Building data centers using Network Attached Storage (NAS) and Microprocessor Operating Systems

Titi Andriani*, Muhammad Hidayatullah², Dekky Saputra³, Shinta Esabella⁴, G Gunawan⁵

¹,²Electrical Engineering Department, Faculty of Engineering, Universitas Teknologi Sumbawa
³,⁴Informatics Department, Faculty of Engineering, Universitas Teknologi Sumbawa
⁵Physics Education Study Program, Faculty of Teacher Training and Education, Universitas Mataram

*titi.andriani@uts.ac.id

Abstract. Computer Laboratory of the University of Technology Sumbawa still does not have a Data Center, in the process of learning and teaching experiencing several obstacles one of which is the difficulty in sharing files between computers. The research objective is to build a Data Center at the Computer Laboratory of the University of Technology Sumbawa with the aim of facilitating practicum participants in sharing files between computer system devices. The method used in this research is the network development method Prepare, Plan, design, Implement, Operate, Optimize (PPDIOO). The results of NAS tests on different devices give results that are file access connections via wireless and LAN can run well and by producing Data Centers at the Computer Laboratory of the University of Technology Sumbawa can facilitate the process of storing cheap and efficient data.

1. Introduction

Data Center is a compilation of servers, storage, network systems, mechanical or electrical systems, applications and tools and governance procedures. There are characteristics of data centers based on a combination of efficiency, availability and flexibility to become one of the important components in the world of business, industry, education and government [1]. In its development, this system can store data at high speed to serve data requests in a network. If in a network there are a lot of data requests, it will need a Data Center system that can later handle requests or requests for large amounts of data.

Sumbawa University of Technology has two Computer Laboratories namely, the Basic Computer Laboratory and the Advanced Computer Laboratory. The current condition of each LabKom consists of twenty-five computer units, one Access point unit, one router unit and two switch units. During this time the problems that exist in the Computer Laboratory of the University of Technology Sumbawa are students and lecturer difficulty in sharing files between computers, because the Basic Computer Laboratory and Advanced Computer Laboratory do not have a server computer so file transfer is still done using a USB flash drive [2].

To overcome this problem, a Data Center was designed using the Network Attached Storage (NAS) operating system as a system that would manage data distribution and the Microprocessor as a server that would become the data distribution center. For market conditions, there are already several types of NAS products such as QNAP, Synology and Asustor, but the prices of these products are relatively...
expensive, so the researchers built Data Centers using the operating system NAS [3] and Raspberry Pi 3 [4] which in terms of price cheaper and efficient.

2. Methods
This study uses a computer network development method with PPDIOO (Prepare, Plan, Design, Implement, Operate and Optimize) the following methods [5]:

![Figure 1. Network Development Method](image)

In Figure 1 there are steps to work on each stage, namely:

a. Prepare, is the preparation phase in terms of management, namely the general conditions desired by the company. Output in the form of management decisions in general form (not specific and detailed).

b. Plan, is a special planning phase, with the capital input from the prepare phase, the results of this analysis in the form of specific goals (technical goals).

c. Design, is the network design phase which is input from the previous phase, namely Plan. In this phase, detailed design is carried out which must be carried out during implementation. Starting from the tools used to configuration (low level design).

d. Implement, the phase of applying the solution, based on the design carried out in the previous phase, namely Design. Verification is done until the network is successfully connected (no connection interruptions).

e. Operate, monitoring and testing phase, to find out whether the project implementation has succeeded in overcoming the problem. In this phase there is also a need analysis to improve the condition of the company's network.

f. Optimize, the network optimization phase, based on the previous phase, namely Operate, suggestions will appear and be analyzed in this phase for further network development.

3. Results and Discussion
Research conducted by researchers with PPDIOO (Prepare, Plan, Design, Implement, Operate and Optimize) Methods, including the following:

3.1. Preparation Phase
At this stage several categories are prepared which will be built by researchers in research in the Computer Laboratory:

| No | Activity category | Explanation |
|----|-------------------|-------------|
| 1  | File Share        | Computer devices can exchange data and files |
| 2  | Access Real Time  | Access between computers can be accessed at any time |
3. Centralized Storage  Has a centralized data storage media
4. Easy Access  Access can be done easily
5. Data Backup  Available backup data storage media

3.2. Planning Phase
At this stage the planned network will be made at the Computer Laboratory of the University of Technology Sumbawa with a general description of Making Network Systems, Making Centralized Storage Media, Making Systems Connected to Networks and Making WEB Based Display.

3.3. Design Phase
In this phase there are devices or software to be used, general network design, network topology and configurations applied to the Computer Laboratory of the University of Technology Sumbawa.

a) Software and Hardware
The hardware and software used in building NAS (Network Attached Storage) are as follows:

| Table 2. Software and Hardware Device |
|--------------------------------------|
| Software                              | Hardware                        |
| (OS) Open Media Vault                 | Raspberry Pi3                   |
| Rufus-2.15                            | SD card 16 Gb                   |
| SD Formatter                          | HDD 500 Gb                      |
| Wireless Network Watcher              | Network Cable                   |
| Web Browser                           | HDMI Cable                      |
|                                      | HDD to USB Cable                |
|                                      | USB Terminal Power              |

b) General Network Design
The general design of computer networks from the Computer Laboratory of the Sumbawa University of Technology is shown in Figure 2 below [6]:

To be able to access the NAS client from the basic and advanced Computer Labs it will be connected via switch 2, while clients using laptops and smartphones will be connected via an Access Point (AP) which will then be connected to switch 1. For NAS and Router will also be connected with switch 1, from the Router will be connected to the modem and modem to the internet (ISP) [7].

c) The Network Topology
The Network Topology [8] that has been planned for the Computer Laboratory of the University of Technology Sumbawa that has been connected with Network Attached Storage (NAS).
If seen from Figure 3, in the topology there is a basic and advanced Computer Laboratory with each Computer Laboratory having twenty-five (25) client computers and connected to two switches (each Computer Laboratory has two switches). Of the two switches in the basic and advanced computer labs that are connected to the switch server. For the router to connect to the switch from the advanced Computer Laboratory, then the router to the modem. Whereas the access point (AP) accessed by the client (which uses a laptop and smartphone) is connected to the server switch.

d) Configuration

Configuration is done at the network configuration stage such as IP address in Figure 4:

In the IP Address configuration, use the default settings of the router or proxy, which is intended to facilitate addressing on the client.

3.4. Implementation

a) Installing OMV on Raspberry pi 3

For the OMV installation on Raspberry [9], an operating system (OS) is installed on the SD card with an image extension (.img) file. Previously SD cards had to be formatted using the SD Formatter application. For installing OMV OS into the SD Card using Rufus-2.15.
b) OMV Configuration
After the installation process is complete, the OMV configuration is performed. Configuration is done according to the needs of the Computer Laboratory.

3.5. Operate
At this stage the OMV testing is done, the testing is done by accessing OMV through different devices. The device used at this stage of testing is Personal Computer [10].

Testing is done on the PC Client Computer Laboratory of the University of Technology Sumbawa, by entering a Username and Password that has been created in a web-based. In addition to this user, the admin can set the permission level of each user or client, set the name and password of the user or client, and add the email address of the user or client. A review of the results of the study is shown in table 3:

| No | Activity Category | Explanation | Test Result |
|----|-------------------|-------------|-------------|
| 1  | File Share        | Computer devices can exchange data and files | Succeed     |
| 2  | Access Real Time  | Access between computers can accessed any time | Can be Access|
| 3  | Centralized Storage | Has a centralized data storage media | Available   |
| 4  | Easy Access       | Access can be done easily | Easy       |
| 5  | Data Backup       | Available backup data storage media | Available   |

3.6. Optimize
At this stage optimization is carried out, which can later be applied to the development of NAS performance. What can be done to optimize NAS is to add larger capacity storage.
4. Conclusion
Making NAS as a Data Center, is already suitable as a cheap storage center. With wireless transmission media and local area network (LAN) makes it easy for users to access and share data. Testing the NAS on different devices gives the result that the file access connection via wireless and LAN can run smoothly. And for further developers Storage can be added with a larger storage capacity than the previous storage and the addition of a fan or cooler on the Raspberry device so that air circulation on the Raspberry becomes smooth. You can also add more than one HDD or SSD to enable the RAID features of Open Media Vault.

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