Network Scenarios

M.Carboni
GARR

10.5281/zenodo.14018035

GARR-T new developments

PNRR projects (2023-2025)

terabit

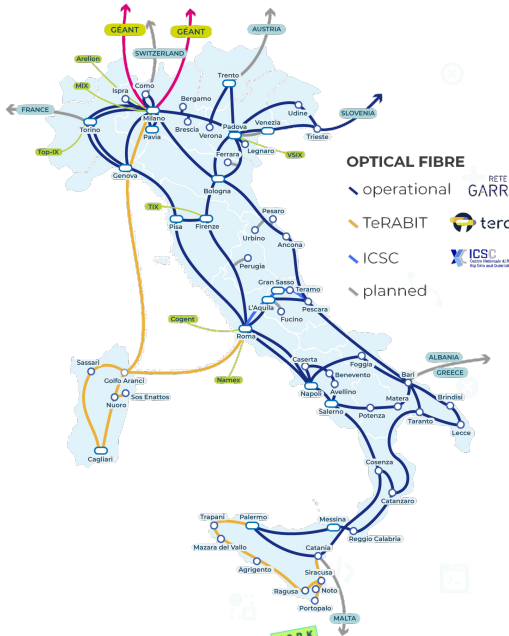
ICSC
Centro Nazionale di Ricerca in HPC, Big Data and Quantum Computing

Opportunity to develop GARR-T network

- Reach new areas: Sardinia and Abruzzo
- Upgrade and integrate network in the South of Italy
- GARR-T reach the goal to become a fully unified and pervasive network for R&E community in the whole country

End User Benefit

- 9 New POPs
- Doubling of POPs in 6 cities
- Distributed 100G access, with 400G available



GARR-T: Optical Network current deployment and evolution

RETE GARR

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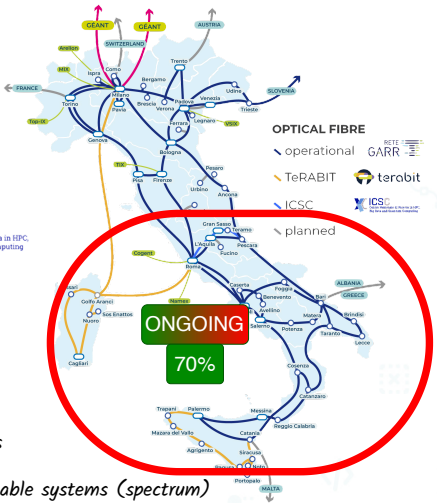
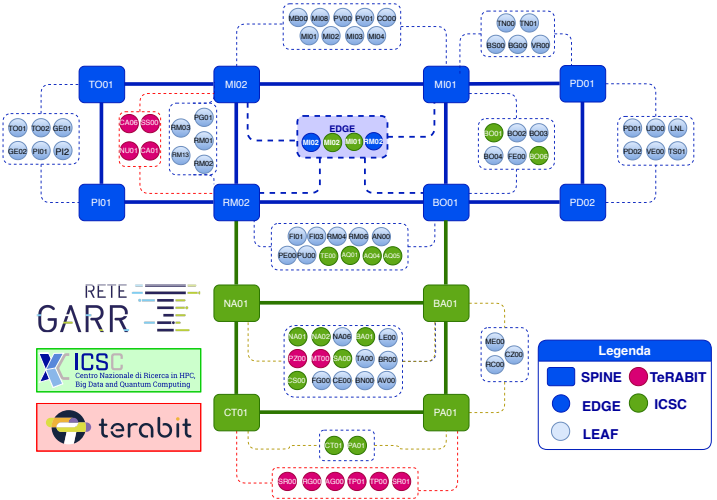


2020-2023
6200 km
42 ROADMs
35 ILA
18 Tbps dayl client capacity

2023-2025
5000 km
35 ROADMs
38 ILA
2 sub-sea cable systems (spectrum)
16 Tbps dayl client capacity

GARR-T: Packet Network current deployment and evolution



2023-2025

- 60+Tbps packet platform upgrade
- 17 new nodes
- 400GEth user interface on packet service platform

The Today Network

Numbers

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

Network Capacity

- ⋆ **new (BB) 23T / (Access) 4T**

BackBone links

- ⋆ **new 200G, 400G ⇒ upto 1T+**

Access Capacity

- ⋆ **new 10G ⇒ 400G+**

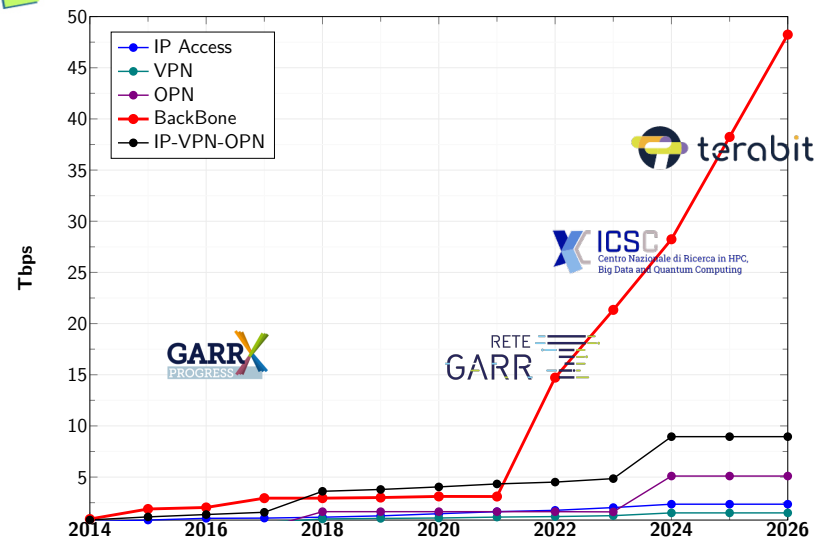
Computing and Storage

- ⋆ 1 DC: distributed on 5 POPs
- ⋆ 1 OS: 4 Cloud Regions
- ⋆ **∼20,000 vCore**, **∼Raw 12PB Storage**

Interconnections

- ⋆ **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

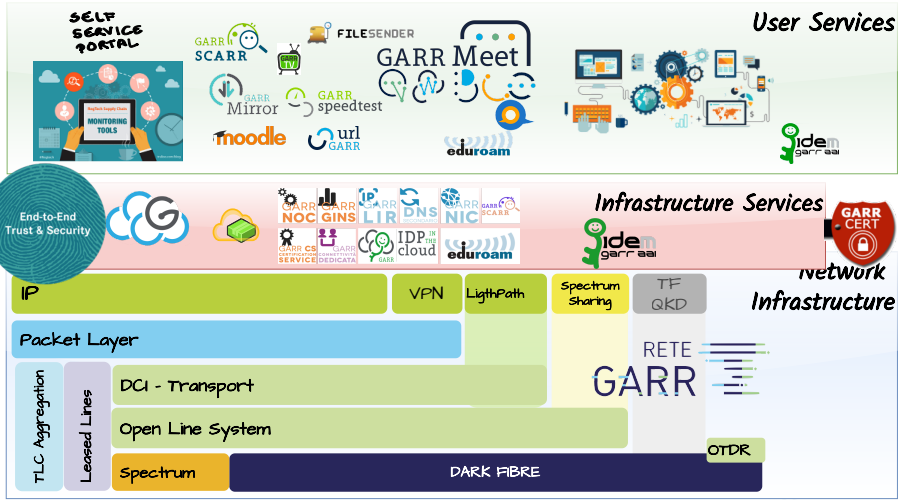
Experimental Infrastructure

Capacity: 8.95T

- **IP: 2.35T**
- **VPN: 1.5T**
- **OPN: 5.1T**

GARR-T platform

network and application infrastructure

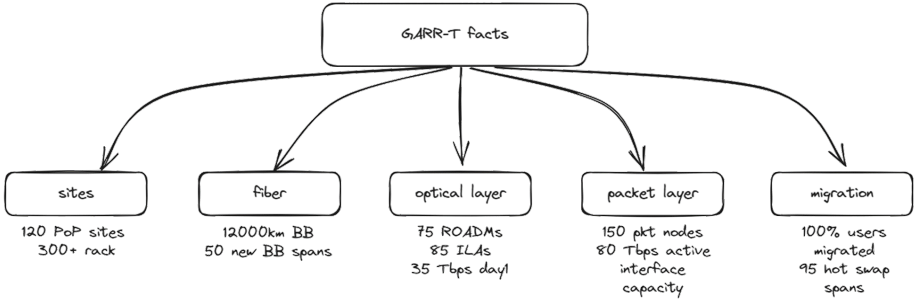


What's next

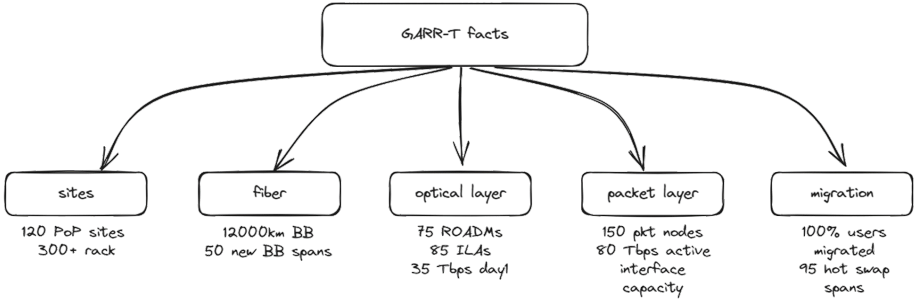
New Requirements

- API-Based Network Configuration
- Update the Generic Network Access (DC vs Users)
- Terabit Access Capacity EuroHPC Hyperconnectivity
- Experimental Network no-data Services

Automation


GARR-T facts
sites
120 PoP sites
300+ rack
fiber
12000km BB
50 new BB spans
optical layer
75 ROADMs
85 ILAs
35 Tbps day!
packet layer
150 pkt nodes
80 Tbps active
interface
capacity
migration
100% users
migrated
95 hot swap
spans

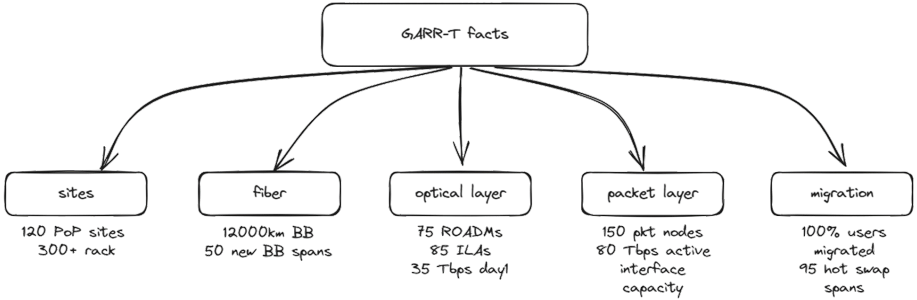
Automation



Packet

- Inventory (Netbox, Paragon)
- Monitoring (TIG)
- Software Upgrade (AWX+Ansible)
- Configuration (PACMAN)
- Consistency Check (PACMAN)
- Traffic Engineering (Paragon)

Automation



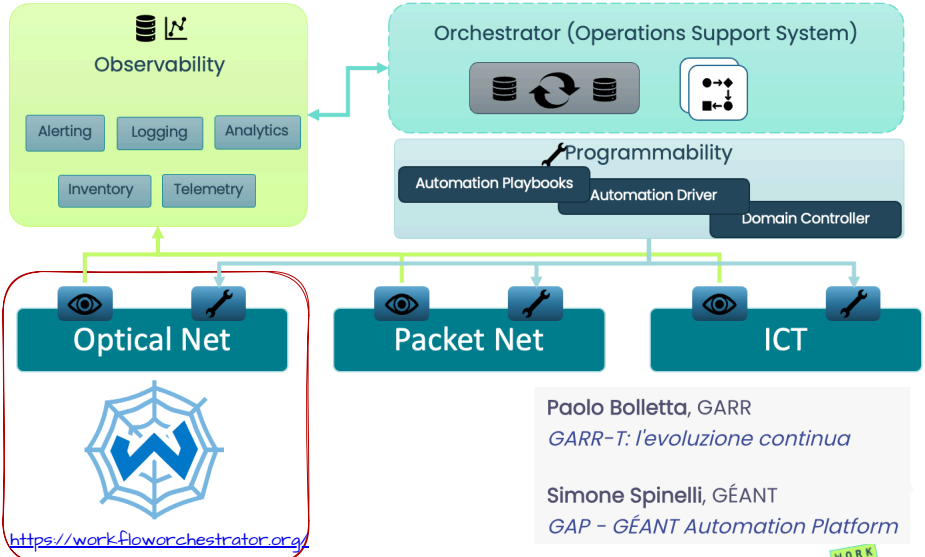
Packet

- Inventory (Netbox, Paragon)
- Monitoring (TIG)
- Software Upgrade (AWX+Ansible)
- Configuration (PACMAN)
- Consistency Check (PACMAN)
- Traffic Engineering (Paragon)

Optical

- Inventory (TNMS Controller, Netbox)
- Monitoring (TIG)
- Software Upgrade (AWX+Ansible)

Orchestration



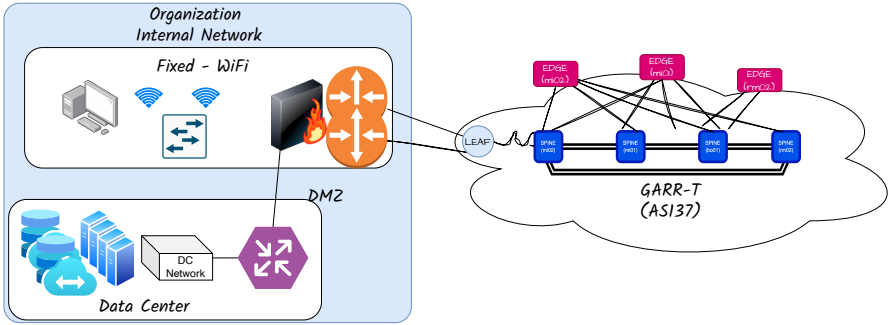
Paolo Bolletta, GARR
GARR-T: l'evoluzione continua

Simone Spinelli, GÉANT
GAP - GÉANT Automation Platform

Reconsidering the Network Access

Tipical User Access

Generic network access with computing infrastructures and end users managed with similar functional criteria



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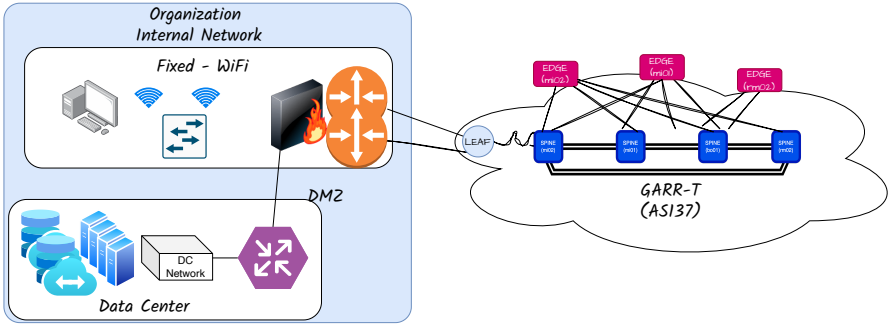
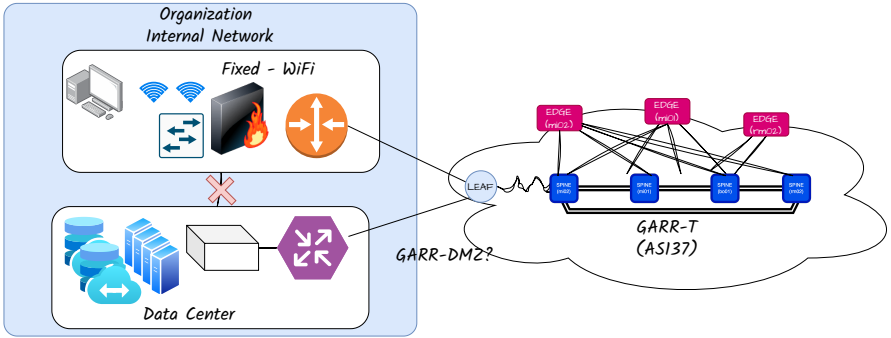


- **Users**: many small flows
- **Servers**: few large flows (Big Flows)

DC and Users Access

Users and computing infrastructures have different needs in terms of bandwidth, security, flexibility. With LAN and WAN becoming synonymous, perhaps we need to start thinking about a **GARR-DMZ**



WORKSHOP GARR 2024

NET MAKERS

HyperConnectivity

EuroHPC JU Call for Extreme Scale Access

EuroHPC JU The ***European High Performance Computing Joint Undertaking*** is a joint initiative between the EU, European countries and private partners to develop a World Class Supercomputing Ecosystem in Europe. **3B€**

preExascale EuroHPC JU has already procured eight supercomputers, located across Europe:

- **LUMI** in Finland
- **Vega** in Slovenia
- **MeluXina** in Luxembourg
- **Discoverer** in Bulgaria
- **Karolina** in the Czech
- **LEONARDO** in Italy
- **Deucalion** in Portugal

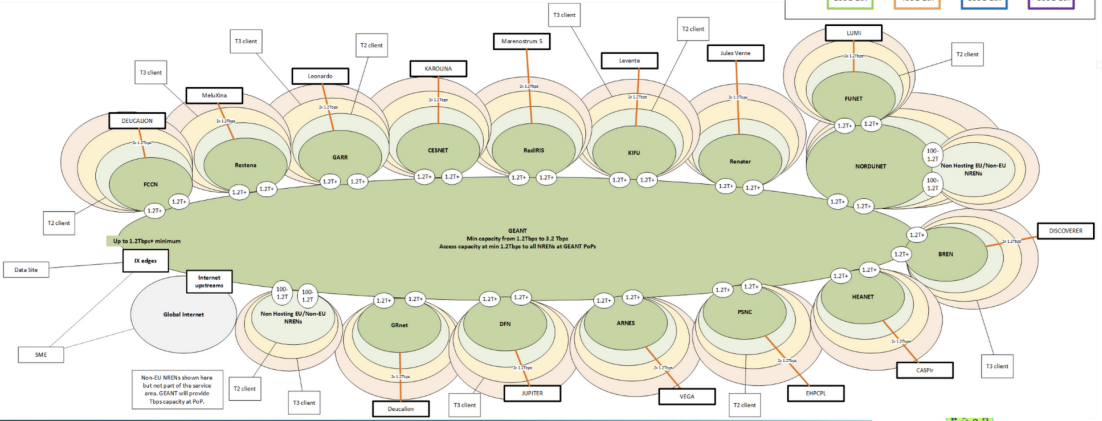
10-11-2022 (EuroHPC JU) launched a call to access its pre-exascale supercomputers **200M€**.

EuroHPC: HyperConnectivity

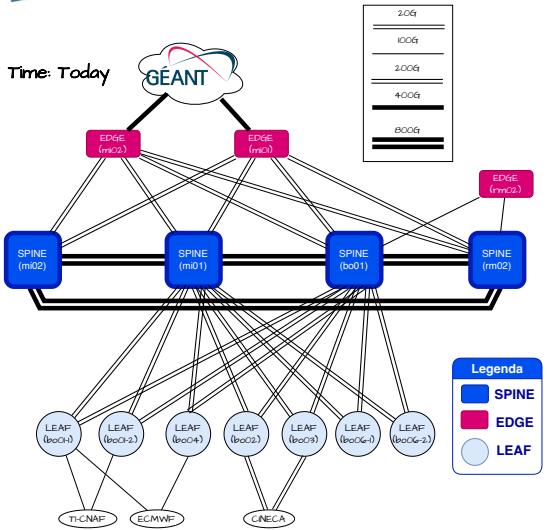
Upgrade the GEANT Access Capacity with an extra 2x1.2Tbps ***Upgrade Access (dual homed) from 0.4T to 1.2T***

	2026	2028	2030
Tier 1	1.2Tbps+	1.6Tbps+	2.4Tbps+
Tier 2	0.4-1.2Tbps	0.8-1.6Tbps	1.6-2.4Tbps
Tier 3	100-400Gbps	0.4-1.2Tbps	0.8-1.6Tbps
Tier 4	Less than 100Gbps	Less than 400Gbps	Less than 800Gbps

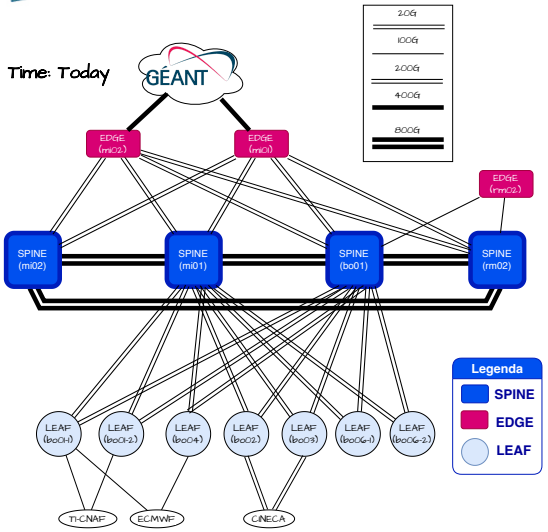
Max client Eth interface rate: 100G Eth | 400G Eth | 800G Eth | >800G Eth

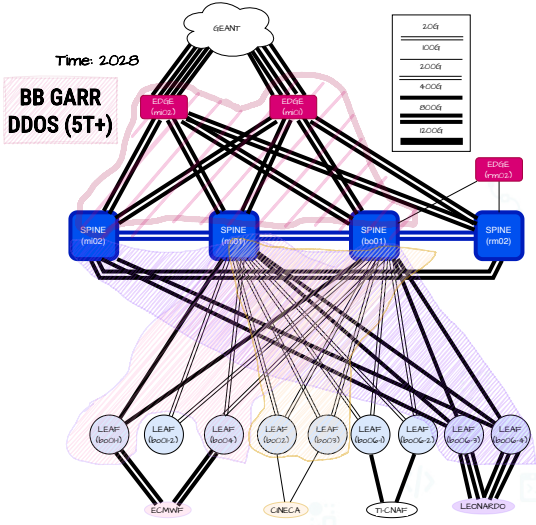


EuroHPC: GARR-T Network Upgrade



EuroHPC: GARR-T Network Upgrade





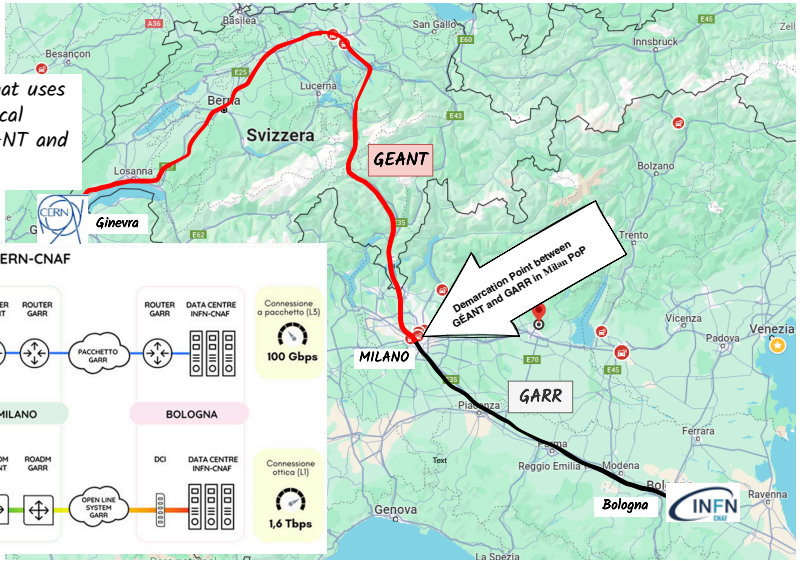
WORKSHOP GARR 2024

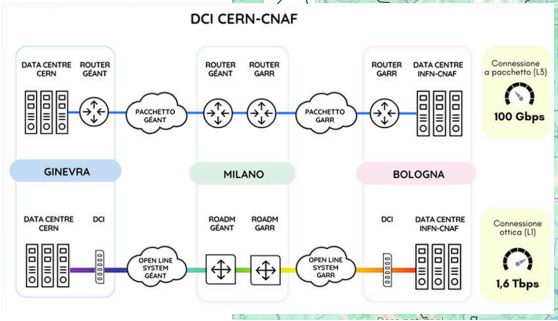
NET MAKERS

Experimental Activities

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





Investigation and Developments

Ballon - open optical network

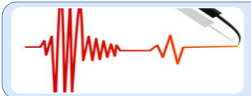
- Optical Network Design and Planning Tool
- Open Optical Network Controller
- Performance Optimization

Politecnico di Torino

Spectrum Sharing

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

GÉANT INFN CERN



Sensing

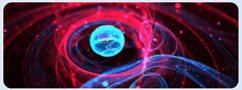
- Sensing over Subsea Cables
- GEANT WP7T2 Demo activity
- SUBMERSE project relationship

UNDER construction

Time and Frequency

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

INRiM ISTITUTO NAZIONALE DI RICERCA METROLOGICA



Quantum Technologies (QKD)

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

PADUA QTECH

Final Remarks

- The GARR-T implementation is on track for completion by Q1 2025, in line with PNRR timelines.
- Hyperconnectivity and enhanced user access are crucial for fully leveraging the infrastructure.
- Optical and Packet Network programming are both essential and challenging areas for future development.
- The GARR-T Platform supports research and development (TF, Sensing, QKD, Quantum Communication) but requires a reevaluation of knowledge-sharing and on-site management models.

Strumenti OpenSource

LaTeX - Draw.IO - GNU.Makefile