



Introduction to INFN Cloud services

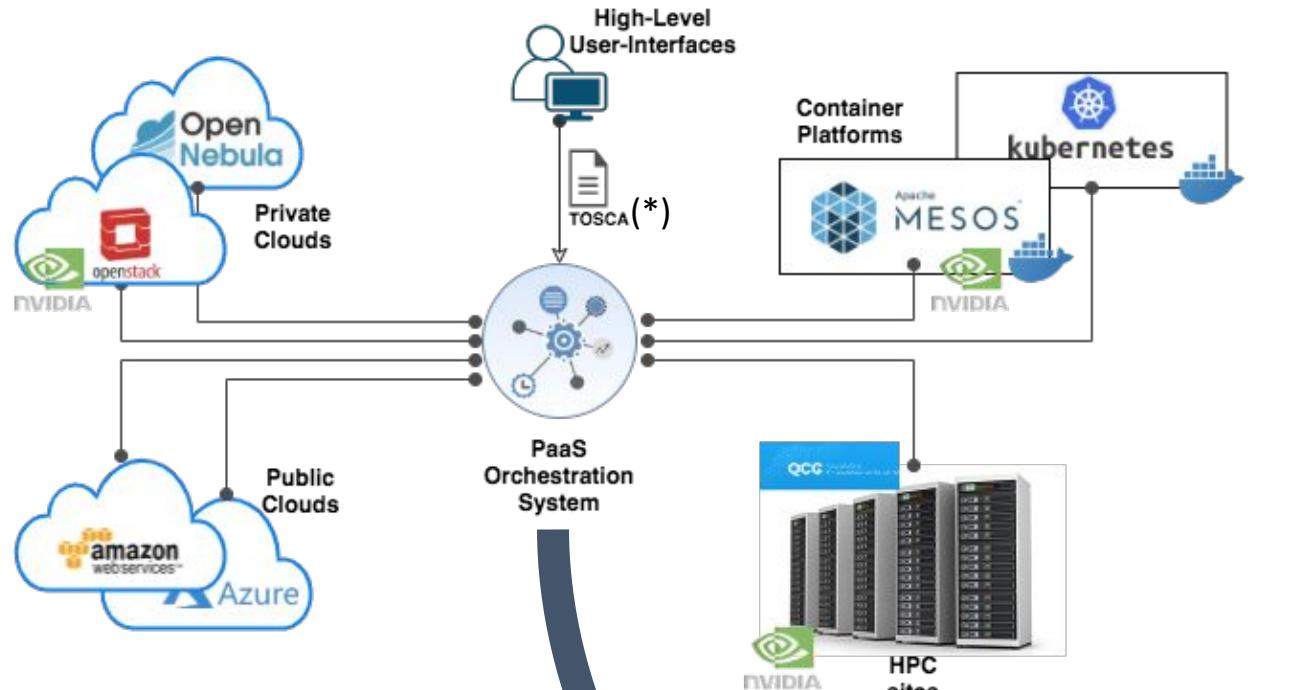
Marica Antonacci (INFN BA)
Corso *Big Data e ML*, 11-15 Ottobre 2021



The INFN Cloud

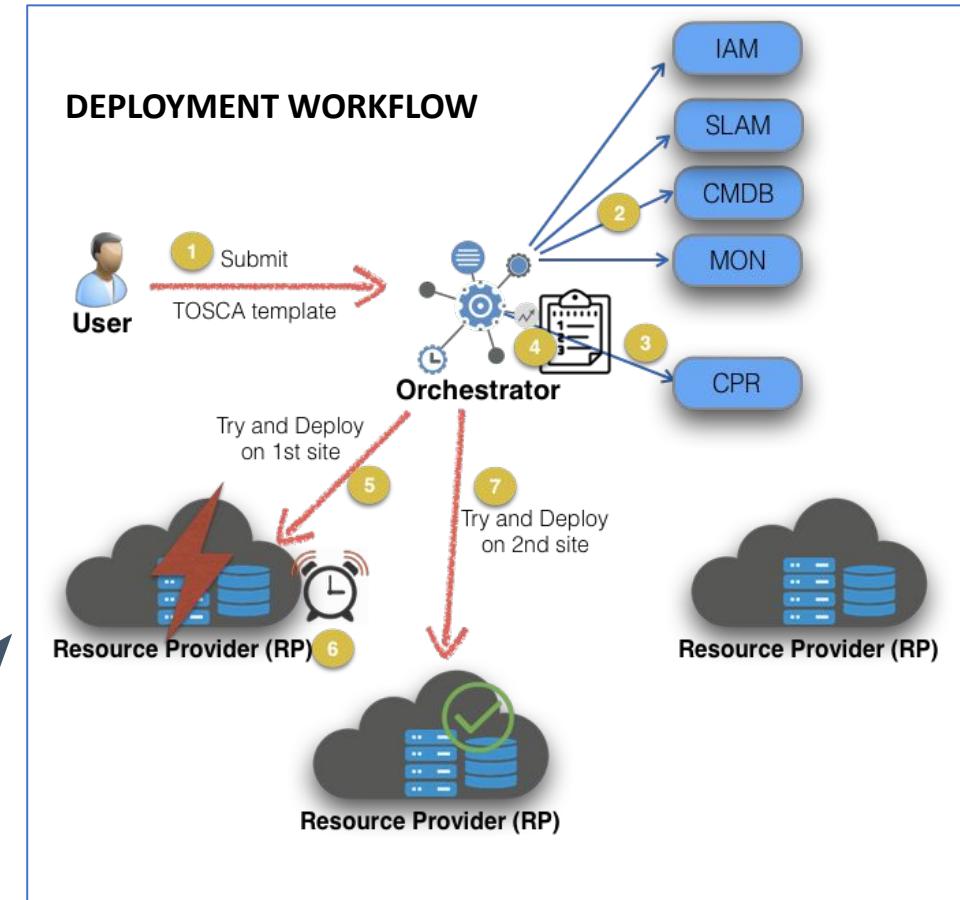
- INFN Cloud aims to offer a full set of **high-level cloud services** to INFN user communities
 - the service catalogue is not static: new applications are included through a defined “on-boarding” process for new use-cases
- Architecturally INFN Cloud is a **federation** of existing infrastructures
 - the *INFN Cloud backbone*, consists of two tightly coupled federated sites: BARI and CNAF
 - a scalable set of satellite sites, geographically distributed across Italy, and loosely coupled.
- Key enabling factors for the federation
 - leverage the same authentication/authorization layer based on **INDIGO-IAM**
 - agree on a consistent set of policies and participation rules (user management, SLA, security, etc.)
 - transparent and dynamic orchestration of the resources across all the federated infrastructures through the **INDIGO PaaS Orchestrator**

PaaS Orchestration System (from 10Km)



(*) Topology and Orchestration Specification for Cloud Applications

Ref: [TOSCA Simple Profile in YAML Version 1.1](#)





The INFN Cloud services

- The INFN Cloud services are based on **modular components and span the IaaS, PaaS and SaaS models** for both computing and data.
- All services are described by [**TOSCA templates**](#) (which can refer internally to other components such as Ansible playbooks, HELM charts, etc.).
- The services can be **deployed** via the INFN Cloud Dashboard or via a command line interface:
 - **Automatically** by the INFN Cloud Orchestrator on one of the federated Cloud infrastructures, depending on resource availability and policies.
 - **Manually** by a user on a specific federated Cloud infrastructure.

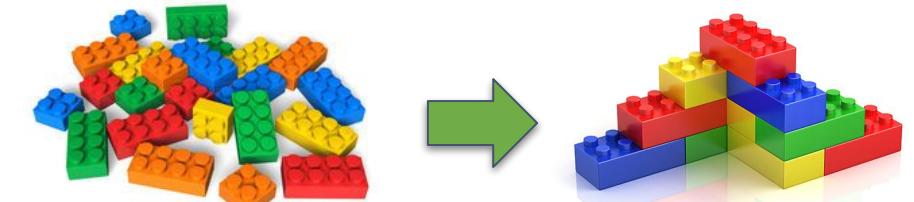
The service catalogue

The catalogue is a graphical representation of the TOSCA templates repository that we have been developing extending the INDIGO-DC custom types

- Each card in the catalogue is associated to one or more templates
- We are following a **lego-like** approach, building on top of reusable components and exploiting the TOSCA service composition pattern

Main objectives:

- #1 - build added value services on top of IaaS and PaaS infrastructures**
- #2 - lower the entry barrier for non-skilled scientists**





Objectives of INFN-Cloud

To provide solutions for a wide range of user/community needs :

- a set of distributed computing solutions, from the simplest (“I need a Linux PC for some uses, I do not want to buy one”) to open source composable components that allow INFN users to use, build and develop modern computing models and related resources.
- For example: ability to leverage a mix of public / private Cloud infrastructures, distributed POSIX / object storage solutions, CPU / GPU resources, reusable ML models



- **Scientific Computing**
- **Development and R&D, testing of new services**
- **Training activities**
- Support to INFN data centers operations (for example for backups of services, etc)

Which services are available?

SIMPLE

- Creation of VMs with different flavors and sizes.
- Creation of containers or of services via docker- compose files.
- Building blocks “as a service” for example for container orchestration (e.g. creation of a Mesos cluster or of a Kubernetes cluster as a service).
- Pre-configured environments for data analytics (e.g. using ElasticSearch and Kibana or Spark).
- Non volatile, object storage and Posix-compliant virtual file system solutions transparently connected to higher-layer services (e.g Jupyter notebooks as a service with permanent, replicated storage).
- Dynamic clusters tailored to specific experiments (e.g. an automated full HTCondor installation realized on a k8s cluster, or a GPU-based Machine Learning-optimized environment).
- Services leveraging transparent user-level encryption of disk volumes.

COMPLEX

The service catalogue can be easily extended with the simple addition/customization of TOSCA templates.



The INFN Cloud Dashboard

Welcome to the INFN Cloud Dashboard!

Please login, or register >

INFN CLOUD

Compute Services

Analytics

Machine Learning

Welcome to infn-cloud

Sign in with

INFN CCR - AAI

Not a member?

Apply for an account

Users are organized in different IAM groups.

Each group can access a specific set of services from the dashboard (personalized view) and is mapped onto a dedicated tenant on the federated clouds.

INDIGO IAM manages the authentication/authorization through the whole stack (from PaaS to IaaS)

INFN Cloud Dashboard Deployments Advanced External Links Users Marica Antonacci

Virtual machine

Docker-compose

Run docker

Elasticsearch and Kibana

Apache Mesos cluster

Kubernetes cluster

Spark + Jupyter cluster

RStudio

TensorFlow with Jupyter

Jupyter with persistence for Notebooks

Working Station for Machine Learning INFN (ML_INFN)

Galaxy



The INFN Cloud Dashboard

Virtual machine 	Docker-compose 	Run docker
Elasticsearch and Kibana 	Apache Mesos cluster 	Kubernetes cluster
Spark + Jupyter cluster 	RStudio 	TensorFlow with Jupyter
Jupyter with persistence for Notebooks 	Working Station for Machine Learning INFN (ML_INFN) 	Galaxy
Working Station for CYGNO experiment 	Cloud Storage Service 	

The services are **easily customizable** and configurable directly by users

Virtual machine

Description: Launch a compute node getting the IP and SSH credentials to access via ssh

Deployment description
description

Configuration Advanced

service_ports
Add rule

Ports to open on the host

flavor
--Select--

Number of vCPUs and memory size of the Virtual Machine

operating_system
--Select--

Operating System for the Virtual Machine

Submit Cancel

Virtual machine

Description: Launch a compute node getting the IP and SSH credentials to access via ssh

Deployment description
mynode

Configuration Advanced

Configure scheduling:
 Auto Manual

Select a provider:

BACKBONE-CNAF: org.openstack.nova

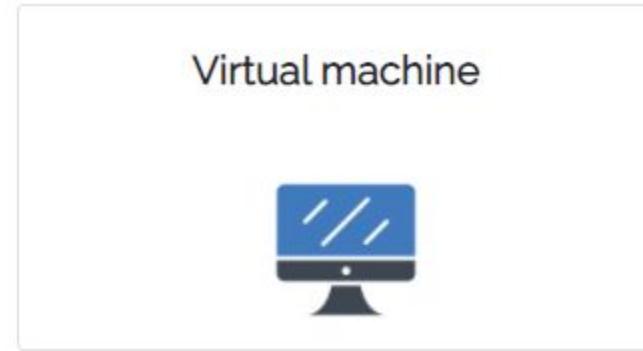
BACKBONE-CNAF: org.openstack.nova

RECAS-BARI: org.openstack.nova

CLOUD-CNAF: org.openstack.nova

BACKBONE-BARI: org.openstack.nova

Submit Cancel



Virtual machine use-case

How to start a virtual server on INFN Cloud

Configure your VM

1 Select

VM with no additional storage
 VM with block storage
Attach a volume to the machine

Submit **Cancel**

3 Virtual machine with block device

Description: Launch a compute node with attached volume and get the IP and SSH credentials to access via ssh

Deployment description
description

Configuration Advanced

ports
Add rule

Ports to open on the host

mountpoint
/data

Path to mount the volume

volume_size
10 GB

Size of the volume to be attached

flavor
--Select--

Number of vCPUs and memory size of the Virtual Machine

operating_system
--Select--

Operating System for the Virtual Machine

Submit **Cancel**

2 SSH keys management

SSH keys allow you to establish a secure connection between your computer and your virtual server(s).

Upload SSH public key
Paste your public SSH key, which is usually contained in the file '`~/.ssh/id_ed25519.pub`' or '`~/.ssh/id_rsa.pub`' and begins with '`ssh-ed25519`' or '`ssh-rsa`'. Don't use your private SSH key.

Upload

Create new key pair
SSH key pair will be created from scratch. The private key will be safely stored in the Vault, while the public key will be stored in the Dashboard database.

+ Create new SSH key pair

3 Virtual machine with block device

Description: Launch a compute node with attached volume and get the IP and SSH credentials to access via ssh

Deployment description
description

Configuration Advanced

ports
Add rule

Ports to open on the host

mountpoint
/data

Path to mount the volume

volume_size
10 GB

Size of the volume to be attached

flavor
--Select--

Number of vCPUs and memory size of the Virtual Machine

operating_system
--Select--

Operating System for the Virtual Machine

Submit **Cancel**

4

11ec2cbc-bbd7-84eo-adef-0242699101a7

Back

Description: test server

Overview Input values Output values

node_ip: 90.147.174.194
ssh_account: antonacci

2. antonacci@vnode-0: ~

```
maricaantonacci@MBP-di-Marica:~$ maricaantonacci@MBP-di-Marica:~$ ssh antonacci@90.147.174.194
The authenticity of host '90.147.174.194' (90.147.174.194) can't be established.
ECDSA key fingerprint is SHA256:7i0//3VKjnYTS7hhuyEC7JBBgC0DtDjVWNPl2NOJU4.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '90.147.174.194' (ECDSA) to the list of known hosts.
Welcome to Ubuntu 20.04.3 LTS (GNU/Linux 5.4.0-81-generic x86_64)

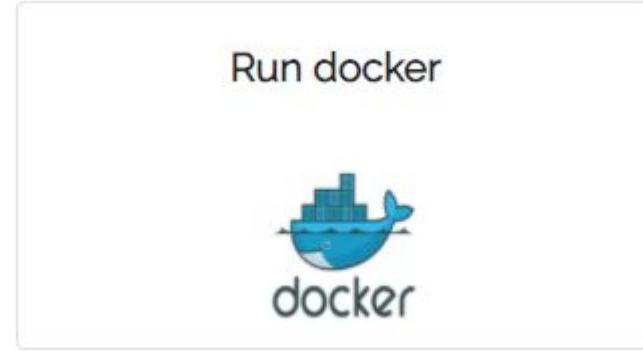
 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/advantage

System information as of Thu Oct 14 07:36:56 UTC 2021

System load: 0.06 Processes: 104
Usage of /: 17.1% of 9.52GB Users logged in: 0
Memory usage: 12% IPv4 address for ens3: 192.168.170.217
Swap usage: 0%
```

60 updates can be applied immediately.
32 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

Last login: Thu Oct 14 07:36:15 2021 from 95.239.81.100
antonacci@vnode-0:~\$



Docker run use-case

How to run a container on INFN Cloud

Configure your dockerized service

Run docker

Description: Run a docker container

Deployment description
description

Configuration Advanced

num_cpus
2

mem_size
1 GB

docker_appname
nginx

docker_image
nginx

docker_tag
latest

docker_ports
8080:80

docker_command

service_ports
8080

environment_variables
[Add](#)

Environment variables

[Submit](#) [Cancel](#)

The configuration form allows you to customize your deployment.

My deployments

Show 10 entries Search:

Description	Deployment identifier	Status	Creation time	Deployed at	Actions
nginx	11ebcf73-a1a1-dc3d-a7b8-0242699101a7	CREATE_COMPLETE	2021-06-17 13:55:00	RECAS-BARI	Details

11ebcf73-a1a1-dc3d-a7b8-0242699101a7

Description: nginx

Overview Input values Output values

node_ip: 212.189.205.23

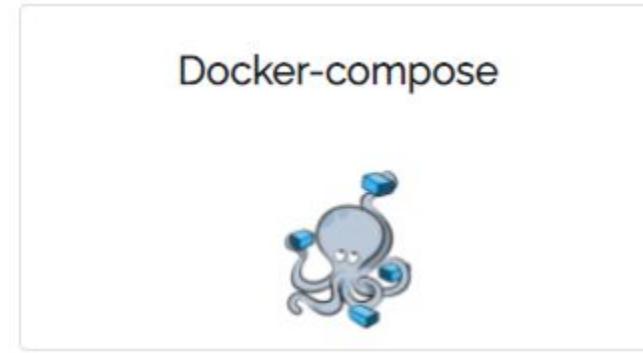
ssh_account: antonacci

Welcome to nginx!

If you see this page, the nginx web server is successfully installed and working. Further configuration is required.

For online documentation and support please refer to [nginx.org](#). Commercial support is available at [nginx.com](#).

Thank you for using nginx.



Docker-compose use-case

How to run a docker compose file fetched from a given URL



Configure your service

Docker-compose

Description: Run a docker compose file fetched from the specified URL

Deployment description

description

General Ports Advanced

project_name

myprj

Name of the project. This name will be used to create a folder under /opt to store the docker compose file

environment_variables

Add

Environment variables

docker_compose_file_url

<https://baltig.infn.it/infn-cloud/apps/-/raw/master/compose-example/docker-demo.yaml>

URL of the docker compose file to deploy

flavor

--Select--

Number of vCPUs and memory size of the Virtual Machine

Submit Cancel

Environment variables management

environment_variables

Key	Value	
DB_USER	wp	
DB_ROOT_PASSWORD	1234qwer	
DB_USER_PASSWORD	3456erty	

[Add](#)

Environment variables

- The special variable *HOST_PUBLIC_IP* is made available by the PaaS system and contains the public IP assigned to the VM
- This env variable can be used as a normal env variable inside the user docker compose file

services:

```
.....
app:
depends_on:
- db
image: wordpress
container_name: app
volumes:
- wp-content:/var/www/html/wp-content
environment:
- WORDPRESS_DB_HOST=db:3306
- WORDPRESS_DB_USER=${DB_USER}
- WORDPRESS_DB_PASSWORD=${DB_USER_PASSWORD}
- VIRTUAL_HOST=wp.${HOST_PUBLIC_IP}.myip.cloud.infn.it
expose:
- 80
```

Ports management

You can define the set of ports that must be automatically opened on the server in order to access your services

Docker-compose

Description: Run a docker compose file fetched from the specified URL

Deployment description
wordpress

General Ports Advanced

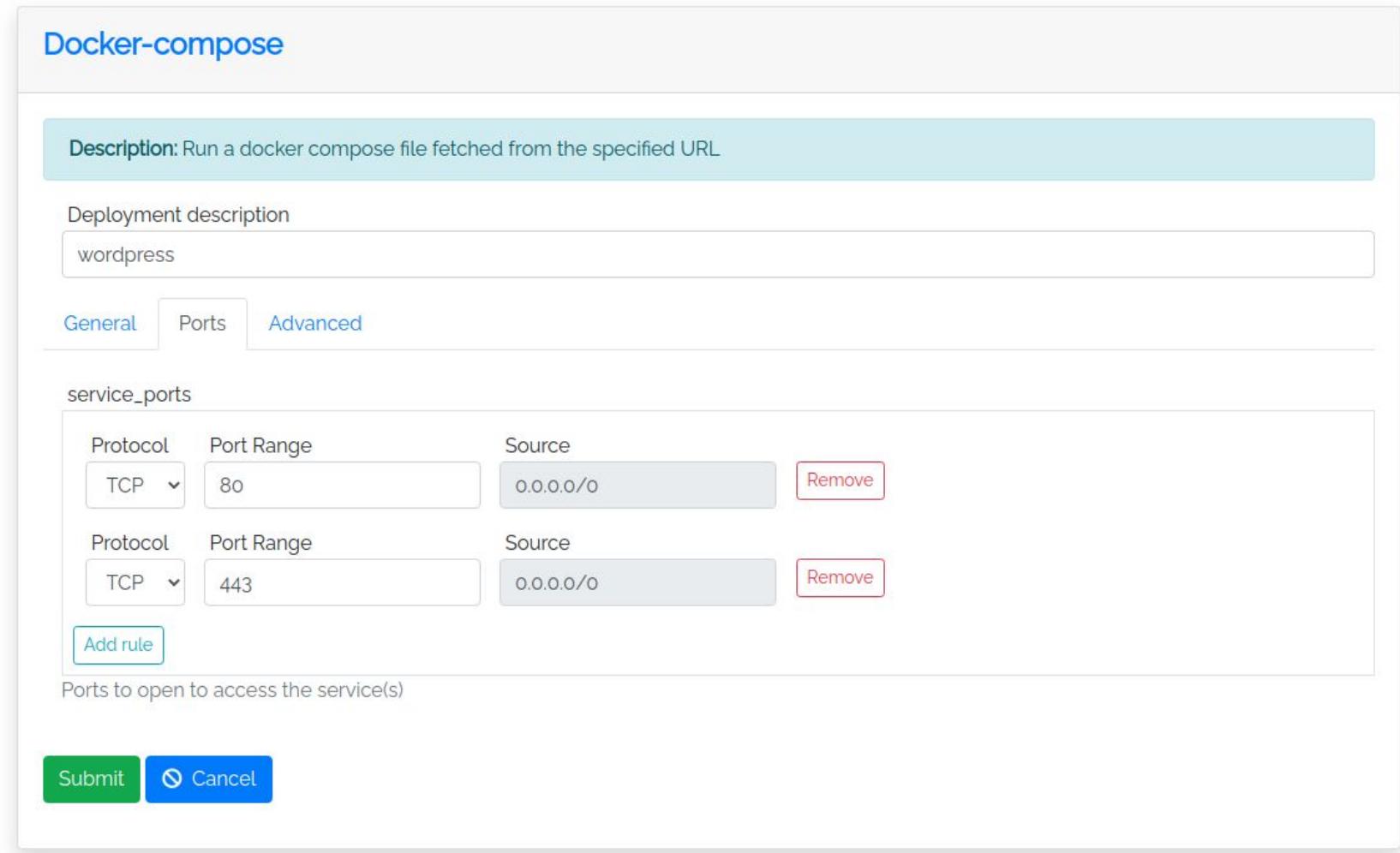
service_ports

Protocol	Port Range	Source
TCP	80	0.0.0.0/0
TCP	443	0.0.0.0/0

Add rule

Ports to open to access the service(s)

Submit Cancel





DNS @INFN Cloud

INFN Cloud provides a DNSaaS mechanism that associates a DNS name to each VM public IP

```
$ host wp.90.147.174.132.myip.cloud.infn.it
wp.90.147.174.132.myip.cloud.infn.it has address
90.147.174.132
```

This mechanism is based on xip.io (wildcard DNS) and is exploited for the automatic generation of ssl certificates (e.g. with letsencrypt)

```
services:
db:
image: mariadb
container_name: db
volumes:
- db:/var/lib/mysql
environment:
- MYSQL_ROOT_PASSWORD=${DB_ROOT_PASSWORD}
- MYSQL_DATABASE=wordpress
- MYSQL_USER=${DB_USER}
- MYSQL_PASSWORD=${DB_USER_PASSWORD}
expose:
- 3306
app:
depends_on:
- db
image: wordpress
container_name: app
volumes:
- wp-content:/var/www/html/wp-content
environment:
- WORDPRESS_DB_HOST=db:3306
- WORDPRESS_DB_USER=${DB_USER}
- WORDPRESS_DB_PASSWORD=${DB_USER_PASSWORD}
- VIRTUAL_HOST=wp.${HOST_PUBLIC_IP}.myip.cloud.infn.it
expose:
- 80
```

SSL Terminator & Load-balancer

- You can use Traefik as load balancer and SSL terminator.
<https://traefik.io/traefik/>
- Traefik is able to renew letsencrypt certificates

```
services:  
load_balancer:  
image: traefik  
container_name: traefik  
volumes:  
- letsencrypt:/letsencrypt  
- /var/run/docker.sock:/var/run/docker.sock:ro  
ports:  
- "80:80"  
- "443:443"  
command:  
- "--api.insecure=true"  
- "--providers.docker=true"  
- "--providers.docker.exposedbydefault=false"  
- "--entrypoints.web.address=:80"  
- "--entrypoints.websecure.address=:443"  
- "--certificatesresolvers.myhttpchallenge.acme.httpchallenge=true"  
- "--certificatesresolvers.myhttpchallenge.acme.httpchallenge.entrypoint=web"  
- "--certificatesresolvers.myhttpchallenge.acme.email=${CONTACT_EMAIL}"  
- "--certificatesresolvers.myhttpchallenge.acme.storage=/letsencrypt/acme.json"
```

Traefik configuration

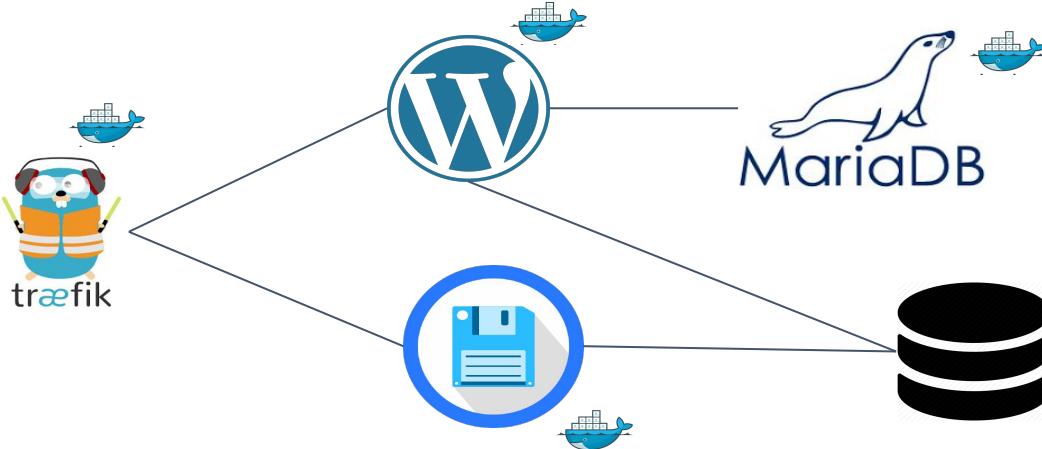
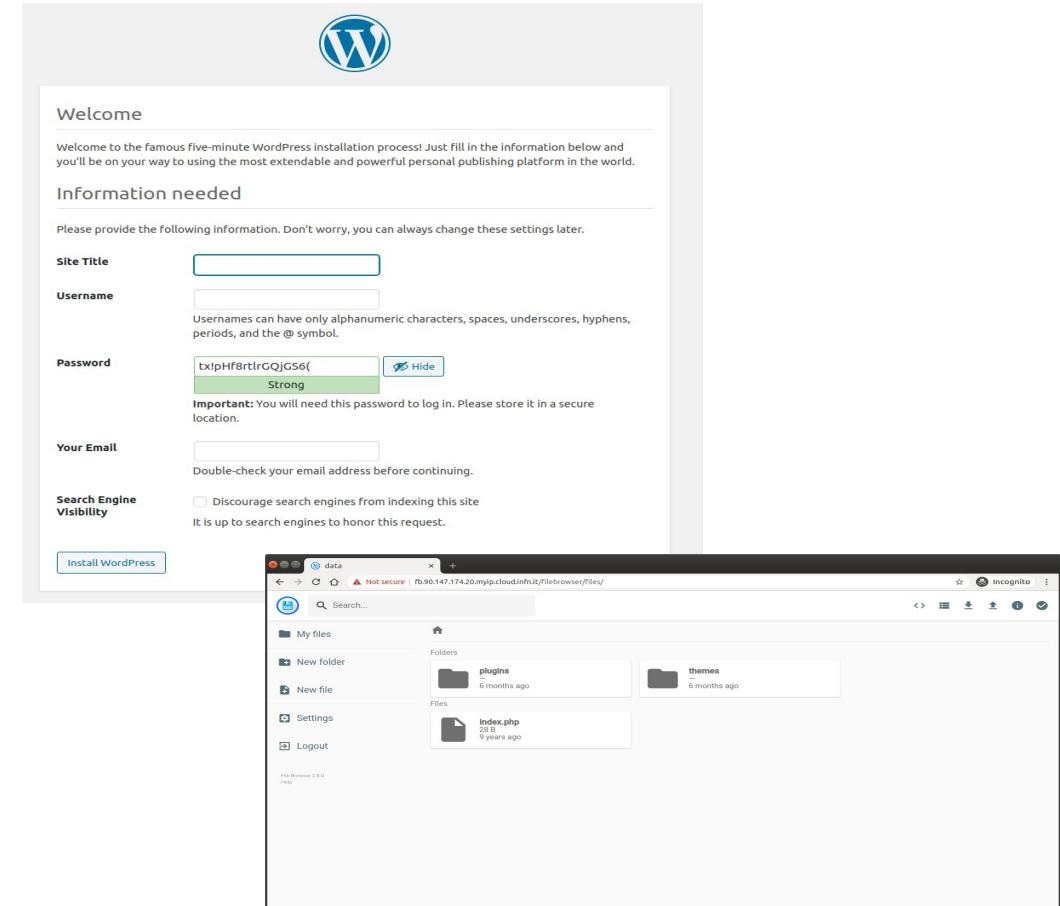
Traefik is automatically configured through the labels* exposed by the containers

(*) “A label is a key=value pair that applies metadata to a container.”

```
services:  
  app:  
    depends_on:  
      - db  
    image: wordpress  
    container_name: app  
    volumes:  
      - wp-content:/var/www/html/wp-content  
    environment:  
      - WORDPRESS_DB_HOST=db:3306  
      - WORDPRESS_DB_USER=${DB_USER}  
      - WORDPRESS_DB_PASSWORD=${DB_USER_PASSWORD}  
      - VIRTUAL_HOST=wp.${HOST_PUBLIC_IP}.myip.cloud.infn.it  
    expose:  
      - 80  
  labels:  
    - "traefik.enable=true"  
    - "traefik.http.middlewares.app-redirect-ssl.redirectscheme.scheme=https"  
    - "traefik.http.routers.app-nossal.middlewares=app-redirect-ssl"  
    - "traefik.http.routers.app-nossal.rule=Host(`wp.${HOST_PUBLIC_IP}.myip.cloud.infn.it`)"  
    - "traefik.http.routers.app-nossal.entrypoints=web"  
    - "traefik.http.routers.app.rule=Host(`wp.${HOST_PUBLIC_IP}.myip.cloud.infn.it`)"  
    - "traefik.http.routers.app.entrypoints=websecure"  
    - "traefik.http.routers.app.tls.certresolver=myhttpchallenge"  
    - "traefik.http.routers.app.tls=true"
```

Docker compose example

<https://baltig.infn.it/infn-cloud/apps/-/blob/master/compose-example/docker-demo.yaml>

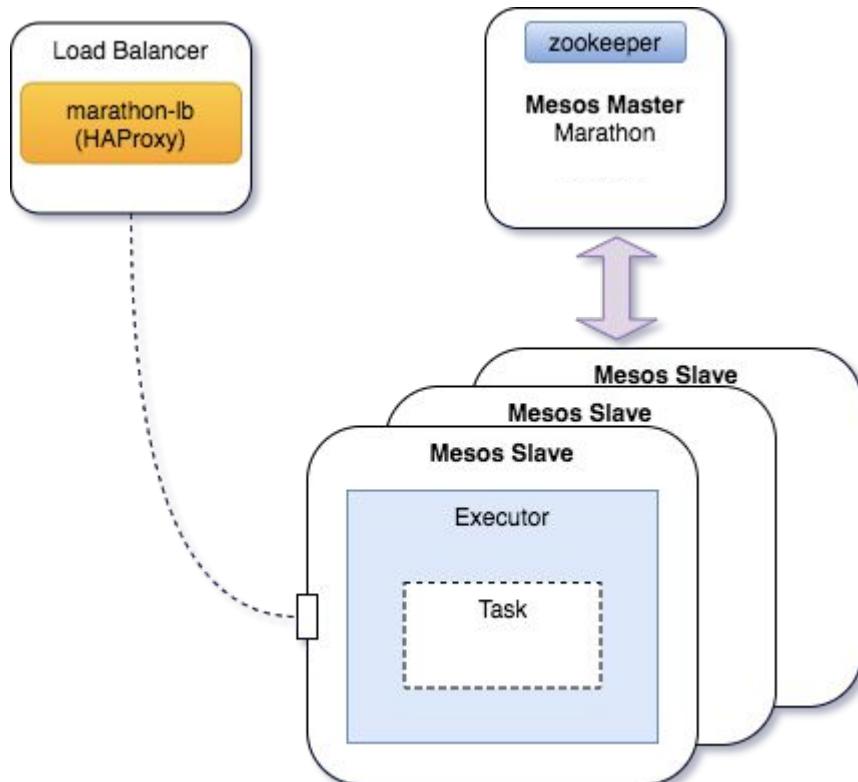
The top screenshot shows the "Welcome" screen of the WordPress installation process. It prompts for "Information needed" including Site Title, Username, Password, Your Email, and Search Engine Visibility. A "Strong" password is selected. The bottom screenshot shows a file browser interface with a "data" folder containing "plugins" and "themes" folders, and an "Index.php" file.



Mesos use-case

How to deploy a complete Mesos cluster

Cluster architecture



Apache Mesos cluster

Description: Apache Mesos abstracts CPU, memory, storage, and other compute resources away from machines (physical or virtual), enabling fault-tolerant and elastic distributed systems to easily be built and run effectively

Deployment description: mesos cluster

Configuration Advanced

mesos_password: Admin password for accessing Mesos HTTP service

marathon_password: Admin password for accessing Marathon HTTP service

slave_num: 2 Number of slave nodes in the cluster

admin_email: antonacci@infn.it Admin email address

master_flavor: medium: 2 VCPUs, 4 GB RAM Number of vCPUs and memory size of the Master Virtual Machine

slave_flavor: large: 4 VCPUs, 8 GB RAM Number of vCPUs and memory size of each Slave Virtual Machine

Submit **Cancel**

Deployment outputs

[11ec2d02-2c66-02ae-adef-0242699101a7](#)

[!\[\]\(a81f8d41ac7696d4fce540895b15f10f_img.jpg\) Back](#)

Description: mesos cluster

Overview

Input values

Output values

mesos_lb_ip: ['90.147.75.69']

mesos_endpoint: <https://90.147.75.68.myip.cloud.infn.it:5050>

marathon_endpoint: <https://90.147.75.68.myip.cloud.infn.it:8443>

mesos_master: ['90.147.75.68']

ssh_account: antonacci

Mesos/Marathon

Apache MESOS Frameworks Agents Roles Offers Maintenance IndigoCluster

Master 67907213-52e8-4c2e-851e-61031f26f144

Cluster: IndigoCluster
Leader: 192.168.100.44:5050
Version: 1.9.0
Built: a year ago by ubuntu
Started: 12 hours ago
Elected: 12 hours ago

Leading Master Log: [Download](#) [View](#)

Agents

Activated	2
Deactivated	0
Unreachable	0

Tasks

Staging	0
Starting	0
Running	0
Unreachable	0
Killing	0
Finished	0
Killed	0
Failed	0
Lost	0

Resources

	CPUs	GPUs	Mem	Disk
Total	4	0	5.7 GB	28.6 GB
Allocated	0	0	0 B	0 B
Offered	0	0	0 B	0 B
Idle	4	0	5.7 GB	28.6 GB

MARATHON

Applications Deployments Search all application: ?

STATUS

- Running
- Deploying
- Suspended
- Delayed
- Waiting

HEALTH

- Healthy
- Unhealthy
- Unknown

RESOURCES

- Volumes

Applications

Name	CPU	Memory	Status	Running Instances	Health
------	-----	--------	--------	-------------------	--------

No Applications Created

Do more with Marathon by creating and organizing your applications.

[Create Application](#)

Jupyter with persistence for
Notebooks



Jupyter with persistence for Notebooks

How to deploy Jupyter on a single VM enabling Notebooks persistence



Configure your service

Jupyter with persistence for Notebooks

Description: Run Jupyter on a single VM enabling Notebooks persistence

Deployment description
description

Configuration Advanced

num_cpus
2

Number of virtual cpus for the VM

mem_size
4 GB

Amount of memory for the VM

iam_groups
end-users-catchall

IAM groups for authorization management

iam_admin_groups
infn-cloud-catchall

IAM groups for JupyterHub ADMIN authorization management

jupyter_images
dodasts/persistent-storage-base:v4

Default image

ports
[Add rule](#)

Ports to open on the VM

[Submit](#) [Cancel](#)

Jupyterhub is automatically installed and configured in the Virtual Machine

- The **integration with INFN Cloud IAM** allows authorized users to login and spawn their containerized jupyter server starting from
 - The available default jupyter image
 - A customized docker image (available locally or shared on a public registry)
- The **integration with the INFN Cloud storage** provides persistence for user notebooks

11ec2cc7-9598-4196-adef-0242699101a7 [Back](#)

Description: jupyter vm

Overview Input values Output values

node_ip: 192.135.24.45

grafana_endpoint: <https://192.135.24.45:3000>

jupyter_endpoint: <https://192.135.24.45:8888>

ssh_account: antonacci

A look inside the machine

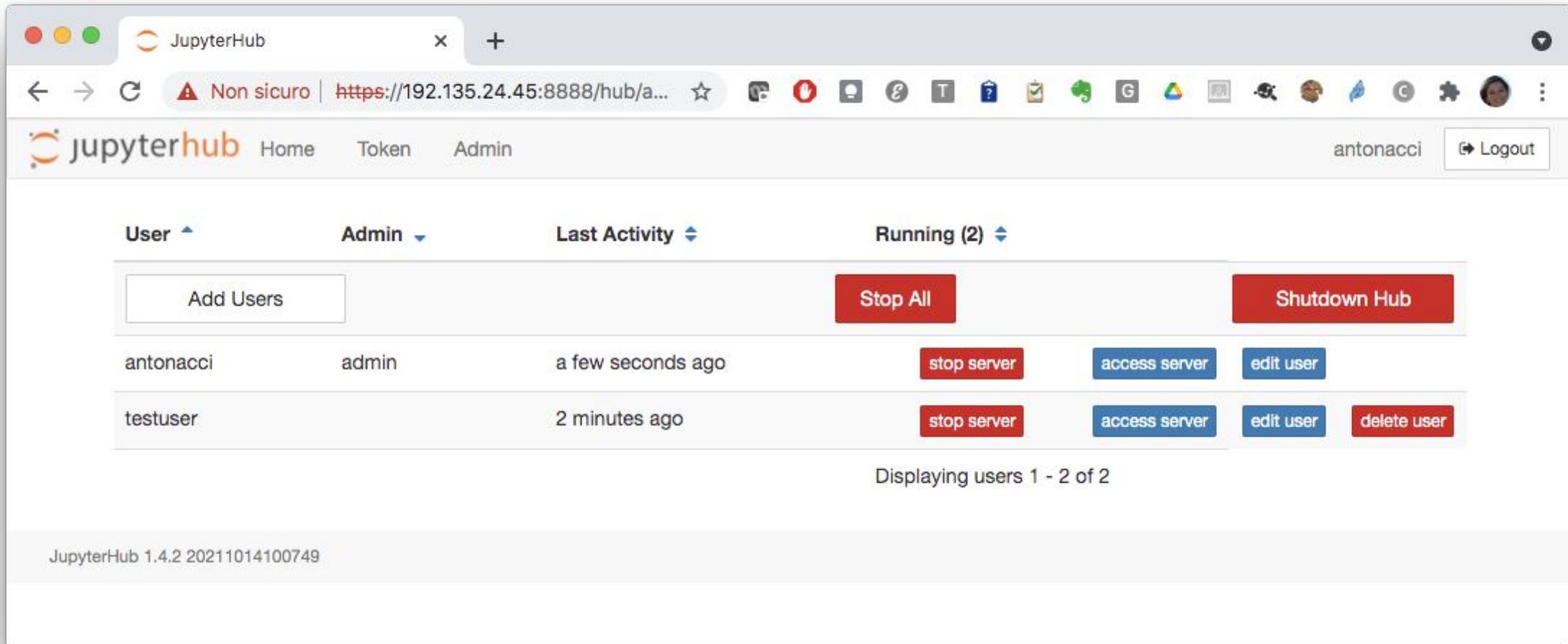
```
antonacci@vnode-0:~$ sudo docker ps
```

CONTAINER ID	IMAGE	COMMAND	NAMES
00757aa6f5eb	dodasts/persistent-storage-base:v4	"jupyterhub-singleuser"	jupyter-antonacci
6d423424d886	grafana/grafana:latest	"/run.sh -config /op..."	monitoring_grafana
de62257e3167	prom/prometheus:latest	"/bin/prometheus --c..."	monitoring_prometheus
27e34015e9ad	google/cadvisor:latest	"/usr/bin/cadvisor -..."	monitoring_cadvisor
bbf6cf47f460	prom/node-exporter:latest	"/bin/node_exporter"	monitoring_node_exporter
bed13c8c937c	jupyterhub/jupyterhub	"/usr/bin/python3 /u..."	jupyterhub_jupyterhub_1
e03657db364b	jupyterhub/configurable-http-proxy	"/srv/configurable-h..."	jupyterhub_http_proxy_1

```
antonacci@vnode-0:~$ sudo docker exec -it jupyter-antonacci bash
```

```
root@00757aa6f5eb:/workarea#
root@00757aa6f5eb:/workarea# ps aux
USER      PID %CPU %MEM    VSZ   RSS TTY      STAT START  TIME COMMAND
root         1  0.3  2.3 979764 94852 ?        Ssl  09:25  0:03 /usr/bin/python3 /usr/local/bin/jupyterhub-singleuser --port 8889 --ip 0.0.0.0 --allow-root --debug
root        12  0.0  0.0      0     0 ?        Z    09:25  0:00 [spawn.sh] <defunct>
root        32  0.1  1.7 903896 71760 ?        S,  09:25  0:01 ./sts-wire https://iam.cloud.infn.it/ antonacci https://minio.cloud.infn.it/ /antonacci ../s3/antonacci
root        33  0.5  0.0      0     0 ?        Z    09:25  0:05 [sts-wire] <defunct>
root        55  0.2  1.5 1370576 63076 ?        S,  09:25  0:02 /root/.cache/sts-wire/rclone --config /.init/.antonacci/rclone.conf --log-file /.init/.antonacci/rclone.log --log-level DEBUG --use-json-log --no-check-certificate --cacert /etc/ssl/certs/ca-certificates.crt
root       182  0.1  0.0 18516  3288 pts/0     Ss   09:43  0:00 bash
root       198  0.0  0.0 34412  2804 pts/0     R+  09:43  0:00 ps aux
```

The admin panel



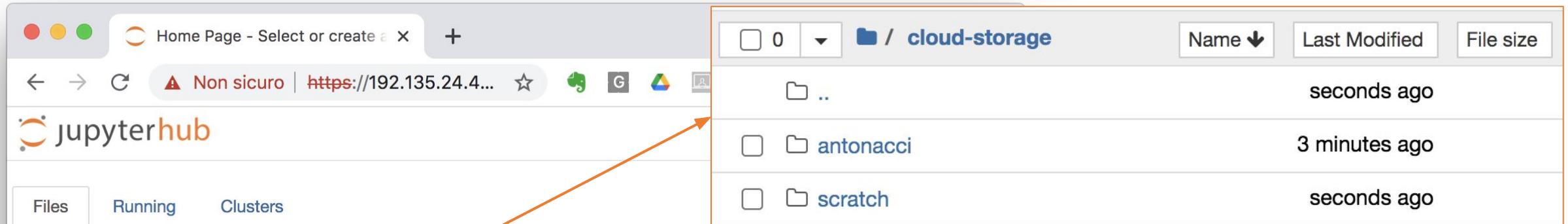
A screenshot of a web browser displaying the JupyterHub Admin panel. The URL is <https://192.135.24.45:8888/hub/admin>. The page shows a list of users: antonacci (admin) last active a few seconds ago, and testuser (admin) last active 2 minutes ago. For each user, there are buttons to Stop All, access server, edit user, and delete user. A red "Stop All" button is also present above the user list. The top navigation bar includes links for Home, Token, Admin, Logout, and a user profile for antonacci.

User	Admin	Last Activity	Running (2)
antonacci	admin	a few seconds ago	stop server access server edit user
testuser	admin	2 minutes ago	stop server access server edit user delete user

Displaying users 1 - 2 of 2

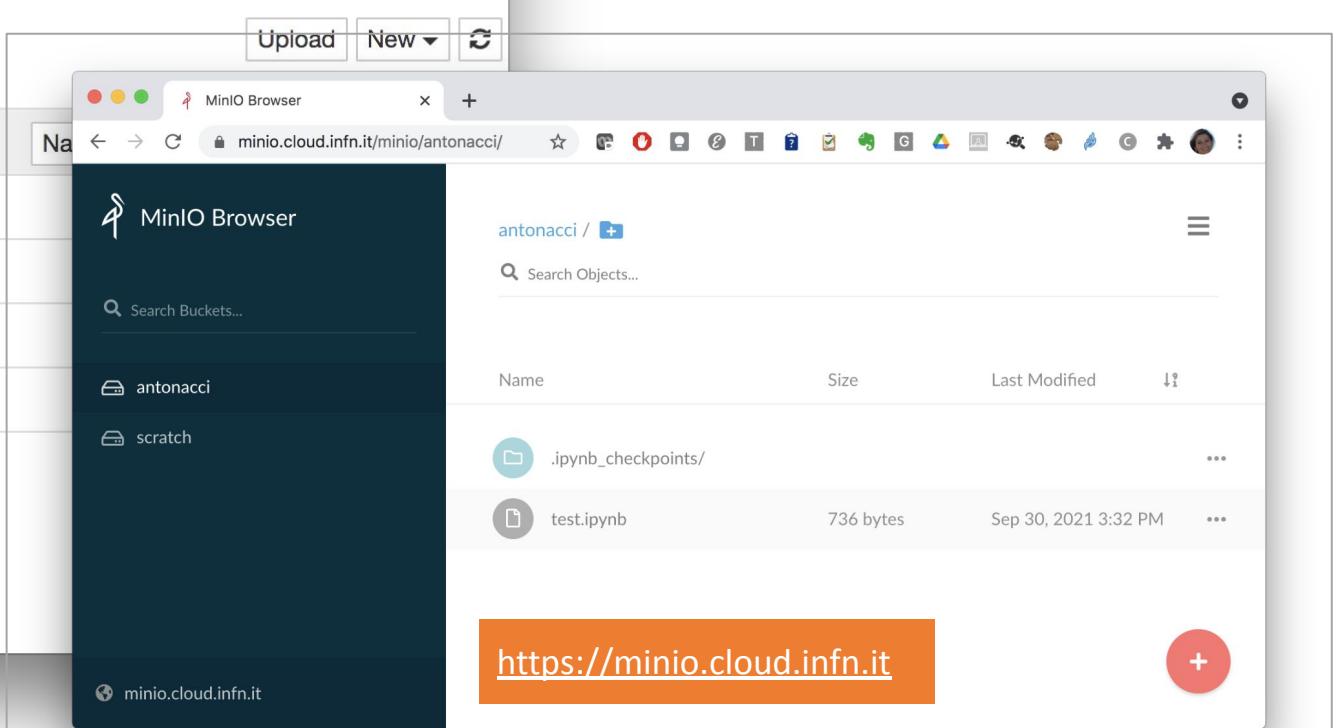
JupyterHub 1.4.2 20211014100749

The user view



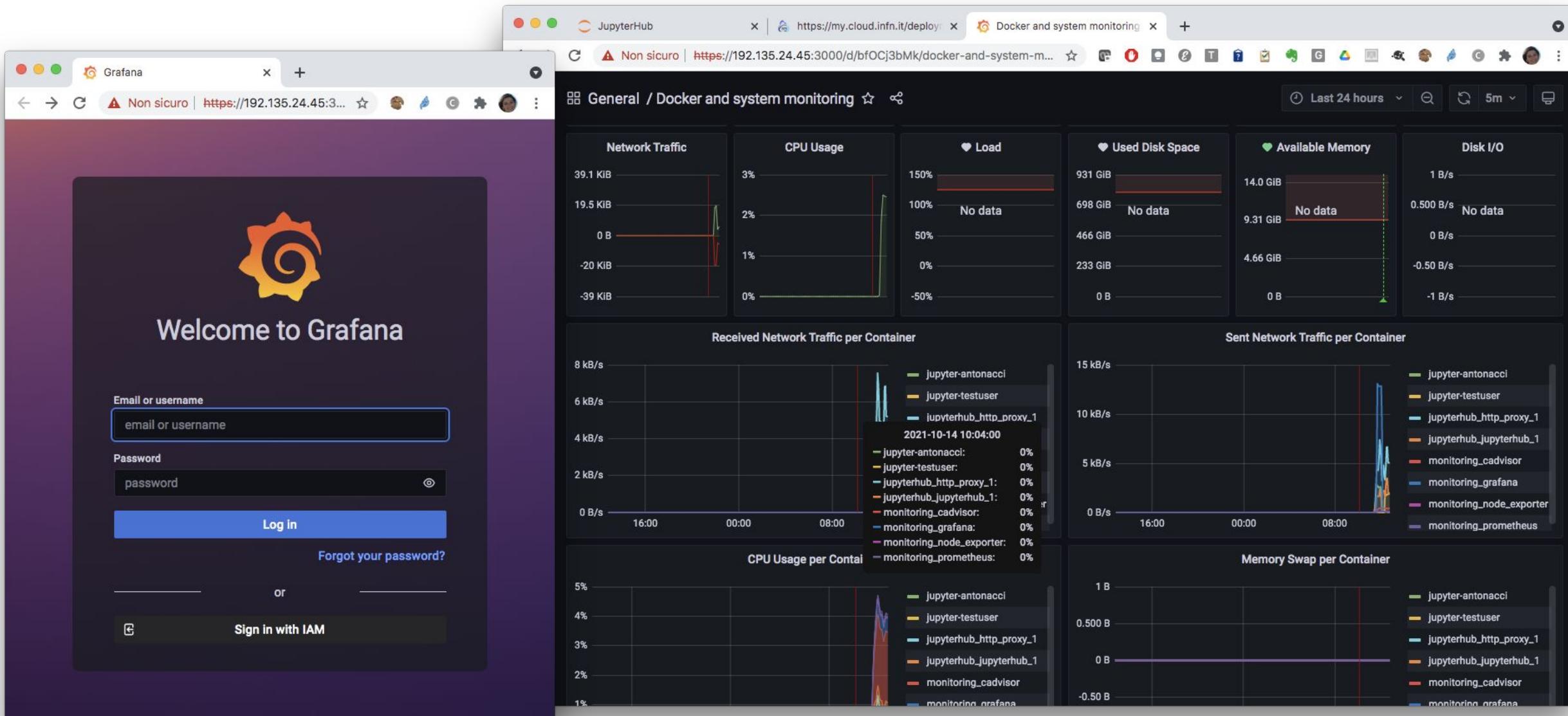
The screenshot shows the JupyterHub interface with a sidebar on the left containing 'Files', 'Running', and 'Clusters' tabs. Below the sidebar, a list of cloud storage options is shown: 'cloud-storage' (selected), 'examples', 'private', and 'shared'. An orange arrow points from the 'cloud-storage' item in the sidebar to the 'cloud-storage' folder in the main content area.

Name	Last Modified
...	seconds ago
antonacci	3 minutes ago
scratch	seconds ago



The screenshot shows the MinIO Browser interface with a sidebar on the left listing buckets: 'antonacci' and 'scratch'. The 'antonacci' bucket is selected. In the main content area, a file named 'test.ipynb' is listed with details: Size 736 bytes and Last Modified Sep 30, 2021 3:32 PM. A red button at the bottom right contains the URL <https://minio.cloud.infn.it>.

Monitoring



The image shows a dual-browser setup for monitoring. On the left, a dark-themed Grafana login screen is displayed, featuring a sunburst logo and the text "Welcome to Grafana". It includes fields for "Email or username" and "password", a "Log in" button, and links for "Forgot your password?" and "Sign in with IAM". On the right, a light-themed Docker and system monitoring dashboard is shown. The top navigation bar includes tabs for "JupyterHub", "https://my.cloud.infn.it/deploy...", and "Docker and system monitoring". The main dashboard area is titled "General / Docker and system monitoring" and displays various metrics over the last 24 hours:

- Network Traffic:** Shows traffic in KiB. A sharp spike from ~-39 KiB to ~39.1 KiB occurred around 08:00.
- CPU Usage:** Shows usage in percent. A peak of ~150% was recorded at approximately 08:00.
- Load:** Shows the load average, which is currently "No data".
- Used Disk Space:** Shows disk usage in GiB. Total capacity is 931 GiB, with 698 GiB used and 233 GiB free.
- Available Memory:** Shows memory usage in GiB. Total available is 14.0 GiB, with 9.31 GiB used and 4.66 GiB free.
- Disk I/O:** Shows disk I/O rates in B/s. Rates are mostly near zero, with a small positive peak around 08:00.

Below these are two line charts for network traffic per container:

- Received Network Traffic per Container:** Y-axis ranges from 0 kB/s to 8 kB/s. Multiple containers show spikes, notably "jupyter-antonacci" and "jupyterhub_http_proxy_1" around 08:00.
- Sent Network Traffic per Container:** Y-axis ranges from 0 B/s to 15 kB/s. Similar to the received traffic, with spikes from multiple containers around 08:00.

At the bottom, there are two more line charts:

- CPU Usage per Container:** Y-axis ranges from 1% to 5%. Spikes are visible for several containers around 08:00.
- Memory Swap per Container:** Y-axis ranges from -0.50 B to 1 B. "monitoring_prometheus" shows a significant spike around 08:00.

The legend for the containers includes:

- jupyter-antonacci
- jupyter-testuser
- jupyterhub_http_proxy_1
- jupyterhub_jupyterhub_1
- monitoring_cadvisor
- monitoring_grafana
- monitoring_node_exporter
- monitoring_prometheus



Computational environment for
Machine Learning INFN
(ML_INFN)



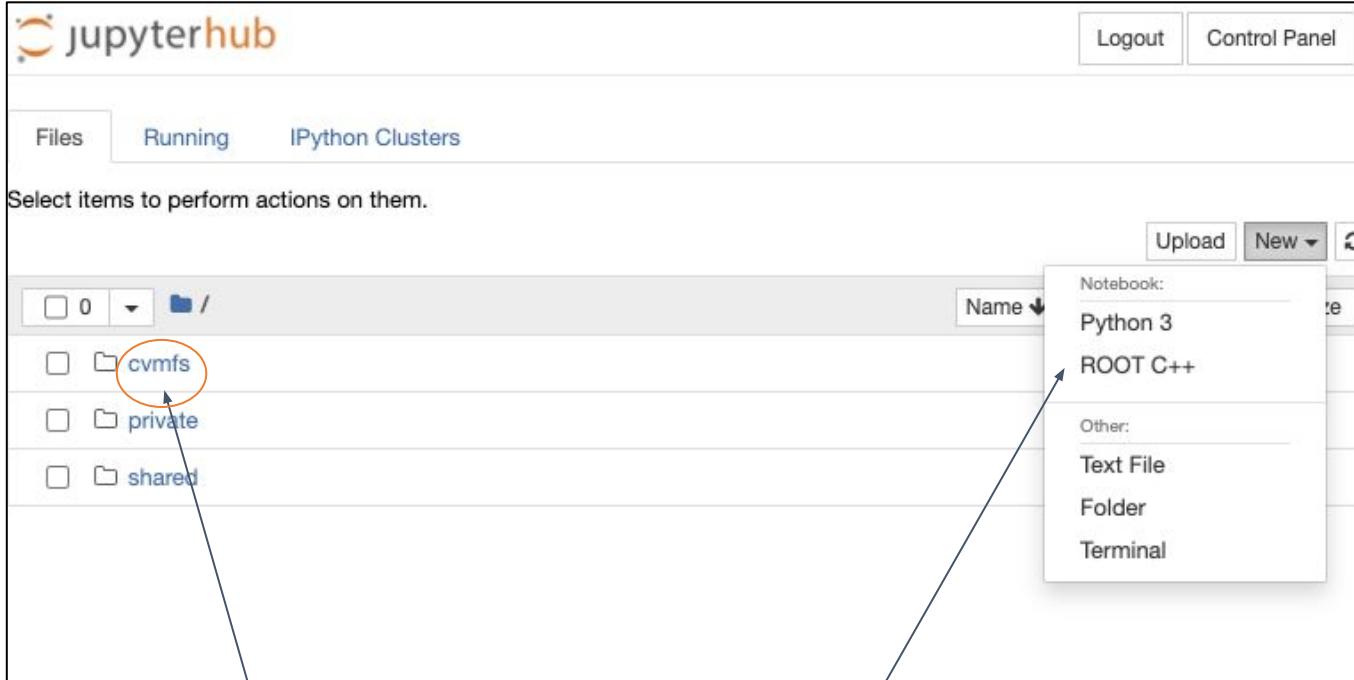
Working Station for CYGNO
experiment



Community customizations

Built on top of the Jupyter VM use-case

ML-INFN environment



CVMFS mount

Customized image
with specific libraries

The screenshot shows a terminal window with the following content:

```
# bash
# /opt/t2k/jupyterhub/notebooks/notebook.ipynb
# WARNING: You are running this container as root, which can cause new files in mounted volumes to be created as the root user on your host machine.
# To avoid this, run the container by specifying your user's userid:
$ docker run -u $(id -u):$(id -g) args...
root@bd8f6fe3da4c:/workarea# nvidia-smi
Sun Mar 21 15:58:10 2021
+-----+
| NVIDIA-SMI 460.32.03    Driver Version: 460.32.03    CUDA Version: 11.2 |
+-----+
| GPU  Name Persistence-M  Bus-Id Disp.A  Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap | Memory-Usage | GPU-Util  Compute M. |
|          |          |          |      % |      %   |        |       MIG M. |
|-----+
| 0  Tesla T4      On   00000000:00:05.0 Off    0MiB / 15109MiB | 0%     Default |
| N/A   34C    P8    9W / 70W |           |          |          |          |
+-----+
| 1  Tesla T4      On   00000000:00:06.0 Off    0MiB / 15109MiB | 0%     Default |
| N/A   35C    P8    9W / 70W |           |          |          |          |
+-----+
+-----+
| Processes:                               GPU Memory |
| GPU  GI CI PID  Type  Process name        Usage |
| ID   ID   |                               |
+-----+
| No running processes found               |
+-----+
root@bd8f6fe3da4c:/workarea#
```

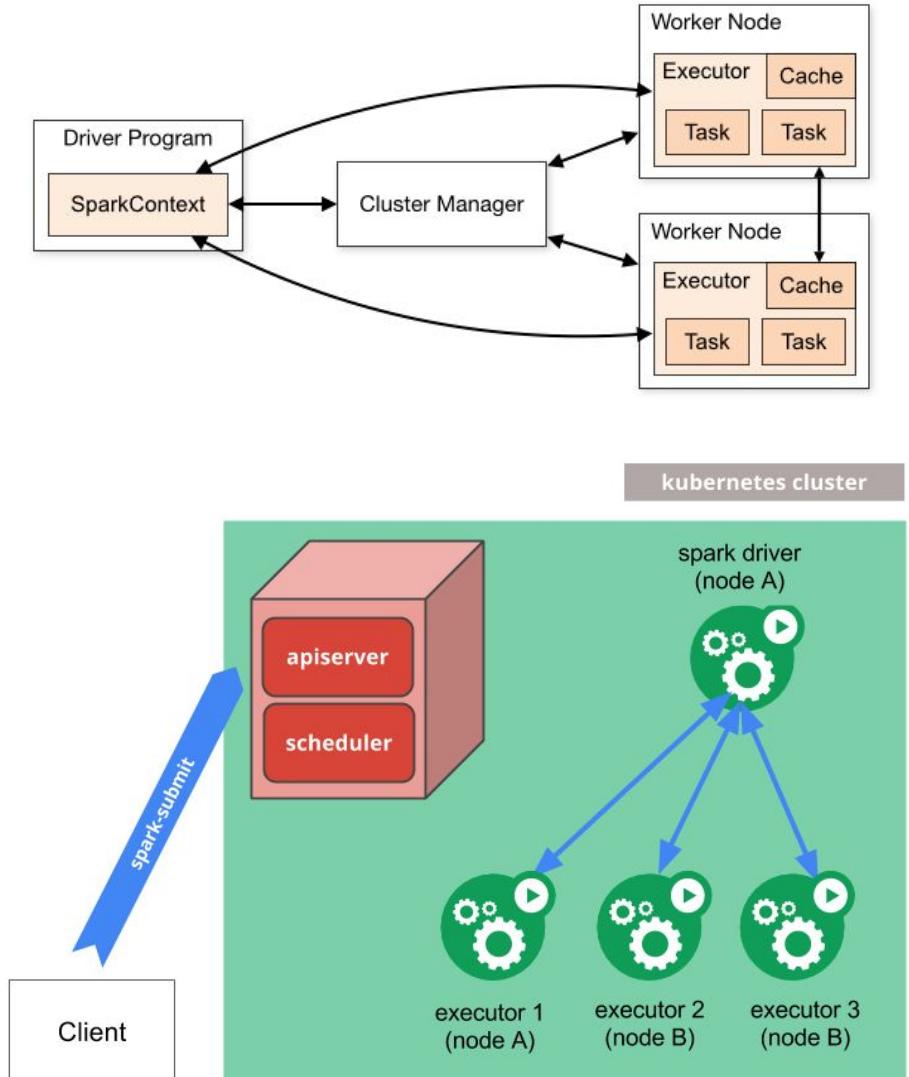
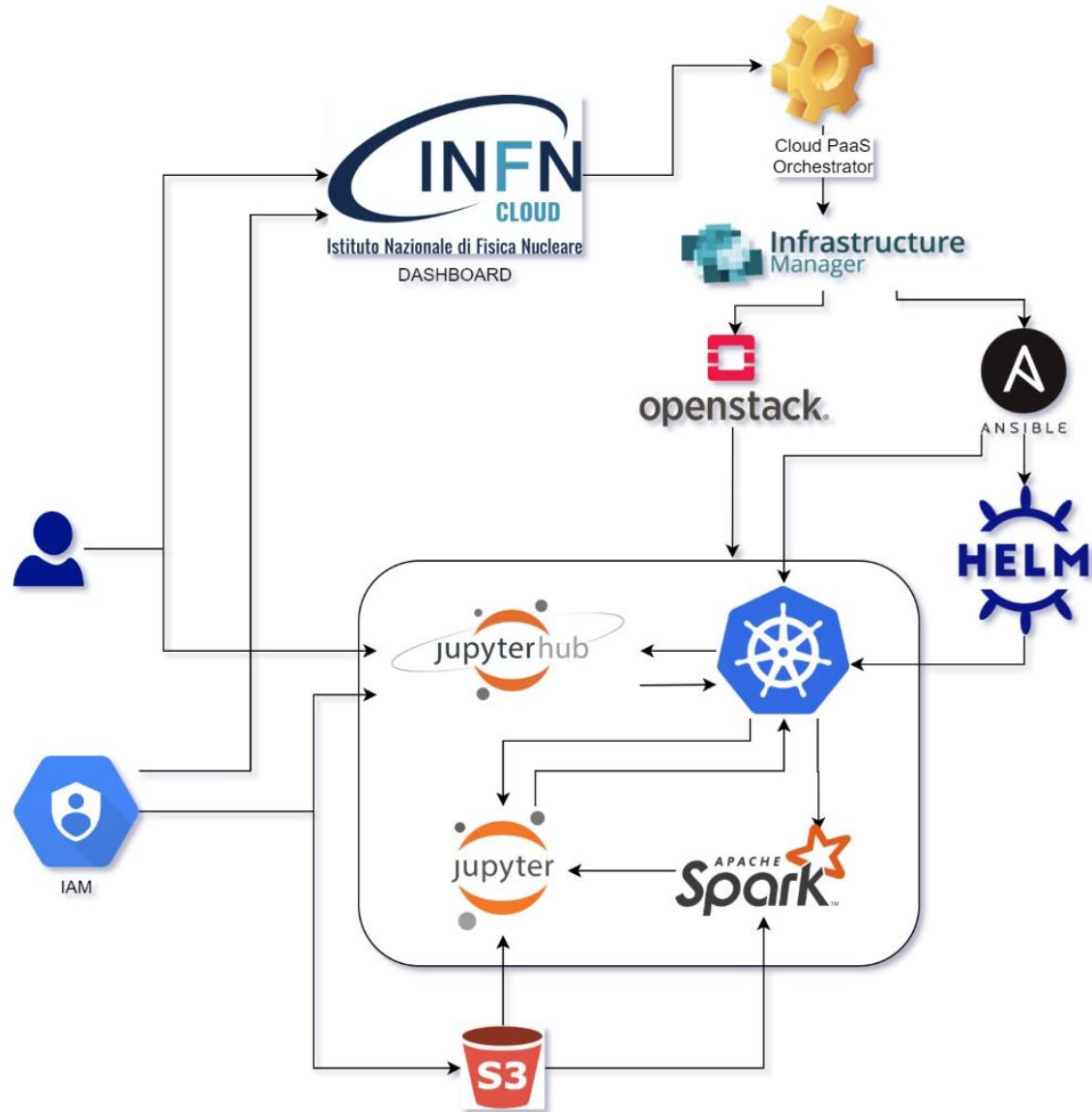
GPU(s) availability



Spark + Jupyter cluster

How to deploy a complete Spark + Jupyter Notebook on top of a Kubernetes (K8s) computing cluster

Deployment architecture





The deployment outputs

11ec1f82-4096-1645-adef-0242699101a7 ← Back

Description: spark

Overview Input values **Output values**

k8s_dashboard: <https://dashboard.192.135.24.228.myip.cloud.infn.it>

k8s_wn_ip: ['192.168.133.229', '192.168.133.157']

grafana_endpoint: <https://grafana.192.135.24.228.myip.cloud.infn.it>

jupyter_endpoint: <https://jhub.192.135.24.228.myip.cloud.infn.it/hub>

k8s_api: <https://api-kubernetes.192.135.24.228.myip.cloud.infn.it/>

k8s_master_ip: 192.135.24.228

ssh_account: antonacci

kubeconfig:

Download Copy to clipboard



And more...

Further use-cases/services

- Elasticsearch + Kibana - already available
- Sync&Share aaS - already available
- HTCondor cluster - will be available soon
- Notebook as a Service (NaaS) - beta testing will start soon

INFN-Cloud allows you to implement new services and/or customize existing ones

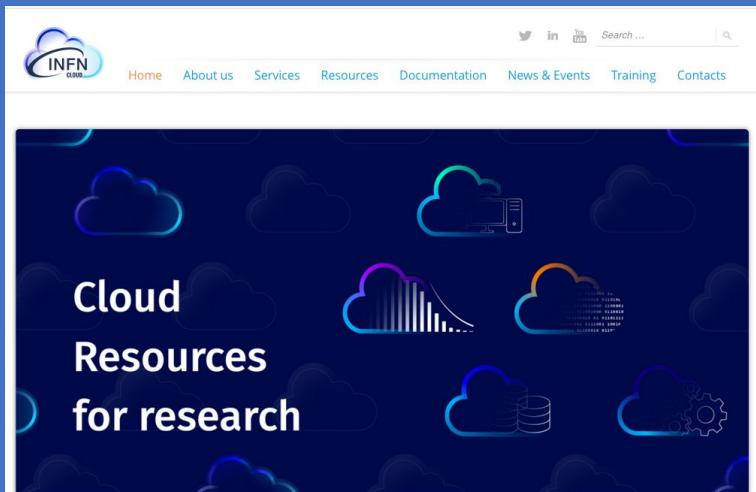
- ❑ please contact us at cloud-support@infn.it and you will be redirected to the proper INFN Cloud support team.



References

Web site:

<https://www.cloud.infn.it>



Documentation :

<https://guides.cloud.infn.it/docs/users-guides/en/latest/>

Docs » Welcome to the INFN Cloud Use Cases Documentation

[View page source](#)

Welcome to the INFN Cloud Use Cases Documentation

You'll find here useful information regarding the use-cases supported on the INFN Cloud infrastructure.

Table of Contents

- Getting Started
- How To: Create VM with ssh access
- How To: Configure the backup on your deployment
- How To: Deploy Sync&Share aaS

Support :

<https://servicedesk.cloud.infn.it> or [✉️ cloud-support@infn.it](mailto:cloud-support@infn.it)



INFN CCR Help Center
INFN Cloud

Welcome! You can raise a request to INFN Cloud from the options provided.

What do you need help with?

Search



General

Training

Suggestions



Services trial questions

Want to see if our services can fit your workflows?
Trying out our services and want more information?
Select this and we'll be happy to answer your questions.

Thank you

for your attention!

Q&A