NETWORK ATTATCHED STORAGE

A PROJECT REPORT SUBMITTED

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SUBMITTED TO

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(Accredited by NBA)

Model Institute of Engineering & Technology (Autonomous)

(Permanently Affiliated to the University of Jammu, Accredited by NAAC with “A” Grade)

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CANDIDATE'S DECLARATION

I, **Amjid Khan (2021a1r106), Amisha Gurndwal (2021a1r062), Sania Fotedar (2021a1r082),** hereby declare that the work which is being presented in the project report entitled, "**Network Attached Storage**" in the partial fulfillment of requirement for the award of degree of B.E. (CSE) and submitted in the Department of Computer Science & Engineering, Model Institute of Engineering and Technology (Autonomous), Jammu is an authentic record of my own work carried by me under the supervision of **Mr. Arsalan Manzoor Zargar** And **Ms. Harashleen Kour**. The matter presented in this project report has not been submitted in this or any other University / Institute for the award of B.E. Degree.

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CERTIFICATE

Certified that this seminar report entitled **"Network Attached Storage"** is the bonafide work of **Amjid Khan (2021a1r106), Amisha Gurndwal (2021a1r062), Sania Fotedar(2021a1r082) of 6th Semester,** Computer Science and Engineering**, Model Institute of Engineering and Technology (Autonomous), Jammu",** who carried out the project work under my supervision during September 2024.

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Dr. Ankur Gupta (Director, MIET)

I would also like to thank my parents, friends etc. who helped me in my Project Report.
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ABSTRACT

A specialized file storage system known as Network Attached Storage (NAS) gives local area network (LAN) users aggregated, centralized disk storage over a typical Ethernet connection. NAS devices are made to provide network access to files by serving them to users and client computers. They are commonly used for data sharing, backup, and storage in both home and office settings.

This study examines the features, design, and advantages of NAS systems with an emphasis on how they might improve the effectiveness of data management. NAS devices provide several benefits, such as easier file sharing and access, better data security via centralized administration, and expandable storage options to meet expanding data requirements. Furthermore, NAS systems with sophisticated features like RAID (Redundant Array of Independent Disks) and snapshot capabilities offer improved alternatives for data recovery and security.

Additionally, we look at a variety of NAS use cases across industries, demonstrating its adaptability to handle everything from basic home media servers to intricate business storage networks. The most recent developments in NAS technology are covered in the paper's conclusion, including the incorporation of cloud services, improvements in data deduplication, and the rise of hybrid NAS solutions.

To sum up, network attached storage (NAS) is an essential part of today's IT infrastructure since it provides dependable, scalable, and effective storage solutions that meet a variety of user requirements. Its ongoing development guarantees that, even in the digital era, it will be an essential instrument for managing and storing data.

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CHAPTER 1

INTRODUCTION

1.1 Background

Information Technology (IT) is an essential part of today's business. IT technology is, among others, in key role for storing business knowledge into a stored format for later use. While IT gives clear advantages over previously used methods for storing knowledge, it also generates various new threats which are discussed in this project. However, these threats can be identified and minimized with the proper combination of hardware and software. This study focuses on utilizing various hardware and software to overcome the threats and it is based on design science.

NAS (Network-attached storage) is a data storage, which is connected to a computer network. NAS acts as a file-server in a network, offering data storage to be located in a stand-alone unit, which other computers can be connected. NAS can be seen as a network drive (via Ethernet) and as such, it can be used to save documents and files as well as read them. Fundamentally, a NAS is a computer, optimized in hardware and software, to be a file server.

The benefits from using NAS are clear; firstly it will improve the security of the data since it will be located in one place only, rather than divided into several PC's of the users personnel. That greatly decreases the chances of information leaks due to thefts, mistakes and accidents. Secondly, it will improve the maintenance of the data, allowing the local administrator to locate the data from one place and because of that, it can be managed easier than if the data would be located in several different places. Thirdly, it allows backing up the data frequently with an efficient way, so that the valuable data will not be destroyed in an accident or a single system failure. Fourthly, it improves the accessibility greatly by allowing users to connect to the device via web from practically anywhere. That allows users to gain access to their documents from home and practically anywhere which has an internet connection. In this case study, NAS will be designed, configured and finally implemented into existing local network to act as a file-server for the users. The project tries to solve and find out the proper way to implement it, as well as how to utilize it correctly. However, a significant focus will be on finding the most affordable solution without losing on features and fault-tolerance. The budget in this project is limited. The aim is to support simultaneous users. The outcome of this project will be a proper implementation of a NAS and as such it can be applied to any existing local network in a small-sized company.

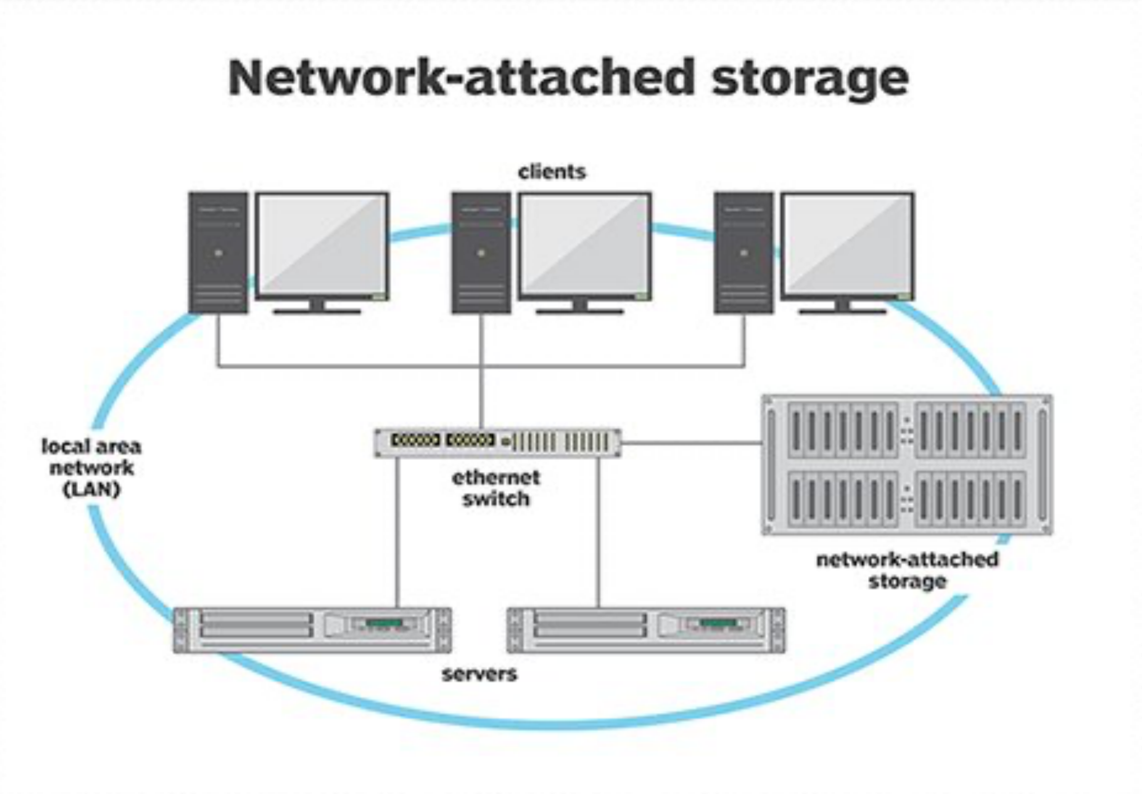


Figure 1.1 (Network-attached storage)

1.2 Problem Statement

Traditionally users manage their own data by storing it into their own hard drives. This generates a threat of a data loss in multiple ways: user may accidentally delete his/her own data, the data may not be recoverable. Another threat is that any of the used laptops may get stolen with the data, which may even generate a risk of misuse of the information which is located in the hard drive. One more threat is the hard drive failure which may lead to a complete data loss of that specific hard drive content.

1.3 Objective and Methodology

The aim of this project is to create a data storage system for users which utilizes and fulfills the following requirements:

- External access over Internet
- Access from LAN

- Optimized data security
- Maintainability
- Future expansions
- System health monitoring

This project allows users to increase their data security in multiple ways as well as increases their mobility as their centralized data storage can be accessed over Internet. This project can also be used as a guide in the implementation stage of a NAS-system in most scenarios. The project is applicable to be utilized in either home use, or in small offices.

1.4 NETWORK STORAGE CONCEPTS

In basic terms, network storage is simply about storing data using a method by which it can be made available to clients on the network. Over the years, the storage of data has evolved through various phases. This evolution has been driven partly by the changing ways in which we use technology, and in part by the exponential increase in the volume of data we need to store. It has also been driven by new technologies, which allow us to store and manage data in a more effective manner.

Network storage is a generic term used to describe network based data storage, but there are many technologies within it which all go to make the magic happen. Storage is frequently used to mean the devices and data connected to the computer through input/output operations - that is, hard disk and tape systems and other forms of storage that don't include computer memory and other in-computer storage. For the enterprise, the options for this kind of storage are of much greater variety and expense than that related to memory. In a more formal usage, storage has been divided into:

(1) Primary storage: which holds data in memory (sometimes called random access memory or RAM) and other "built-in" devices such as the processor's L1 cache.

(2) Secondary storage: which holds data on hard disks, tapes, and other devices requiring input/output operations.

1.4.1 Storage devices: It is alternatively referred to as digital storage, storage, storage media, or storage medium, a storage device is any hardware capable of holding information either temporarily or permanently.

There are two types of storage devices used with computers: a primary storage device, such as RAM, and a secondary storage device, like a hard drive. Secondary storage can be removable, internal, or external storage. Without a storage device, your computer would not be able to save any settings or information and would be considered a dumb terminal

1.4.2. Examples of Storage devices

Magnetic storage devices:

Today, magnetic storage is one of the most common types of storage used with computers and is the technology that many computer hard drives use.

- Floppy diskette
- Hard drive
- Super drive
- Tape cassette
- Zip diskette

Optical storage devices:
It uses lasers and lights as its method of reading and writing data

- Blu-ray disc
- CD-ROM disc
- CD_R and CD-W disc

Flash Memory devices: It is a non-volatile storage and it is cheaper, reliable and more efficient than magnetic media.

- Jump drive
- Memory card
- Memory stick
- SSD

Online and Cloud: It is becoming popular as people need to access their data from more than one devices.

- Network media
- Dropbox
- One drive

1.4.3. Storage location

When saving anything on a computer, it may ask you for a storage location, which is the area in which you would like to save the information. By default, most information is saved to your computer hard drive. If you want to move the information to another computer, save it to a removable storage device such as a flash drive.

1.4.4 Primary storage

Primary storage, also known as main storage or memory, is the area in a computer in which data is stored for quick access by the computer's processor. The terms random access memory (RAM) and memory are often as synonyms for primary or main storage. Primary storage is volatile and can be contrasted with non-volatile secondary storage, also known as auxiliary storage. The terms main storage and auxiliary storage originated in the days of the mainframe computer to distinguish the more immediately accessible data storage from data stored on punch cards that required input/output (I/O) operations. when mainframe data storage contained ferrite cores, the term core storage was often used in place of primary storage.

In the label primary storage is often used to describe storage for data that is in active use, as opposed to data at rest in a backup. In this usage, the label primary storage may actually be describing the non-volatile secondary storage referred to in meaning above. It should be noted that although these two meanings conflict, the appropriate meaning is usually apparent from the context. For example, primary storage in a tiered-storage architecture might consist of hard disks or flash-based solid state drives on a centralized storage-area network (SAN) or network-attached storage (NAS)array that stores transactional data or mission- critical application data that requires extremely high performance.

1.4.5 Direct Attached Storage (DAS)

Direct attached storage is the term used to describe a storage device that is directly attached to a host system. The simplest example of DAS is the internal hard drive of a server computer, though storage devices housed in an external box come under this banner as well. DAS is still by far the most common method of storing data for computer systems. Over the years, though new technologies have emerged which work if you'll excuse the pun out of the box.

1.4.6 Network Attached Storage (NAS)

Network Attached Storage, or NAS, is a data storage mechanism that uses special devices connected directly to the network media. These devices are assigned an IP address and can then be accessed by clients via a server that acts as a gateway to the data, or in some cases allows the device to be accessed directly by the clients without an intermediary. An increasing number of companies already make use of NAS technology, if only with devices such as CD- ROM towers (stand-alone boxes that contain multiple CD-ROM drives) that are connected directly to the network.

Some of the big advantages of NAS include the expandability; need more storage space, add another NAS device and expand the available storage. NAS also bring an extra level of fault tolerance to the network. In a DAS environment, a server going down means that the data that server holds is no longer available. With NAS, the data is still available on the network and accessible by clients. Fault tolerant measures such as RAID, can be used to make sure that the NAS device does not become a point of failure.

1.4.7 Storage Area Network (SAN)

A SAN is a network of storage devices that are connected to each other and to a server, or cluster of servers, which act as an access point to the SAN. In some configurations a SAN is also connected to the network. SAN's use special switches as a mechanism to connect the devices. These switches, which look a lot like a normal Ethernet networking switch act as the connectivity point for SAN's. Making it possible for devices to communicate with each other on a separate network brings with it many advantages. Consider, for instance the ability to back up every piece of data on your network without having to 'pollute' the standard network infrastructure with gigabytes of data. This is just one of the advantages of a SAN which is making it a popular choice with companies today, and is a reason why it is forecast to become the data storage technology of choice in the coming years.

1.4.8. Secondary storage

Computer storage is made up of primary and secondary storage. Primary storage typically refers to random access memory (RAM) placed near the computer's CPU to reduce the amount of time it takes to move data between the storage and CPU. Secondary storage (sometimes referred to as secondary memory) is at the lower level of the storage hierarchy. It commonly refers to hard disk drives (HDDs), solid-state drive (SSD) storage (flash) or other types of storage devices. Computers use primary and secondary storage for a number of reasons.

• RAM based storage is versatile
• RAM is far more expensive than non-volatile storage on cost-per giga byte

Chapter 2

LITERATURE SURVEY

This chapter contains the theories and the background to justify the usage of NAS based solutions in business. When implemented properly, it lowers the risk for a data loss as well as greatly improves the mobility of the work thus allowing employees to work abroad. This chapter contains the basic knowledge of the NAS based solutions as well as different ways to implement them.

RELATED WORKS

Due to the exceptional growth of Internet in the past few years, computing resources are available everywhere. The existing system uses cloud computing for data storage. Cloud Computing Environment consists of two components.

a. Infrastructure Providers: Infrastructure providers handle the cloud platforms and rent out resources according to usage

b. Service Providers: Service providers lease resources from infrastructure providers and make it available to end users.
In spite of this technology having many opportunities and applications in today’s world, there still exist a number of challenges which need resolution. The biggest challenge faced is the open characteristic and multi-tenant nature of the cloud. This technology has a huge impact in the field of information security. The various impacts are described in detail below.

(1) There is no security boundary in this technology due to features such as dynamic scalability, service abstraction, and location transparency. In addition there is no fixed infrastructure for the applications and data making it difficult to keep the information secure.
(2) There is a need for quick information processing in this kind of storage because the platform will be dealing with large amount of data. The security needs to be in line with this high speed processing.

(3) In this type of system, it is difficult to have a common security measure as the resources may belong to multiple providers.

(4) There is a possibility of unauthorized user access due to the openness of cloud and sharing virtualized resources by multi-tenant .

2.1 NAS ARCHITECTURE

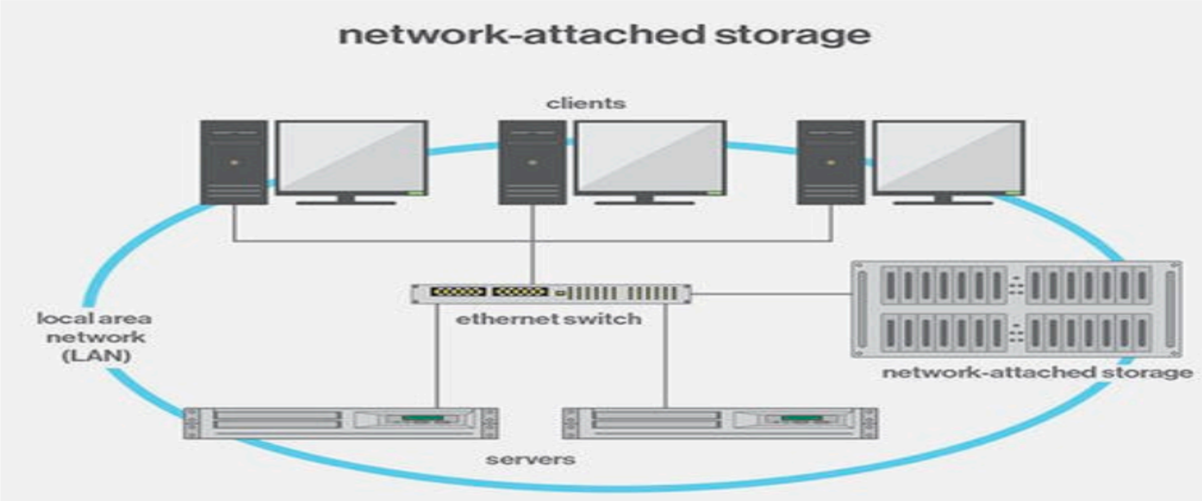


Figure 2.1 (NAS Architecture)

The above figure shows a typical NAS architecture. NAS helps the organizations to quickly and easily add file storage capacity to their technology infrastructure. NAS focuses mainly on serving files ,while hiding many of the details of the actual file system implementations. NAS appliances are easy to deploy and are self sustained. NAS works well for organization that need to deliver data to multiple clients over a network. NAS functions well in places where data must be transferred over long distances. NAS can be used for domestic automation of data storage.

2.1.1 STORAGE: There are basically two modes of data storage: a) offline storage b) online storage.

a) Offline storage: This is the storage media that must be manually inserted into the system. The information is safely stored and retrieved when required. The data stored is permanent and its is unaltered until edited by user, the data stored is also more portable and can be accessed easily . eg: hard disk ,pen drives.

b) Online storage: It is a concept of storing of electronic data over a network. This type of data is more secured , portable and can be accessed from any part of the world . It helps in sharing of files among the multiple users at the same time.

Networked storage: Networked storage is an online data storage mechanism that uses special devices connected directly to the network media. These devices will be assigned with an IP address and can then be accessed by the clients via the server. The server acts as the gateway to the data. In some cases, networked storage allows the device to be directly accessed without any intermediate source .The biggest advantage of networked storage is expandability.

2.1.2 RASBERRY PI: The raspberry pi is a series of small single board computer developed by the Raspberry pi foundation to promote teaching of basic computer science in

schools. The Raspberry Pi platform can run the Linux operating system, which means that the Applications of open source software can be used directly with it.

Figure.3: Block diagram of Raspberry pi 3 model B

The SD card inserted into the slot on the board acts as the hard drive to the Raspberry. It is powered by USB and the video output can be viewed on a traditional RCA TV set, a more modern monitor, or even a TV using a HDMI port .This enables all the basic features of a computer. It also has an extremely low power consumption of 5 watt.

Figure 4: Raspberry pi3 physical layout

The availability of drivers for opened source software makes the raspberry pi interfaced with devices such as keyboard, camera with USB, and adapter of WIFI, without having any source proprietary alternatives. Raspbian is a Debian based operating system for Raspberry pi. There are several versions available including Raspbian Stretch and Raspbian lassie. The operating system is a UNIX type, open source model. The latest release includes Raspbian Stretch with Desktop .The working platform involves ARM i386 version. The kernal is a monolithic environment.

2.2 NAS Appliance Theory of Operation

A NAS device is essentially a plug-and-play storage appliance, designed to respond to client requests for stored data in real time. NAS devices are well suited to serve networks that have a heterogeneous mix of clients and servers, such as UNIX, Microsoft Windows, and Linux. The NAS appliance can do this by running a suite of file system software compatible with the clients it services. When a client on the LAN requests data from the storage system, the application layer of the client sends a data request over the network to the NAS platform. The local file system of the NAS determines the origin of the request and sends the appropriately formatted data back to the originating client.

A NAS system provides file security, through methods such as "Access Control Lists," and it performs all file and storage services through standard network protocols, including TCP/IP for data transfer, Ethernet for media access, and HTTP, CIFS, and NFS for remote file services. In addition, a high-performance NAS appliance may handle tasks such as Web cache and proxy, audio and video streaming, and tape backup.

2.3 SOFTWARE CONSIDERATIONS

This section describes the software layers in this solution stack and highlights technical considerations for software implementation.

2.3.1 BIOS and Drivers

In addition to the numerous vendors providing BIOS solutions for Intel processors, equipment manufacturers also develop custom BIOS versions for their particular solution. Original equipment manufacturers may also develop drivers for their own hardware (such as hard drives) or use drivers provided by Intel or other hardware manufacturers.

2.3.2 Operating System

The operating system (OS) manages all the software applications and hardware resources on the system. NAS appliances may use off-the-shelf desktop or server operating systems, such as Windows, Linux, or UNIX, or may utilize an embedded OS, such as Windows CE or Embedded Windows NT*. Another alternative is a real-time operating system (RTOS) such as VxWorks* or QNX*.

The main considerations for a NAS OS are the size and performance. Desktop operating systems are easier for the customer to implement, but take up more disk space (which means less storage) and also contain unnecessary overhead that usually degrades performance. An RTOS offers a smaller footprint and may even reside in Flash rather than on disk. Development using an RTOS allows for more direct control of the hardware, enabling optimum performance tuning. However, there is a significant investment required in developing with an RTOS. Plus, this may limit the ability to include value-added functionality, such as using the NAS device as a Web server. Embedded operating systems such as Embedded Windows NT are good alternatives because they are modular and provide tools to allow only the necessary modules to be installed. Many Linux packages also have this capability. High Availability (HA) is also becoming a key consideration for OS selection. Linux, for example, has an HA initiative underway.

2.3.3 Application Software and Protocols

The application software layer can be segmented into several functional areas, including services, access permissions, storage, fault tolerance, and networking. Additionally, NAS products may come with client-based tools for setup and access to the NAS device. All functional areas, aside from networking and storage, are value-added capabilities that NAS manufacturers use to differentiate their products.

2.3.4 File Systems

- NFS: The Network File System (NFS) is an application that lets a computer user view, update, or store files on a remote computer as though they were on the user’s local hard drive. Most UNIX and Linux operating systems include NFS client and server software.
- SMB: The Server Message Block (SMB) protocol allows a Windows client to access, create, and update files on a remote server. The protocol also allows the same client to access other resources such as printers and mail slots. The SMB protocol can be used over TCP/IP or other network protocols such as IPX and NetBEUI. Microsoft Windows 95 and later versions of the operating system include client and server SMB protocol support. For UNIX and Linux systems, a shareware program called Samba is available. The SMB protocol originated at Microsoft and has gone through a number of developments, eventually evolving into the CIFS standard.
- CIFS: Common Internet File System (CIFS) is a standard protocol that enables programs to request files and services on remote computers on the Internet. CIFS is an open variation of SMB. Like SMB, CIFS is built upon the TCP/IP protocol. CIFS is currently the most commonly used protocol for NAS systems because it is readily available on Windows, UNIX, and Linux operating systems, and can also be used in conjunction with Novell* IPX/SPX protocols.

2.3.5 Networking Protocols

Networking protocols control the communication to and from the NAS device. The physical connection of a NAS is Ethernet. Because most NAS devices attempt to homogeneously communicate over the LAN, multiple network protocols are typically supported.

TCP/IP: TCP/IP (Transmission Control Protocol/Internet Protocol) is the basic communication language of the Internet. Many higher-level protocols are built on top of TCP/IP, such as Hypertext Transfer Protocol (HTTP), the File Transfer Protocol (FTP), Telnet, and the Simple Mail Transfer Protocol (SMTP).

2.4 Literature Review

1. David F. Nagle, Gregory R. Ganger, Jeff Butler, Garth Goodson, and Chris Sabol have done project on Network Support for Network-Attached Storage. High- performance, low- latency networking is essential to achieving the potential of scalable network-attached storage. User-level networking solutions, such as VIA, have the potential to do this, but must be mindful of the amount of on-drive resources required — connection state and buffering can consume considerable resources. However, Remote DMA can help minimize drive resources while providing a great deal of flexibility in drive scheduling and buffer management. Further, VIA's application-level flow control enables aggregation of flow control across arbitrary storage components, something low-level network flow control is not designed to support.

2. Darrell D.E. Long University of California have done project on authenticating network-attached storage. The importance of distributed computing as the pivotal approach to managing computing resources and data is well recognized. Scaling distributed computing solutions is a challenge. Network-attached storage provides a solution for creating scalable network access to data, but requires reliable and efficient authentication techniques to ensure that while data is widely accessible, its content is secure from unauthorized access. The SCARED architecture provides a mechanism for efficient and reliable authentication to network accessible storage. We are building a distributed file system on top of SCARED which we call Brave. It is serverless in the sense that there is no central file server, but it stores all data and metadata on network-attached storage unlike the serverless file system described earlier.

3. Howard Gobioff Garth Gibson Doug Tyger have done project in Security for Network Attached Storage Devices .The NASD architecture is an innovative approach to the problems of high performance and cost effective I/O based on network attached storage systems. By providing security to network attached storage, we enable clients to utilize the potential performance and scalability benefits inherent in network attached storage without compromising their data security. The essence of our capability scheme is the encapsulation of the bearer's access rights on a particular version of a storage object using a secret key shared between capability issuer (file manager) and capability enforcer.

4. The project Best Practices for running VMware vSphere on Network Attached Storage by Paul Manning. Network Attached Storage has matured significantly in recent years and it offers a solid availability and high performance foundation for deployment with virtualization environments. Following the best practices outlined in this paper will ensure successful deployments of vSphere on NFS. Many people have deployed both vSphere and VI3 on NFS and are very pleased with the results they are experiencing. NFS offers a very solid storage platform for virtualization. Both performance and availability are holding up to expectations and as best practices are being further defined, the experience of running VMware technology on NFS is proving to be a solid choice of storage protocols. Several storage technology partners are working closely with VMware to further define the best practices and extend the benefits for customers choosing to deployment VMware vSphere on this storage protocol option.

5. Anna Suganthi, Karnavel ,Rajini Girinath.D have done project in Network Attached Storage for Data Back Up Over a Local Area Network Software for the critical data in a LAN was developed. The software could perform backing up of files in remote nodes, deletion of files from remote node, retrieve files from remote node, join the group and unsubscribe from the group. The software is also provided with an easy to use graphical user interface. A program was developed through which one could write, delete, and retrieve files to the external storage medium NAS which provides an additional reliability for data storage.

Chapter 3

PROPOSED WORK

Here in this chapter we will discuss the components we are using. Since this project is purely based on the concepts of networking therefore will discuss all networking related concepts and why we are using RaspberryPi in the project.

3.1 Block Diagram

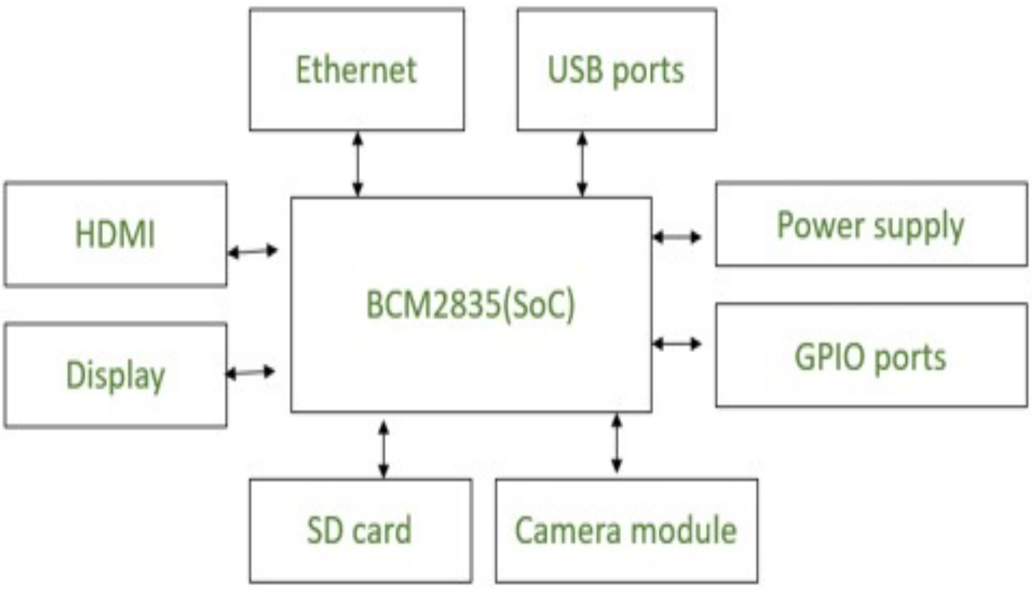


Figure 3.1 (Raspberry Pi 4 Block Diagram)

The Raspberry is powered by USB and the video output can be viewed on a traditional RCA TV set, a more modern monitor, or even a TV using a HDMI port. This enables all the basic features of a computer. It also has an extremely low power consumption of 5watt. Offline storage devices are connected through USB port to Raspberry pi and it also has a separate port to connect Ethernet cable. NAS solutions are configured as file serving appliances accessed through the workstations and servers using a network protocl TCP/IP. Network File System (NFS) or Common Internet File system (CIFS) are some of the application used for accessing the file. Most of the NAS connections reside between workstation clients and the NAS file sharing facility.

3.2. NAS vs SAN

The primary difference between NAS and SAN solutions is the type of access protocol. NAS protocols such as NFS and CiFS provide shared file level access to storage resources. The management of the file system resides with the NAS device. SAN protocols such as iSCSI and fiber channel provide block level access to storage resources. Block level devices are accessed by servers via the SAN, and the servers manage the file system. Despite their differences, SAN and NAS are not mutually exclusive, and may be combined in multi-protocol or unified storage arrays, offering both file-level protocols (NAS) and block-level protocols (SAN) from the same system.

Benefits of NAS

• NAS devices typically leverage existing IP networks for connectivity, enabling companies to reduce the price of entry for access to shared storage.
• The RAID and clustering capabilities inherent to modern enterprise NAS devices offer greatly improved availability when compared with traditional direct attached storage.

• Because NAS devices control the file system, they offer increased flexibility when using advanced storage functionality such as snapshots.

• With 10GE connectivity, NAS devices can offer performance on par with many currently installed fiber channel SANs.

3.3 Creating a NAS solution

NAS is a common storage infrastructure offering in data centers worldwide.

Eastern Computer has assisted many of our customers in justifying, designing, and implementing enterprise NAS solutions.

• Lower acquisition and management costs
• Meet performance and availability requirements
• Handle ever increasing annual storage growth with minimal to no impact to your business

3.4 Implementation of NAS

We're going to use Raspberry Pi Imager to install Raspberry PiOS Lite onto your microSD card. Raspberry Pi Imager isavailable for free for Windows, macOS, Ubuntu for x86 and Raspberry Pi OS, and can be downloaded-: https://www.raspberrypi.com/software/

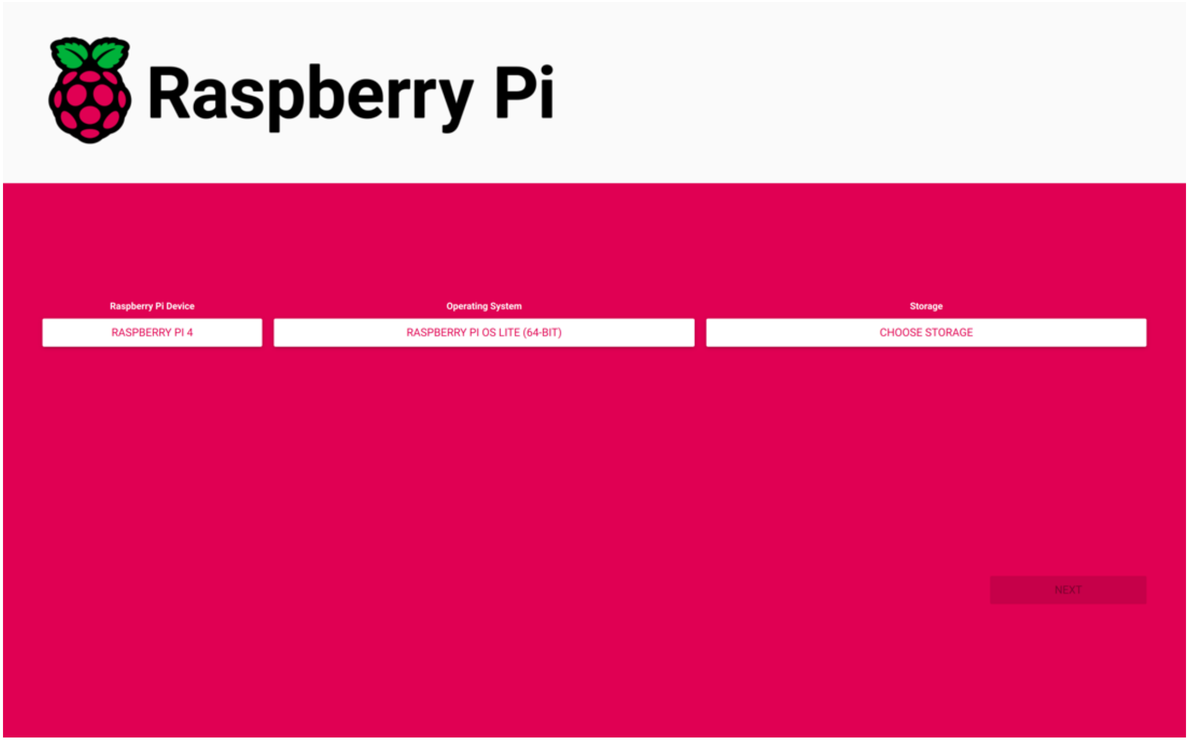


Figure 3.2(Raspberry Pi Imager)

Open the Imager application and connect your microSD card to your computer Connect your microSD card to your computer using an SD card adapter. We recommend a minimum storage size of 16GB.

Install Raspberry Pi OS to your microSD card

In Raspberry Pi Imager:

CHOOSE OS: Raspberry Pi OS can be found under Raspberry Pi OS (other). We're using the smaller-sized Raspberry Pi OS Lite, as we do not need the desktop environment for our project.

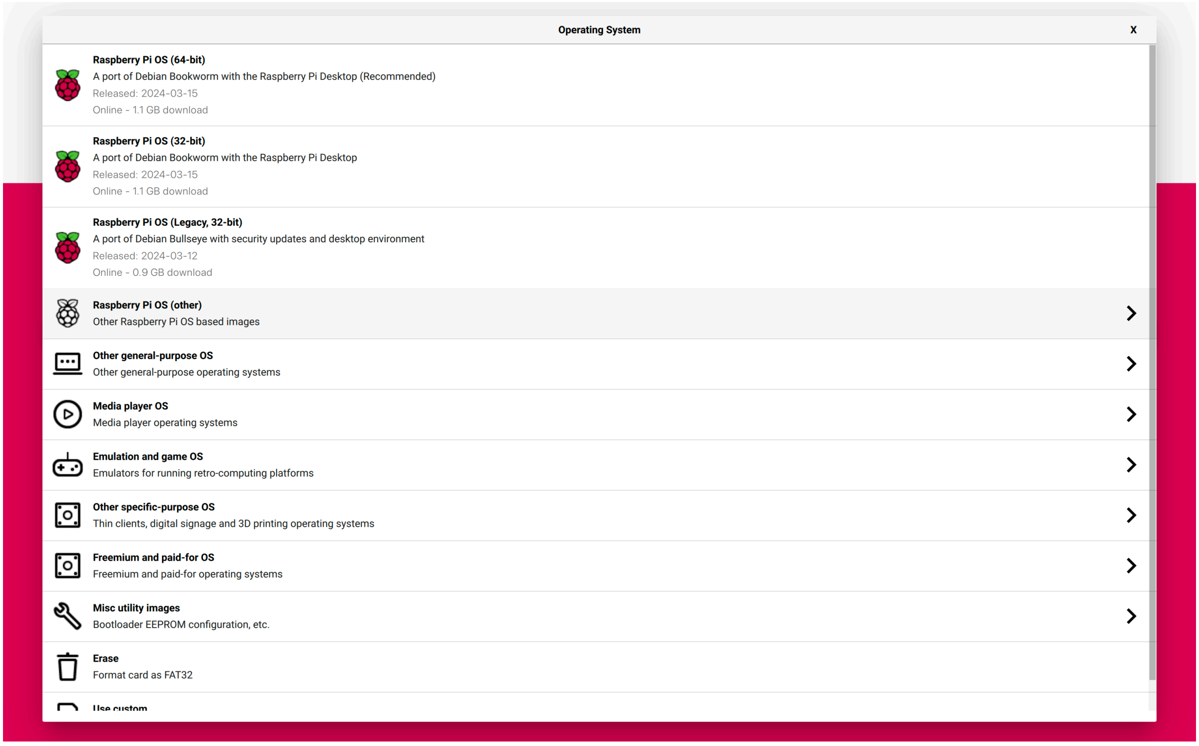


Figure 3.3 (OS Selection)

Enable SSH: check the Enable SSH box and set a username and password in advanced menu: press Ctrl-Shift-X to bring up the Raspberry Pi Imager advanced menu, or click the Advanced Menu button.

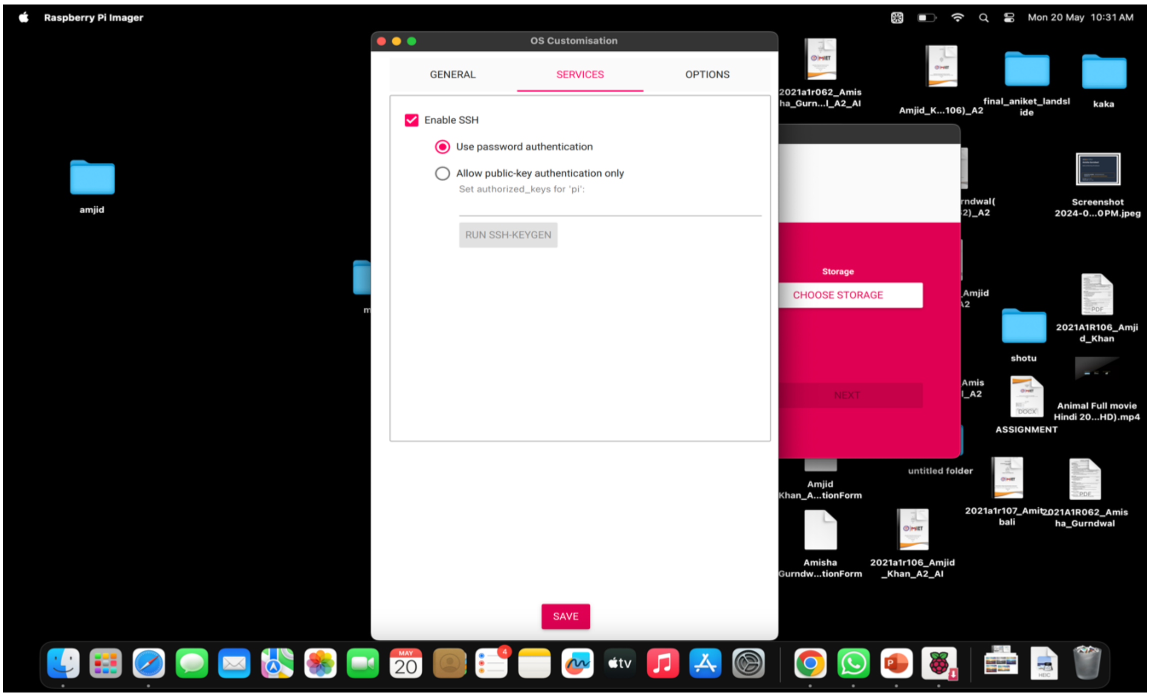


Figure 3.4 (Enable SSH)

Select save to close the advanced menu. CHOOSE STORAGE: select your microSD card.

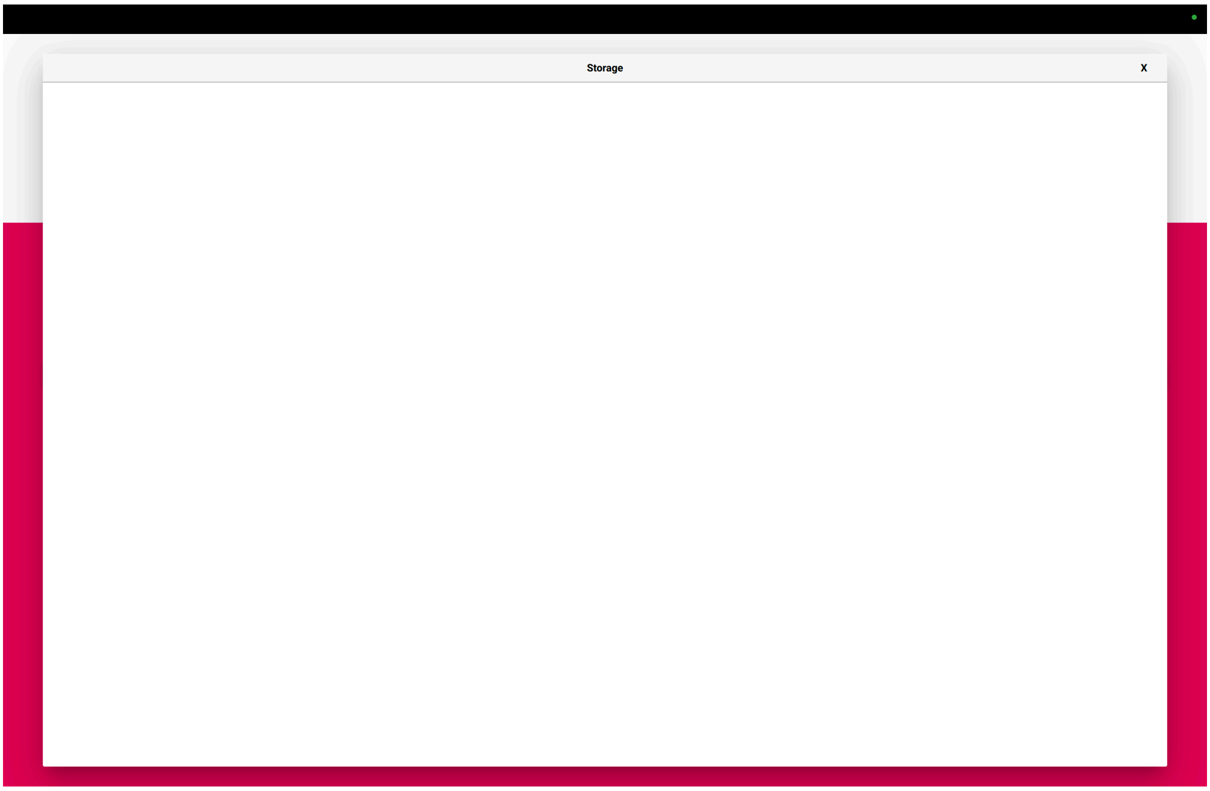


Figure 3.5 (Storage Selection)

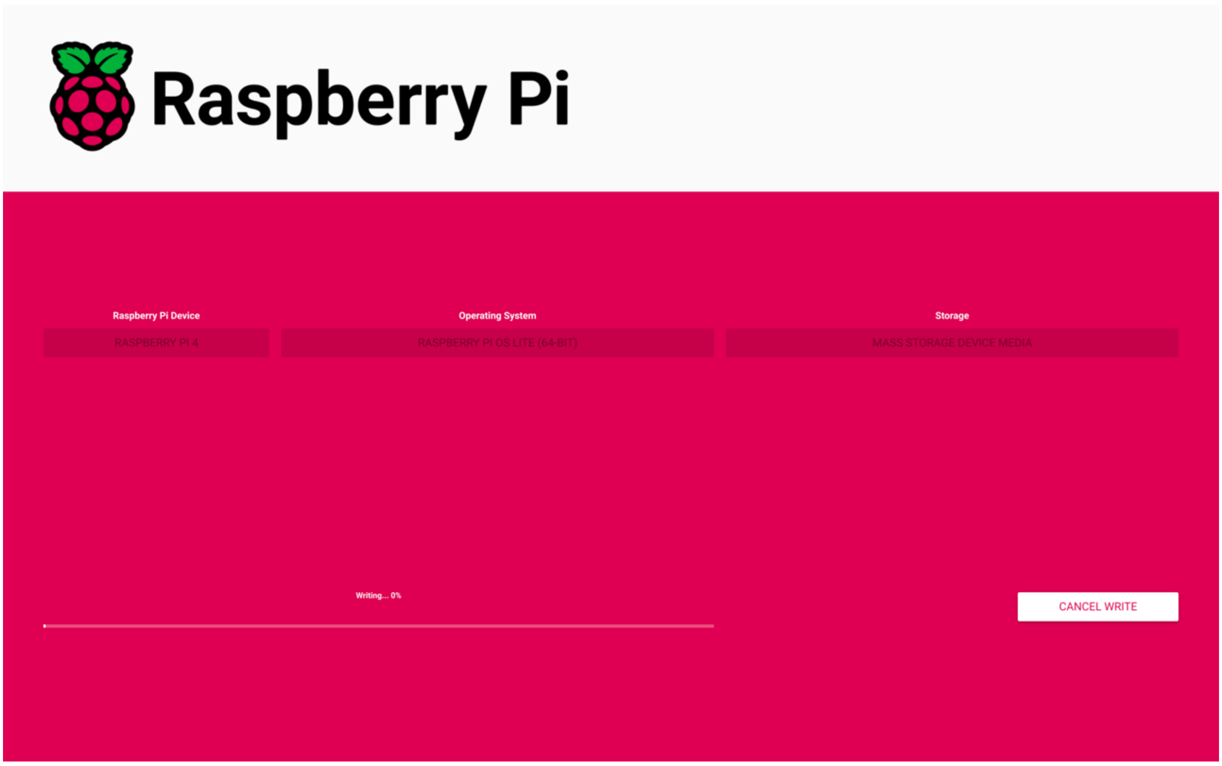


Figure 3.6 (OS Installation)

Storage options

For this tutorial, we'll be using a portable USB hard drive and an internal hard drive with a SATA-to-USB adapter. You can also use a USB flash drive if you prefer. We recommend clearing your drive of data, as you may need to format it later on in the process.

To maintain a consistent power supply to your external hard drives, it is best to use a powered USB hub to connect your storage to your Raspberry Pi.

Setting up your Raspberry Pi

Your Raspberry Pi needs to be connected to your network via an Ethernet cable. For most people, this means connecting the device directly to your router. Once connected, attach your storage to the powered USB hub, and the hub to your Raspberry Pi. Lastly, connect your Raspberry Pi to the mains power via a USB-C power supply unit.

Retrieving your IP address

In order to access your Raspberry Pi via SSH from your usual computer, you're going to need the Raspberry Pi's IP address. An IP address is a unique string of numbers that identifies a device on your network. The easiest way to find it is to access your home router and check what devices are connected via Ethernet (LAN). The login details for accessing your router should be printed on it (look for a sticker on the side or the base), or alternatively you will be able to find them on the website of the router's manufacturer (or of your ISP if they provided the router).

Connect via PUTTY

PuTTY is an open source application that supports multiple network protocols, such as - SSH, Telnet, SCP, rlogin, serial port and raw socket connection. PuTTY communication is established over a TCP/IP socket, such as TY, but it uses the secure socket with public key encryption. A typed command is sent and received a text response.

• Open Putty and enter the raspberry Pi address. Make sure that SSH is selected and click open.

• Once Open is clicked, the raspberry Pi terminal will open and you can login using the username and password authentication

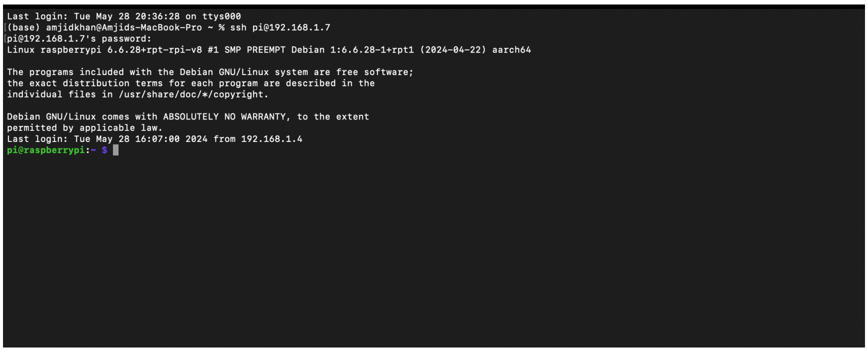


Figure 3.7 (Accessing Raspberry pi using SSH)

WHAT IS OPENMEDIAVAULT?

Openmediavault is the next generation network attached storage (NAS) solution based on Debian Linux. It contains services like SSH, (S)FTP, SMB/CIFS, DAAP media server, RSync, BitTorrent client and many more. Thanks to the modular design of the framework it can be enhanced via plugins.

Openmediavault is primarily designed to be used in small offices or home offices, but is not limited to those scenarios. It is a simple and easy to use out-of-the-box solution that will allow everyone to install and administrate a Network Attached Storage without deeper knowledge.

Features

Ospenmediavault includes the following key features

Networking

* Link aggregation Wake On Lan
* IPv6 support

Volume management

* HDD power management (APM/AAM)
* GPT partitions
* EXT/EXT4/XFS/JFS/BTRFS/... filesystem support
* Software RAID JBOD/0/1/5/6/...

* Quota (per volume) * ACL
* Share management

Monitoring
* Syslog
* Watchdog
* S.M.A.R.T.
* S N M P (v1/2c/3) (read-only)
* Email notifications
* Proactive process and system state monitoring

Services
* SSH
* FTP
* NFS (v3/v4)
* SMB/CIFS
• RSync

Plugins
With the plugin system it is possible to add additional services, e.g.
* Antivirus
* DAAP/MPD/RSP server > LVM
* Shairport
* SNMP
* TFTP
* UPS
* USB Backup
* Microsoft OneDrive
* PhotoPrism
* FileBrowser
* S3
* SSH web console

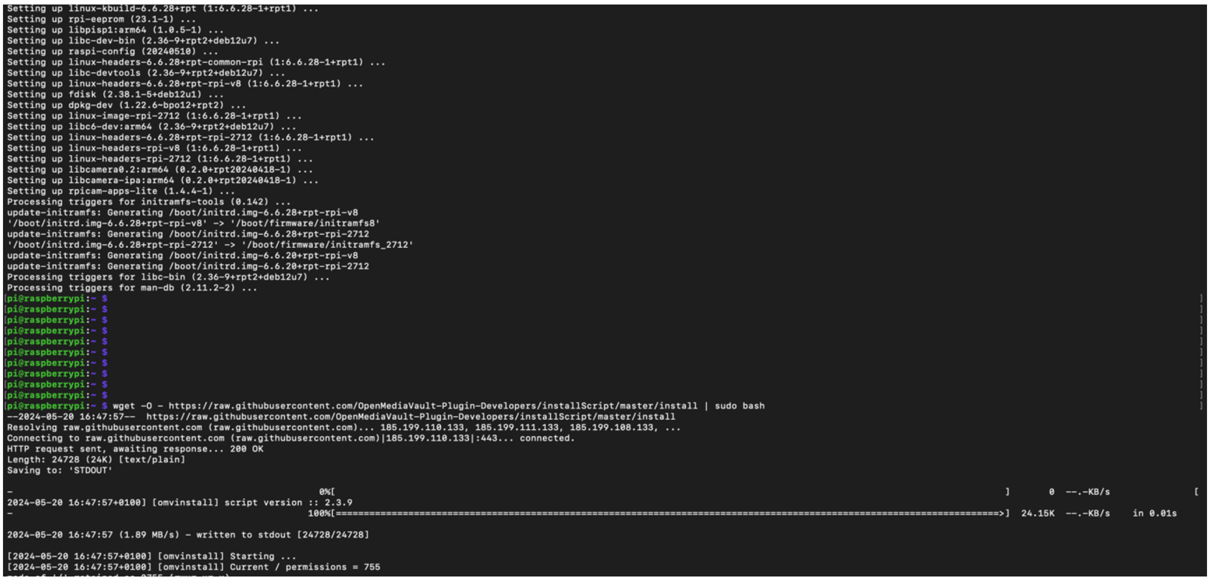
INSTALLING OPENMEDIAVAULT TO A RASPBERRY PI

Before we install OpenMediaVault, let's update the existing packages by running the following command.

IN TERMINAL:-
• sudo apt update
• sudo apt upgrade

Now we can run the following command to download the OpenMediaVault-5 install script and pipe it directly through to bash.

wget -O - https://raw.githubusercontent.com/OpenMediaVault-Plugin-Developers/installScript/master/install | sudo bash



```
Setting up linux-kbuild-6.6.28+rpt (1:6.6.28-1+rpt1) ...
Setting up rpi-eeprom (23.1-1) ...
Setting up libpisp1:arm64 (1.0.5-1) ...
Setting up libc-dev-bin (2.36-9+rpt2+deb12u7) ...
Setting up raspi-config (20240510) ...
Setting up linux-headers-6.6.28+rpt-common-rpi (1:6.6.28-1+rpt1) ...
Setting up libc-devtools (2.36-9+rpt2+deb12u7) ...
Setting up linux-headers-6.6.28+rpt-rpi-v8 (1:6.6.28-1+rpt1) ...
Setting up fdisk (2.38.1-5+deb12u1) ...
Setting up dpkg-dev (1.22.6~bpo12+rpt2) ...
Setting up linux-image-rpi-2712 (1:6.6.28-1+rpt1) ...
Setting up libc6-dev:arm64 (2.36-9+rpt2+deb12u7) ...
Setting up linux-headers-6.6.28+rpt-rpi-2712 (1:6.6.28-1+rpt1) ...
Setting up linux-headers-rpi-v8 (1:6.6.28-1+rpt1) ...
Setting up linux-headers-rpi-2712 (1:6.6.28-1+rpt1) ...
Setting up libcamera0.2:arm64 (0.2.0+rpt20240418-1) ...
Setting up libcamera-ipa:arm64 (0.2.0+rpt20240418-1) ...
Setting up rpicam-apps-lite (1.4.4-1) ...
Processing triggers for initramfs-tools (0.142) ...
update-initramfs: Generating /boot/initrd.img-6.6.28+rpt-rpi-v8
'/boot/initrd.img-6.6.28+rpt-rpi-v8' -> '/boot/firmware/initramfs8'
update-initramfs: Generating /boot/initrd.img-6.6.28+rpt-rpi-2712
'/boot/initrd.img-6.6.28+rpt-rpi-2712' -> '/boot/firmware/initramfs_2712'
update-initramfs: Generating /boot/initrd.img-6.6.20+rpt-rpi-v8
update-initramfs: Generating /boot/initrd.img-6.6.20+rpt-rpi-2712
Processing triggers for libc-bin (2.36-9+rpt2+deb12u7) ...
Processing triggers for man-db (2.11.2-2) ...
pi@raspberrypi:~ $
pi@raspberrypi:~ $
pi@raspberrypi:~ $
pi@raspberrypi:~ $
pi@raspberrypi:~ $
pi@raspberrypi:~ $
pi@raspberrypi:~ $
pi@raspberrypi:~ $
pi@raspberrypi:~ $
pi@raspberrypi:~ $
pi@raspberrypi:~ $ wget -O - https://raw.githubusercontent.com/OpenMediaVault-Plugin-Developers/installScript/master/install | sudo bash
--2024-05-20 16:47:57--  https://raw.githubusercontent.com/OpenMediaVault-Plugin-Developers/installScript/master/install
Resolving raw.githubusercontent.com (raw.githubusercontent.com)... 185.199.110.133, 185.199.111.133, 185.199.108.133, ...
Connecting to raw.githubusercontent.com (raw.githubusercontent.com)|185.199.110.133|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 24728 (24K) [text/plain]
Saving to: 'STDOUT'

-                                   0%[                                        ]       0  --.-KB/s               [
2024-05-20 16:47:57+0100] [omvinstall] script version :: 2.3.9
-                                 100%[=======================================>]  24.15K  --.-KB/s    in 0.01s

2024-05-20 16:47:57 (1.89 MB/s) - written to stdout [24728/24728]

[2024-05-20 16:47:57+0100] [omvinstall] Starting ...
[2024-05-20 16:47:57+0100] [omvinstall] Current / permissions = 755
```

Figure 3.8 (OpenMediaVault Installation)

SETTING UP OPENMEDIAVAULT

Open the internet browser on your usual computer and type your Raspberry Pi's IP address into the address bar.

After finishing the installation, you will be prompted with a login screen when accessing the OMV server thru your web browser. It is in the installation manual. Ididn't see it the first time either.

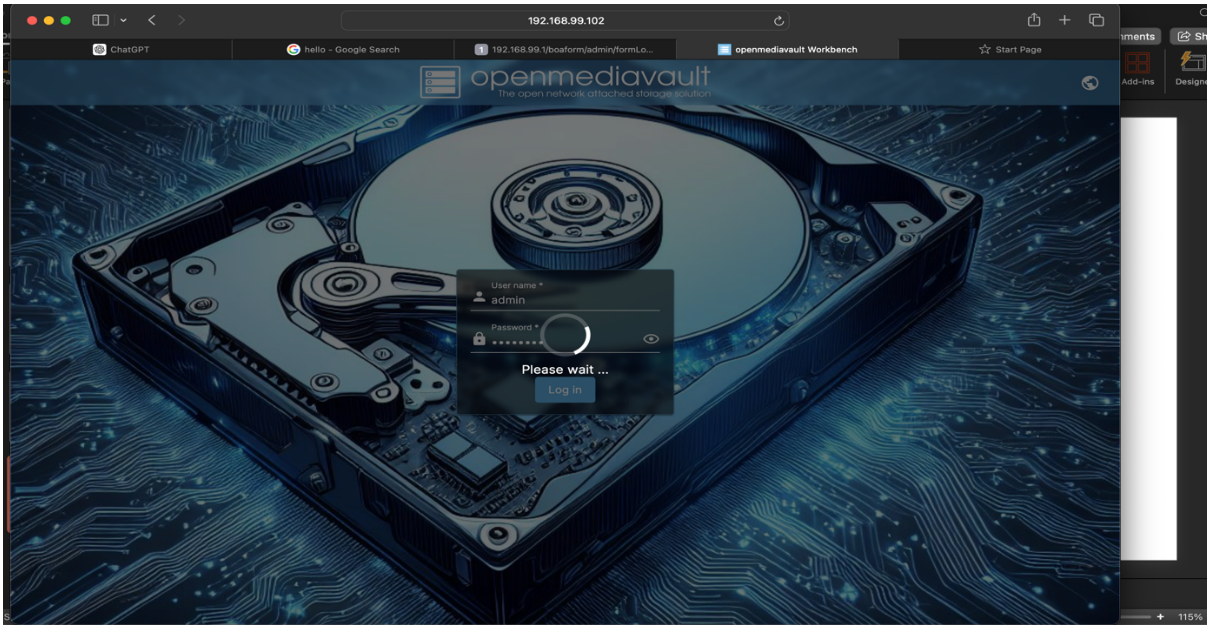


Figure 3.9 (signing in to OpenMediaVault)

Sign in to OpenMediaVault using the following credentials:

Username: admin

Password: openmediavault

Change your OpenMediaVault admin password

Select the "cog" icon in the top right corner to open settings and change your OpenMediaVault admin password.

CREATING AN SMB/CIFS SHARE USING OPENMEDIAVAULT

In this section, we will show you how to set up a simple SMB/CIFS share using OpenMediaVault 6 by using a USB thumb drive as a storage device for OpenMediaVault 5. You can use a USB HDD/SSD fi you want; the process will be the same.

If you want to use a USB HDD/SSD or a thumb drive to store data for OpenMediaVault, you have to format it first. To do that, go to Storage › Disks and select the USB HDD/SSD or thumb drive that you want to use as a storage device for the share and click Wipe.

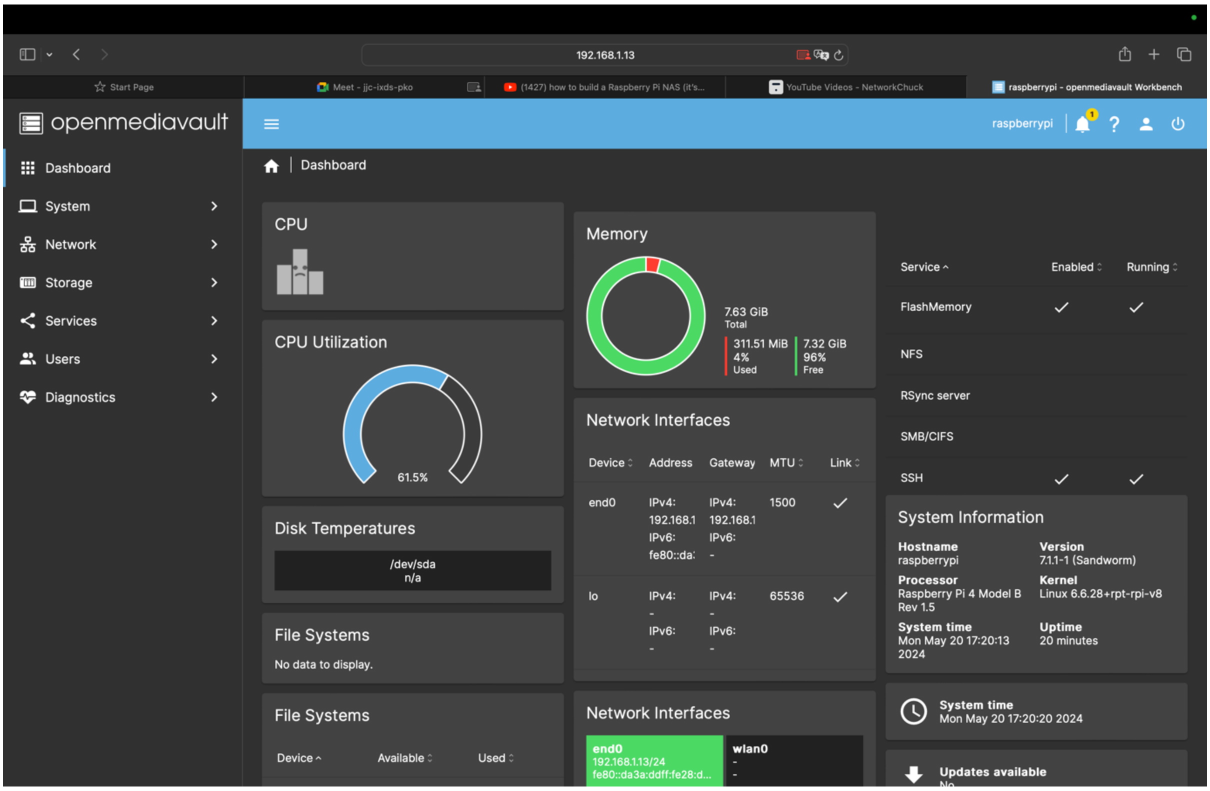


Figure 3.10 (OpenMediaVault Interface)

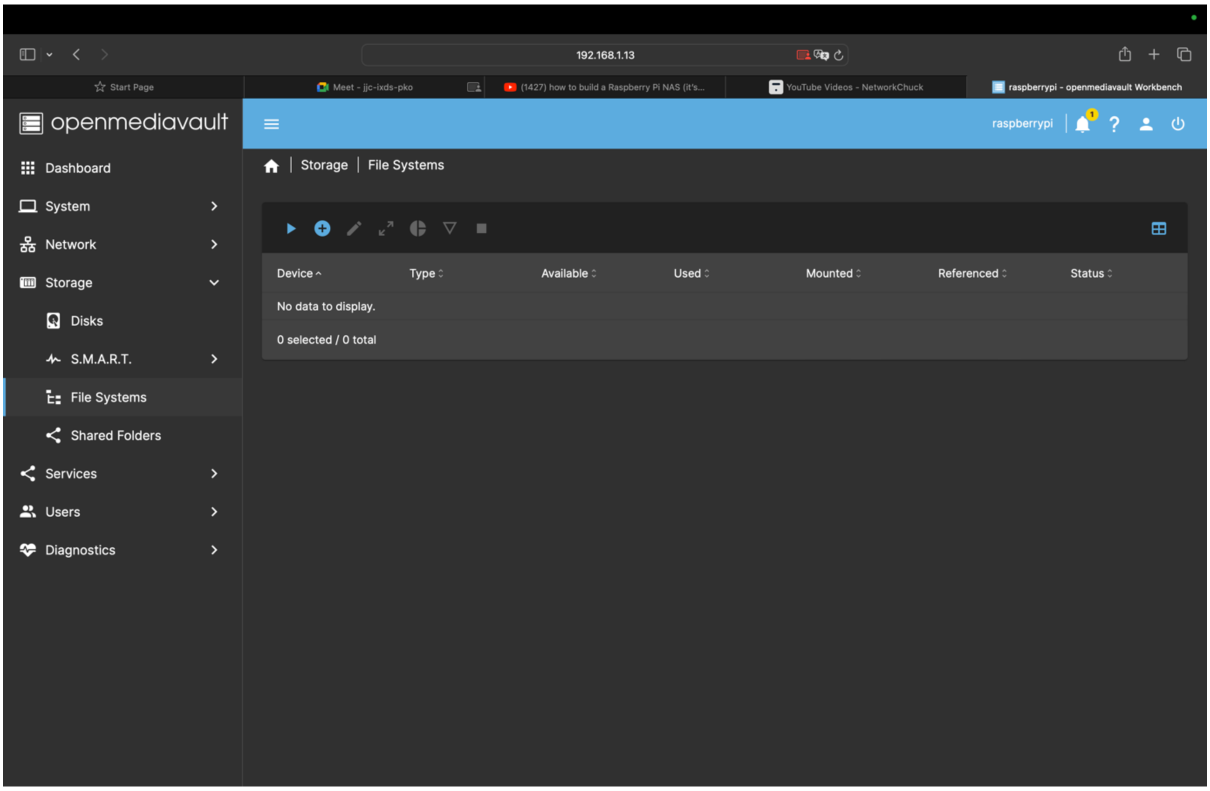


Figure 3.11 (OpenMediaVault File System)

Next, navigate to Storage and File Systems. You likely won't see anything here, so select Create. Here, you can select your storage device. We recommend selecting EXT for the drive format. Select OK and close.

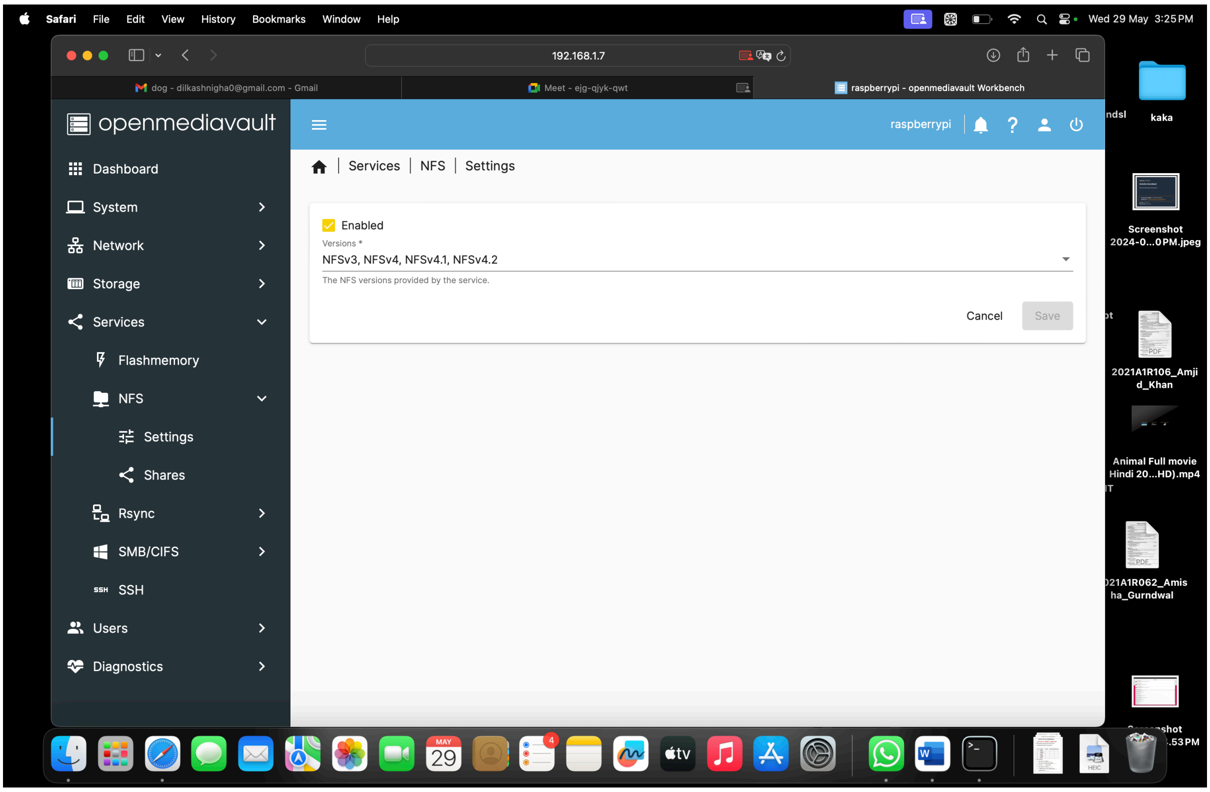


Figure 3.12 (Enabling NFS)

Now, you can share a folder.

To share a folder, go to Access Rights Management > Shared Folders and click Create.

Type in the Name of your shared folder, select the file system that you just created from the Device dropdown menu, and select the permissions for your shared folder using the Permissions dropdown menu.

Once you have completed this step, click Save.

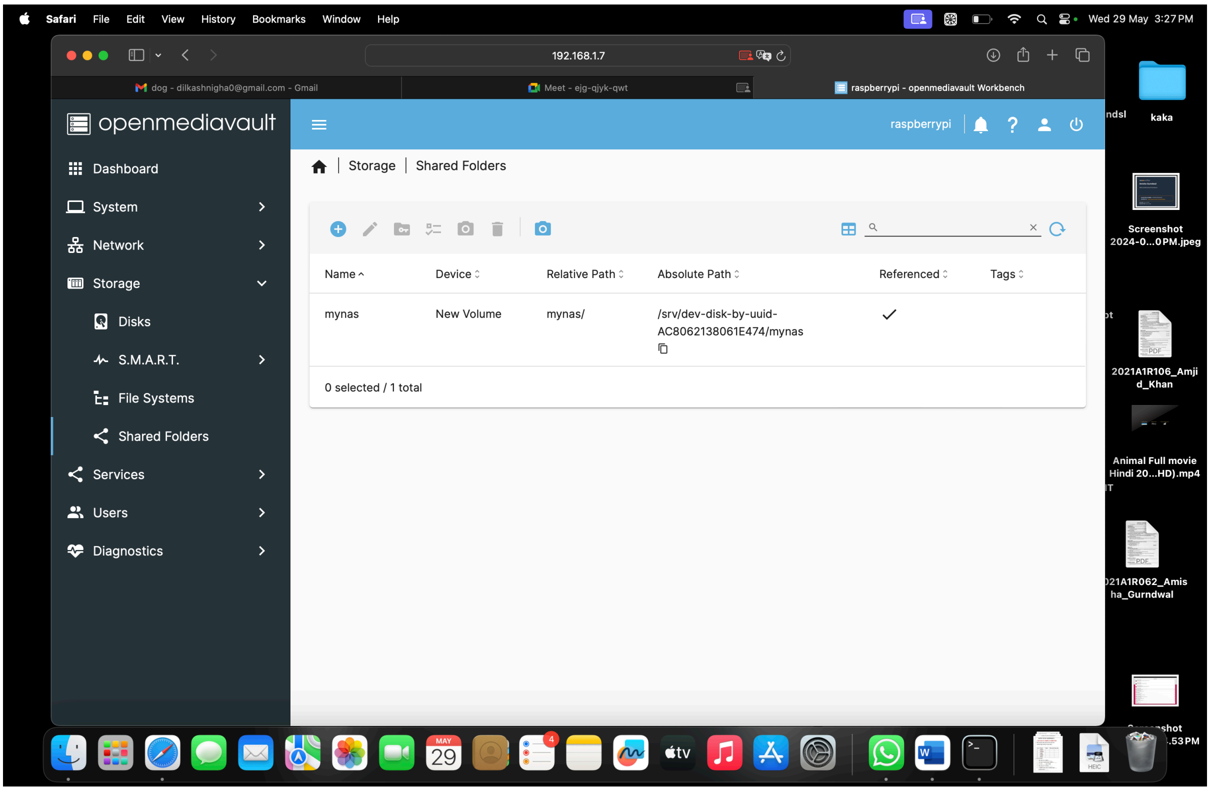


Figure 3.13 (Creating Shared Folders)

Navigate to Storage and Shared Folders and select Create.

Here you can name the folder, select which drive it should exist on, and grant permissions to users. By default, the permissions should be correct, but you can tweak them if you prefer a different option for your network preferences. Save and apply changes.

Lastly, we need to make sure computers on your network can find the folder.

Navigate to Services and select SMB/CIFS.

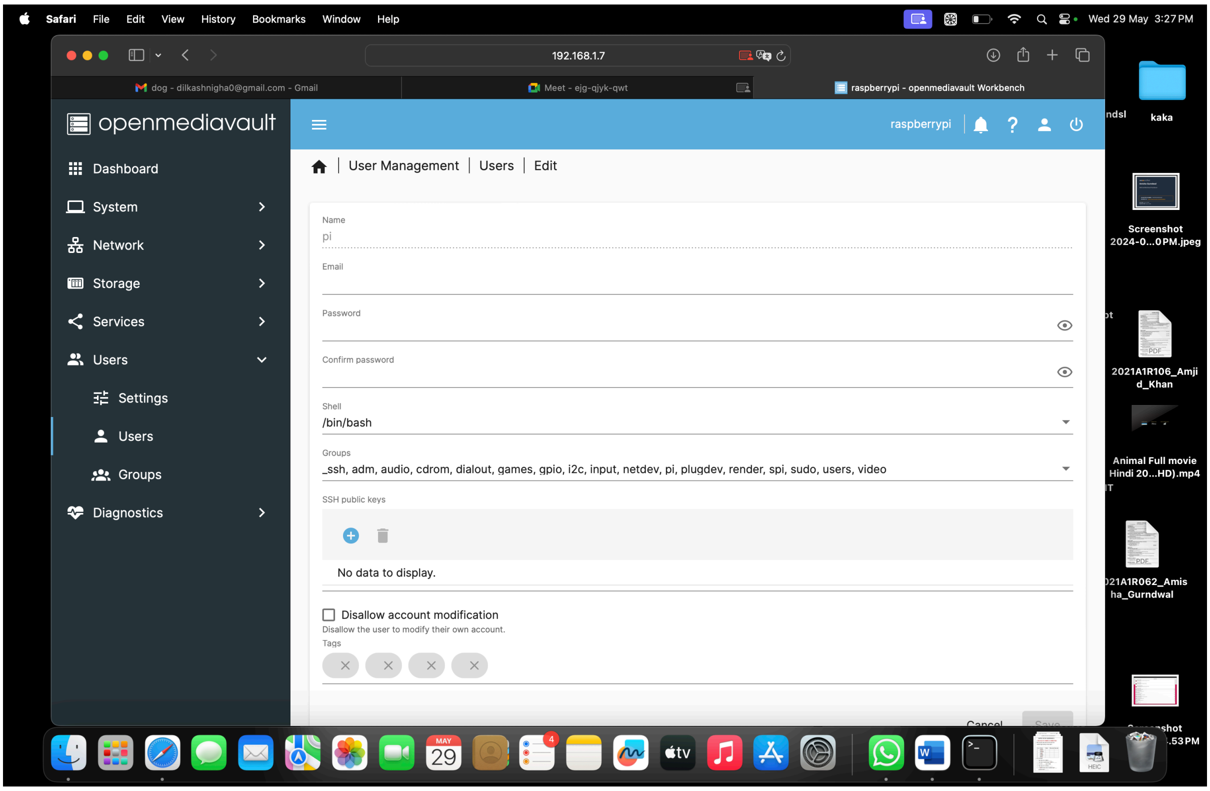


Figure 3.14 (Enabling User Access)

Under Settings, check the Enabled box and save. Under Shares, select Create, add your shared folder, and save.

Your NAS system should now be ready to use.

Access your NAS from Windows

Open Windows Explorer. nI the path bar, write X| XXXXXX. X. XX (using the IP address of your Raspberry Pi NAS).

That should create a new entry under Network in the left navigation bar and show its contents. Double-click on the share you want and enter the username and password that you created in Raspberry Pi Imager when prompted.

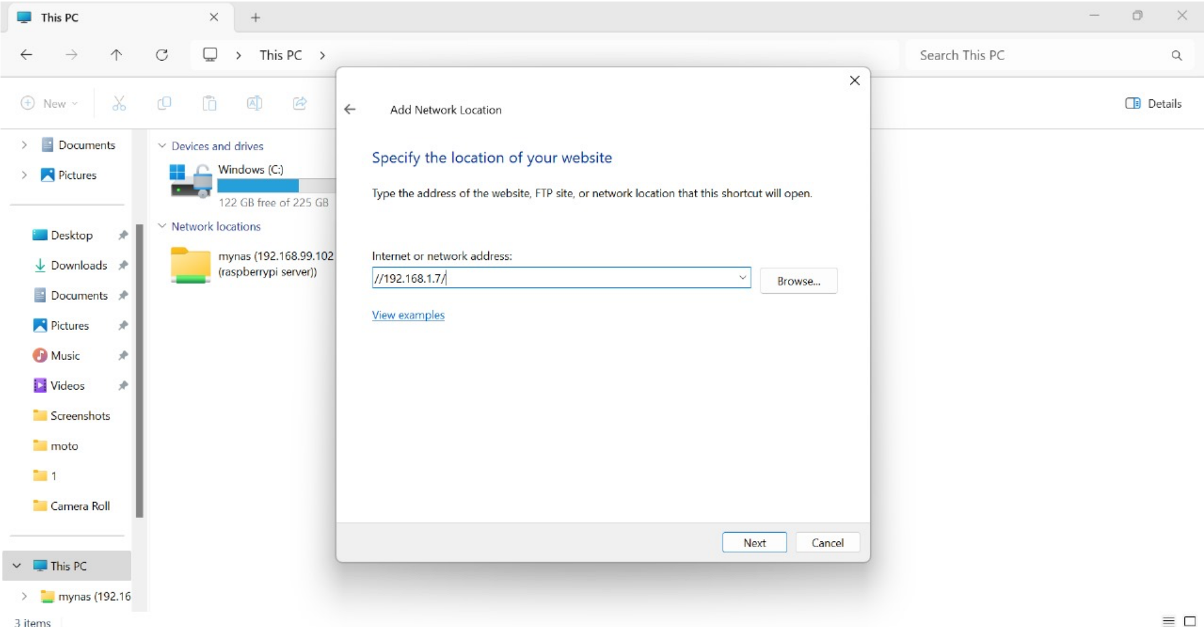


Figure 3.15 (Adding Network Location in Windows)

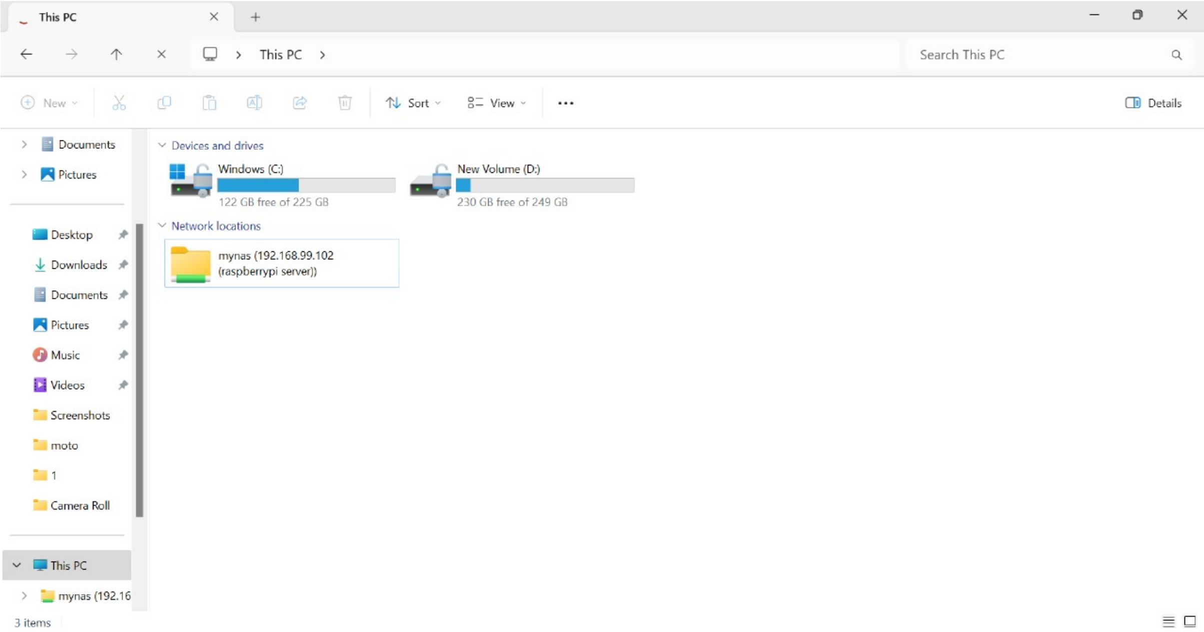


Figure 3.16 (Start using the NAS)

3.5 Installing Plex Media Server

A Plex Media Server can function as a home theater PC and can stream content to Plex's front-end media player client applications that run on a myriad of devices and web browsers.

Now we can run the following command to download and Install Plex Media Server

- sudo apt install plexmediaserver

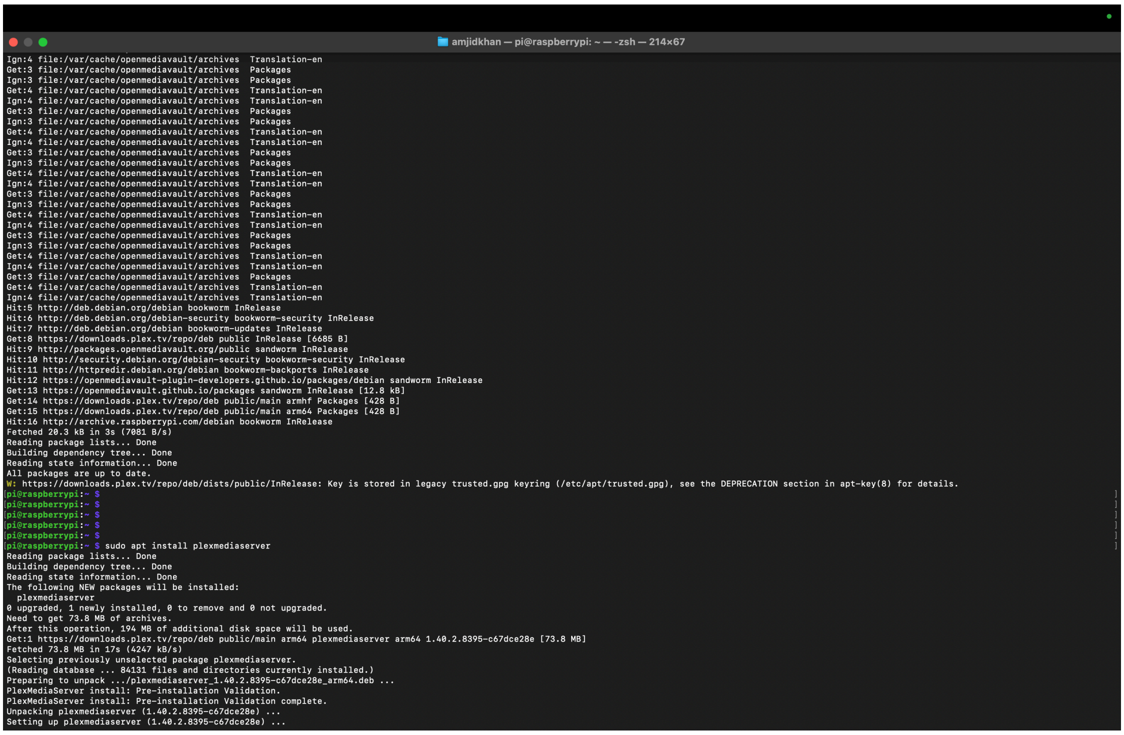


Figure 3.17 (Installing Plex Media Server)

Enable UPNP for access it outside the network

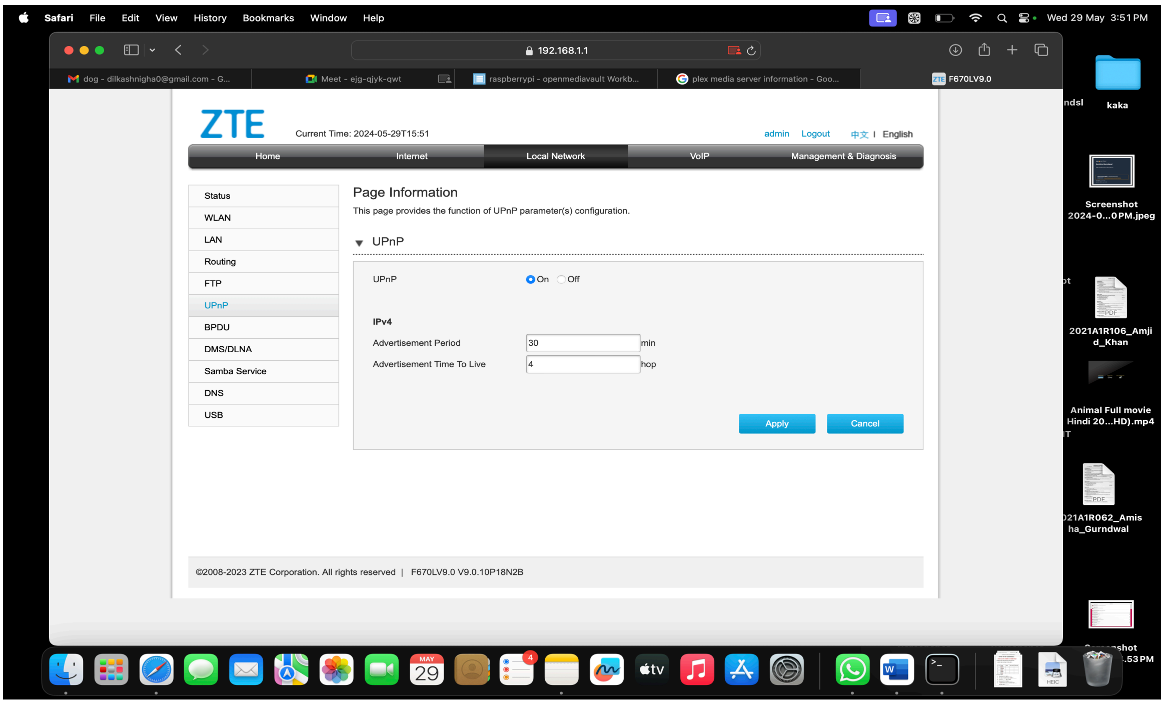


Figure 3.18 (Enabling UPNP)

Accessing Plex Media server

Enter the Ip address followed by port number/web in any Browser (192.168.1.7:32400/web)

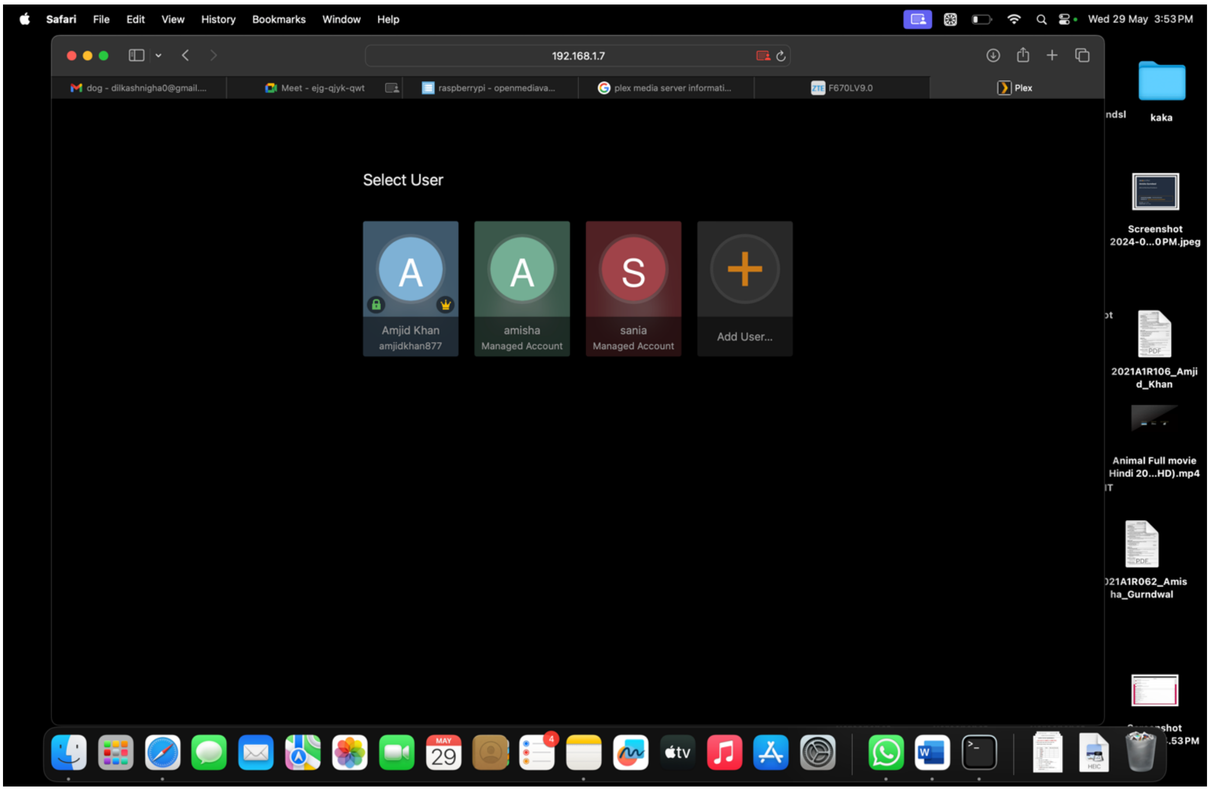


Figure 3.19 (Start Using Plex)

Chapter 4

RESULT ANALYSIS

4.1 Use cases –analysis

The main aspect in use cases –analysis is that a functional NAS has to allow external connections to users. It is very essential for today's business that the company's data storage is reachable around the globe due to globalization. In this specific case, the users are also doing distance work and they will benefit from a system which will grant the access to all the needed files, no matter where they are. It is also mentioned that while observing there were clients who liked to have an access to specific documents.

As the usability is always a concern, this system should allow the users to see data storage folders (and drives) as their network drives. There should be at least one network drive which is user-specific, meaning that only the user has the rights to read and write to the folder and one network drive which is for all the users.

4.2 Features –analysis

As the data in features show, the greatest priority is given to user-specific network drives. This is relatively easy to configure with appropriate software. The common folder is also one of the key features and is as easy to configure as user specific network drives. As it will give the needed security for any type of data loss in the primary device (NAS). The backup feature will be implemented in the near future, but due to the budget, it was withdrawn from this artifact. The optional way to overcome this problem will be constant backups to external storage drive, which will be stored in an external location after the backup operations.

One of the hoped-for features was a web-based user management, which would be rather easy to implement but very hard to manage. This type of management might lead to accidental user removals which might lead to severe data loss. So we declined to implement this type of web-based service as it might cause more trouble than what is the gain.

Chapter 5

5.1 CONCLUSION

The implemented NAS architecture represents a groundbreaking approach to achieving high performance and cost-effective data storage solutions. By integrating advanced security measures, we enable clients to fully leverage the performance potential of NAS while ensuring the utmost data protection. The inherent scalability of NAS systems allows for seamless expansion without compromising on data security, making it an ideal solution for growing businesses.

Our innovative capability scheme encapsulates the bearer access right on specific versions of storage objects using a secret key shared between clients, thereby enhancing security and ensuring data integrity. This approach not only safeguards sensitive information but also streamlines access control, providing a robust framework for secure data management.
In the modern business landscape, Information Technology plays a crucial role in daily operations. Even small companies generate substantial amounts of valuable data that require reliable and secure storage solutions. While local storage on individual PCs can be convenient, centralized storage solutions like NAS offer significantly advanced capabilities. When implemented and maintained correctly, NAS provides unparalleled safety for valuable data, ensuring that businesses can rely on their storage infrastructure to protect critical information.
Furthermore, the use of NAS in a business environment supports various essential functions, including data backup, disaster recovery, and efficient data sharing among users. Its ability to handle large volumes of data with high performance and reliability makes it indispensable for businesses of all sizes. As data continues to grow in both volume and importance, the role of NAS will become increasingly vital in providing scalable, secure, and efficient storage solutions.

In conclusion, the adoption of NAS with advanced security measures not only enhances the performance and scalability of storage solutions but also ensures the protection and integrity of valuable business data. As organizations continue to generate and rely on vast amounts of data, the importance of secure, scalable, and high-performance storage solutions like NAS cannot be overstated. By leveraging these advanced technologies, businesses can achieve greater efficiency, security, and reliability in their data management practices, ultimately supporting their growth and success in an increasingly data-driven world.

5.2 Future Scope and Limitations

Network Attached Storage (NAS) is a dedicated file storage system that provides local-area network (LAN) users with centralized, consolidated disk storage through a standard Ethernet connection. The future scope of NAS is promising, driven by increasing data storage needs, advances in technology, and the evolving demands of businesses and consumers. Here are some key aspects of its future scope:

1. **Integration with Cloud Services**:

Hybrid Storage Solutions: Combining on-premises NAS with cloud storage to create hybrid solutions that offer the benefits of both environments, such as scalability, cost-efficiency, and disaster recovery.

Seamless Data Migration: Improved tools and services for seamless data migration between NAS and various cloud platforms, making it easier for businesses to adopt hybrid strategies.

2. **Enhanced Performance and Efficiency**:

NVMe and SSD Integration: Incorporating NVMe (Non-Volatile Memory Express) and SSD (Solid State Drive) technologies to significantly enhance the speed and performance of NAS systems.

Data Deduplication and Compression: Advanced data deduplication and compression techniques to maximize storage efficiency and reduce costs.

3. **Security and Data Protection**:

Advanced Encryption: Implementing robust encryption methods to protect data at rest and in transit, ensuring higher security standards.

Ransomware Protection: Developing better mechanisms to detect, prevent, and recover from ransomware attacks, protecting critical data from cyber threats.

4. **AI and Machine Learning Integration**:

Predictive Maintenance: Using AI and ML to predict hardware failures and perform proactive maintenance, thereby reducing downtime and improving reliability.

Smart Data Management: Leveraging AI for intelligent data management, including automated tiering, access pattern analysis, and optimizing storage resources based on usage patterns.

5. **Scalability and Flexibility**:

Modular and Scale-out Architectures: Designing NAS systems with modular and scale-out architectures that allow for easy expansion and adaptation to growing data needs.
Software-Defined Storage (SDS): Transitioning towards software-defined storage solutions that provide greater flexibility and control over storage resources through software rather than hardware.

6. **Support for Modern Workloads**:

IoT and Edge Computing: Adapting NAS solutions to support the growing demands of IoT devices and edge computing, where data needs to be processed and stored closer to the source.
Big Data and Analytics: Enhancing NAS systems to efficiently handle big data workloads and support advanced analytics and data processing tasks.

7. **Improved User Experience**:

Unified Management Interfaces: Developing more intuitive and unified management interfaces that simplify the configuration, monitoring, and management of NAS systems.
Enhanced Collaboration Tools: Integrating advanced collaboration features and tools that facilitate seamless file sharing and collaboration among users, both locally and remotely.

Overall, the future of NAS is geared towards creating more efficient, secure, scalable, and user-friendly storage solutions that can meet the evolving needs of businesses and individuals in an increasingly data-driven world.

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