

# Between autonomy and innovation

M. Carboni

the hidden costs of digital transformation

Linux Day (2024) Palermo



# GARR: the Italian Research & Education Network

**GARR** stand for **Gruppo Armonizzazione Rete della Ricerca**  
Research Network Harmonization Group, started late 80'

- **The Community:** 1,000+ sites, 3 million of end users (research institutions, universities, schools, ehealth, ...)
- **The Network:** 20,000 km of fibre, 100 PoPs, 10 DC, 4Tbps (BB), 100G+
- **Lightweight Organisation:** 80+ staff that evolve, manage and control network, cloud, applications



Since **Nov/87**

# The Community



# The Today Network

## Numbers

- ★ 3M+ end users
- ★ 20,000+ km Fibre
- ★ 1,500 km Submarine Spectrum
- ★ 100+ PoPs (Optical/Packet)

## Network Capacity

- ★ **new** (BB) 21T / (Access) 5T

## BackBone links

- ★ **new** 200G, 400G ⇒ upto 1T+

## Access Capacity

- ★ **new** 10G ⇒ 400G+

## Computing and Storage

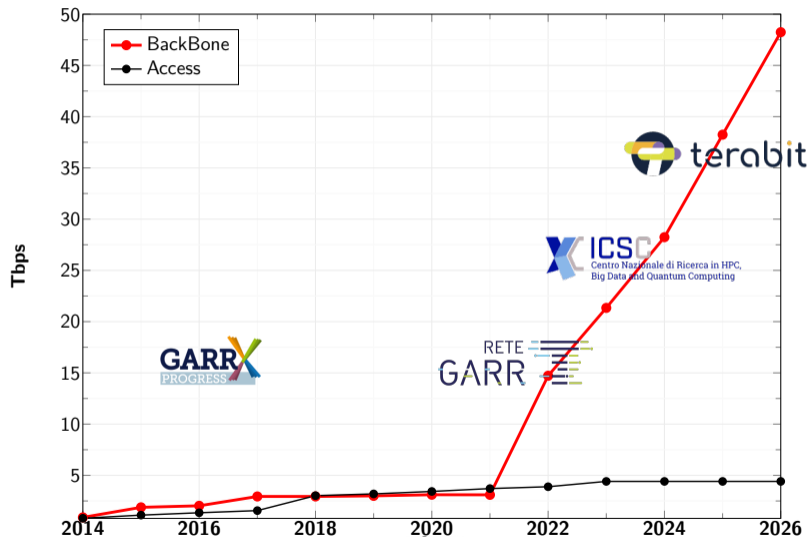
- ★ 1 DC: distributed on 9 POPs
- ★ ~20,000 vCore, ~12PB Storage

## Interconnessioni

- ★ **Ricerca 2T+**
  - ⇒ GEANT, CERN, ecc.
- ★ **Global Internet: 400G+**
  - ⇒ Arelion, Cogent, MIX, Namex, ecc.
- ★ **Peering Diretto: 800G+**
  - ⇒ Microsoft, Google, Amazon



# Backbone Traffic Growth



Dark Fibre 12,000 km

Submarine 1,500km

Backbone 20T, 50T+

Access 100G+, 400G+, 1T+

Global Connectivity

Experimental Infrastructure



# Network Services

## Connectivity

10G, 100G, 400G,  
IPv4, IPv6,  
Multicast, L2/L3  
VPN  
LI: 100G+,  $\lambda$ ,  
Spectrum

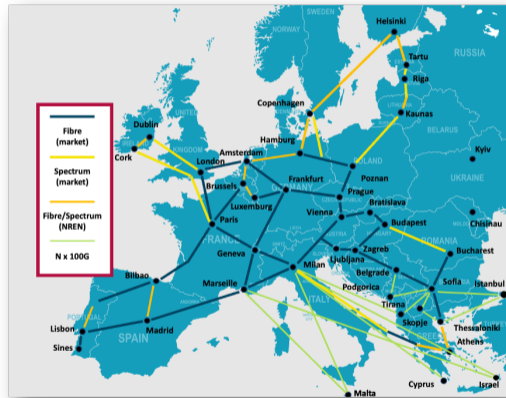
## Infrastructural

DNS, LIR, NIC,  
EduRoam,  
SCARR, Idem,  
EduGain,  
TCS  
(Trusted Certificate Service)

## Experimental

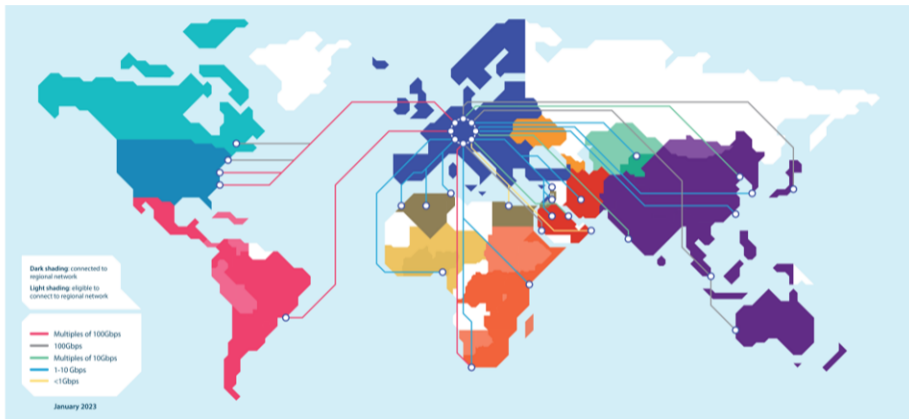
Quantum  
Communication,  
Time-Frequency,  
Sensing

# GEANT Network



Total kilometers fibre/spectrum **30,928km**

# Global Networking attraverso GEANT







Consortium  
**GARR**

THE ITALIAN  
EDUCATION  
& RESEARCH  
NETWORK

# Innovation Impact



# Investigation and Developments

from limited resources to new possibilities



## Ballon - open optical network

Optical Network Design and Planning Tool  
Open Optical Network Controller  
Performance Optimization



## Spectrum Sharing

CNAF-CERN DCI pilot (Multidomain GARR+GEANT)  
Spectrum Sharing User Service Definition



## Sensing

Sensing over Subsea Cables  
GEANT WP7T2 Demo activity  
SUBMERSE project relationship



## Time and Frequency

White Rabbit over DWDM  
Pan-European Infrastructure (CLONETS)  
GN5-2 Incubator



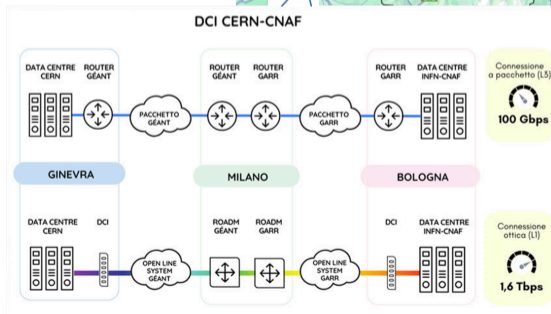
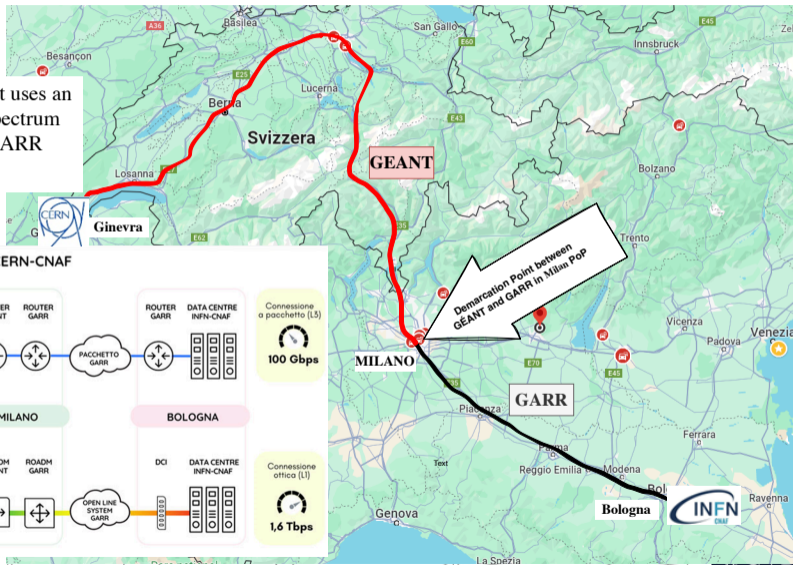
## Quantum Technologies (QKD)

University of Padua: QKD + Data link field trial  
Quantum Initiative  
GEANT Quantum Strategy group



# 1.6Tbps CERN-CNAF INFN DCI

Pure Optical connection that uses an empty slice of the optical spectrum available on GÉANT and GARR fibre infrastructure

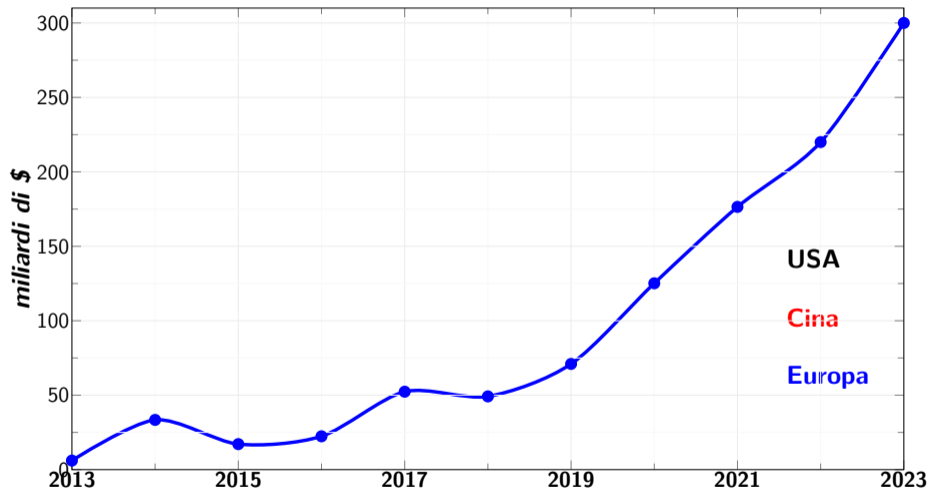


# What if innovation is growing too fast?

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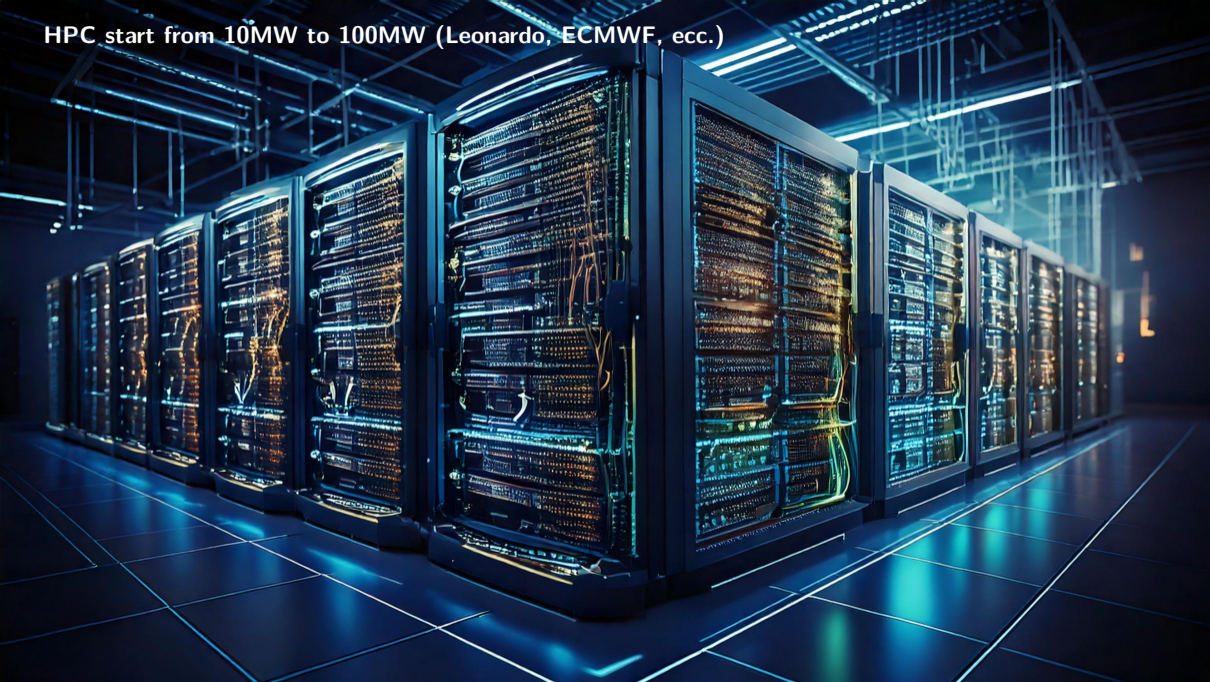
In some cases resources for technology seem to be unlimited, and limitless growth feels within reach...

# AI: Global Investments from 2013 to 2023



Fonte: Our World in Data

HPC start from 10MW to 100MW (Leonardo, ECMWF, ecc.)



The background features a blue gradient with white wireframe models of industrial cooling towers and other structures. A vertical red line is positioned on the left side of the text.

**Google announces plan to  
build 7 nuclear reactors to  
power AI systems**

# AI drives 48% increase in Google emissions

3 July 2024

Share  Save 

**Imran Rahman-Jones**

Technology reporter

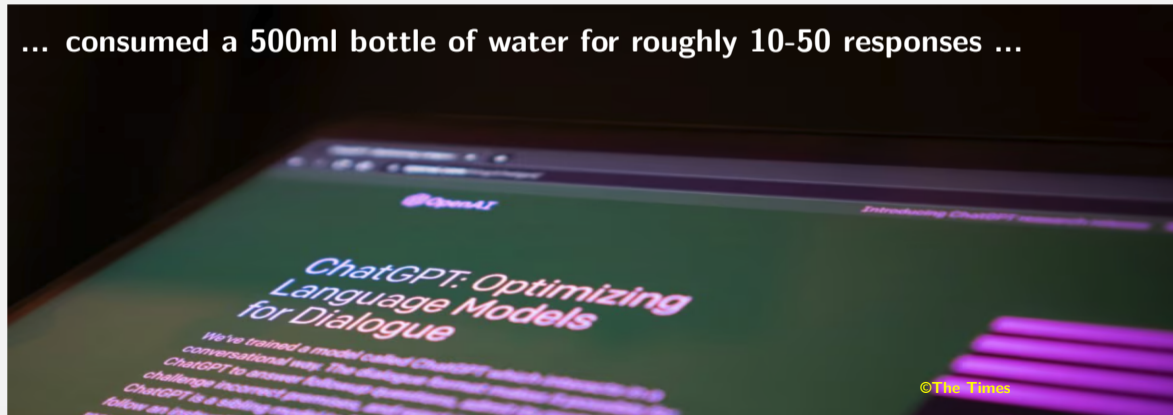




# ChatGPT consumes more water than expected

According to a study by the University of California, the clusters that power OpenAI's intelligence require a lot of water, four times more than was thought.

... consumed a 500ml bottle of water for roughly 10-50 responses ...



# Server Energy Consumption

■ Chassis ■ CPU ■ Other ■ RAM ■ COOLING

kW

5

4,5

4

3,5

3

2,5

2

1,5

1

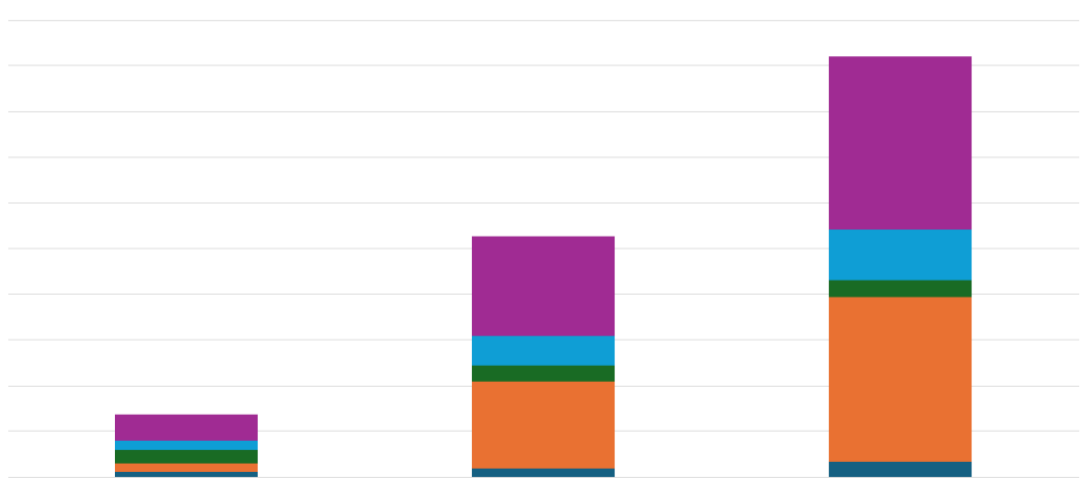
0,5

0

Idle

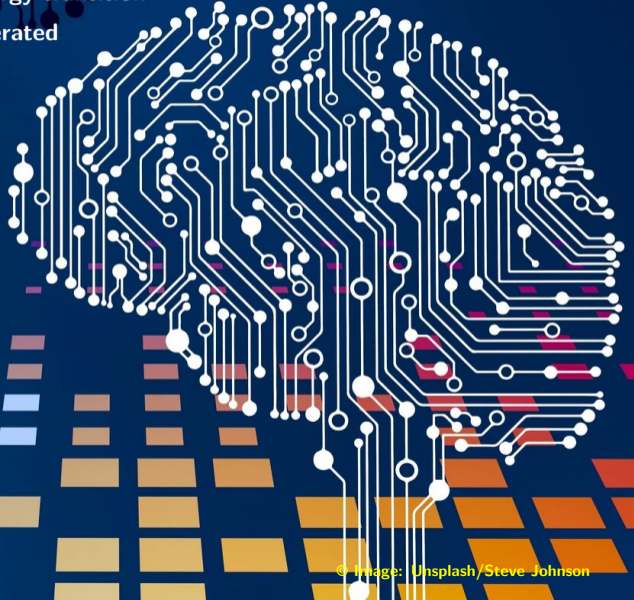
70% Load

100% Load



AI requires significant computing power...  
But AI tools can also help facilitate the energy transition  
Transitioning from CPU-only to GPU-accelerated

World Economic Forum





technology



# THE 2024 MAD (MACHINE LEARNING, ARTIFICIAL INTELLIGENCE & DATA) LANDSCAPE

The main grid is organized into several key sections:

- INFRASTRUCTURE:** Includes logos for storage (AWS, Azure, Google Cloud), data lakes (Databricks, Snowflake), data warehouses (Snowflake, Databricks, Redshift), and various database providers (CockroachDB, Yugabyte, etc.).
- ANALYTICS:** Features visualization tools (Tableau, Power BI), data science platforms (DataCamp, Coursera), and analytics providers (Alteryx, SAS, etc.).
- MACHINE LEARNING & ARTIFICIAL INTELLIGENCE:** A large section with a central 'ML/AI' logo. It includes data science platforms (DataRobot, H2O), enterprise ML platforms (Databricks, AWS SageMaker), and various AI/ML startups (OpenAI, Anthropic, etc.).
- APPLICATIONS - ENTERPRISE:** Divided into sub-sections like CRM (Salesforce), HR (Workday), and various industry-specific solutions.
- APPLICATIONS - HORIZONTAL:** Focuses on cross-industry solutions like cybersecurity (Okta), cloud security (CrowdStrike), and productivity tools.
- APPLICATIONS - INDUSTRY:** Tailored for sectors like healthcare (Tempus), finance (BlackRock), and manufacturing (Siemens).

## OPEN SOURCE INFRASTRUCTURE

This section highlights various open-source projects and tools, including:

- DATA MANAGEMENT:** Apache Hadoop, Apache Spark, Apache Kafka, Apache Flink, Apache Beam, Apache Airflow, Apache Druid, Apache Kudu, Apache Hive, Apache Pig, Apache Tez, Apache Mahout, Apache Storm, Apache Solr, Apache Lucene, Apache Mahout, Apache Mahout, Apache Mahout.
- INFRASTRUCTURE:** Kubernetes, Docker, Prometheus, Grafana, Elasticsearch, OpenSearch, InfluxDB, TimescaleDB, PostgreSQL, MySQL, MongoDB, Redis, Apache ZooKeeper, Apache ZooKeeper, Apache ZooKeeper.
- ANALYTICS:** Apache Mahout, Apache Mahout, Apache Mahout, Apache Mahout, Apache Mahout, Apache Mahout, Apache Mahout, Apache Mahout, Apache Mahout, Apache Mahout.

## DATA SOURCES & APIS

This section lists various data sources and APIs, including:

- DATA SOURCES & APIS:** LinkedIn, GitHub, Kaggle, Amazon, Google, Facebook, Twitter, etc.
- DATA SOURCES & APIS:** LinkedIn, GitHub, Kaggle, Amazon, Google, Facebook, Twitter, etc.
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# Can we cope?

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In some cases resources for technology seem to be unlimited, and limitless growth feels within reach...

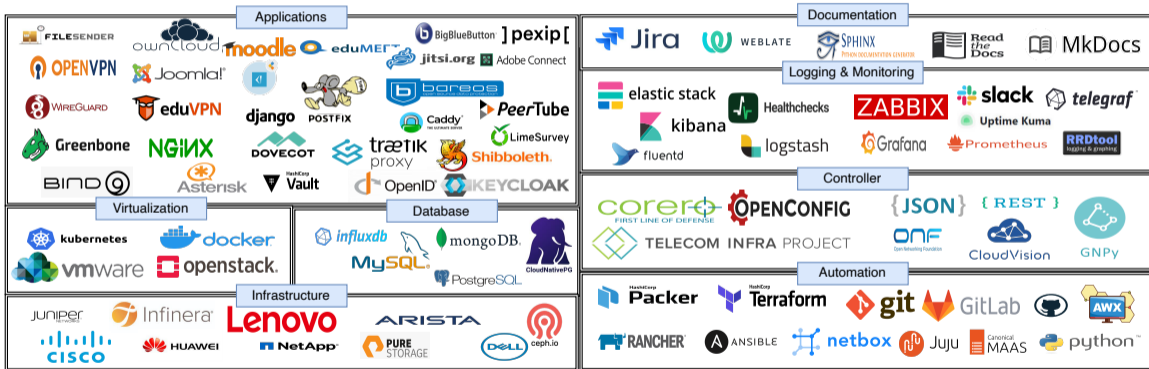
# An Alternative Approach





# The ICT complexity (our playground)

.... GARR toolbox (2016-today)



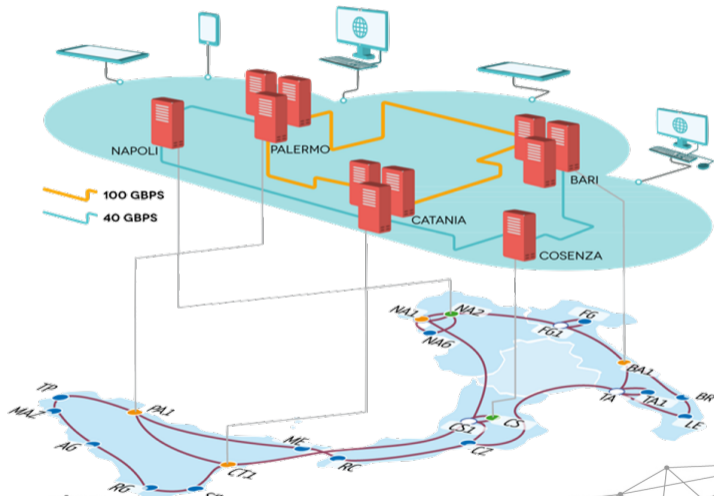
# GARR Cloud Distributed Infrastructure

## Services:

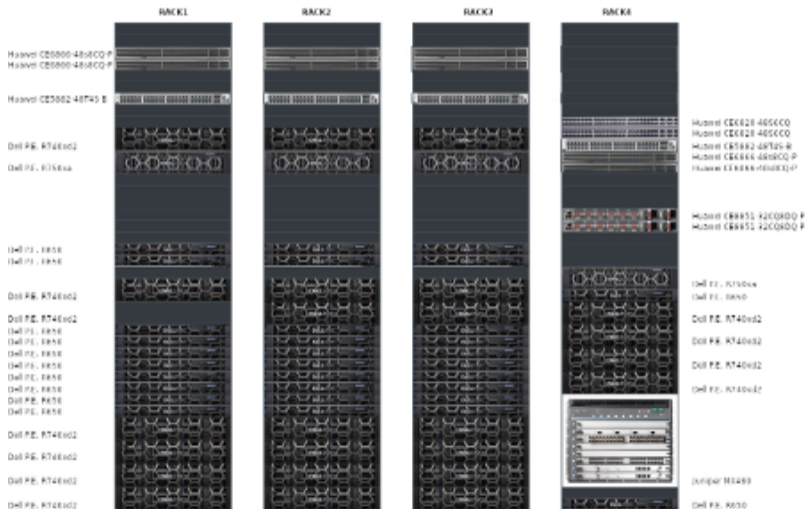
- ➔ IaaS
- ➔ Object Storage

## Resources:

- ➔ Cores: 11500
- ➔ RAM: 90 TB
- ➔ Storage: 16.3 PB (15% SSD)
- ➔ GPU: 333 TFlops



# Palermo Cloud Region



- ➡ CPUs: 2700 cores
- ➡ RAM: 21 TB
- ➡ Storage: 1.3 PB
- ➡ GPUs: 120 TFLOPS

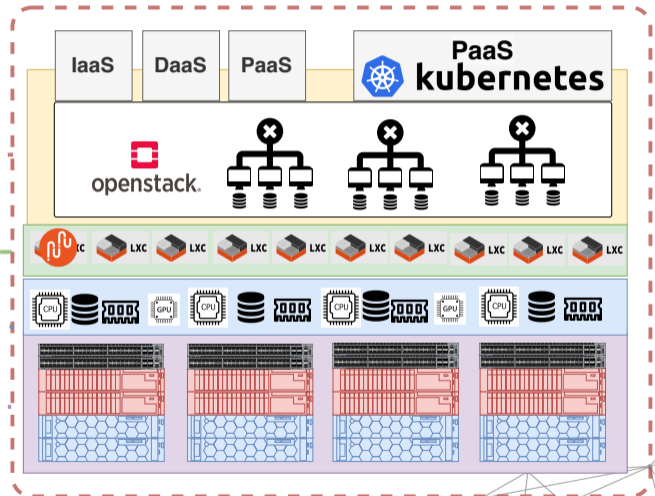
# GC: 4-Layers recipe

1. Application Service

2. Infrastructure Virtualization

3. Operating System

4. Physical Resources



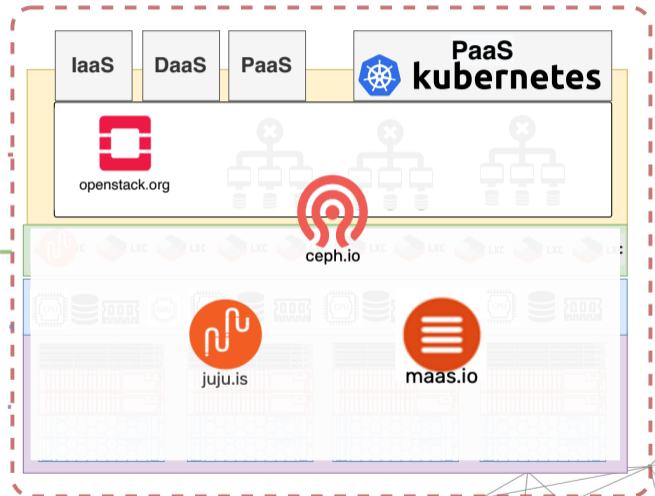
# GC: The Engines

1. Application Service

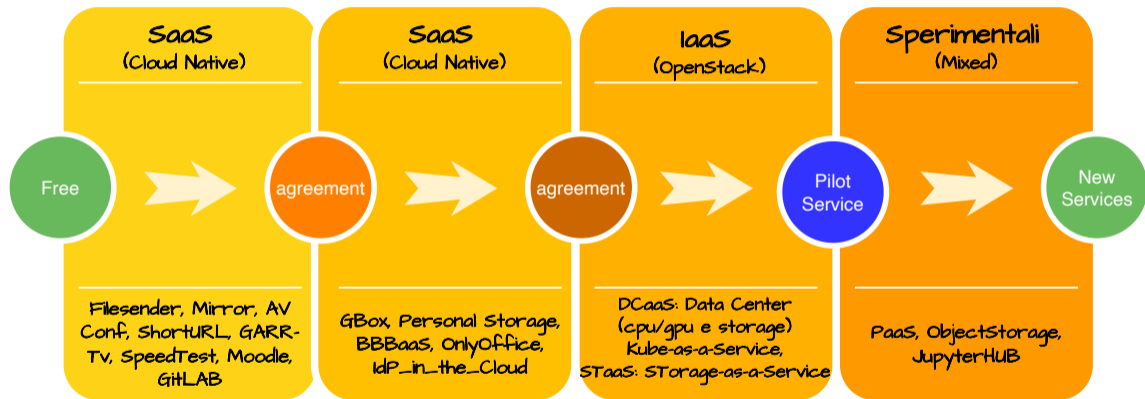
2. Infrastructure Virtualization

3. Operating System

4. Physical Resources



# ICT Services



- Accounting
- Dashboard
- Servizi
- Enti
- Convenzioni
- Persone
- Tags

Servizio  
GARR Virtual Data Centers

**137** ↗ VDC


Dettaglio

Servizio  
GARR Object Storage

**122** ≡ VDC abilitati

Dettaglio

**Energia**



**41kW**

Sum {pa1,ct1,na2}

Enti

**97** 📄 registrati

Dettaglio

Convenzioni

**24** 🤝 registrate

Dettaglio

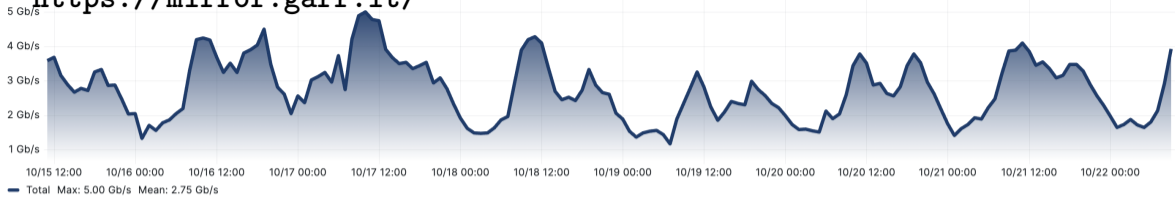
Persone

**577** 👤

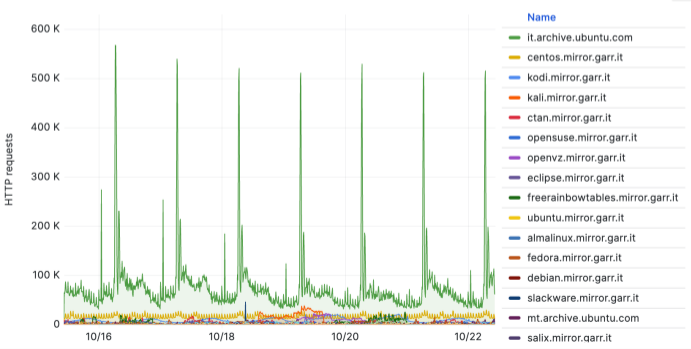
Dettaglio

- Monitoring
- Dashboard
- Servizi
- Floating IPs

# https://mirror.garr.it/



## HTTP Request - Top 20 repos



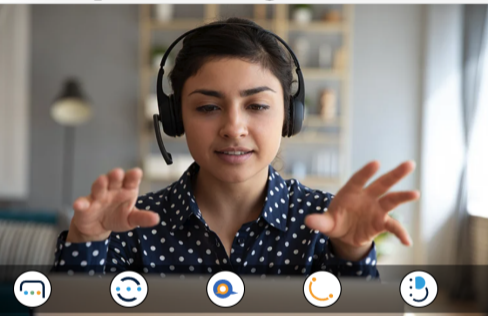
## GeoMAP - Countries



## Transferred data - Top 20 repos



<https://meet.garr.it/>



## Welcome to GARR Meet

### GARR audio and video conferencing portal

A wide choice of simple and secure audio and video conferencing tools, in order to meet all the needs of the Italian research and education community.

[READ MORE >](#)



Webinar mode

Virtual rooms on-demand for webinars



Bridge PSTN

Participation by dialling a phone number



WebRTC

Participation directly from desktop and mobile browser



Recording

Meeting or webinar video-recording feature



Search videos, playlists, channels...



# GARR.tv

The Research and Education community channel

<https://garr.tv/>



Massimo Car...  
@\_w\_3\_g\_...

My account

My library

### IN MY LIBRARY

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Subscriptions

History

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GARRtv Channel



Università e centri di ricerca in Italia  
sono connessi



RAI TG1 Economia - L'Internet della ricerca scientifica

Other videos

AUTOPLAY

<https://scarr.garr.it/>  
GARR SCARR



Greenbone

SCARR is a flexible, secure, remote vulnerability scanning service for GARR APMs, it provides detailed information about identified issues in user network assets, also suggesting remediation.

FIRST LOGIN? PLEASE CHECK FAQ

SUBMIT SCAN

Choose language



SCANNING



PERIODIC BOOKING



REPORT

https://workplace.garr.it/



# ONLYOFFICE

## GARR Workplace

GARR IDP Login

or

Your registration email


Password

Remember 

[Forgot your password?](#)

Sign In

 **No access to the portal?**  
[Contact the portal administration](#)

 **Want to become the portal user?**  
[Click here to join](#)

<https://speedtest.garr.it/>  
GARR SPEEDTEST



LibreSpeed

Start

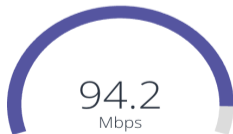
Server:

Roma

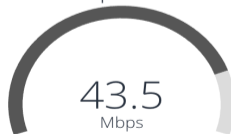
Ping  
19.0 ms

Jitter  
1.75 ms

Download



Upload



90.147.163.7 - Unknown ISP

<https://www.garr.it/it/servizi-garr/eduroam>

eduroam



## CONTATTI

+06 4962 2000  
[eduroam@garr.it](mailto:eduroam@garr.it)

## EDUROAM (EDUCATION ROAMING)

eduroam è il servizio che permette agli utenti in mobilità presso altre organizzazioni di accedere in modo semplice e sicuro alla rete wireless usando le stesse credenziali fornite dalla propria organizzazione.

[EDUROAM.ORG](https://www.eduroam.org)

[NOTIZIE](#)

[STATISTICHE](#)

no free lunch  
knowledge sharing  
solidarity



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Strumenti OpenSource

L<sup>A</sup>T<sub>E</sub>X - Draw.IO - GNU.Makefile