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The Development Of Voice Over Internet Protocol (VOIP) Network Circuit Using Debian Server Based On Virtual Machine

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ABSTRACT
The Current developments in information technology and the internet have changed the way people communicate and interact, including in the education sector. One technology that supports this progress is Voice over Internet Protocol (VoIP), which offers a communication solution at a lower cost compared to traditional telecommunications technology. This journal discusses the implementation of VoIP technology using the Debian Linux operating system and Asterisk software in the Telkom 1 Medan Vocational School environment. This research uses a Star network topology with components such as a laptop as a VoIP server, Mikrotik as a switch, and a smartphone as a client. The research method includes installing Debian 9 on VMware, configuring Asterisk, and setting up a VoIP client using the PortSIP UC and 3CXPhone applications. The research results show that the implemented VoIP technology can make voice and video calls well, as well as optimize bandwidth usage. This technology has proven to be efficient and economical, and can be adopted in various environments including education and offices. Suggestions for further development include implementation on IP Phone devices and local networks and the wider internet.

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INTRODUCTION

The developments in technology and the internet that occur today, People not only use technology and the internet as a means of communication, but thanks to the advances in technology and the internet that have occurred, the internet has also played a very important role in providing information to the public and has become one of the supports for progress in the field of communication. education, both from elementary level education to college level. Therefore, the government also has an additional obligation to provide networks and communications in every corner of Indonesia. Advances in information and communication technology encourage every level of society to be able to use this technology to the maximum extent possible Not just for society. In general, in the world of education, students are also taught to be able to use technology optimally while still complying with applicable rules and norms, such as VoIP (voice over internet protocol) technology. The use of technology used within the Telkom 1 Medan Vocational School environment can be said to be quite capable so that Many students already enjoy the

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development of information technology that already exists, the author is only trying to develop the information technology that has been used, so that students can be more enjoy the development of information technology that exists today.

VoIP (voice over internet protocol) is an information technology that does not require quite expensive costs because this technology does not only use the internet network, this technology can also use local networks that run using IP (Internet Protocol) networks, this technology allows us to communicate using either voice or video calls so that this can provide advantages for individuals or groups who always need communication tools in their work environment, especially in educational or school environments due to costs. which is said to be cheaper (Toyib & Wardiman, 2020).

The Linux operating system has various types that can be used for networking needs, without having to pay costs which are quite expensive for networking needs. The Debian operating system which uses the Linux kernel is a Linux operating system that is quite popular for its stability. With various Debian-based operating systems, such as Ubuntu, Xubuntu, Knoppix, Mint, and others, Debian has become an operating system that is widely used in the world (Zulfa & Cs, nd). So this can be beneficial for students or schools who want to build communication network without having to incur costs which are quite expensive.

This technology replaces traditional telephone systems that require physical hardware and are more expensive. IP-PBX systems allow users to access features such as voicemail, conferencing, and others through the internet network. In developing an IP-PBX system, companies need to consider whether to use a cloud-based IP-PBX or a physical server with a protocol (Session Initiation Protocol). This is important because the choice of infrastructure can affect the cost, security, and scalability of the IP-PBX system. However, in Indonesia, there is still little research that examines the choice of cloud-based IP-PBX infrastructure or a physical server with the SIP protocol. In fact, choosing the right infrastructure can affect the effectiveness and efficiency of the IP-PBX system implemented in a company.

Literature Review

Voice Over Internet Protocol (VOIP)

VoIP (voice over internet protocol) is a technology that uses the Internet Protocol to provide real-time electronic voice communications. VoIP technology is today's telecommunications technology, where the costs arising from this technological infrastructure are much cheaper than the costs arising from technology. Telecommunication use PSTN. The elements that make up VoIP are user agents, proxies, protocols, and encoder-decoders (CODECs). Asterisk and X-Lite are open source software used to create VoIP. Asterisk can run on various operating systems (Windows, Linux, Mac, OpenBSD and FreeBSD). And allows developers and implementers to create better communication solutions for free (Berlian, 2020).

SIP (Session Initiation Protocol)

SIP (Session Initiation Protocol) is a communication protocol used to initiate, change, and end multimedia communication sessions over an IP network. This protocol is used in services such as VoIP (Voice over IP), video conferencing, instant messaging, and other real-

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time communication services[4]. SIP works as a control protocol to manage and control communication sessions between two or more parties. Through SIP, users can initiate, run, and end voice or video calls over an IP network[5]. This protocol focuses on call initiation and call status handling, including negotiation of communication parameters such as codecs, IP addresses, and data formats[6]. B. GCP (Google Cloud Platform) GCP (Google Cloud Platform) is a cloud platform provided by Google[7]. It is a suite of services and infrastructure that allows users to build, manage, and implement applications and services in a cloud environment[8]. GCP offers a variety of services that include computing, data storage, networking, analytics, artificial intelligence (AI), machine learning, security, application development, and so on [9].

Internet Protocol Private Branch Exchange.

IP-based telephone system used to connect offices or branches in an organization or company [10]. IP-PBX is an evolution of the traditional telephone system that utilizes analogue lines or TDM (Time Division Multiplexing) and allows users to make voice and video calls over the internet network [1]. D. QOS (Quality of Service) QoS is an abbreviation of (Quality of Service) which in the context of communication and networking refers to the ability of a network or system to provide the desired or guaranteed quality in the delivery of data, voice, or other services [11]. QoS aims to manage and optimize the use of network resources to meet the different needs of the applications and services running on it. In the context of VoIP, QoS becomes very important because real-time voice and conversations sent over the internet network require low latency, consistent speed, and high reliability[12]. E. Wireshark Wireshark is one of the tools used to determine the quality of a network on a system. Where wireshark is able to capture data packets or information on a running network[13]

Computer Network

1. A computer network is a system consisting of two or more devices connected to each other through a local network or communication media, such as cables or wireless, to share information or resources, communicate, and exchange data. The basic principle of a computer network is that the process of sending data or collecting information occurs through certain media. While the main purpose of building a computer network is to send data/information from the sender to the recipient quickly and accurately without error through several transmissions or certain communication media (Agustina & Suprianto, n.d.). In this case, the author has compiled or collected the benefits that can be obtained when we build a computer network, including:
2. Sharing Resources Computer networks allow many different devices to share resources such as printers, scanners, and data storage. This increases the efficiency of overall resource use (Deagama et al., n.d.).
3. Efficient communication The network allows fast and efficient communication between users, either in the form of text messages, voice, or video. It helps team collaboration and information exchange (Pemanfaatan et al., 2020).

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4. Information Access Networks allow users to access information from multiple locations, both locally and via the Internet. This facilitates quick access to global data and resources (Wintolo & Farhati, 2020).
5. Increased Security Computer networks allow for the implementation of more centralized and integrated security systems, such as firewalls and data encryption, to protect sensitive information from unauthorized access (Christmartha et al., 2020).
6. Increased productivity By facilitating information exchange, better collaboration, and faster access to resources, computer networks can significantly increase individual and organizational productivity (Rizkyah & Herwanto, 2023).

Asterisk is a hybrid TDM and PBX packet voice software that has an Interactive Voice Response (IVR) and Automatic Call Distribution (ACD) platform with open source code. Asterisk is licensed under the General Public License (GPL) and non-General Public License (GPL) and written in C. Asterisk can be configured as the core of an IP or Hybrid PBX. Asterisk functions as a call switch. Asterisk can be run on several types of Operating Systems, such as Linux, Mac OS, OpenBSD, FreeBSD and Sun Solari (Mulyani, 2016).

Oracle VM Virtual Box is a virtualization application (Hypervisor), which can be installed on a computer, either Physical, either Intel or AMD based, does not require processor features built into new hardware such as Intel Vt-x or AMD-V. Oracle VM Virtual Box can be used on old hardware/processors that do not support hardware virtulization (Larosa, 2016). Zoiper is a softphone software that runs on the Android operating system and is usually downloaded via the Android Playstore. This software allows you to chat or make voice and video calls with other people (Muhammad, Triwinarko, & Fatulloh, 2017).

Computer Network Topology

Computer topology is a physical or logical arrangement of devices referring to how these devices are connected to each other. This includes the physical connection structure between devices such as computers, switches, routers and other network devices. There are various types of network topologies that are often used in computer networks, including:

1. Bus Topology
   Bus topology is a topology where each device or computer is connected to each other using only one main transition line (Putra et al., nd).
2. Ring Topology
   Ring topology is a topology where each device or computer is connected to each other by forming or in the form of a closed circle (Al Hayubi et al., 2024).
3. Star Topology
   Star topology is a topology where every device or computer is connected to a Switch or Hub, generally this network topology is shaped like a star (Tiara Pramesti Wulandari et al., 2024).

VMwere

VMware is software that provides virtualization and cloud computing capabilities for servers, computers, and other hardware. For example, with VMware, users can run Windows and macOS operating systems on one computer, just like having two devices. This process can also be done directly by importing the VM software to the device without

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needing to reboot first. The user then enters another operating system as the host operating system. For example, switching from Windows to Linux and vice versa. Therefore, later the second operating system that runs will be on top of the host operating system or what is often called the guest operating system. VMware can run on Microsoft Windows, Linux and macOS (Martha Pratama & Firdaus, nd).

The development of the internet network is no longer separated as a supporter of daily activities, with the internet it can be used to exchange image data and even videos in a fast time, the key to the internet is data security and data speed as a supporter of quality of service. In other fields, the internet is used as a very important support for example companies or rooms with separate offices, so by creating communication access using a Local Area Network (LAN) or Virtual Local Area Network (VLAN) so that communication can be done quickly. The addition of VOIP technology and or Virtual Local Area Network (VLAN) allows the creation of a safer network and saves more devices because different networks can be created in one network. Voice Over Internet Protocol (VOIP) technology is a technology through voice calls that converts data from analog to digital data format, the network uses a packet switch using a wireless network type (Wahyu, 2017). In a distributed system, speed and efficiency of time in obtaining accurate information using the internet network are essential. Speed and efficiency are supported by the role of webserver operating system technology. By implementing an intranet web server, it is expected to solve the problems faced in a distributed system. Referring to the above conditions, how does the web server work on Linux Fedora 22 in terms of serving requests from clients and how to optimize Linux Fedora 22 as a web server (Sirait & Siahaan, 2017).

Voice over Internet Protocol (VOIP) is one of the results of the implementation of developments in the telecommunications sector which is slowly starting to shift the choice from traditional wired telephone systems to Voice over Internet Protocol (VOIP) systems to reduce high telephone costs (Soelistianto, Atmadja, & Junus, 2016).

METHOD

VoIP information technology can be implemented in various network topologies, so this can make it easier for us to build a simple VoIP network without having to use a complicated topology and incur a lot of costs. building a complex topology, but we also have to pay attention to several things when we want to build a VoIP network, including: Location and distance. So when we build a VoIP network, we get the desired results. In designing a VoIP network, The author uses Star topology using one laptop, two laptops.

One cellphone/smartphone is a Mikrotik, and one Access Point, where one laptop functions as a VoIP server using Asterisk, one Mikrotik functions as a Hub/Switch, one Access Point functions as Wireless, and two cellphones/Smartphones function as clients. All clients are connected to an Access Point which is connected to a Hub / Switch which gets an IP or is connected directly to the Laptop Server. As seen in Figure 1 below:

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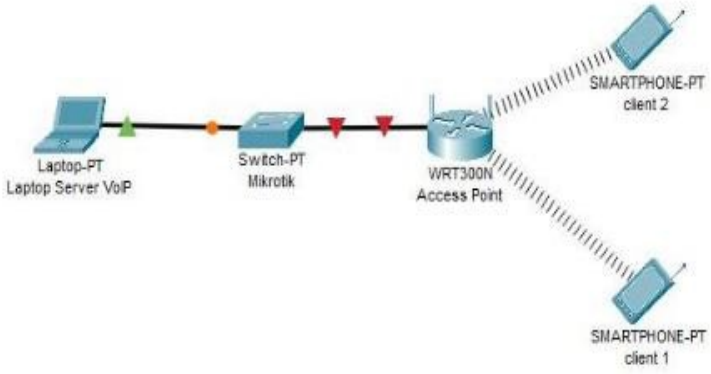

Figure 1. VoIP Network Configuration

A Linux Debian 9 Server Installation Process The Linux Debian 9 installation process uses a VMwere Virtual Machine, as an intermediary so that we can make Linux Debian 9 a server on the VoIP network that we will build later. As seen in figure 2 below this :

Figure 2. Debian 9 Linux installation

Vim installation process as a Text Editor in the Linux terminal which the author will use to build a VoIP network using Asterisk by using the command: apt-get install vim - y. As in Figure 3 below:

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Figure 3. Vim installation

Inserting the Debian 9 ISO Linux DVD In this process the author will show the process of inserting the Debian 9 ISO Linux DVD into the Virtual Machine that the author has created for the purpose of creating a VoIP network using Asterisk later by using the command: apt-cdrom add. As in figure 4 below this :

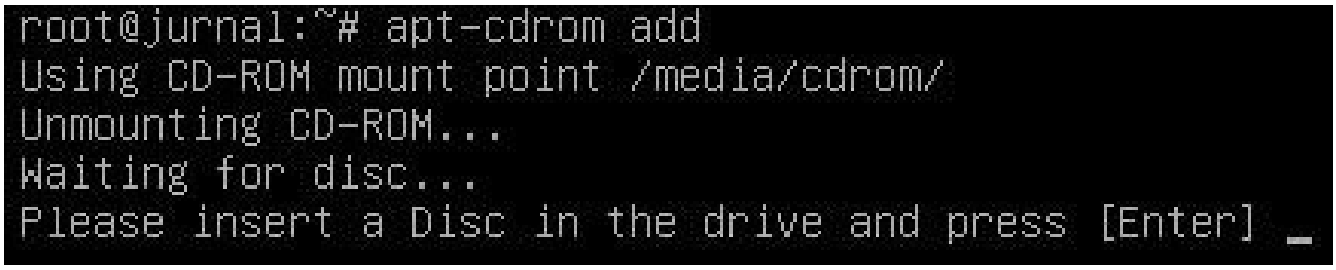

Figure 4. 4DVD Insertion Process

IP Insertion Process on Linux Debian 9 Process for Inserting the IP to be implanted into Linux Debian 9 as a VoIP Server which will be built later with using the command: Vim/etc/network/interfaces on the Linux Debian 9 terminal. As in Figure 5 below:

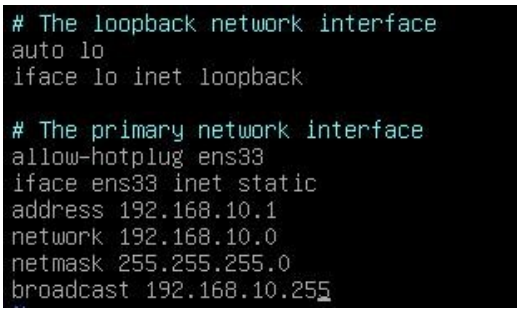

Figure 5. Entering IP in Debian 9

RESULT

Client 1 VoIP using the PortSIP UC application that successfully connected to the local network after entering the network that the author transmitted through the Access Point

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can be connected properly. Client 1 VoIP using the extension number 175714 successfully made a calling process to the same client 2 VoIP using the PortSIP UC application using the extension number 175715. As in figure 6 in below.

Figure 6. Client 1 display performing the Calling Process

During the Calling process, client 1 VoIP with extension number 175714 can also perform the Video Call process with client 2 VoIP with extension number 175715 and vice versa client 2 VoIP with extension number 175715 can perform the Video Call process to client 1 VoIP with extension number 175714. The display of the Video Call process between the two clients is as shown in figure 7 below:

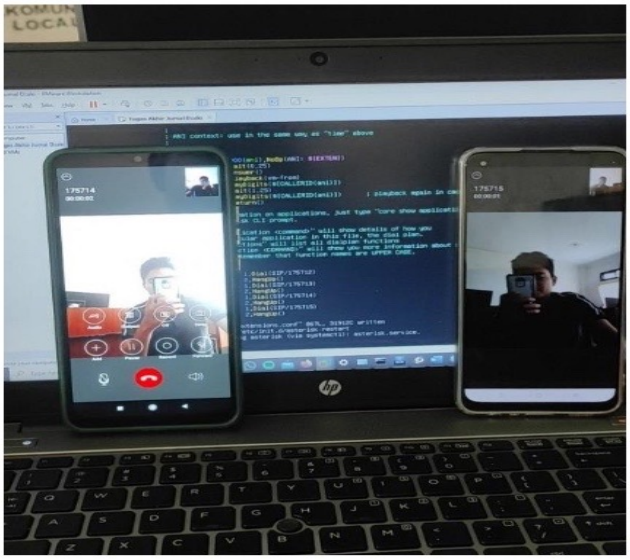

Figure 7. Video Call Process

The author also performed the Calling and Video Call process on client 3 VoIP or Laptop Server with extension number 175712 to client 2 VoIP with extension number

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175715, and obtained satisfactory results or can be said to be connected between Client 3 VOIP and client 3 VoIP Smartphone. As shown in figure 8 below:

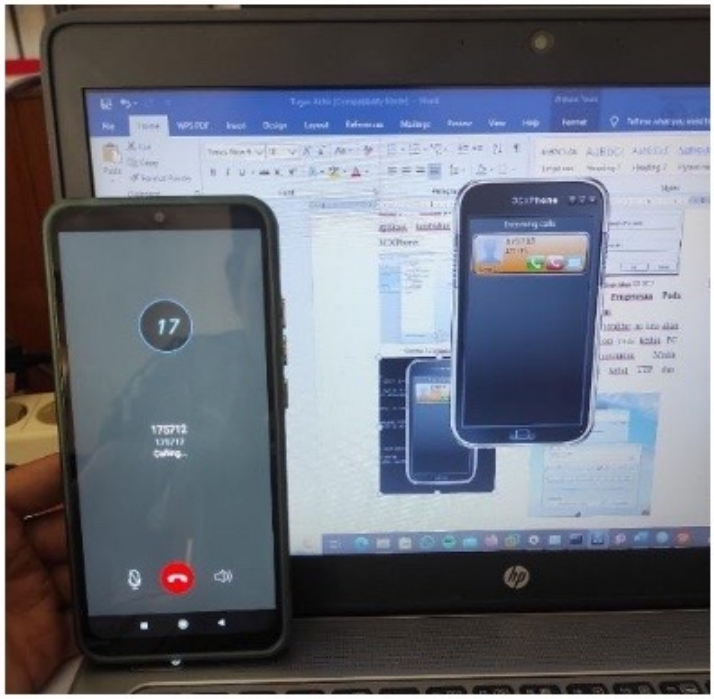

Figure 8. Calling Client Process

CONCLUSION

With all the potential that the author has summarized, the author believes that this VoIP communication technology in terms of cost can be said to be relatively cheap for communication. VoIP technology using Debian server based on virtual machine and Asterisk as IP PBX can be a solution to reduce the cost of developing a VoIP network, this has great potential to be developed. This VoIP communication technology can use existing topology or infrastructure without having to build a new topology or infrastructure like VoIP in general and is not subject to relatively expensive costs like the general VoIP that we use. The use of Bandwidth used by VoIP communication technology using Asterisk as IP PBX is smaller than the use of Bandwidth used in general VoIP.

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