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Private Cloud Storage Implementation with Nextcloud on a Virtual Private Server Network

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Abstract

In the era of rapid globalization, technological advances have significantly changed the way how we store, share data, and communicate. The constraints on traditional storage media and the need for efficient storage solutions have driven the use of cloud storage technology. Cloud Storage, which utilizes virtual servers to store digital data, has become a relevant solution to overcome the limitations of physical storage media such as hard drives. One of the platforms that utilizes this technology is Nextcloud which functions as a cloud storage medium. This research aims to evaluate the extent to which Nextcloud can assist in these aspects and measure network performance by utilizing Quality of Service (QoS) parameters. The QoS test results obtained an average throughput of 2410 kbps, packet loss of 0.050%, delay of 5.113ms, and jitter of 5.115ms. According to the Tiphon standard, it can be concluded that the results are categorized as "Good."

Keywords: Cloud computing, Nextcloud, Private cloud storage, QoS, VPS

1. Introduction

In this globalization era, technology development grown rapidly. We often experience limited data storage media when storing important files, so special storage is needed to back up temporary files [1]. Cloud Storage is a digital data storage technology that utilizes virtual servers as storage media. Unlike hardware storage media in general such as compact discs or hard drives, Cloud storage technology does not require any additional devices, all that is needed to access digital files is a computer device or gadget [2].

Some companies, such as Google Drive and Dropbox, are examples of existing Cloud Storage service providers. However, for free users, there is a limit on file storage capacity, and premium users must pay a subscription fee to increase storage capacity. To overcome these problems, building a private Cloud Storage server using Nextcloud can be an alternative to avoid paid Cloud Storage service subscription fees, both in file management and performance as a server service provider to a user, as well as a file storage medium that can be accessed anywhere and anytime.

1.1. NextCloud

Nextcloud is an open-source platform that gained great attention as a self-hosted collaboration and data storage solution. With Nextcloud, organizations can provide a secure and centralized environment for sharing files, managing calendars and contacts, and collaborating on web-based documents. It can be hosted on an organization's internal infrastructure or in the cloud, so it provides significant flexibility.

1.2. Cloud Computing

Cloud computing is a model that provides access to computing resources in IT. Cloud computing has become the dominant business in providing on-demand IT infrastructure and applications. With Cloud computing, individuals and organizations can access needed IT resources from a variety of devices at any time, reduce investment costs in cloud infrastructure, and deliver flexible services according to growing demand [3].

1.3. Cloud Storage

Cloud storage is an online storage files solution that allows access via the internet from various devices such as smartphones, tablets, and personal computers. The advantage of using cloud storage compared to traditional storage is the ease of access and the ability to share files easily with others [4]. Cloud storage is a development of the concept of cloud computing or cloud computing, where the providers create online storage media [5].

1.4. Cloud Storage

Virtual Private Server (VPS) is a physical server that is divided into several virtual servers. It is called a virtual server because the server does not have a physical one. In server virtualization using virtualization technology, the physical server hardware is divided into several different resources. With this virtualization, it allows us to install additional OS and software as needed, which cannot be done in hosting. Each created virtual server serves operating systems and software independently with fast configuration. Most VPS are often used for Cloud Computing or other purposes. VPS works like a stand-alone server. It has processes, users, and files, and provides full root access. Each VPS has its IP address, port number, tables, filtering, and routing rules [6].

1.5. Quality of Service

Quality of Service (QoS) is a method to measure how good a network and it is an attempt to define the characteristics and properties of a service. QoS is used to measure a set of performance attributes that have been specified and associated with a service. QoS is designed to help end users (clients) become more productive by ensuring that users get reliable performance from network-based applications. QoS refers to the ability of a network to provide better service to specific network traffic through different technologies. QoS is a major challenge in IP-based networks and the whole internet [7].

Table 1. QoS parameter Index

Value	Percentage (%)	Index
3,8 - 4	95 - 100	Very good
3 - 3,79	75 - 94,75	Good
2 - 2,99	50 - 74,75	Medium
1 - 1,99	25 - 49,75	Poor

1.6. Wireshark

Wireshark is an open-source application for network analysis and troubleshooting, as well as software testing. With its ability to capture data packets and analyze the contents of the packets, Wireshark supports .cap and .erf file formats. It is a continuation project of Ethereal, started by Gerald Combs in 1998, and updated by volunteer network experts around the world. Wireshark can identify protocols, including WEP and WPA/WPA2 [8].

1.7. Ubuntu

Ubuntu is a Linux-based open-source operating system that supports free software development. In the context of Linux distros, there are many variations such as Debian, SuSE, Gentoo, Red Hat, Mandriva, and Mikrotik Router that also rely on the Linux kernel. Ubuntu aims to be an up-to-date Linux distribution for desktops and servers [9]. Ubuntu is a Linux distribution derived from Debian and officially supported by Canonical Limited, which is owned by Mark Shuttleworth, a cosmonaut. The name "Ubuntu" is taken from a South African philosophical concept that means "humanity towards fellow human beings" in an ancient African language. The main mission of creating Linux Ubuntu is to integrate the values of the Ubuntu Philosophy into the software world [10].

2. Methods

This design is used as an explanation of the description of the system design that will be made.

2.1. System Design

In Figure 1 below, it can be seen the design of private cloud storage using the server used is the Linux Ubuntu 22.04 operating system then so that the server is connected to employees or users using a LAN network or the internet.

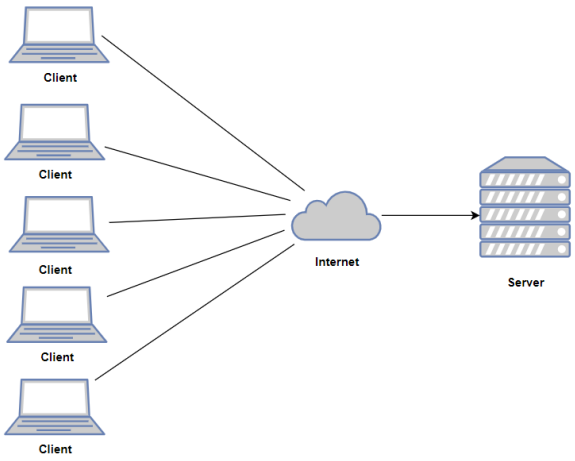

Figure 1. System Design

2.2. System Design

Use Case Diagram is one type of diagram used in software modeling to describe how users or actors interact with software systems.

2.2.1. Use Case Diagram Admin

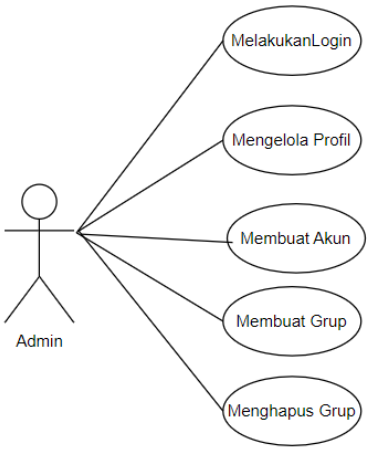

Figure 2. Use Case Diagram Admin

Figure 2 explains the use case diagram where the admin can access login, manage profiles that can change profile data and passwords, create accounts, creating employee accounts, create and deleting groups, create groups based on employee work fields.

2.2.2. Use Case Diagram User

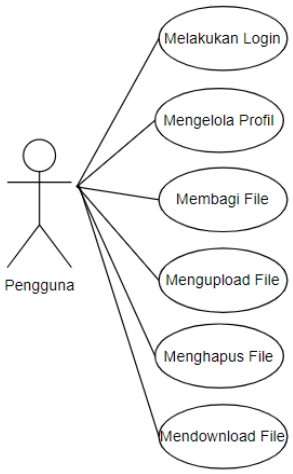

Figure 3. Use Case Diagram User

Figure 3 explains the use case diagram where the users can log in by entering the username and password that has been created by the admin, manage profiles, which can change profile data and passwords, share files with other users, upload files to the cloud, delete the files that have been saved, download shared or saved files.

2.3. System Block Diagram Design

This block diagram describes the system that will be designed in *implementing private cloud storage* with nextcloud on a *virtual private server* network.

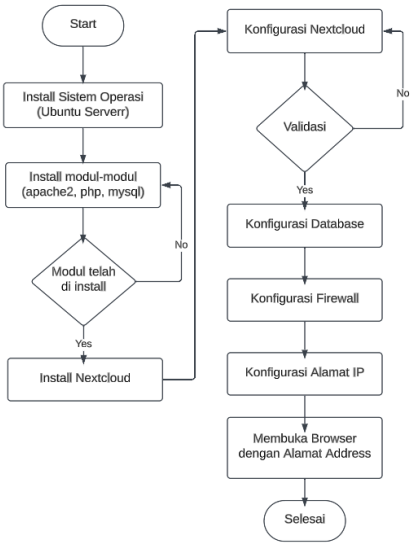

Figure 4. System Block Diagram

Figure 4 shows the process of the system creation which consists of the stages of installing the operating system, installing the necessary modules, installing nextcloud, configuring nextcloud, validating, configuring the database, configuring the firewall, configuring the IP address and opening the browser to display the nextcloud display. Nextcloud has been built and can be accessed by users through a computer network using their login accounts that have access anywhere and anytime.

3. Result and Discussions

3.1. Server Creation

Server creation involves a series of steps to build and manage a virtual computing infrastructure that can be accessed by users through a cloud service provider. The process begins with the selection of a suitable virtual private server (VPS) service provider. After that, users can select the type of resources they want to rent, such as CPU, RAM, and storage. Through proper configuration, virtual machines (VMs) are created with operating systems and settings that suit the user's needs.

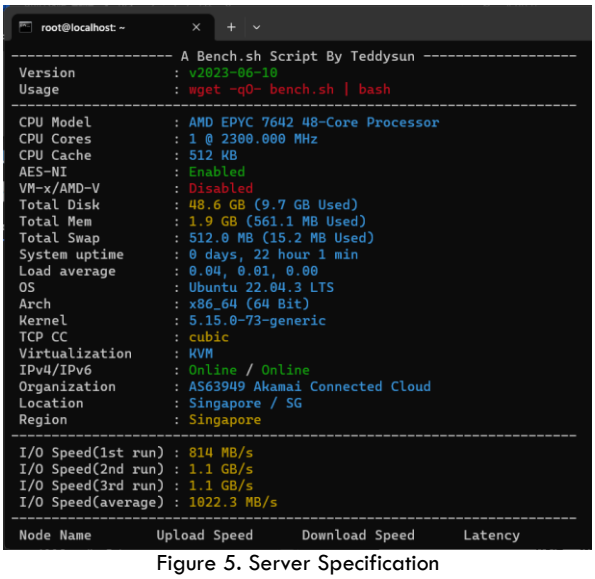

Figure 5. Server Specification

3.2. Server Creation

This stage contains an explanation of the user *interfaces* that aim to make it easier for users to use nextcloud cloud storage.

3.2.1. Nextcloud Login View

The login page is a page used to verify user data. User will be asked to enter a username and password.

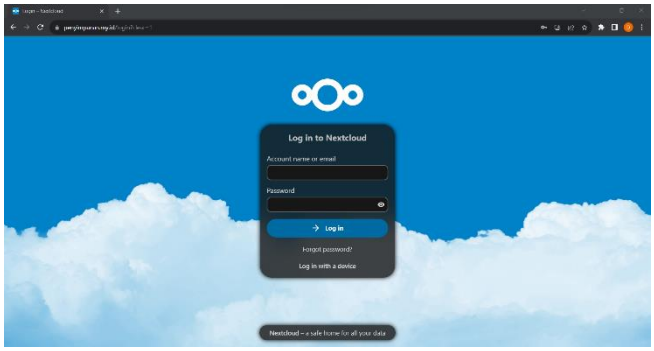

Figure 6. Login page

After logging in, the system will display the available dashboard pages. There are 2 user levels, administrators and ordinary users, account creation is done by the administrator.

3.2.2. Nextcloud Login View

The file/folder upload page allows users to upload files or folders into the nextcloud *cloud storage*.

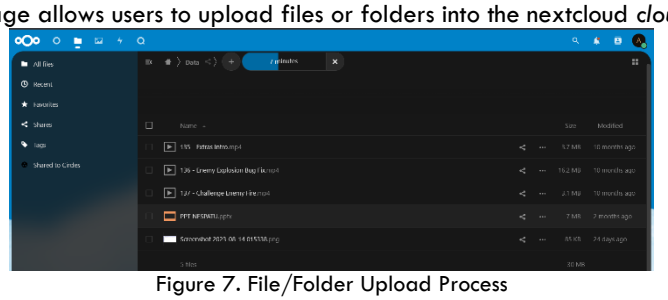
Figure 7. File/Folder Upload Process

3.2.3. File Sharing View

The file sharing page allows users to perform the file sharing process to other users.

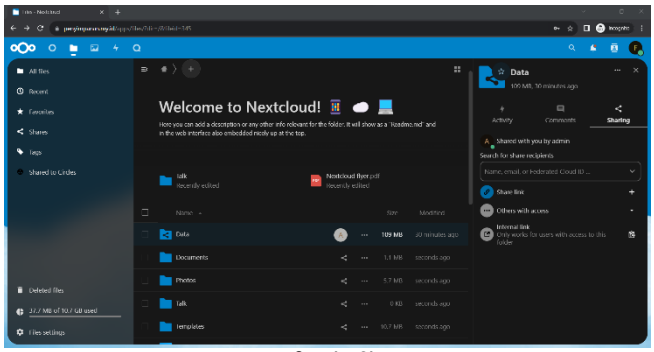

Figure 8. File Sharing

Through *file sharing*, users can select files or folders that they want to share with other users. The types of files shared can be document files, images, videos, or other files.

3.2.4. Video Talk View

The video *talk* page allows users to conduct a video talk process with other users.

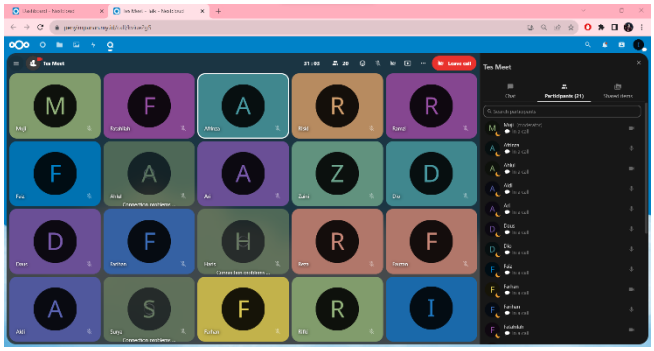

Figure 9. Video Talk

3.3. Testing Result

The test results use *quality of services* parameters on the nextcloud private cloud storage system. Testing is done by uploading and downloading files on the nextcloud cloud storage. In this test, five experiments were carried out.

3.3.1. Throughput Testing

Table 2. Throughput Result

Scenario	Throughput (kbps)	Description	
		Index	Category
Trial 1	1827	3	Good
Trial 2	1443	3	Good
Trial 3	4355	4	Very Good
Trial 4	2166	4	Very Good
Trial 5	2258	4	Very Good

Table 2 explains that of the five upload and download experiments that have been carried out, each experiment gets different throughput results. Experiment 1 gets a value of 1827 kbps, experiment 2 gets a value of 1443 kbps, experiment 3 gets a value of 4355 kbps, experiment 4 gets a value of 2166 kbps and experiment 5 gets a value of 2258 kbps. In the five experiments that have been carried out, the best value was recorded in experiment 3 at 4355 kbps which shows the highest level of data transfer speed among all experiments. The worst value was obtained in experiment 2 of 1443 kbps which indicates that at that time the data transfer rate obtained was the lowest among all experiments.

3.3.2. Packet Loss Testing

Table 3. Packet Loss Result

Scenario	Packet Loss (%)	Description	
		Index	Category
Trial 1	0,012	4	Very Good
Trial 2	0,043	4	Very Good
Trial 3	0,050	4	Very Good
Trial 4	0,135	4	Very Good
Trial 5	0,011	4	Very Good

Table 3 explains that of the five upload and download experiments that have been carried out, each experiment gets different packet loss results. Experiment 1 gets a value of 0.012%, experiment 2 gets a value of 0.043%, experiment 3 gets a value of 0.050%, experiment 4 gets a value of 0.135% and experiment 5 gets a value of 0.011%. In the five experiments that have been carried out, the best value is recorded in experiment 5 with a packet loss rate of 0.011%, this result shows that almost no data packets are lost during the transfer process. While the worst value was recorded in experiment 4 with a packet loss rate of 0.135%, although this rate is still considered low but in the five experiments that have been carried out this packet loss rate is the highest although the risk is still small, there is a small potential for data loss during the transfer process in these experiments.

3.3.3. Delay Testing

Table 4. Delay Result

Scenario	Delay (ms)	Description	
		Index	Category
Trial 1	4,361	4	Very Good
Trial 2	6,992	4	Very Good
Trial 3	1,873	4	Very Good
Trial 4	7,778	4	Very Good
Trial 5	4,569	4	Very Good

Table 4 explains that of the five upload and download experiments that have been carried out, each experiment gets different delay results. Experiment 1 gets a value of 4.361ms, experiment 2 gets a value of 6.992ms, experiment 3 gets a value of 1.873ms, experiment 4 gets a value of 7.778ms and experiment 5 gets a value of 4.569ms. In the five experiments that have been carried out, the best value is recorded in experiment 3 with a delay of 1.873ms which indicates a very fast data transfer. While the worst value was recorded in experiment 4 with a delay of 7.778ms which indicates a longer delay in the data transfer process in that experiment.

3.3.4. Jitter Testing

Table 5. Jitter Result

Scenario	Delay (ms)	Description	
		Index	Category
Trial 1	4,359	3	Good
Trial 2	7,013	3	Good
Trial 3	1,872	3	Good
Trial 4	7,756	3	Good
Trial 5	4,564	3	Good

Table V explains that of the five upload and download experiments that have been carried out, each experiment gets different jitter results. Experiment 1 gets a value of 4.361ms, experiment 2 gets a value of 6.992ms, experiment 3 gets a value of 1.873ms, experiment 4 gets a value of 7.778ms and experiment 5 gets a value of 4.569ms. In the five experiments that have been carried out, the best value is recorded in experiment 3 with a jitter of 1.872ms which shows a very small variation in arrival time among all experiments. While the worst value was recorded in experiment 4 with a jitter of 7.778ms which illustrates a larger variation in arrival time compared to the other experiments, which is required for the data packet to reach its destination during the transfer process.

3.3.5. QoS Parameter Calculation

Table 6. QoS Calculator Result

Scenario	Qos Parameter				Average index	Category
	Throughput (kbps)	*Packet Loss (%)*	*Delay* (ms)	*Jitter* (ms)		
Trial 1	1827	4,361	4,361	4,359		
Trial 2	1443	6,992	6,992	7,013		
Trial 3	4355	1,873	1,873	1,872		
Trial 4	2166	7,778	7,778	7,756	3,75	Good
Trial 5	2258	4,569	4,569	4,564		
Average Index	2410 4	0,050 4	5,115 4	5,113 3		

From Table VI, it can be seen that the average value obtained from the measurement and calculation of QoS parameters after testing uploads and downloads on nextcloud cloud storage from five trials obtained an average throughput value of 2410 kbps with an index of 4, an average packet loss value of 0.050% with an index of 4, an average delay value of 5.115ms with an index of 4 and a jitter value of 5.113ms with an index of 4. The average index value of the four parameters obtained a result of 3.75. It can be concluded that the quality of the internet network on the use of cloud storage with nextcloud on a virtual private server network categorized as "Good" according to the Tiphon standard.

4. Conclusion

Based on the conducted research, it can be concluded that the implementation of *private cloud storage* with *nextcloud* on a *virtual private server* network with the following conclusions:

1. Nextcloud usage can help in cloud storage, data sharing, and video talk. Nextcloud is a secure and reliable platform for storing data in the cloud, allowing access from anywhere. In addition, the ability to share data with other users and set access permissions. Then video talk features such as nextcloud talk provide convenience in real-time communication, supporting remotely. With this combination, nextcloud becomes a powerful solution to address the needs of data storage, data sharing and video talk in a digital environment.
2. Based on the total average value of QoS parameters obtained from measurements and calculations such as throughput of 2410 kbps, packet loss of 0.050%, delay of 5.113ms, and jitter of 5.115ms from these overall values that the category of private cloud storage with nextcloud on a virtual private server network is in the "Good" category according to TIPHON standards.
3. Based on the results of the calculation of qos parameters with 5 five times the throughput experiment got the best value of 4355 kbps in experiment 3, in packet loss got the best value of 0.011% in experiment 5, in delay got the best value of 1.873ms in experiment 3, and in jitter got the best value of 1.872ms in experiment 3.
4. Based on the results of the calculation of qos parameters with 5 five times the throughput experiment got the worst value of 1443 kbps in experiment 2, in packet loss getting the worst value of 0.135% in experiment 4, in delay getting the worst value of 7.778ms in experiment 4, and in jitter getting the worst value of 7.756ms in experiment 4.

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