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The Application of VoIP Technology on Ship's Interior Communication System

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Abstract:
Ship's interior communication system is important to the operation of the ship. Improper communication among the different parts of the ship can cause the failure of a mission. Although, traditional ship's internal communications provide reliable message delivery, there are some limitations of these methods. However, since the evolution of data communication has continuously developed, it is feasible to apply proper technology to improve the way the crew communicates to one another on board for enhancing the ability of communication system. This paper aims to provide an overview of Voice Over Internet Protocol technology focusing on Elastix, including related softwares. This paper also aims to suggest the direction of how to apply the low-cost but effective technology to existing devices such as mobile phones and notebooks for communication alternatives.

Keywords: *Ship's Interior Communication System, VoIP, Elastix, Asterisk, SIP*

1. Introduction

Voice over Internet Protocol (VoIP) is one of the greatest technologies that have various benefits to many organizations and communication areas. It has been around for both the commercial use about the last decade. VoIP is not dealing with only telephone but it is also dealing with data devices that transmit in real-time audio communication. In other words, Voice over Internet Protocol (VoIP) is defined as a technology that transmits voice signal in real time using the Internet Protocol (IP) over a public Internet or private data network [i]. First, the analogue signal is converted to the digital signal. Then compressing and encoding processes are made. The transmission of IP packets is carried out over the IP network to the receiver. At the receiver end, the received IP packets reassembles in order before decompressing and processing through the use of a Digital to Analogue Converter (DAC) to generate the initial signal transmitted [ii]. Since VoIP is based on two existing technologies, the telephone and the Internet, It allows for inexpensive voice and data communication. All these factors converge to the innovation of modern communication system.

2. Elastix

Elastix is an open source software that provides not only telephony, but also combines other modern communication methods to make an organization more productive and efficient. This software includes the common media such as Voice Over Internet Protocol, Fax Server, Instant Messaging, Mail Sever and Video Conference. Elastix is capable to establish an efficient environment on the organization with lots of communication features. The prominent features include PBX Interconnection, Web Interface Configuration, and Virtual Conference.

Elastix Components

Elastix comprises the components that the organization can benefit to. Major components are Asterisk, Free PBX, Flash Operator Panel, OpenFire, and HylaFax. We will brief the functions of each feature in order to understand the abilities of Elastix.

2.1. Asterisk

Asterisk is an open source framework for building communication application. This communication server software is well-known and widely used by organizations and businesses from small to large scale. The objective for the Asterisk project is to conduct the telephony. In order to achieve the goal, Asterisk now supports various technologies related to telephony matters. This includes many VoIP protocols, including both analog and digital connectivity to the traditional telephone network, or the PSTN (Public Switched Telephone Network) [iii].Asterisk can be implemented as a standalone system, or implemented as an adjunct to an existing PBX or IPPBX implementation. It can have a variety of hardware interfaces to directly tie in with existing TDM (Time Division Multiplexing) equipment [iv]. This software supports Session Initiation Protocol (SIP), an application-layer control protocol for creating modifying and terminating sessions with one or more participants. The sessions include Internet telephone calls, multimedia distribution, and multimedia conferences [v].

2.2. FreePBX

FreePBX is a PBX software working on Web-based. It provides an easy way to customize the needs of organizations. The smart management is an important function of this software. It is able to handle the communication of all sizes.

2.3. Open Fire

OpenFire is an open source that supports Extensible Messaging and Presence Protocol (XMPP) or Jabber ignite realtime about. Its important function is real-time messaging. Moreover, OpenFire offers lots of plugins such as Asterisk-IM, Broadcast, Content Filter and IM Gateway.

2.4. Flash Operator Panel

Flash Operator Panel is a switchboard application for the Asterisk PBX. This component uses web-based technology. It is very effective to display information in real time.

2.5. Hyla Fax

HylaFax is a software designed for sending and receiving facsimiles. It is robust and lightweight. This software also supports various modems.

The components we mentioned above have great abilities for building VoIP system. They are also functional to display information in real time and beneficial to findings analysis.

3. Ship's Interior Communication Systems

Ship's interior communication is considered one of the most important parts of the ship operations. The faster the message moves though the ship's interior, the more efficient the ship will operate. This is absolutely true not only for normal operations but also the wartime. In the past, internal communication systems rely on voice and visual methods. Onboard communication conducted by messengers is probably the oldest way but the most reliable method. Generally, interior communications deal with the communication between senders and receivers aboard the same ship. Various stations within a ship must be able to exchange messages with one another. For example, the bow lookouts must be able to inform the officer of the desk (OOD) about the situation of what they see and hear. There are 4 major types of interior communication still using onboard which are voice tube, ship's service telephone, shipboard announcing system and sound-powered telephone system.

3.1. Voice Tube

Voice tube is the main communication method. It is used by some types of vessels such as mine craft and patrol vessels. The limitation is that if the distance between sender and receiver is long, it is difficult to communicate to each other.

3.2. Ship's Service Telephone

This telephone service type is similar to the one we use at home. It can be used to communicate with any part of the ship that has the telephone device stationed by dialling a phone number. The disadvantage of this method is the number of the people can reach at a time. Also, the number of the telephones is very limited onboard.

3.3. Shipboard Announcing System

This system is operated by the circuits called MC circuits. Almost everyone onboard can hear the announcement via this system, except for the room that is not installed the device. Moreover, the private communication is not possible for this type of system. The circuits are assigned the specific codes such as 2MC for engineering room and 3MC for hangar desk.

3.4. Sound-Powered Telephone

Sound-powered telephone operates on voice power. This type needs neither external batteries nor external electrical power source. Usually, sound-powered telephones are used at the bow, stern, bridge, combat information center (CIC) and engineering room to communicate to one another and report the situation to the in-charge officer. However, the equipment needs to be interconnected with

wires. The communication problem might take place if the wires are separated. Furthermore, the distance that lookouts can operate depends on the length of wires.

All of four types of interior communications are still being used by lots of vessels today. Each type has limitations as mentioned above. This paper, therefore, proposes the feasibility of applying VoIP technology to improve the existing ship's internal communication methods.

4. The Application of voip on Ship's Interior Communication

This section describes the application of VoIP on the ship's interior communication system. The aim of this section is to point out the possibility of how to apply VoIP to the internal communication. First, the VoIP system is setup using virtual box and Elastix. Then, the Zoiper software is installed to mobile phones. The configurations of Elastix and Zoiper are made for interconnection test.

4.1. Software Setup

We setup Oracle Virtualbox (4.3.26) which is the general-purpose virtualizer for x86 architecture from Oracle on Windows 7 professional edition to prepare for Elastix. We then install Elastix (2.5.0) within Virtualbox and configure it as basic needs in order to run PBX and SIP server features. The web interface of Elastix server after successfully installed and configured shown in Fig. 1.

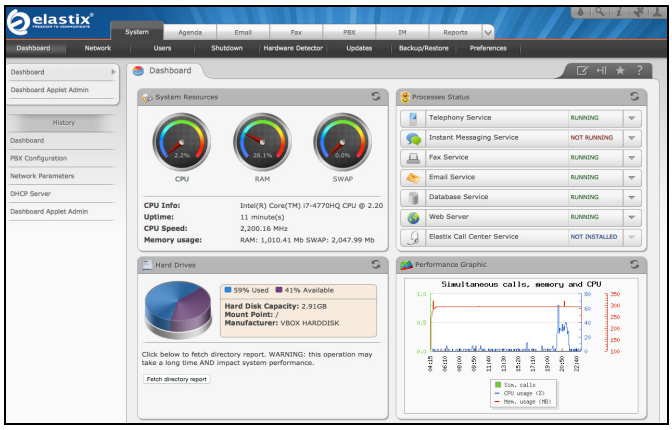

Figure 1: Elastix Server Setup.

PBX and SIP server are essential for SIP registration process. Basically, SIP uses 3 main parts to locate an endpoint. First, the SIP URI address which is similar to email address. The SIP URI has phone numbers such as 100@domain.com. Domain.com can be any kind of domain. For example, domain.net, domain.ac.th or domain.go.th. For our communication test, we use 192.168.1.12 as an address. The endpoint or the mobile phone is installed with Zoiper software. SIP Registration occurs in which the endpoint sends a SIP register to the SIP server. The SIP server creates an account for a client including user ID and password. The connection starts by the client sends the request to the SIP server. The server will validate the user's credentials. Then, the endpoint can communicate to the server. When the endpoint wants to communicate to another endpoint which is a mobile phone for our experiment, the server will redirect and forward the packet to requested client.

4.2. Hardware Setup

Generally, the space of the vessel is very limited. The wiring system onboard is complicated and difficult to fix or repair later. Therefore, in order to reduce copper wires, we deploy wireless technology. However, according to the study of Wireless Sensor Network on Board Vessels mentioned about the limitation of wireless communications on board by vessel structure such as bulkheads and watertight doors which severely decrease the signals strength. Furthermore, wave propagation effects such as the multi-path due to the metallic environments, can be a serious cause of received signal degradation [vi]. We use a 2.4 GHz wireless router. The DHCP function to manage IP address for the clients on the same network is enabled. The 16-port switch is connected to both router and Elastix server. The IP address of the server is configured as 192.168.1.12/24. The assigned IP address for a router is 192.168.1.2/24. Three mobile phones and a notebook are setup and configured using Zoiper software.

4.3. Deployment Procedures

We first test the strength of the WiFi signal on the vessel environment. The vessel that we tested is Frigate Class that temporarily docked at Royal Thai Naval Academy Port. The environment we did the test excluded radar operation and the equipment that could cause the serious propagation effect. To picture the scenario more clearly, we need to know what compartment is. The ship compartment is a space within a ship defined vertically between desk and horizontally between bulkhead. It is like a room of a building [vii]. 4 compartments of the ship are separated by walls. The compartments are on the same desk to simplify this experiment. The test aims to determine the quality of communication among endpoints and Elastix server and ensure the endpoints can communicate to one another. We found that most equipments and walls on board are made of metal and steel resulting in the

degradation of the wifi signal. The strength of the signal is measured by using Netspot, the wireless site survey application. The overall signal strength is shown in Fig. 2.

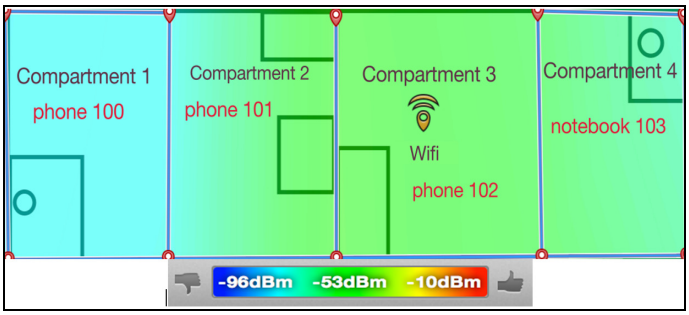

Figure 2: The Overall Signal Strength.

The signal strength within compartment 3 where the mobile phone 102 is measured as Fig. 3.

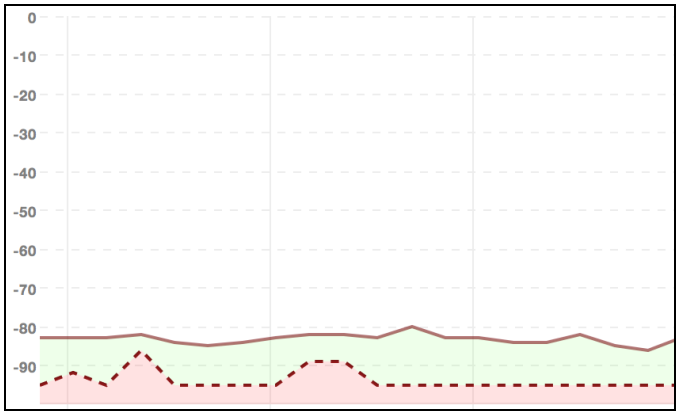

Figure 3: The Signal Strength of Compartment 3

The blue area indicates weak signal; this dues to the particular characteristic materials such as metallic walls. The material characteristics affect the signal strength. It is more difficult for measurement if the material is not made only from pure steel or one type of substance. For the blue area, the software measures the strength of signal in blue area shown in Fig. 4.

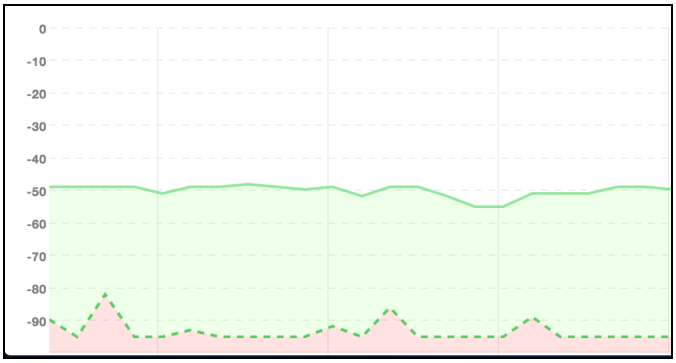

Figure 4: The Signal Strength of Compartment 1.

The Elastix server, a switch and a wifi router are installed at compartment 3. The server created the SIP accounts for four devices. The account numbers are 100, 101, 102, and 103. The first three are assigned for mobile phones and the last one is for a notebook. The domain of the SIP server is 192.168.1.12.

The communication test is implemented by each endpoint tries to communicate to each other. After SIP registration processes between Elastix server and endpoints are done, the communication test is ready. However, according to the strength of signal, it obvious shows that only phone 100 at compartment 1 cannot contact to other endpoints since the signal is too weak. For others, the connection is successful. Also, the function of Zoiper works flawlessly. All mobile phones and a notebook, except for phone 100, can operate as normal phones. The problem is echo issue which sometimes occurred but the voice is still clear enough.

4. Discussion and Conclusion

From the initial experiment on board, we have done by deploying Elastix based on VoIP technology as an IP PBX server and Zoiper on endpoint devices, mobile phones and a notebook. The Elastix server is connected with a switch and a router in the compartment of the ship. The wifi connection is made and tested for the signal strength among the compartments. We found that the signal is degraded because of the metallic walls and steel materials. Nevertheless, as long as the signal is strong enough to make connections among the server and endpoints, the system can operate flawlessly. The voice quality is good enough to understand, though echo sometimes occurred. By using Elastix based on VoIP technology and Zoiper with existing devices that everybody has, the crew can communicate to one another or the ship can improve ship's internal communication system. The limitations of traditional ship internal communications which are long distance and a number of telephone devices could be compensated by VoIP technology. Hence, most of the ships can take this suggestion for further consideration.

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