

CLOUD COMPUTING FINAL PROJECT

CLOUD BASED FILE STORAGE
SYSTEM

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INTRODUCTION

This project consist in the deployment and implementation of a cloud-based file storage system.



DESIGN AND DEPLOYMENT

Nextcloud is an open-source cloud storage solution that allows users to save and share files in a private storage space.

It has a user-friendly interface and several built-in security features.



MariaDB is a relational database management system that is fully open-source and known for its performances and scalability.

In this project it's used as Nextcloud's backend database.

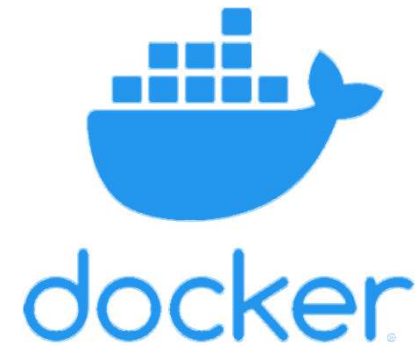


DESIGN AND DEPLOYMENT

Nextcloud and MariaDB were deployed with docker compose through a .yml file.

This tool allows to handle multiple containers at once.

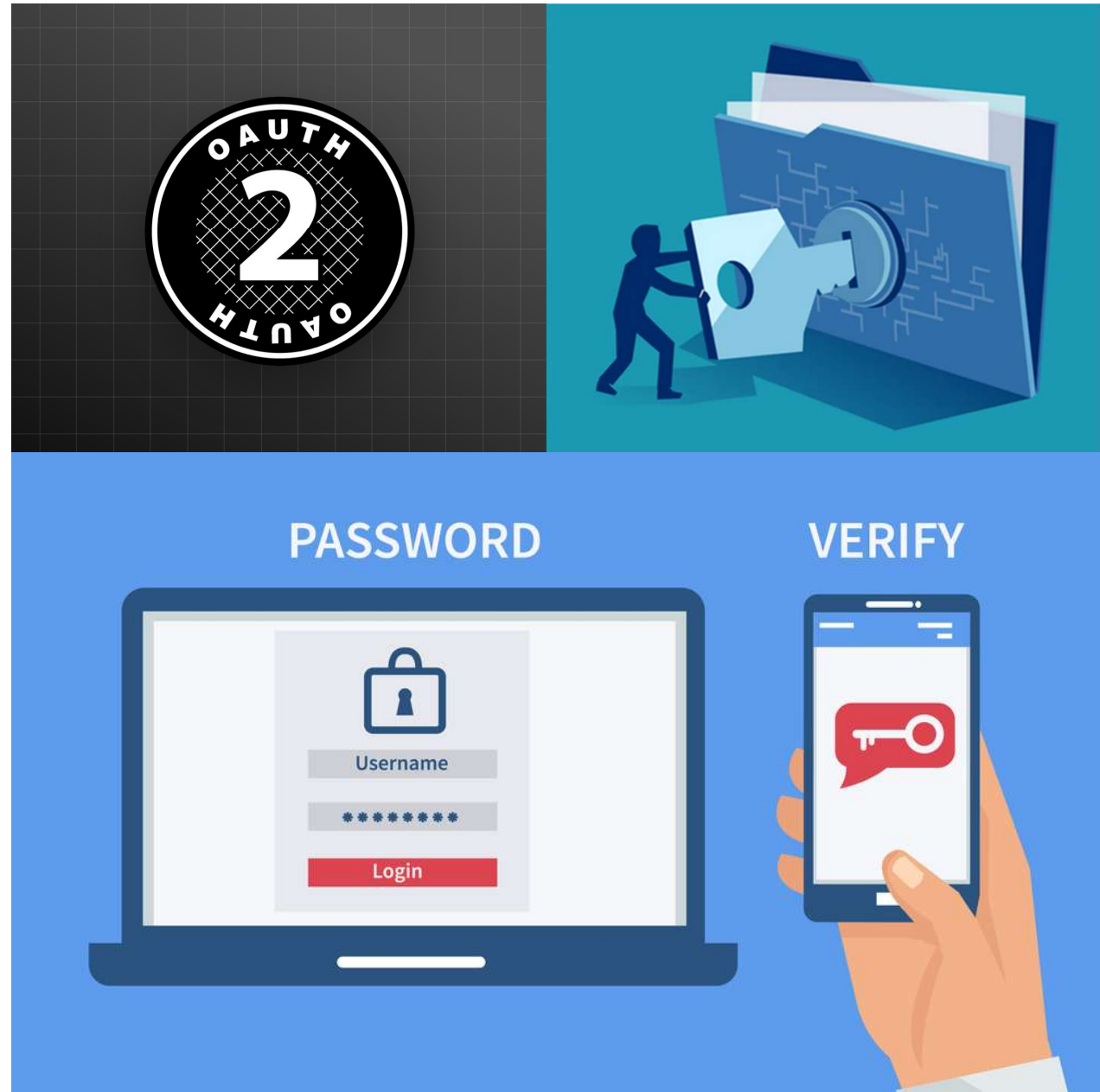
Two different volumes were saved to persist data when containers are removed or stopped.



SECURITY

The following features are available on Nextcloud, but weren't activated:

- Two factor authentication
- OAuth 2.0
- Server side encryption
- Logging and monitoring



PASSWORD POLICY

- Minimum password length: 10 characters
- Uppercase and lowercase letters
- At least one number
- At least one special character
- Failed login attempts before account is blocked: 5
- Password expiration: 30 days

Criterio della password

10

Lunghezza minima della password

0

Cronologia della password degli utenti

30

Numero di giorni per la scadenza della password dell'utente

5

Numero di tentativi di accesso prima che l'account utente venga disattivato fino a intervento manuale.

Si noti che questa opzione è pensata per proteggere gli account sotto attacco. Gli account disattivati devono essere riattivati a mano da un amministratore. Gli aggressori che tentano di indovinare le password degli account avranno il loro accesso bloccato dalla protezione bruteforce indipendentemente da questa impostazione.



Vieta le password comuni



Forza i caratteri maiuscoli e minuscoli



Forza i caratteri numerici



Forza i caratteri speciali



Verifica la password con l'elenco di password compromesse di haveibeenpwned.com

Questo controllo crea un hash della password e invia i primi 5 caratteri di questo hash alle API di haveibeenpwned.com per recuperare un elenco di tutti gli hash che iniziano con questi caratteri. Poi controlla se la password dell'istanza è nei risultati.



Accedi a Nextcloud

Accedi con nome utente o email

Accedi con nome utente o email

Password



→ Accedi

Hai dimenticato la password?

Accedi con un dispositivo

USER MANAGEMENT

Scripts:

- create_user.sh: Creates 100 test users
- delete_files.sh: Deletes files in each test user's folder
- delete_user.sh: Deletes the test users

Access:

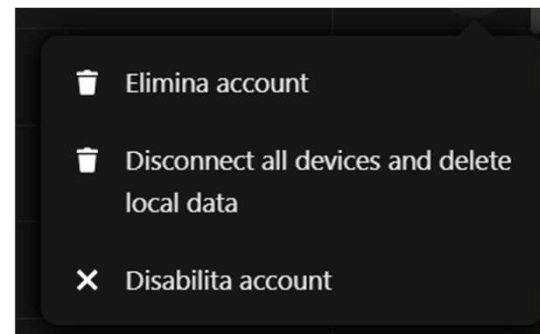
Username : Admin password: SecureAdmin15\$

Username: test_userX password: Test_passwordX!

☰	Nome visualizzato	Password	Posta elettronica	Gruppi
	Nome utente			
A	admin admin			admin
T1	TestUser 1 test_user1			Users
T1	TestUser 10 test_user10			Users
T1	TestUser 100 test_user100			Users
T1	TestUser 11 test_user11			Users
T1	TestUser 12 test_user12			Users
T1	TestUser 13 test_user13			Users
T1	TestUser 14 test_user14			Users
T1	TestUser 15 test_user15			Users
T1	TestUser 16 test_user16			Users
T1	TestUser 17 test_user17			Users

USER MANAGEMENT ADMIN

- Privileges:
- Creating/Deleting users
 - Setting security measures
 - Managing user groups
 - Setting user quotas
 - Disabling suspicious accounts



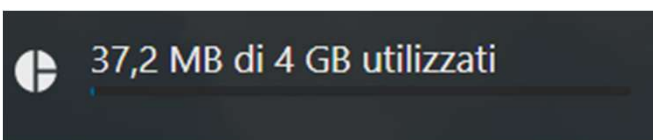
USER MANAGEMENT

TEST USERS

Privileges:

- Upload/download files to/from storage
- Change personal interface settings
- Change password/personal information

Storage quota: 4GB



LOCUST TESTING



An open source tool to simulate concurrent user behaviour

Start new load test

Number of users (peak concurrency) *

100

Ramp up (users started/second) *

1

Host

http://localhost:8080

Advanced options



Run time (e.g. 20, 20s, 3m, 2h, 1h20m, 3h30m10s, etc.)

5m

Profile

START

Five minute tests, with spawn rate of 1 user per second

Test	Uploaded test file size	Number of users	Task frequency
Light test	1 KB	80	[2 ,4] s
Medium test	1 KB, 1 MB	80	[1,2] s
Heavy test	1 GB, 1 KB, 1 MB	10	[2 ,4] s

LOCUST TASKS

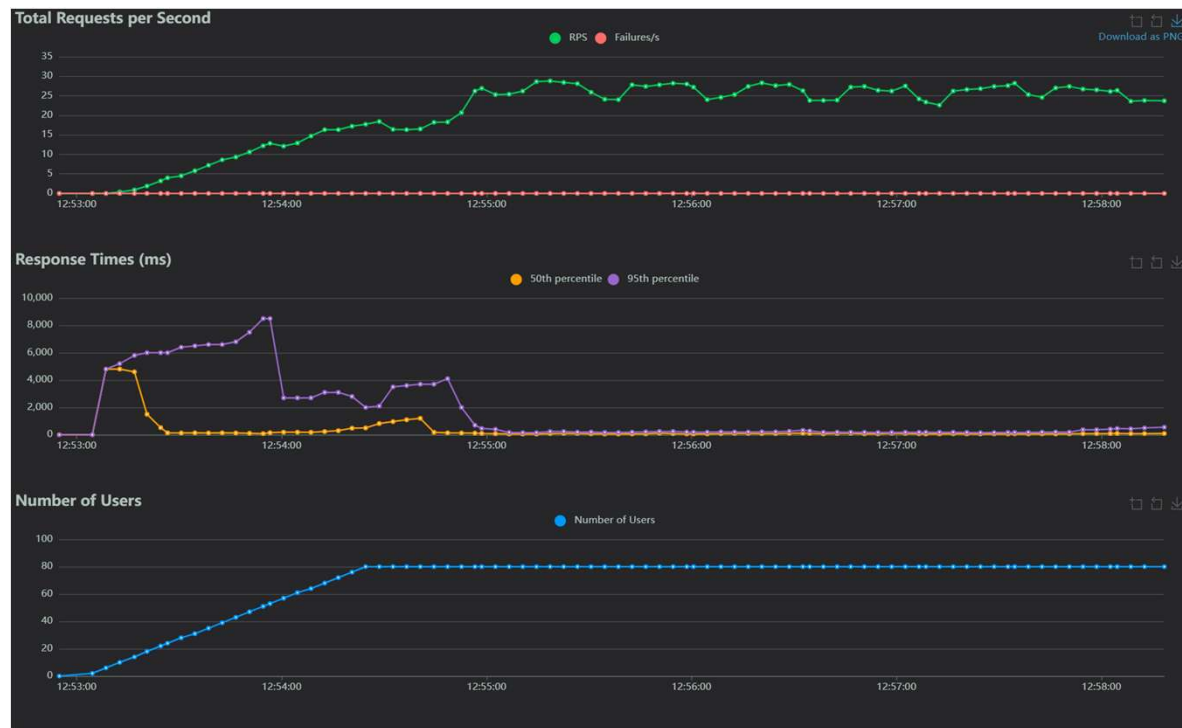


Task name	Description
Authentication (HEAD)	Verifies user credentials and server availability
Search (PROPFIND)	Lists the contents of the user's root directory
Read (GET)	Retrieves the contents of the Readme.md file (included by default)
Upload (PUT)	Uploads files of various sizes, depending on the load scenario
Deletion (PUT + Delete)	Uploads a temporary file and then immediately deletes it

On_start: initializes each virtual user randomly from the test pool and sets up an empty list to track the paths of uploaded files during the test.

On_stop: at the end of the simulation iterates over the uploaded file paths and deletes them

LIGHT LOAD TEST

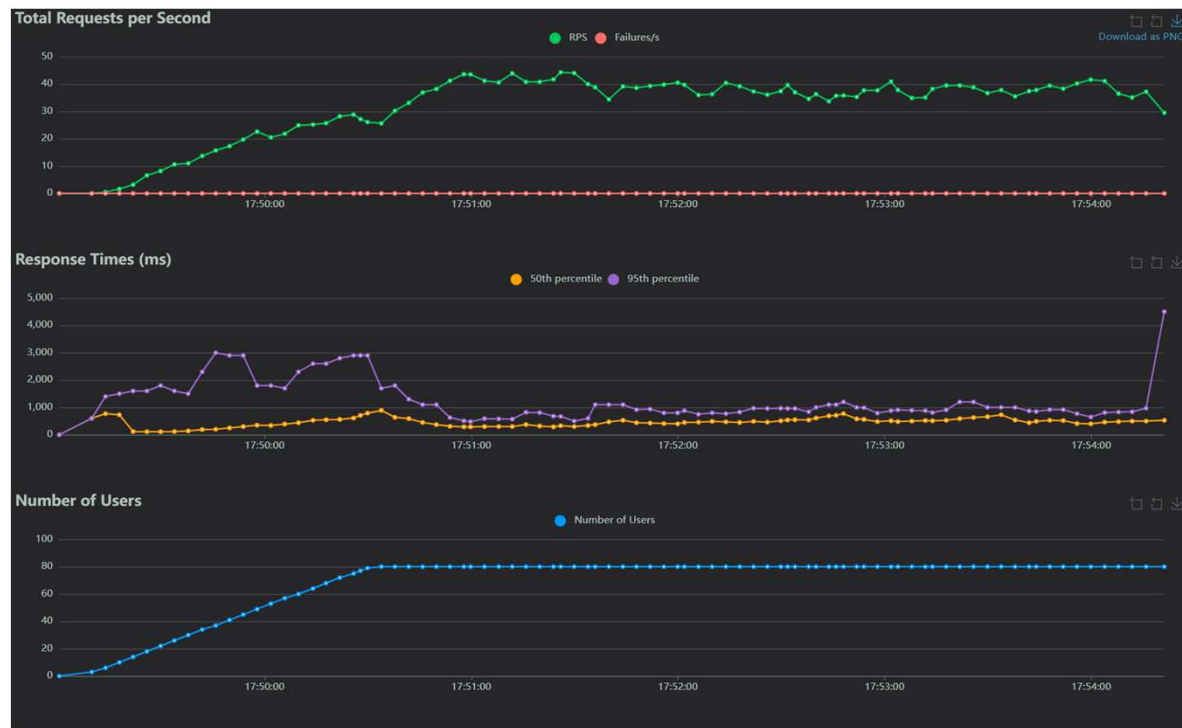


Failures: None

Average response time: 653.01 ms

Average upload response time: 438.05 ms

MEDIUM LOAD TEST

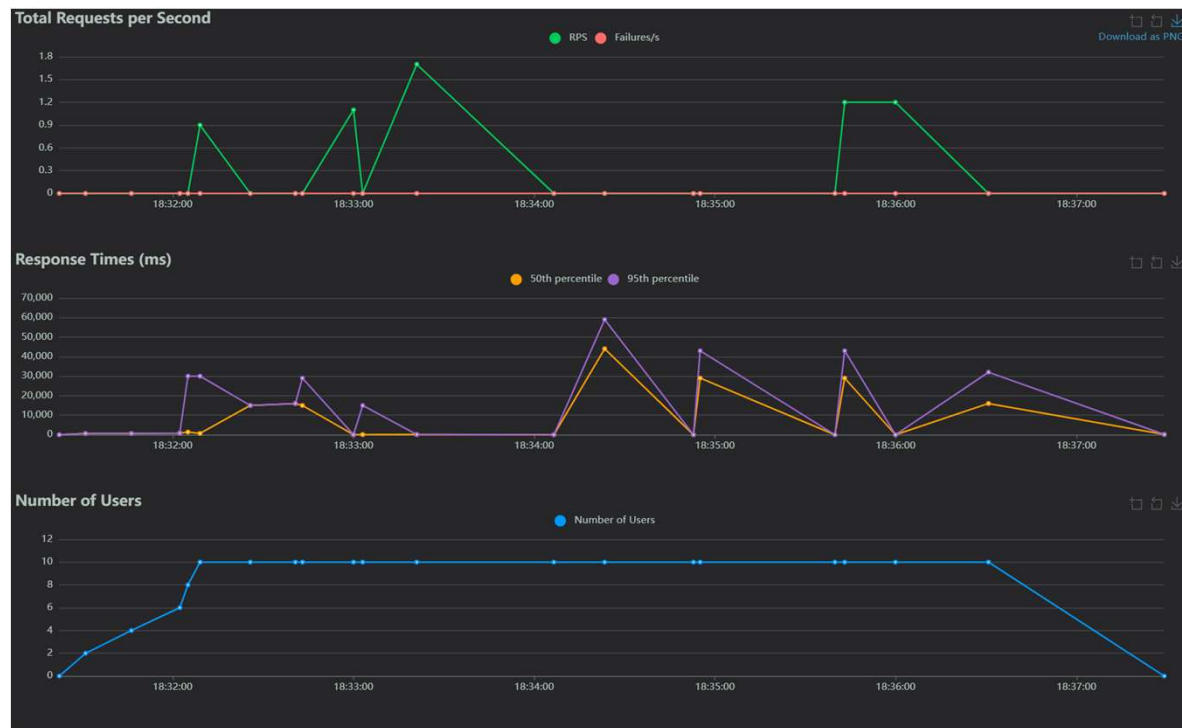


Failures: 4 Remote Disconnected errors

Average response time: 1038.79 ms

Average upload response time: 631.7 ms

HEAVY LOAD TEST

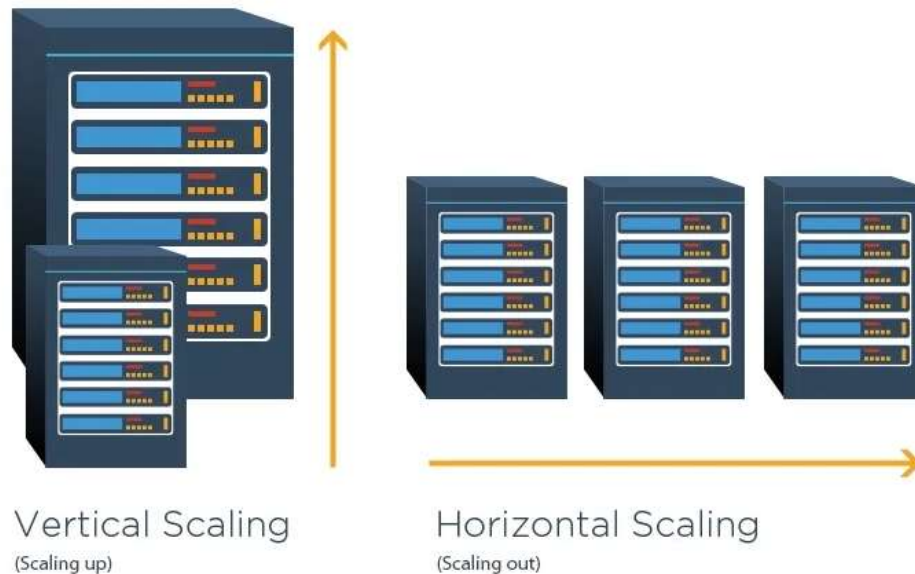


Failures: None

Average response time: 10452.42 ms

Average upload response time: 19437.61 ms

SCALABILITY AND COST EFFICIENCY



Cost saving measures:

- Storing under-accessed files in cheaper storage
- Monitoring resource usage (Grafana, Prometheus)
- Using a more optimized database

Run multiple instances of the cloud storage platform container with a load balancer to distribute incoming requests

CONCLUSIONS

The cloud-based file storage system was successfully implemented.

The simulations with Locust revealed that the system performs well under **light and medium loads**, maintaining adequate latency and reliability.

However, under **heavy load**, performance degraded significantly, indicating the need for additional computational resources.

To address these challenges, **horizontal scaling** with multiple Nextcloud container instances behind a load balancer is recommended.



Horizontal Scaling

**THANKS FOR THE
ATTENTION!**

REFERENCES



Nextcloud Documentation,
<https://docs.nextcloud.com/>



MariaDB, <https://mariadb.org/>



Locust Documentation,
<https://docs.locust.io/en/stable/>



Docker Documentation,
<https://docs.docker.com/>



Docker Compose Documentation,
<https://docs.docker.com/compose/>