the Internet and from applications based on the Internet Protocol (IP). The Internet has become a ubiquitous means of communication, and the total amount of packet-based network traffic has quickly surpassed traditional voice (circuit-switched) network traffic. In the wake of these technology advancements, it has become clear to telecommunications carriers, companies, and vendors that voice traffic and services will be one of the next major applications to take full advantage of IP. This expectation is based on the impact of a new set of technologies generally referred to as voice over IP (VoIP) or IP telephony. VoIP is a technology that allows telephone calls to be made over computer networks like the Internet. VoIP converts analog voice signals into digital data packets and supports real-time, two-way transmission of conversations using Internet Protocol (IP). There are three basic protocols which are used to implement a voice over IP solution: H.323, SIP and RTP. H.323 and SIP are mainly concerned with the call establishment and voice encoding, whereas RTP (Real-time Transport Protocol) is used by both protocols for the transport of encoded voice packets over an IP network. This paper is intended to study the technology and its benefits, characteristics, protocols, architectures, differentiates with traditional PSTN, all the hardware and software both the IP technology and its applications, and how Malaysia are approaching IP-enabled technologies, particularly VoIP, and the implement issues surrounding VoIP. In addition, this study case will include the latest technology that support VoIP like VoIP with WIFI, and also satellite.

# ABSTRAK

Lebih sedekad yang lalu, industri telekomunikasi telah menyaksikan pecutan perubahan bagaimana pengguna dan industri berkomunikasi. Kebanyakan perubahan ini adalah bersandarkan kepada penumbuhan pesat penggunaan Internet dan aplikasi berdasarkan Protokol Internet (IP). Internet telah menjadi satu kebiasaan dalam erti kata perhubungan manakala jumlah rangkaian paket-paket dengan pesatnya telah berubah melebihi rangkaian suara konvensional. Dengan kemajuan pembangunan teknologi ini memberikan gambaran jelas kepada organisasi-organisasi, pembekal serta syarikat-syarikat telekomunikasi bahawa perkhidmatan panggilan suara akan menjadi aplikasi utama menggunakan kelebihan IP. Jangkaan ini berdasarkan kepada impak teknologi baru iaitu Panggilan Suara melalui Protokol Internet (VoIP) atau dikenali juga Telefon IP. VoIP merupakan teknologi yang membenarkan panggilan suara melalui rangkaian komputer seperti internet. Ia menukarkan isyarat analog suara kepada paket-paket data secara digital dan menyokong masa nyata (real time) dan perhubungan dua hala melalui IP. Terdapat tiga protokol – protokol asas yang digunakan untuk melaksanakan VoIP: H.323, SIP dan STP. H.323 dan SIP lebih menumpukan kepada bagaimana panggilan suara dilaksanakan dan pengekodan suara. Manakala RTP digunakan SIP dan H.323 untuk menghantar suara yang telah dikodkan melalui rangkaian IP. Kajian ini akan mengkhususkan kajian kepada ciri – ciri, seni bina, kelebihan, aplikasi, protokol-protokol, perbezaan dengan talian konvensional (PSTN), perkakasan dan perisian yang digunakan, serta pelaksanaan VoIP di Malaysia. Sebagai tambahan, kajian turut meliputi bagaimana teknologi lain menyokong VoIP seperti WiFi dan satelit.

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## ABBREVIATION

| | |
|---|---|
| DSL | Digital Subscriber Line |
| DVB | Digital Video Broadcast |
| FTP | File Transfer Protocol |
| GPRS | General Packet Radio Service |
| IETF | Internet Engineering Task Force |
| IP | Internet Protocol |
| IPSAT | Internet Protocol Satellite |
| ISDN | Internet Service Digital Network |
| ISP | Internet Service Provider |
| ITSP | Internet Telephone Service Provider |
| ITU | International Telecommunication Union |
| LAN | Local Area Network |
| MAC | Media Access Control |
| MEGACO | Media Gateway Control |
| MGCP | Media Gateway Control Protocol |
| NIC | Network Interface Card |
| PBX | Public Branch eXchange |
| POTS | Plain Old Telephone Service |
| PSTN | Public Switch Telephone Network |
| RAS | Registration, Admission & Status |
| RTP | Real-time Transport Protocol |
| SAP | Session Announcement Protocol |
| SIP | Session Initial Protocol |

| | |
|---|---|
| Sigtran | Signaling Transport |
| SS7 | Signaling System 7 |
| TDM | Time Division Multiplexing |
| TCP | Transfer Control Protocol |
| TCP/IP | Transfer Control Protocol / Internet Protocol |
| UAC | User Agent Client |
| UAS | User Agent Server |
| UDP | User Datagram Protocol |
| VoIP | Voice over Internet Protocol |
| VPN | Virtual Private Network |
| WAN | Wide Area Network |
| WiFi | Wireless Fidelity |

# APPENDICES

# CHAPTER I

# INTRODUCTION

## 1.1 OVERVIEW

To most of us, VoIP may sound like a new advancement in technology, but it has actually been in Malaysia for a decade. As Malaysians started embracing the Internet in 1995, the more sophisticated computer users among us began to venture into the world of VoIP. Most toyed with software to make PC-to-PC voice calls, and while it was considered a very cool thing to do, it was not very effective as a means to communicate.

Compared to now, consumer-level Internet connections were pretty poor back then if we wanted VoIP, we would have to put up with conversations that were disrupted by hissing sounds and lag. However the situation was different for VoIP companies, who could use their own networks for transporting voice data instead of the Internet. And so, several companies in Malaysia started offering VoIP services by selling prepaid cards (or post-paid accounts to businesses) that promised cheaper international calls. This also gave rise to the trend of call shops in Malaysia, especially with the increase of foreign workers and students who needed a more affordable way to call back home.

However, the Internet connection quality has significantly improved in the past few years, and with the advent of broadband in Malaysia, VoIP has become more practical for households. The Internet has become a ubiquitous means of communication, and the total amount of packet-based network traffic has quickly surpassed traditional voice (circuit-switched) network traffic. In the wake of these technology advancements, it has become clear to telecommunications carriers, companies, and vendors that voice traffic and services will be one of the next major applications to take full advantage of IP. In fact, last year itself we saw a few local companies enter the consumer-level VoIP scene by offering VoIP packages catered to homes and small businesses. But as these packages are only limited to PCs connected to the Internet, it makes VoIP calls less convenient than using a cell phone. Fortunately, this situation may yet change with the arrival of mobile VoIP and VoIP prefix number 015 from several Malaysia's provider.

## 1.2 TITLE AND OBJECTIVES.

The title of this project is 'The Protocol and implementation of voice over IP (VoIP) in Malaysia: A case study. There is more than one major of VoIP providers in Malaysia using the same protocols but some of them are different in implementing of this technology. The main purpose of this research is to specialist study in implementing VoIP in Malaysia. Thus, it will include:

- To describe the protocol used to implementing VoIP
- To review and list the software and hardware.
- Identify the application and technology
- To define and differentiate with PSTN technology
- Identify the importance and benefit of VoIP to user in Malaysia.

## 1.3 SCOPES OF WORKS

### 1.3.1 Protocol

#### 1.3.1.1 H.323

International Telecommunication Union Telecommunication Standardization Sector (ITU-T) Recommendation H.323 describes the architecture to support multimedia communications over networks without quality of service (QoS) guarantees. Originally intended for LANs, H.323 has been adapted for IP.

#### 1.3.1.2 MEGACO

The MEGACO protocol is used in environments in which a media gateway consists of distributed subcomponents and communication is required between the gateway subcomponents

#### 1.3.1.3 MGCP

Defines a call control model that controls VoIP gateways from an external call control element or call agent

#### 1.3.1.4 SIP

Describes a multicast mechanism for advertising the session characteristics of a multimedia session, including audio and video

#### 1.3.1.5 Real-time Transport Protocol (RTP)

Used by H.323 and SIP protocols to transport of encoded voice packets over an IP network. Also defines a format for different audio and video encodings to promote interoperability among different computer platforms, operating system and application software products.

### 1.3.2 Service

#### 1.3.2.1 IP Telephony

The two-way transmission of voice over a packet-switched IP network, which is part of the TCP/IP protocol suite.

#### 1.3.2.2 Internet Telephony

Is another term for IP telephony and VoIP. Internet telephony referred to voice over the public Internet, while VoIP referred to voice over private IP networks.

#### 1.3.2.3 LAN Telephony

An IP telephony system that is controlled within a local area network (LAN). More appropriate for medium to large enterprises that wish to use their existing IP network to save money on voice calls.

### 1.3.3 Applications

#### 1.3.3.1 PC to PC

VoIP applications that end to end user are PC as tools to communicate each other. Apparently need VoIP software (Softphone) that sometimes provided free by VoIP provider.

#### 1.3.3.2 PC to Telephone

This type of application need regular phone hardware or special IP phone that can uses to received or calling to VoIP number

#### 1.3.3.3 Telephone to Telephone

VoIP applications that uses regular or IP phone that can be made like normal call using PSTN.

### 1.3.4 Transmission

VoIP use various ways in order to transmitted over. Transmission line should support as voice packet are big enough than data even it had converted. There are several transmission types' uses to implement VoIP such as:

- **Over PSTN**
- **Broadband**
- **Satellite**
- **WiFi**

### 1.3.5 Differentiates between VoIP and PSTN

To understand the VoIP operation and to show it benefit, the differences of this technology must compare to PSTN. These will include:

- Architecture
- Switching
- Transfer rate
- Noise (if any)
- Bandwidth

I'll cover these scopes of work in chapter IV for more fine points.

## 1.4 THESIS STRUCTURE

Chapter I (on this part) discuss about introduction and overview about background VoIP in Malaysia. It also include of objective and scope of works for this thesis.

Chapter II discover on project literature including VoIP and PSTN background, how VoIP and PSTN related and PSTN protocol.

Chapter III discuss on project methodology used to achieve the study of this title including the flow chart of the methodology.

Chapter IV is the most importance, discover on the result and founding of the thesis. It includes VoIP protocol and standard, how VoIP implementing in Malaysia, what transmission used, comparison to PSTN and also it benefit.

Chapter V is the last part but not least for this thesis which states the discussion and conclusion.

# CHAPTER II

# PROJECT LITERATURE

## 2.1 INTRODUCTION

### 2.1.1 The Telephony Network

From a user's perspective, a telephone network is a big cloud that connects the originating points for transmitted information with terminating points for information. A network is typically made up of nodes interconnecting transmission links to form transmission paths for the transmitted information to follow. The transmission links in typical network often use different transmission modalities (e.g. wire, wireless, fiber).

The nodes may contain electronic devices, such as switches, which establish a temporary or permanent path to be taken by the communicated information traveling from one link onto another link, and/or those nodes may contain conversion devices that change the modality of the transmitted signal to allow it pass between links using different modalities (e.g. connected a wired link to a wireless link, an analog link to a