The background features a light gray cloud on the right side, partially overlapping a dark gray semi-circle on the left. Several network cables in blue and teal colors are draped across the scene, with some plugged into the bottom of the cloud. The overall aesthetic is clean and modern, representing cloud computing and network infrastructure.

Cloud-Based File Storage System

ANNALISA PALADINO

Introduction

Task: Exploring and deploying a solution for a cloud-based file storage system



Manage user authentication/authorization and file operations



Discuss scalability, security and cost-efficiency



Deployment



Test the infrastructure

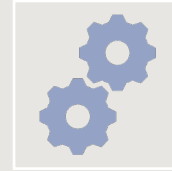
Nextcloud



Open-source



Extensive
documentation



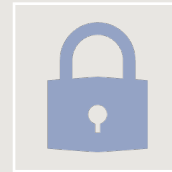
Easy to implement
the system



Customizable
database backend
solutions



Simple dockerized
deployment




Production ready
security system

User Authentication and File Operations

Nextcloud support by default user authentication, authorization and file operations:

- Users can: *sign up, log in and log out*
- Users have different roles: **ADMIN** and **REGULAR USER**
- Each user is provided of a **private** storage space (1GB)
- Users can upload/delete/download files in their storage space

Admin Management: 
• Create/modify/delete users
• Assign/change roles and permission



Address Scalability

- Divide the system into a *set of small services*, each service can be scaled independently, allowing for more precise resource allocation based on demand for specific functionalities.
- Implement *stateless* application servers: any server can respond to any request
- *Horizontal scaling*: adding more servers increases capacity without additional complexity
- Cloud-based resources that automatically scale up or down based on real-time (eg. AWS Auto Scaling or Kubernetes' horizontal pod autoscaler)
- *Load balancers* to equally distribute incoming requests across the servers can prevent bottlenecks
- Implementing *caching* at various levels to reduce the load on the backend minimizes the need to compute or retrieve the same information repeatedly
- Continuously *monitor* system performance metrics (CPU usage, memory usage, response times) to identify trends and predict when to scale

Address Security

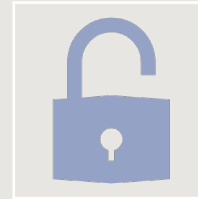
To improve Nextcloud default configuration some additional security measures can be applied:



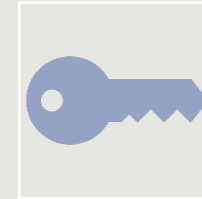
Encryption



Transport
Layer Security
(TLS)

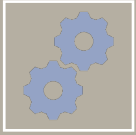


Multi-Factor
Authentication
(MFA)



Stronger
passwords
requirements

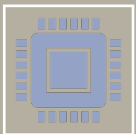
Cost-Efficiency



Auto-scaling to dynamically adjust resources based on demand, this ensures you're not paying for inactive resources during low usage periods



Continuous monitoring over resource usage and cost trends



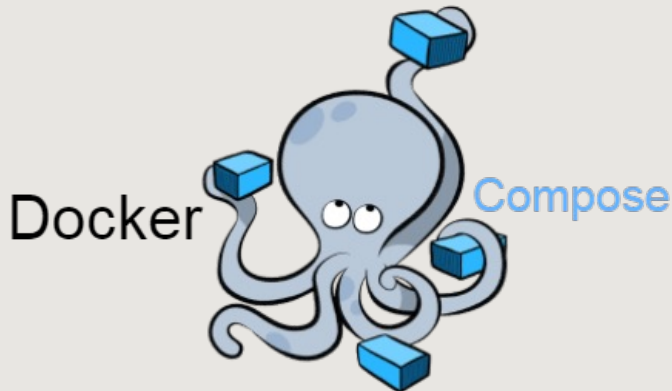
When designing the system it's crucial to have in mind cost-efficiency from the start (choosing the right algorithms, minimizing dependency on external services...)

Deployment



The deployment of Nextcloud has been executed using **Docker** and **Docker Compose**

1. Create a Dockerfile that specifies the environment, dependencies and commands needed to run the service, it puts together the Nextcloud and the MariaDB instances
2. Define a docker-compose.yml file: it describes the application's services, networks and volumes
3. Start the application with **docker-compose up -d**
4. Access to Nextcloud with <http://localhost:8080> URL



To monitor and manage the deployed system some tools can be used:

- *Portainer* provides a web-based UI for container management, including detailed statistics, log viewing, and container control
- *Prometheus* (metrics collection) and *Grafana* (metrics visualization)



... deploy the system in production

Amazon Web Services (AWS) is a cloud provider that could be used to deploy the system in a production environment because:

- It provides *auto-scaling* capabilities that can automatically adjust the number of compute instances based on the application's load
- It can host applications closer to the end-users, reducing latency and improving user experience
- It relies on high standards of *security*
- It has a *pay-as-you-go* pricing model, which is very useful for optimizing costs



Locust



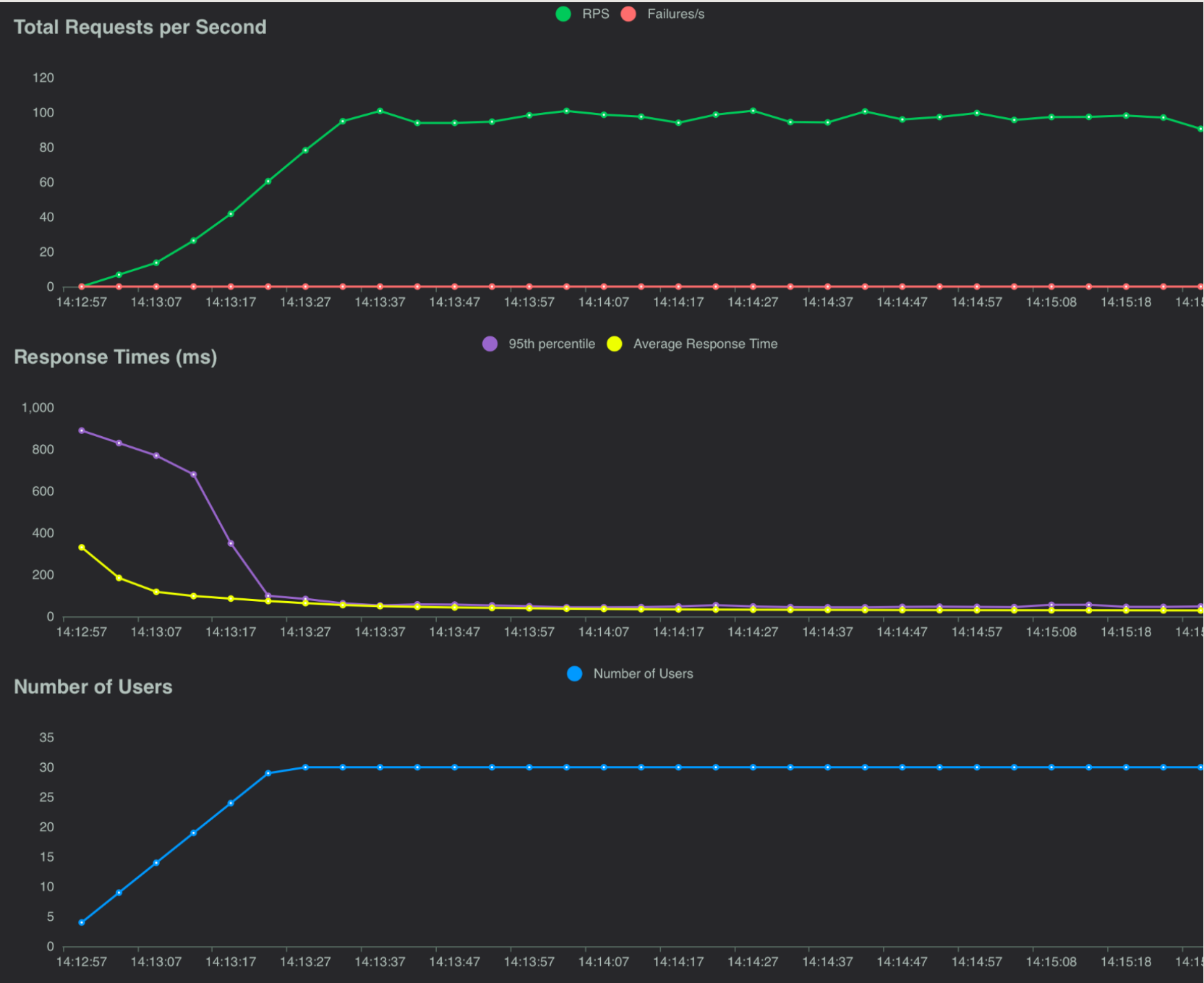
Open-source Python library and tool for performance testing and load testing of web applications

Defines test scenarios, simulates user behaviour and generates load on a web server to perform stress-test



LOCUST

Small file, 30 users



Big file, 30 users



Thank you for your attention!