COMPARISON ANALYSIS PERFORMANCE OF SYNOLOGY NAS AND XIGMANAS WITH RAID CONFIGURATION

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Abstract—This research is to find out which NAS performance is the best in handling file delivery with RAID configuration, the methods needed in this test include transfer rate parameters, CPU and Memory resource usage, and QoS which includes throughput, delay, and packet loss by uploading and testing. download with variations in different file capacities. The results showed that Synology is better in the transfer rate parameters of both RAID configurations, both upload and download, with the delivery of variations in file capacity delivery with an average transfer rate of 116-118MBps, and Xigmanas 97-118MBps. In the resource usage parameter, the percentage of resource usage in both RAID configurations with testing upload or download Xigmanas is lower with a CPU usage of 22%, memory usage 1.4-1.5GB or 30%, compared to Synology CPU 30-34%, with CPU usage memory 190-201MB or about 42%. On the parameters of QoS throughput Xigmanas 780-930Mbit/s and Synology, >800Mbit/s (standard >75% very good) from both upload and download RAID configurations. The average delay of both servers is 0.03ms (standard <150ms is very good), and packet loss is 0 (standard 0% is very good) on both servers from upload and download tests. QoS results from both servers are in the very good category according to TIPHON standards.

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Keywords—Network Attached Storage, NAS, RAID.

1. Introduction

In the era of technology that can help users with various data files or virtual, requires a computer network that can serve the file storage process by its users, therefore a file server network is needed that can serve the needs of its users in backup storage activities and sharing digital files centrally[1]

Digital storage in the current era of digitization is very important because a physical file can be lost, then the ease of sharing files is very important because of its effectiveness in daily activities and work. So, it takes a data storage media that is cheap, simple, large capacity, good performance, and privately owned. From here Network Attached Storage (NAS) exists. For example, brands on the market such as Synology, WD Station, Qnap, and others[2]

NAS comes with a solution to this problem because it does not require high hardware resources to share and store files and the NAS itself is private. NAS is a storage server with a Linux-based operating system that is devoted to serving the needs of data files. NAS is accessed with local network media because of its core use or can use the internet. However, the NAS on the market is relatively expensive to buy an enclosure, so another solution is if you make a NAS with your PC that is not used by implementing an open source-based operating system to become a replacement NAS for the existing enclosure on the market[3]

The journal[3] describes his research on making a NAS server that does not require expensive costs, namely by implementing an open-source operating system on an unused desktop PC. In addition, the NAS is connected to the LAN media and configured with the web GUI system via a *browser*[4]. Therefore, in this study, we take the topic of NAS by comparing the NAS on the market or the Synology NAS enclosure and the XigmaNAS desktop PC operating system physically to find out which one is better in performance with the parameters to be tested for QoS, resource usage, and file transfers. The development carried out in this research is to add RAID 0 and 1 configurations as an addition to the comparison variation.

2. Literature Review

Network Attached Storage (NAS) is a storage device that is connected to a network and performs data storage and retrieval from a central location for multiple network users and clients. NAS has a modified Linux-based operating system and is devoted to storing digital files or data files[5]. Components in a NAS device like a computer in general consist of a motherboard, central processing unit (CPU), and Random Access Memory (RAM) that support its performance. The role of the CPU on the NAS is very important, especially in data processing [6]. But what distinguishes it is its designation which is used as a special server for centralized digital storage and is connected to a private network with a LAN or the internet.

The way NAS works is like cloud storage but private property with small and medium scale depending on specifications and needs. An operating system embedded in

a pc that will become a storage server, with a web GUI to manage it, which requires a connected client to manage the NAS control as an administrator. NAS is intended for a local network by logging in using the internet protocol that has been created by NAS which usually uses the DHCP method or automatic IP addressing for clients with Synology assistants, then enters the internet protocol address in the browser on the client PC, then logs in with the username and password that has been set. made. NAS can access directly via local area networks with protocols such as TCP/IP.

A NAS is sometimes available as an integrated computer, or an appliance specifically built for the functionality of a file server called an enclosure. The attractive advantages of an application compared to a file server, include faster data access, and easier and more practical management and configuration. NAS takes over the functions and responsibilities to serve the handling of files from other servers in a network and also provides access by protocols such as FTP, NFS, CIFS/SMB, or AFP. NAS is a device in which there is a hard disk hardware storage, its operating system, and software for managing and tasked with storing and sharing files on a network. So, with the presence of NAS server storage in the LAN, shared and centralized, access does not need a flash drive to perform, thus making work faster.

3. Research Method

The stages of the research process shown in Figure 1 begin with:

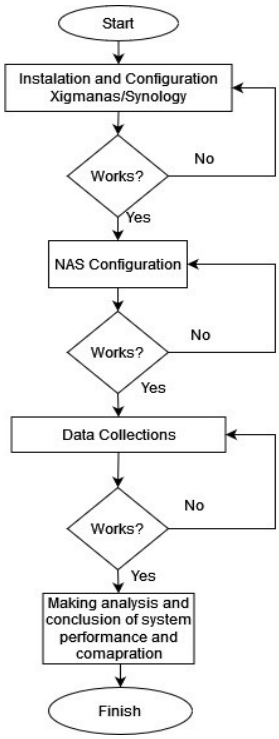

Figure 1 Research Flowchart

From figure 1, before the start is study literature which leads to an easier configuration system, and then the first step is Installing the Xigmanas server or Synology operating system on a desktop PC with a 32 GB bootable flash drive filled with the Xigmanas operating system by win32 manager software. Installing Xigmanas and Synology includes setting the IP address and then it can be accessed by the web GUI client 2. Then installing Wireshark and Filezilla on client 1. If successful then the next configuration stage. Configure NAS on each NAS operating system by including creating RAID configurations such as mount points on Xigmanas or polling disks on Synology, which is to make both hard drives grouped into one logic or RAID 1 and 0 (not concurrently), then create a directory or folder for accessed by user client 1, then create a username and password for user client 1 so that it can be accessed by the FileZilla client on the Web GUI client. And finally, configure the FTP service on the server by filling in the port field to be used as a code when filling in the port on the Filezilla client. Then if successful then to the next stage of data collection.

Data retrieval in this study is to transfer files from the client to the server (upload) and the server to the client (download) by comparing the RAID 0 and 1 configurations on each server with the transfer rate parameter, what is the speed when sending files with MBps parameters on FileZilla, resource usage is the use of CPU and RAM Memory, then Quality of Services includes throughput, delay, and packet loss. If the data is successfully obtained, then to the next stage, namely conclusions and suggestions from the research. The conclusion of the data includes a comparative analysis of data from RAID 0 and 1 and testing which upload and download are the best from the two servers and then concludes.

The network topology used in this study uses a direct topology with a gigabit switch as a line divider, which consists of 2 physical laptop clients as shown in Figure 3.18 below. 1 client to access and implement the operating system on a XigmaNAS NAS. The switch is responsible for dividing the traffic path from the server to the client via a 1GBps cat6 UTP cable. Then on the XigmaNAS and Synology server side which has been filled by 2 hard drives as RAID-based storage. The RAID that will be configured first is to use RAID 0 by testing the upload first and its parameters, after that, testing the download and its parameters, after the data is obtained, the researcher will restart the server to return to the re-configuration to test the RAID 1 configuration with upload and download tests and their parameters. In this study, we add a comparison of the two servers made by myself with the operating system obtained from the internet, namely Xigmanas with a licensed server, namely Synology. Where this gives an idea of which is better at handling file transfers with a RAID configuration. The advantage of this study is the addition of

a RAID 1 configuration so that it can be an illustration of the transfer rate of file transmission.

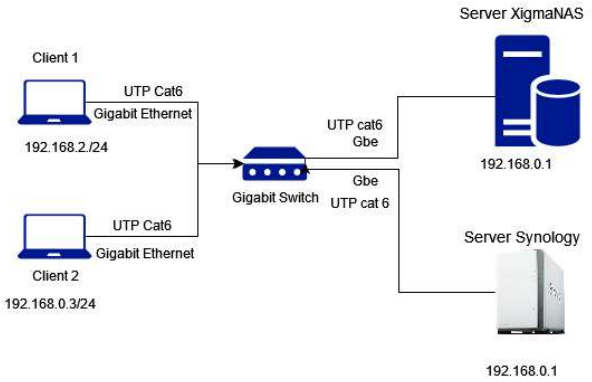

Figure 2 Both Server Scenario

This test uses 2 scenarios, namely the first scenario with a Xigmanas server with RAID 0 first with upload and download tests as a table which includes transfer rate parameters, resource usage which includes CPU and RAM or memory, then QOS which includes throughput, delay, and packet loss as in Figure 3.12. Then in the second scenario using a Synology server, using a RAID 0 configuration first with upload and download testing as in table 3.12 with the observed parameters including transfer rate, resource usage consisting of CPU and Memory usage, then QOS consisting of throughput, delay and packet loss as in table 1. In the retrieval process by sending 5 file capacities with a capacity of 1, 2, 3, 4, and 5GB, the data transmission test takes place as long as the file is sent until it is finished. The experiment was carried out 20 times for each variation of the file capacity that was sent. From the results of these scenarios, comparative results will be obtained which will later be used as material for analysis of the two servers in this study which one is better in performance. Here is the data retrieval scenario:

Table 1 Scenario Test

Skenario	Parameter file yang dikirim	Parameter yang di uji	Layanan	Konfigurasi pengujian yang dilakukan
Server Xigmanas	1, 2, 3, 4, dan 5GB	*Transfer rate, Resource Usage (CPU dan RAM), QoS (Throughput, Delay, Packet loss)*	FTP	RAID 0 dan 1 *upload* dan *download*
Server Synology				RAID 0 dan 1 *Upload* dan *download*

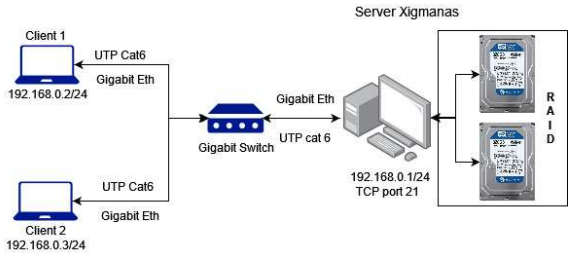

Figure 3 Xigmanas topology

The first scenario is data retrieval from the Xigmanas server, using 2 clients as shown in Figure 2, client 1 as a file sender with variations in file capacity sent by FileZilla (upload) with RAID 0 while monitoring transfer rates and at the same time recording network traffic with Wireshark, and also on client 2 monitoring resource usage on the web GUI server with the Mozilla browser. With the repetition of the experiment 20 times each capacity. After the upload data is obtained, then the download data is retrieved in the same way as before. If the RAID 0 uploads and downloads data have obtained the data results, then the researcher restarts the server and reconfigures RAID 0 to RAID 1, then returns to testing by sending files as before for uploading and downloading until they get RAID 1 data results. The results of the data from the Xigmanas server scenario with RAID 0 and 1 upload and download of the Xigmanas server have been obtained.

The second scenario is to use a Synology server as shown in Figure 4. The test method is using the RAID 0 upload configuration first, to get the upload data by including the transfer rate, resource usage, and QoS parameters, after the data upload from RAID 0 is obtained, then start testing the download data with the parameters as before, after the RAID 0 download data is obtained. , then the researcher will restart the server and reconfigure the server by starting to configure RAID 1, and start testing on RAID 1 with the data uploaded first, after the upload data is obtained then the test data download. After the two data from RAID 0 and 1 configurations of upload and download tests were obtained, the researchers began to analyze and compare the two servers.

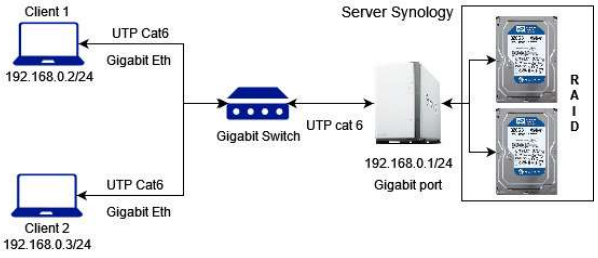

Figure 4 Synology topology

4. Results and Analysis

In the test results of the transfer rate parameter, it produces the values contained in value 4. Transfer rate testing aims to measure how fast the file is sent in Bytes per Second (Bps) from uploads and downloads in RAID 0 and 1 configurations on both servers where the resulting numbers are bigger, faster, and better.

In the first test using the Xigmanas server to get the transfer rate results as in figure 4 The comparison of the transfer rate value in configuration 0 on upload or download in each file capacity has a higher speed than configuration 1, this is because storage prioritizes backup storage in RAID 1 configuration, so it doesn't affect the transfer rate speed at the time of writing from client to server. servers.

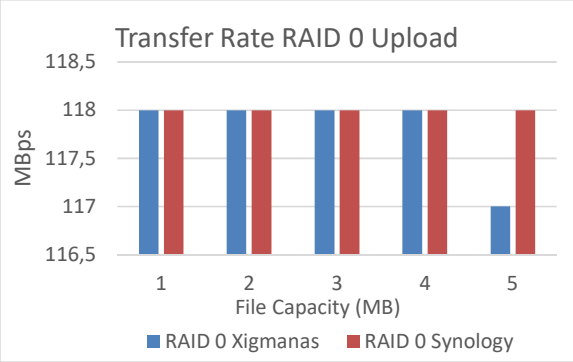

Figure 5 Transfer rate RAID 0 upload

Figure 5 shows that the RAID 0 configuration on the Synology server has a higher speed than the Xigmanas server in the upload test in each capacity, which means that the Synology NAS server operating system is better at writing data than the servers. Xigmanas. This is because the Synology operating system can process writing data better on the server.

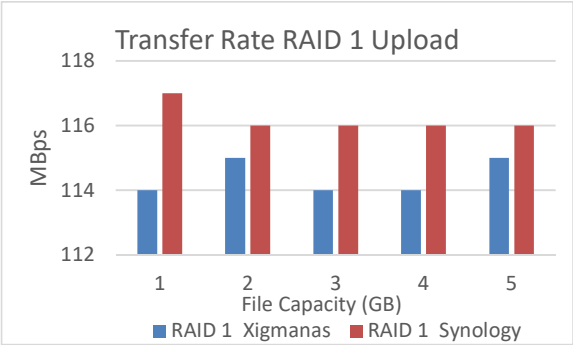

Figure 6 Transfer rate RAID 1 upload

From figure 6, it shows that Then the comparison of the two configurations in RAID 1 as shown in the 4.55 comparison chart above, it is shown that Synology RAID 0 is faster in data writing and data upload writing than Xigmanas RAID 0 with an average speed of 116 MBps in each test file capacity. This shows that the Synology transfer rate performance that has been implemented with a desktop PC has a reliable enough work test result to compete with Xigmanas performance with RAID 1, with a difference of 1 MB on the transfer rate side from the client to the server (upload).

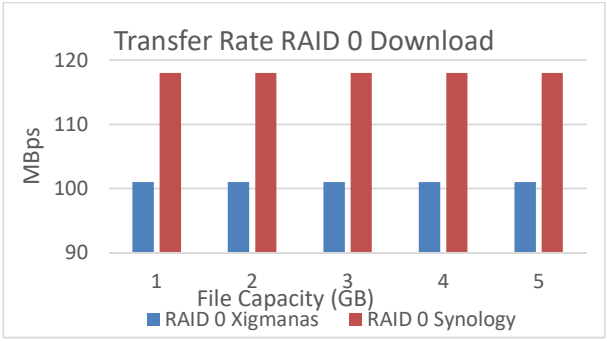

Figure 7 Transfer rate RAID 0 download

The comparison of the transfer rate from both servers with RAID 0 configurations and the value shown in Figure 7 with the larger capacity value does not significantly affect the average file transfer speed. But the results in this download test, the Synology server is superior to the Xigmanas server which can process and send files from the server to the client (download) at a faster and more stable speed for each file capacity sent, with a Xigmanas transfer rate at a speed of 101 MBps, and Synology at 118 MBps. This is because the Synology operating system is better able to read data from the server's hard disk than Xigmanas.

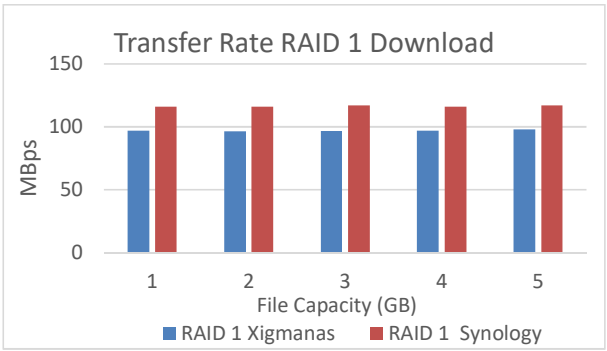

Figure 8 Transfer rate RAID 1 download

The comparison of the transfer rate value shown in Figure 8 with the larger capacity value does not significantly affect the average file transfer speed in RAID 1 download. But the results in this download test, the Synology server is superior to the Xigmanas server which can process and send files from the server to the client (download) at a faster and more stable speed for each file capacity sent, with a Xigmanas transfer rate at a speed of 101MBps, and Synology at 118MBps. This is because the Synology operating system is better able to read data from the server's hard disk than Xigmanas.

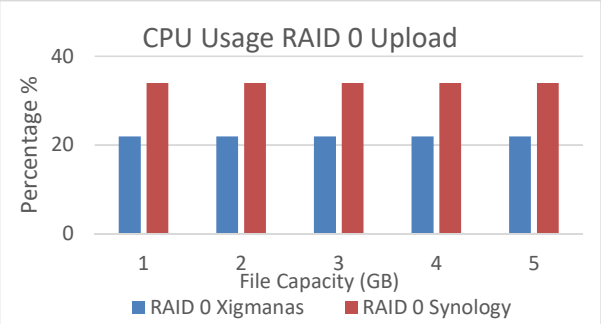

Figure 9 CPU usage RAID 0 upload

The comparison of CPU usage values in the RAID 0 configuration with the two NAS servers can be seen in Figure 9, the results obtained are the CPU on the Synology server handles a percentage of 34-35% in the RAID 0 configuration, while Xigmanas works with an average percentage of 22% in the configuration. RAID 0. Then in RAID1 Synology handles with 30-31% and Xigmanas an average of 22%. This shows that the CPU usage when testing was carried out by the Xigmanas server was lower in CPU resource usage.

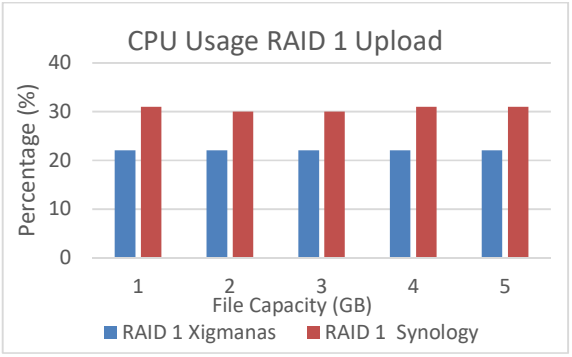

Figure 10 CPU usage RAID 1 upload

The comparison of CPU usage values in the RAID 1 upload configuration with the two NAS servers can be seen in Figure 10, the results obtained are the CPU on the Synology server handles a percentage of 30-31% in the RAID 1 configuration, while Xigmanas works with an average percentage of 22% in the configuration. RAID 1. This shows that the CPU usage when testing was carried out by the Xigmanas server was lower in CPU resource usage.

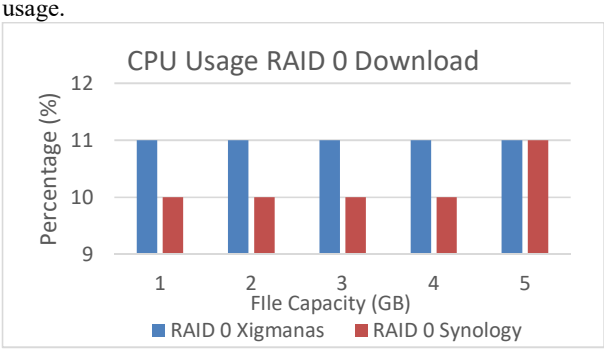

Figure 11 CPU usage RAID 0 Download

In figure 11, it is shown that CPU usage when the delivery takes place from the server to the client or download, in the RAID 0 configuration Xigmanas only uses about 11-12% CPU usage, then in Synology in the RAID 0 configuration it gets an average of 10-11% which means that Synology can handle the sending process with a minimum of CPU usage, then in RAID 1 the Xigmanas server processes files with a percentage of 11-12% and Synology an average of 6%, this shows the Synology server excels in sending data with minimal CPU usage.

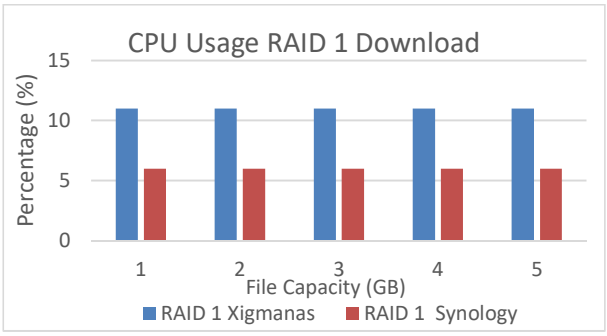

Figure 12 CPU usage RAID 1 Download

In figure 12, it shows the use of CPU resources when the delivery takes place from the server to the client or download, in the RAID 1 configuration Xigmanas only uses about 11-12% of CPU usage, then in Synology in the RAID 0 configuration, it gets an average of 6% which means that Synology can handle the delivery process with minimum CPU usage.

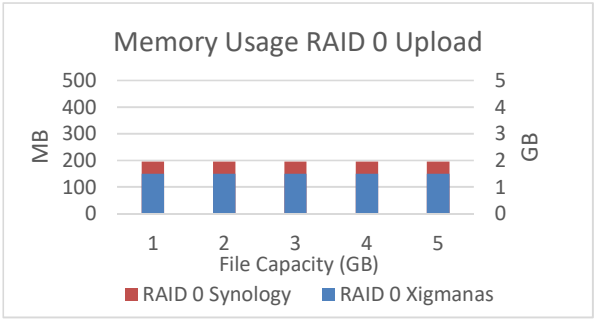

Figure 13 Memory usage RAID 0 Upload

In the uploaded test graphic figure 13, it shows that the use of RAM in the RAID 0 configuration of the Xigmanas server is stable at 1.5 GB which uses about 30% of the total 5GB RAM used. But in the RAID 0 configurations, the Synology server has an average of 195MB which is about 43% of the total 512MB RAM usage, this shows the operating system usage condition with less RAM on Xigmanas which has a percentage of 30% of the total memory used of 5GB. While in the RAID 1 configuration, the Xigmanas server has a value in all conditions of the capacity of the file being sent, which is 1.4 GB or 28% of the total RAM used. This shows that the Xigmanas server uses less RAM than the Synology server in the upload test.

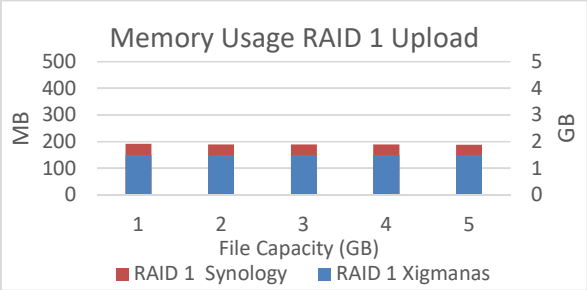

Figure 14 Memory usage RAID 1 upload

In the uploaded test graphic figure 14, it shows that with the use of RAM in the RAID 1 configuration. In RAID 1 configuration, the Xigmanas server has a value in all conditions of file capacity being sent, namely 1.4 GB or 28% of the total RAM used. This shows that the Xigmanas server uses less RAM than the Synology server in the upload test.

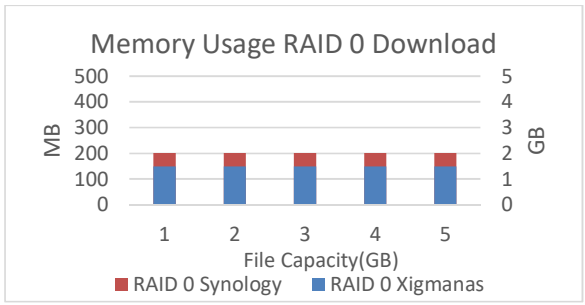

Figure 15 Memory usage RAID 0 download

In figure 15, the results of testing memory usage when sending downloads from RAID 0 with the Xigmanas server show an average memory usage of 1.5 GB of the total memory of 5GB which means the percentage is around 30%, and in RAID 0 server Synology uses an average of 201MB at each capacity or about 45% of the total installed memory, which is 512MB. So, this shows that the memory usage on Xigmanas is lower than the sinology server on RAID 0.

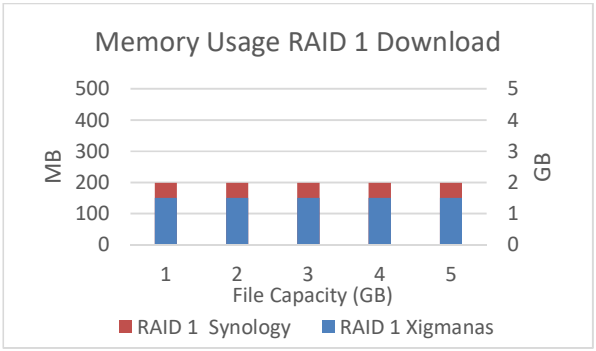

Figure 16 Memory usage RAID 1 download

Figure 16 shows that the RAID 1 server Xigmanas download test results obtained about 1.5GB or about 30% of the total 5GB memory and Synology uses an average of 199MB which, if present, is about 43%. So from this, the Xigmanas server is better at using memory which is only an average of 30% of the total memory compared to Synology which uses 43-45%. But from all tests, Synology still excels because the memory used in the enclosure is a total of 512 MB.

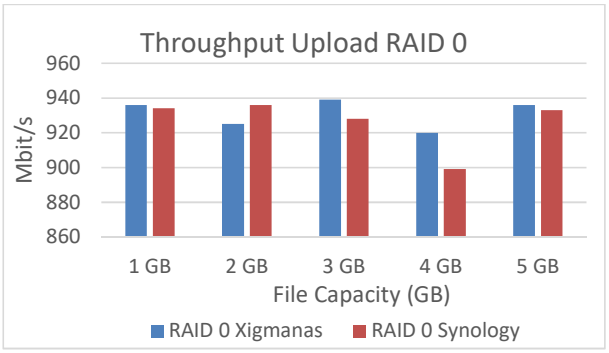

Figure 17 Throughput upload RAID 0

Testing the results of the average upload throughput in Figure 17 obtained by Wireshark software shows that the network conditions used when uploading has a throughput above 800Mbit/s in all capacities, RAID 0 configuration, and both servers being tested. So from the results of the graph above, all RAID configurations and both NAS servers have a percentage above 75% which is at index 4 which means it is very good in the TIPHON TR 101 standard.

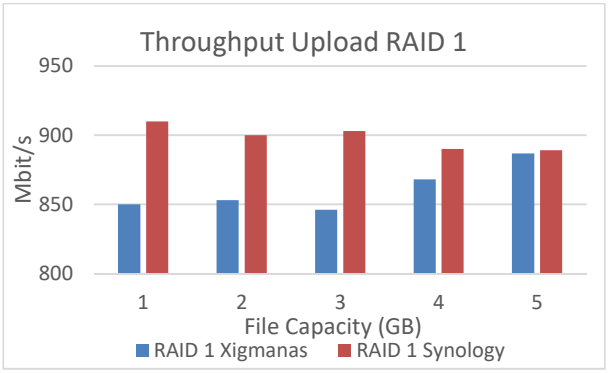

Figure 18 throughput upload RAID 1

Testing the average upload throughput results in Figure 18, obtained by Wireshark software shows that the network conditions used when uploading has a throughput above 800Mbit/s in all capacities, RAID 0 configuration, and both servers tested and in all file capacities sent. does not affect the throughput value as in the 5GB file capacity bar on the graph, that the larger the file capacity, does not affect the output file. So, from the results of the graph above, the server with the Synology operating system has better throughput output than Xigmanas, this is because the Xigmanas operating system is not yet stable. But in all RAID configurations and both NAS servers have a percentage above 75% which is at index 4 which means it is very good in the TIPHON TR 101 standard.

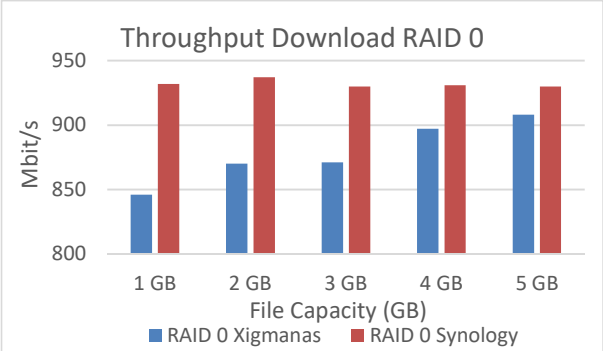

Figure 19 throughput download RAID 0

Figure 19 above shows that, the results of throughput performance in RAID 0 configuration have index 4 which all cover 75% throughput except for Xigmanas RAID 1 configuration at 1GB capacity which only has 64% throughput which is in the standard index enough. TYPHON. This is because the Xigmanas operating system is not sufficient to process and read data from the hard disk in a RAID 0 configuration.

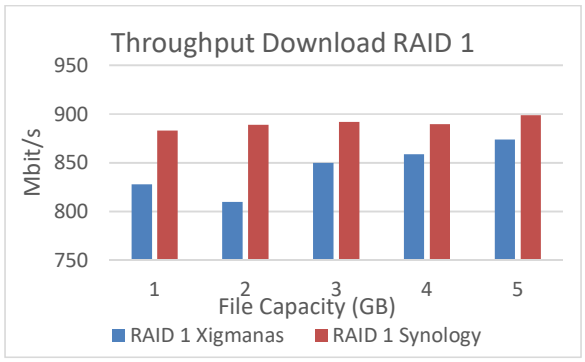

Figure 20 throughput download RAID 1

Figure 20 above shows that, the throughput performance results in RAID 0 configuration have index 4 which all cover 75% throughput except for Xigmanas RAID 1 configuration at 1GB capacity which only has 64% throughput which is in the standard index enough. TYPHON. This is because the Xigmanas operating system is not sufficient to process and read data from the hard disk in a RAID 0 configuration.

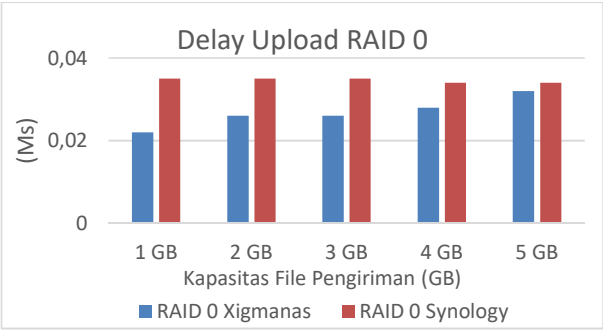

Figure 21 delay upload RAID 0

Graph from figure 21 shows the delay in this study, where a large number in the delay indicates how long the file travel time is when it is sent. And in the RAID 0 configuration by uploading files from the client to the server, the average delay is below 0. These results indicate that all configurations of this research are in good condition in the TIPHON 101 standard.

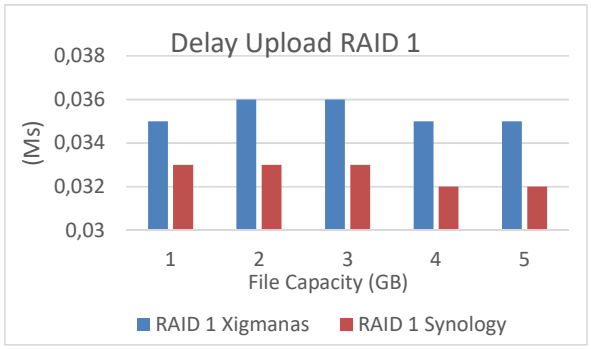

Figure 22 Delay upload RAID 1

Graph figure 22 shows the delay in the RAID 1 configuration of this study, where a large number in the delay indicates how long the file travels time when it is sent. And in the RAID 1 configuration with file uploads from the client to the server, the average delay results are below 0. These results indicate that all configurations of this study are in good condition in the TIPHON 101 standard.

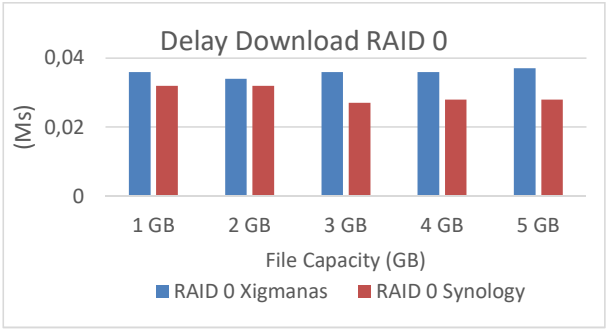

Figure 23 Delay download RAID 0

Graph figure 23 the results of the download research test, it is shown that all RAID 0 configurations in this study have a delay below 0 if in the TIPHON standard it has an index of 4 which is very good in every capacity test, RAID configuration, and both servers. This illustrates that in this study it is not affected by distance, the physical media is in good condition, and there is no congestion in network packets.

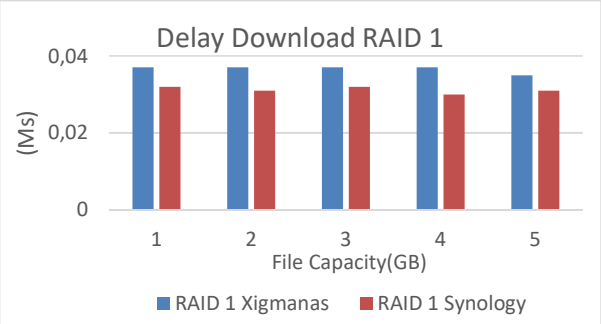

Figure 24 Delay download RAID 1

From graph figure 24 the results of the download research test, it is shown that all RAID 1 configurations in this study have a delay below 0 if the TIPHON standard has an index of 4 which is very good in every capacity test, RAID configuration, and both servers. This illustrates that in this study it is not affected by distance, the physical media is in good condition, and there is no congestion in network packets.

5. Conclusion

The measurement results from the transfer rate test from the Xigmanas server with the Synology server have a higher transfer rate than the RAID 0 or 1 configuration from the upload and download tests.

The measurement results on the upload and download CPU Resource Usage usage test, the CPU usage upload test is higher than the download test, this is due to software RAID characteristics that require more CPU usage. Testing Xigmanas upload 22%, Synology 33%. Then on the download test, Xigmanas server 11-12% on both RAID and 6-10% Synology.

In the Memory Usage test, there is no increase when the test is carried out, starting at the dial or without doing anything. The second RAID upload test found that Xigmanas is lower than Synology. The use of Xigmanas server memory when testing uploads obtained an average value of 1.4-1.5 GB or about 30%. While on the Synology server, the average memory usage for RAID 0 is 190-195MB, 45%. In the Xigmanas download server memory test, the average usage is 1.5GB or 30% of the total memory in RAID 0 and 1 configurations, while in Synology the average value for RAID 0 is 201MB which if it is a percentage of 46% and 199MB in RAID 1 or about 44% of the total memory used. So, in the memory usage test, the Xigmanas server has a lower value than the Synology server.

QoS testing with good average results on all parameters in each RAID configuration of both servers. In the throughput, the average value of 800Mbit/s is obtained from the bandwidth of 1000Mbit/s, which according to the TIPHON standard is above 75%, which means index 4 is very good. Then in the delay test, the average value is 0.03, and the packet loss value is 0 in all tests and RAID types. This shows that the network conditions used are direct, where the only bridge between the server and client is a gigabit switch and cat 6 LAN cable.

6. Future Work

1. Future research can use 2.5 Gigabit ethernet for maximum results research.
2. Subsequent research using SSD for NAS servers.
3. Further research can use other open-source NAS operating systems, such as Rockstor, TrueNAS, etc.
4. Further research can use other types of NAS enclosures such as Qnap, Asustor, etc.
5. Future research can use more clients and test different delivery files to add variation to the QoS parameters.

7. References

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