

# Deploying Own Private Cloud

Divyamsh Reddy A<sup>1</sup>, CB Manogna Reddy<sup>2</sup>

Email: divyamsh2001[at]gmail.com

Email: manognareddy[at]gmail.com

*Private Cloud Deployment on Personal Laptops: A Research Exploration of Educational, Developmental, and Privacy Implications, Accessing the storage and data.*

**Abstract:** This research investigates the multifaceted advantages and implications of deploying a private cloud environment on personal laptops. Focused on educational outcomes, the study delves into the hands - on learning experiences in cloud technologies and system administration afforded by this approach. Additionally, it examines the private laptop - based cloud's utility in serving as a controlled environment for testing and developing applications, optimizing resource utilization, and enabling offline development. The research also explores the enhanced privacy and security aspects, offering insights into data control and customization. Acknowledging scalability limitations, the study positions private laptop - based clouds as valuable for educational purposes, controlled testing environments, and scenarios demanding heightened data privacy. The findings contribute to a deeper understanding of the role of personal laptops in the evolving landscape of cloud computing.

**Keywords:** Public and private cloud, Cloud deployment, Virtual Machines (VM Ware), Storage, Security, Integration - Next Cloud

## 1. Introduction

In the dynamic landscape of cloud computing, this research examines a distinctive paradigm—deploying private cloud environments on personal laptops. In an age dominated by public cloud services, this study explores the educational, developmental, and privacy implications associated with utilizing personal laptops for hosting private clouds. As individuals and small organizations seek cost - effective and controlled solutions, the investigation delves into the unique advantages and limitations of this approach. By scrutinizing hands - on learning experiences and developmental opportunities, the research contributes insights to the intersection of personal computing and cloud technologies. Additionally, the study investigates the private laptop - based cloud's utility in controlled testing environments, optimizing resource utilization, and enabling offline development. Enhanced privacy and security aspects are also explored, offering insights into data control and customization. Recognizing scalability limitations, this research positions personal laptops as valuable for educational purposes, controlled testing environments, and scenarios demanding heightened data privacy. Overall, this study enriches the understanding of the evolving relationship between personal computing and cloud deployment.

## 2. Analysis

In working with the private cloud deployment we come across the a query which shows what is the major difference between the available clouds and this private cloud using our own laptops. The difference includes in wide ranges as like security , storage and more which is described more in below.

### Scale and Accessibility:

- **Public Clouds:** Offered by major providers like AWS, Azure, and Google Cloud, public clouds operate on a

global scale, providing vast resources that are accessible over the internet to a wide range of users.

- **Private Clouds on Personal Laptops:** Operate on a smaller scale, confined to individual laptops, and are not accessible externally without additional configurations.

### Ownership and Control:

- **Public Clouds:** Resources are owned and managed by third - party providers, offering users less control but the advantage of scalability and professional management.
- **Private Clouds on Personal Laptops:** Provide complete ownership and control to the individual or organization deploying them, allowing for customization and a higher degree of control over data.

### Resource Utilization:

- **Public Clouds:** Dynamically allocate resources based on demand, providing scalability and flexibility.
- **Private Clouds on Personal Laptops:** Limited by the hardware of the individual laptop, which can impact scalability and resource availability.

### Security and Privacy:

- **Public Clouds:** Adhere to stringent security measures, but concerns may arise regarding data privacy and control.
- **Private Clouds on Personal Laptops:** Offer enhanced control over data and privacy, as data remains on the local machine, mitigating some security and compliance concerns.

### Cost:

- **Public Clouds:** Typically involve usage - based pricing, potentially more cost - effective for large - scale applications with variable workloads.
- **Private Clouds on Personal Laptops:** May be more cost - effective for small - scale or personal projects, with fewer overhead costs, but limited scalability.

### Purpose:

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- **Public Clouds:** Ideal for large - scale applications, businesses, and scenarios with variable workloads.
- **Private Clouds on Personal Laptops:** Suited for educational purposes, small - scale testing, and projects where complete control and privacy are prioritized over scalability.

Understanding these differences helps individuals and organizations choose the cloud solution that aligns best with their specific needs and goals. Public clouds offer scalability and convenience, while private clouds on personal laptops provide control, privacy, and a tailored environment for specific use cases.

### Defining the Stages:

While creating our own private cloud using our local device or personal laptop we need to look over few categories and we need to have few stages which helps to define the exact the process.

The stages include:

1: Defining the purpose of the cloud 2: Determine the types of service to host 3: Select the Virtualization platform to set up environment 4: Define and work on Storage, security and cloud management 5: Backup and Testing

### Defining the Purpose of cloud:

*“The purpose of developing the private cloud is to work on the personal storage configuration, specifically in the mode of offline development where there is low power and low storage options, once the servers are connected to internet and having power on, the file which are there in mobile device can be backup to the storage location mentioned in the system, which provides huge storage space for the users and also security of the data as recovery if the mobile phone is lost.”*

### Types of services to host:

When setting up a private cloud on your laptop, you can host various services to meet your specific needs. The type of services you choose to host will depend on your goals and the requirements of the project. Here we are considering three major things

- 1) Virtual Machines
- 2) Storage Services
- 3) Database Services

#### 1) Virtual Machines:

*“A virtual machine (VM) in the context of cloud computing refers to a software emulation of a physical computer within a virtualized environment”.* It allows you to run multiple operating systems and applications on a single physical server. Cloud providers offer virtual machines as a service to users, enabling them to deploy and manage applications in a flexible and scalable manner.

#### 2) Storage Services:

*“Storage services refer to the cloud - based solutions that allow users to store, manage, and retrieve data over the internet”.* These services are a key component of cloud infrastructure and provide scalable and flexible storage solutions for individuals and businesses.

#### 3) Data Base Services:

*“Database services in the context of cloud computing refer to cloud - based solutions that provide scalable and managed databases for storing, managing, and retrieving data”.* These services aim to simplify database administration tasks, such as setup, configuration, scaling, and maintenance.

#### Virtualization platform:

*A virtualization platform is a software or hardware system that enables the creation and management of virtual machines (VMs).* Virtualization allows multiple operating systems to run on a single physical machine, providing a more efficient use of resources and greater flexibility in managing computing environments. There are both Type - 1 (bare - metal) and Type - 2 (hosted) virtualization platforms.

#### Type - 1 Hypervisors (Bare - Metal Hypervisors):

These hypervisors run directly on the physical hardware of the host system. They do not require a host operating system and are often used in enterprise environments and data centers.

Examples of Type - 1 hypervisors include:

\***VMware vSphere/ESXi:** A leading virtualization platform for enterprise environments.

\***Microsoft Hyper - V Server:** Microsoft's hypervisor for virtualization in Windows environments.

\***KVM (Kernel - based Virtual Machine):** A Linux kernel module that turns the host OS into a hypervisor.

#### Type - 2 Hypervisors (Hosted Hypervisors):

These hypervisors run on top of a host operating system. They are typically used for development, testing, and other scenarios where performance is not as critical.

Examples of Type - 2 hypervisors include:

\***Oracle VirtualBox:** A free and open - source hosted hypervisor for x86 and AMD64/Intel64 systems.

\***VMware Workstation/Player:** Desktop virtualization solutions for Windows and Linux.

\***Parallels Desktop:** A virtualization solution for macOS.

**Note:** In developing the private virtual cloud we are working with **TYPE - 2 HYPERVISOR** like VM ware workstation, Oracle Virtual box, etc

#### Storage and Security:

The storage configuration is crucial to ensure that our virtual machines (VMs) and additional storage services operate effectively. We have several options to consider.

1: Local Storage

2: External Storage Options

3: Network Attached Storage and more

for developing the local cloud or private cloud we are usually considering the local storage.

Here are the details of the local storage

\***Local Storage\*:**

**Advantages:**

**Simplicity:** Using the local storage on your laptop is the most straightforward option.

**Cost:** No additional hardware is required.

#### Considerations:

**Limited Capacity:** Laptops typically have limited storage capacity. Depending on your needs, you might quickly run out of space.

**Performance:** Performance may be constrained by the speed and capacity of the laptop's internal drive.

#### Configuration Steps:

When creating virtual machines, allocate storage space on your laptop's local drive.

Ensure you have enough free space for the VMs and any data they will store.

#### Security

- 1) Configure the firewalls
- 2) Secure login credentials
- 3) Network security
- 4) User Access Control
- 5) Anti mal - ware and End point protection (depends)

#### Configure the Fire walls:

- 1) Access the window firewalls
- 2) Configure the Inbound and Outbound rules
- 3) In this create a specific rules where only specific traffic data flows in

#### Secure the login credentials:

For virtual machines which we are using the we need to consider password management tools to secure our data.

#### Network Security:

Segmentation:

Internal Networks:

\*Segment your virtual machines into internal networks based on their roles.

Control traffic flow between networks using firewall rules.

VPN for Remote Access:

If Accessing Remotely:

\*Consider setting up a Virtual Private Network (VPN) to secure remote access to your private cloud.

#### User Access Control:

Role - Based Access Control (RBAC):

Virtualization Platform:

\*If your virtualization software supports RBAC, configure it to restrict access based on roles.

Guest Operating Systems:

Use Least Privilege Principle:

\*Limit user privileges on guest operating systems to the minimum necessary for their tasks.

#### Anti Mal - Ware and End Protection:

Windows Security:

For Windows VMs:

Use Windows Defender or install reputable anti - malware software to protect against malicious software.

#### Steps to develop private cloud:

##### 1) Choose Virtualization Software:

Install and set up your preferred virtualization software on your Windows laptop. VMware Workstation, VirtualBox, and Hyper - V are popular choices. (*VM Ware*)

##### 2) Create Virtual Machines (VMs):

Within your virtualization software, Create virtual machines that will serve as your cloud servers. You can install various operating systems on these VMs, such as Linux distributions or Windows Server.

#### Steps to Create Virtual Machines with VMware Workstation:

##### a) Install VMware Workstation:

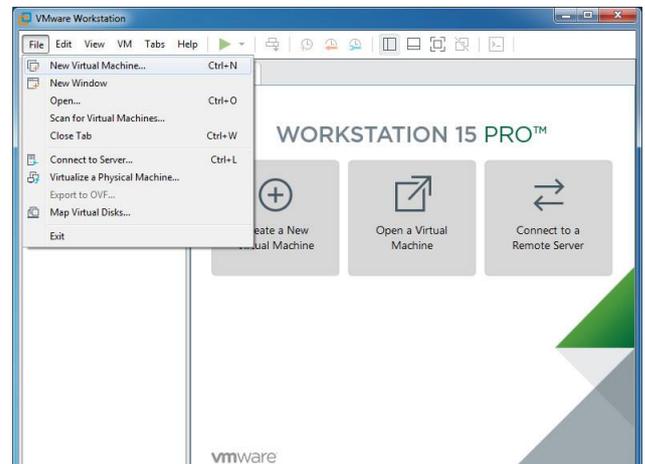
Download and install VMware Workstation from the official website.

##### b) Launch VMware Workstation:

Open the VMware Workstation application.

##### c) Create a New Virtual Machine:

Click on "File" in the menu, then select "New Virtual Machine. "



##### d) Virtual Machine Wizard:

The Virtual Machine Wizard will guide you through the setup process.

##### e) Select Configuration Type:

Choose "Typical" for a straightforward setup, or "Custom" for more advanced options.

##### f) Guest Operating System:

Select the operating system you plan to install on the VM (e. g., Linux, Windows). If the exact version isn't listed, choose the closest match.

##### g) Name and Location:

Enter a name for your virtual machine and choose a location to store it.

##### h) Specify Disk Capacity:

Choose the size of the virtual hard disk. This will be the storage space allocated to your VM.

- i) Select Disk Type:  
Choose either "Store virtual disk as a single file" or "Split virtual disk into multiple files. "
- j) Finish and Review:  
Review your selections and click "Finish" to create the virtual machine.



- k) Customize Hardware (Optional):  
After creating the VM, you can customize its hardware settings (e. g., RAM, CPU, network adapters) by selecting the VM in the list and clicking "Edit virtual machine settings. "
- l) Install the Operating System:  
Power on the VM and install the chosen operating system. You'll need an ISO file or installation media for this step.
- m) Install VMware Tools (Optional):  
After the OS is installed, you may want to install VMware Tools, which enhances VM performance and integration with the host system.
- n) Repeat for Additional VMs:  
Repeat these steps to create additional virtual machines for your private cloud, selecting the appropriate operating systems for each.

### 3) Networking Configuration:

Set up networking within your virtual environment. You can configure virtual networks, assign IP addresses, and set up network services like DHCP if needed.

### 4) Install Cloud Software:

Choose the cloud software stack you want to use for your private cloud. Some popular options include:

**OpenStack:** An open - source cloud computing platform.

**Nextcloud:** A self - hosted file sharing and collaboration platform.

**OwnCloud:** Similar to Nextcloud, a self - hosted file sharing and synchronization platform.

Install and configure the chosen cloud software on your VMs. Follow the respective documentation for each software.

### Setting Up Nextcloud:

#### Prerequisites:

A web server (e. g., Apache or Nginx) with PHP and a database (MySQL, MariaDB) installed. A domain name or IP address pointing to your server.

**Download Nextcloud:** Visit the Nextcloud website and download the latest release.

**Install and Configure Web Server:** Set up your web server and configure it to serve Nextcloud.

**Install required PHP modules and configure PHP settings for Nextcloud. Database Setup:** Create a database and user for Nextcloud in your database server.

**Nextcloud Installation:** Extract the Nextcloud archive into your web server's document root. Visit your server's IP address or domain to complete the Nextcloud installation through a web interface.

Set up an admin account and specify the database details.

- **Storage Configuration:** Configure where Nextcloud will store user data. You can use local storage or external storage solutions like Amazon S3.
- **Security Enhancements:** Enable HTTPS to secure data in transit using SSL/TLS certificates.
- Configure a firewall to restrict access to necessary ports
- **User and Access Management:** Create user accounts and manage user access and permissions within the Nextcloud interface.
- Configure user - specific settings like file versioning and two - factor authentication.
- **Add Apps and Extensions (Optional):** Customize your Nextcloud instance by adding apps and extensions to enhance functionality (e. g., calendar, contacts, and external storage support).
- **Regular Backups and Maintenance:** Set up regular backups of your Nextcloud data. Keep the Nextcloud software and server components up to date.

### 5) Storage Configuration:

Set up storage for your private cloud. You can use local storage on your laptop or attach external storage devices. Configure storage pools, volumes, and file systems as required by your cloud software.

### 6) User and Access Management:

Create user accounts and configure access control settings within your chosen cloud software. Define user permissions and access levels.

### 7) Security and Firewall Settings:

Implement security measures and configure firewalls to protect your private cloud environment.

Regularly update and patch your VMs and cloud software to address security vulnerabilities.

### 8) Testing and Validation:

Thoroughly test your private cloud environment to ensure that it functions as expected.

Verify that data storage, file sharing, and user access work correctly.

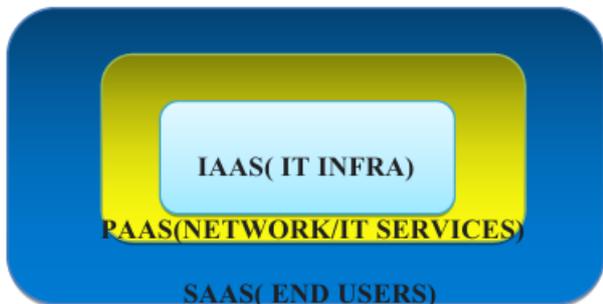
### 9) Backup and Disaster Recovery:

Implement a backup and disaster recovery strategy to safeguard your data in case of hardware or software failures.

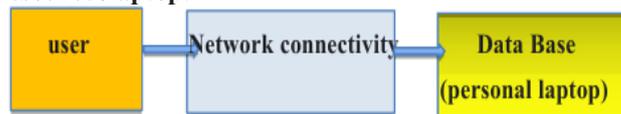
**10)Monitoring and Maintenance:**

- Set up monitoring tools to keep an eye on the health and performance of your private cloud.
- Perform regular maintenance tasks, including software updates and security audits.

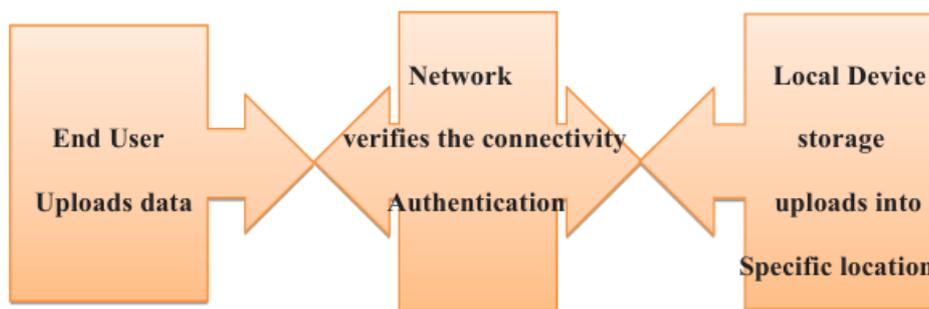
**Generic Structure of the private Cloud deployment:**



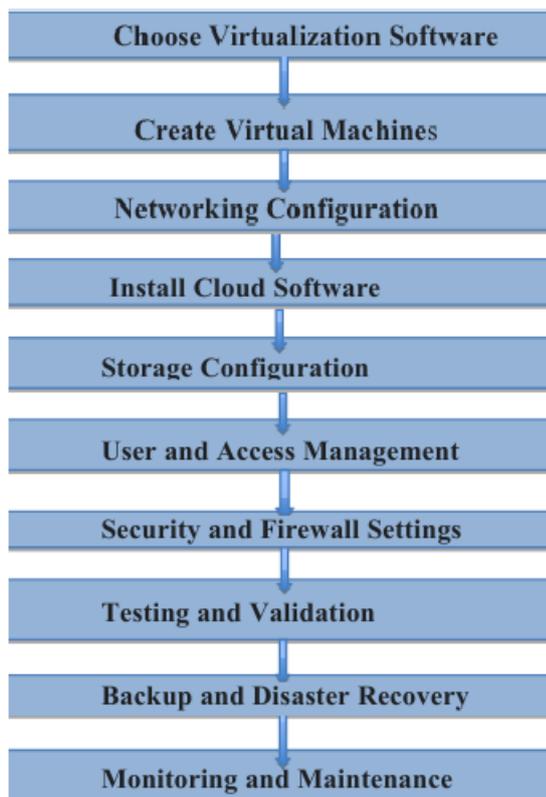
**Working process of Private cloud deployed in our own resource /laptop:**



**Working Structure:**



**Flow Chart of Developing Private Cloud**



using the integration concept of the cloud.

Here we are integrating the VM ware (used for our Virtual machines) and Application - Next cloud

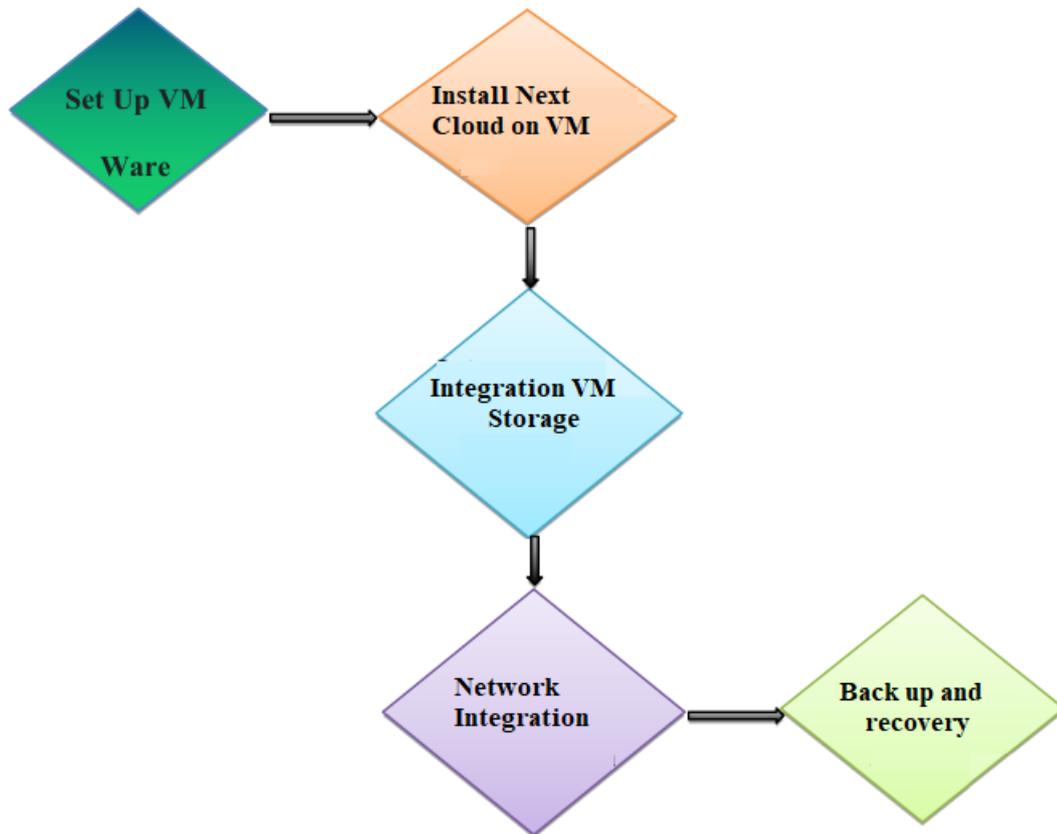
This integration process consists of 5 steps which are already defined in setting up cloud - concept (**Refer: Steps to deploy the private cloud**)

Steps includes:

- 1) Set up VM Ware
- 2) Install Next cloud on VM ware
- 3) Integrate VM Storage with Next Cloud
- 4) Network integration
- 5) Back up and Recovery

**Accessing the personal cloud with the link:**

In order to connect our personal cloud with the devices to upload the data and retrieve the data from the storage we are



#### Steps to develop or create the link using Next cloud Application:

Actually creating a link associated with the private cloud on your laptop typically involves setting up a web server or utilizing the built - in capabilities of your private cloud software.

Since we have used VM ware and Next cloud for our private cloud deployment we are currently integrating both of them and sharing the access to the people with the link to upload and retrieve the data from our cloud using few authentication process.

Considering the data privacy and Security policies the data protection is enabled for this where only the registered or users with password can only access the data with the link shared.

#### Steps:

- 1) After successful installation of the Next cloud application and integrated with the VM storage, Which includes configuration and setting up the storage locations and user accounts (Configuring the Next Cloud)
- 2) Enable external sharing
- 3) Configure the link with uploading and data retrieving options
- 4) Enable the link with the password options (to ensure only users with the passwords can access the link for the data protection)
- 5) Test the process with uploading and retrieving the data using the link (try using different devices to work on for more confirmation and clarity)

#### Configuration of Next Cloud:

Set up and configure Nextcloud, including creating user accounts and defining storage locations

#### Enable External Sharing:

- Log in to the Nextcloud web interface as an administrator.
- Navigate to the settings or admin section.
- Look for options related to sharing and external links.
- Enable external sharing and adjust settings according to your preferences.

#### Configure the link settings:

- Ensure the link have the access to upload and retrieve the data.
- Enable the password protection to ensure for the data protection

#### Accessing the Shared Link:

- Users who receive the link can open it in a web browser.
- If a password is set, they will be prompted to enter it before accessing the shared data.

#### Uploading Data:

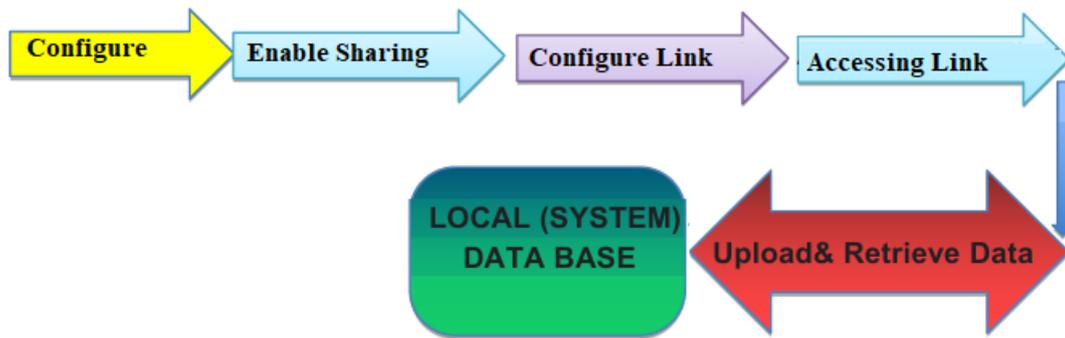
- Users can use the same link to upload data to the shared folder if the link includes upload permissions.
- Depending on the private cloud solution, there might be an option to upload files directly from the web interface or using other methods.

#### Retrieving Data:

- Users can download files directly from the shared link if download permissions are granted.
- If a password is set, they will need to enter it for authentication before downloading.

#### Testing and Verify:

- Try to upload the image files or other using the link verify the data available at the storage location.
- After successful Verification, try to retrieve the data which is uploaded to the cloud using the same link by entering the password.



## References

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