

WORK
SHOP
GARR
2024

NET
MAKERS

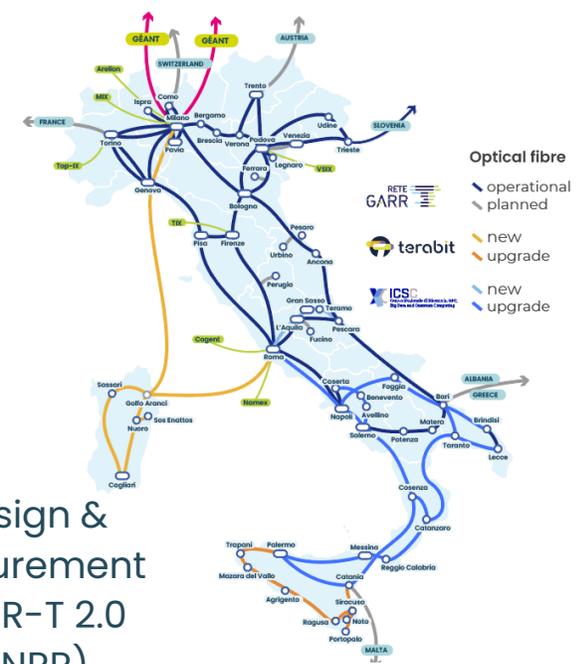
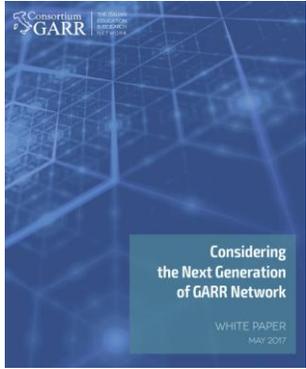
GARR-T: evoluzione continua

Paolo Bolletta

GARR

Per domande:
wooclap.com
code WSGARR24





ELISA-WG
2017

GARR-T
Procurement
2020

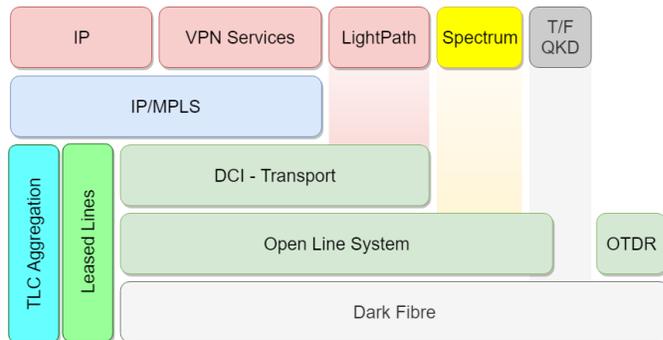
Design &
Procurement
GARR-T 2.0
(PNRR)
2023

2019

2021-2023

2024-2025

Design &
Architecture GARR-T



Implementation and
migration to GARR-T



Implementation
and migration
GARR-T 2.0 (PNRR)



GARR-T facts

sites

120 PoP sites
300+ rack

fiber

12000km BB
50 new BB spans

optical layer

75 ROADMs
85 ILAs
35 Tbps day¹

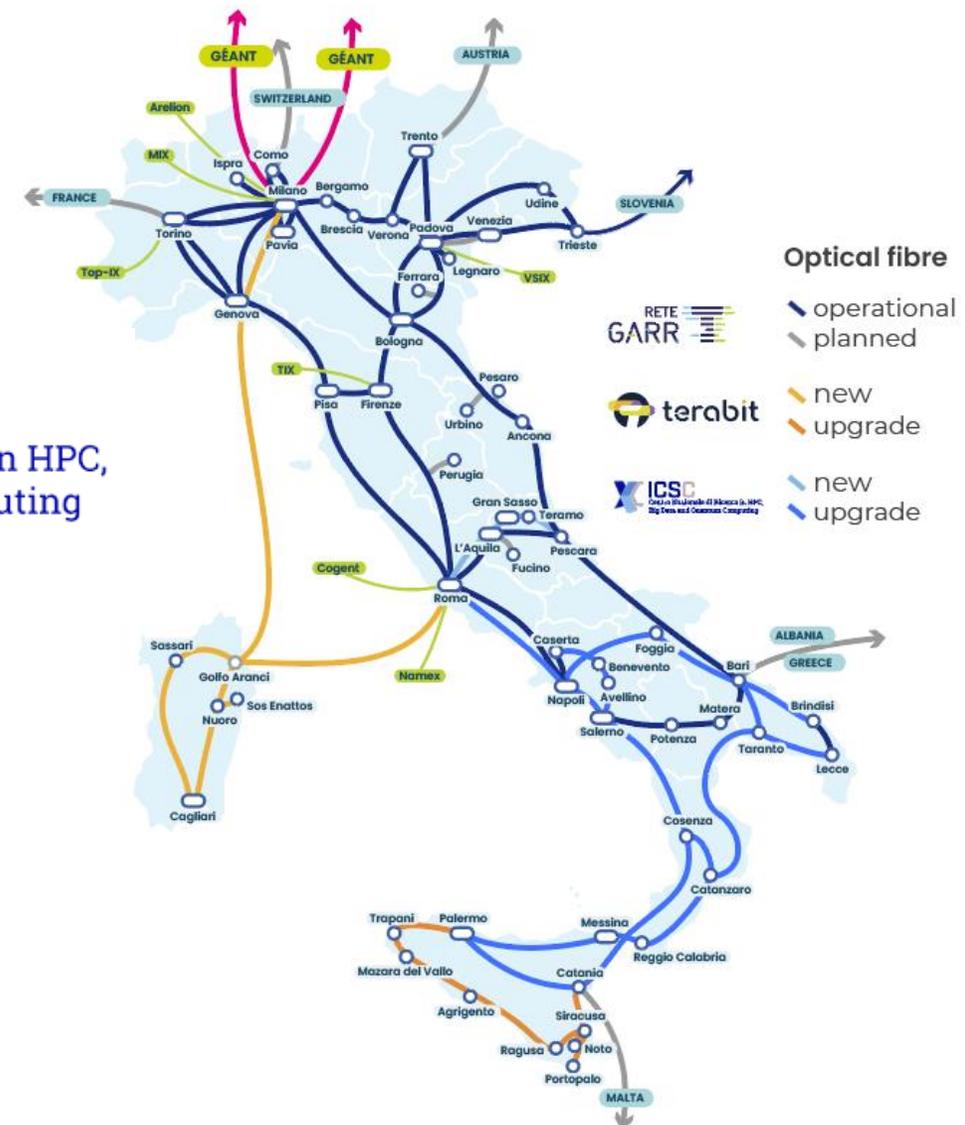
packet layer

150 pkt nodes
80 Tbps

migration

100% users
migrated
95 hot swap
spans

GARR-T (2.0) new developments: PNRR projects (2023-2025)



Opportunity to develop GARR-T network:

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

From WS GARR 2023 ...

GARR-T: next steps...

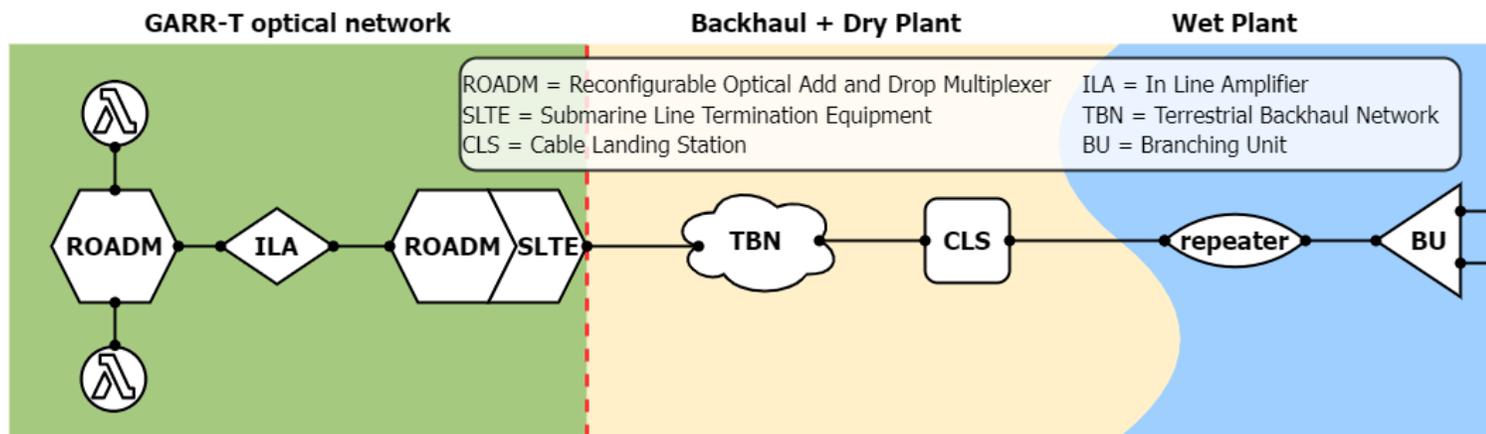


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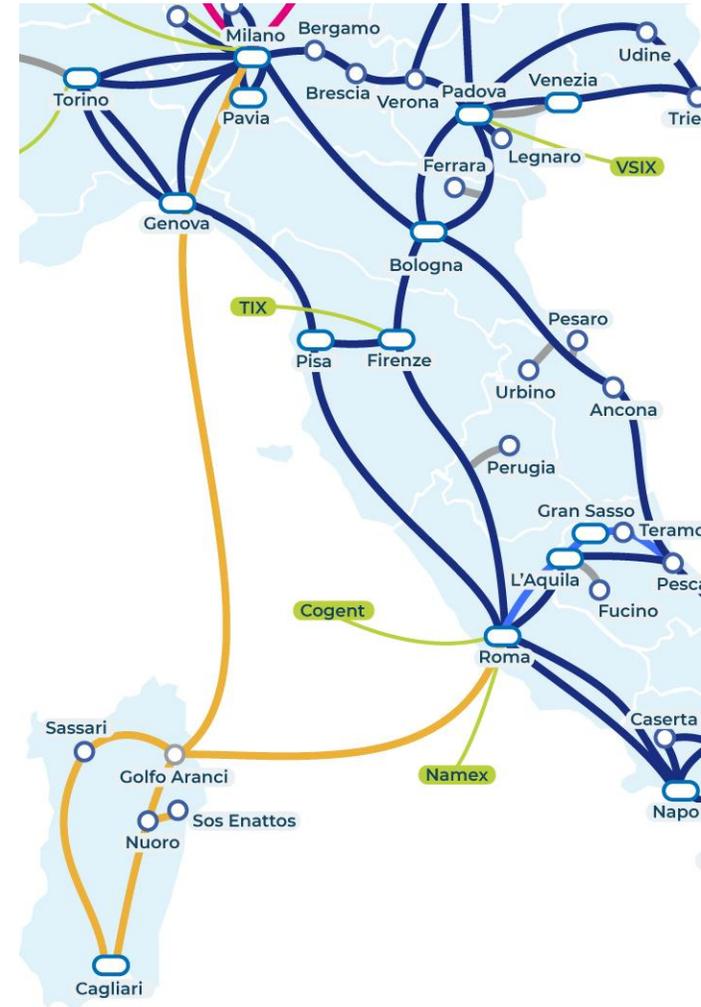
Spectrum over Subsea Open Cable

GARR-T is completing a unified infrastructure all over Italy reaching also Sardinia through subsea cables.

- 900GHz of spectrum over Open Cable Subsea System between Sardinia and Rome and Sardinia and Milan
- 20 years IRU
- nx400GEth interconnections

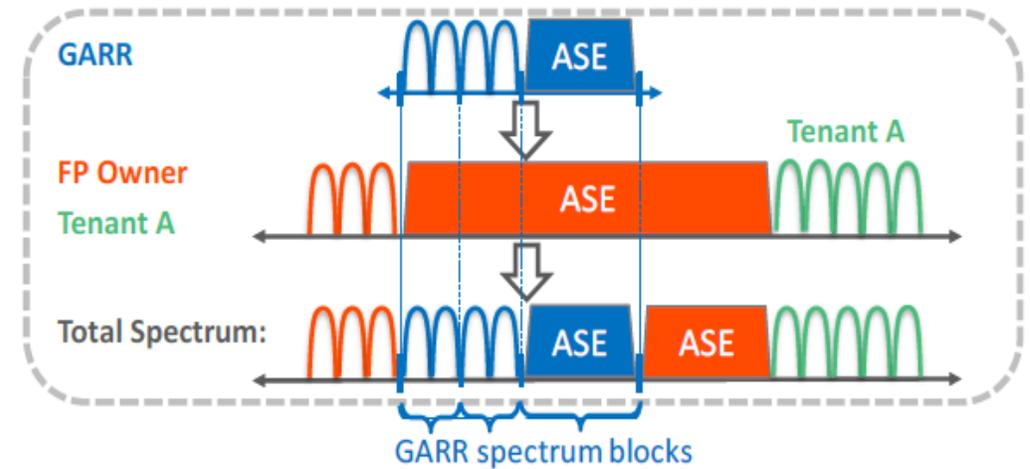


Spectrum Service Demarcation Point



Spectrum over Subsea Open Cable

- Subsea Links Testing phase completed on July 2024
- GARR manages directly the dedicated spectrum as a virtual subsea fiber pair
- Hybrid subsea and terrestrial system
- Fine granularity in spectrum management



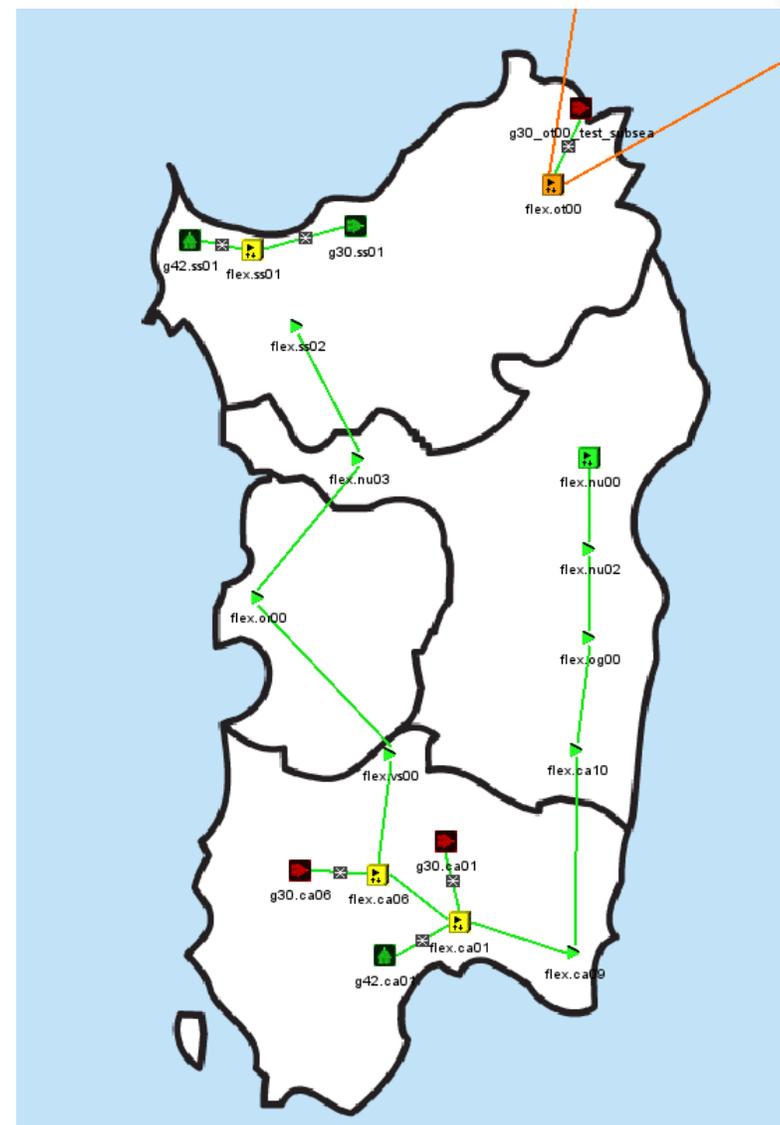
Greenfield Terrestrial Infrastructure

100% Hardware delivered and available for installation!

Terrestrial fiber spans $\approx 60\%$ delivered

Implementation:

- **Sardinia:** ahead of schedule.
- **Abruzzo:** behind schedule we are confident to catch up!



Optical Line System Migration

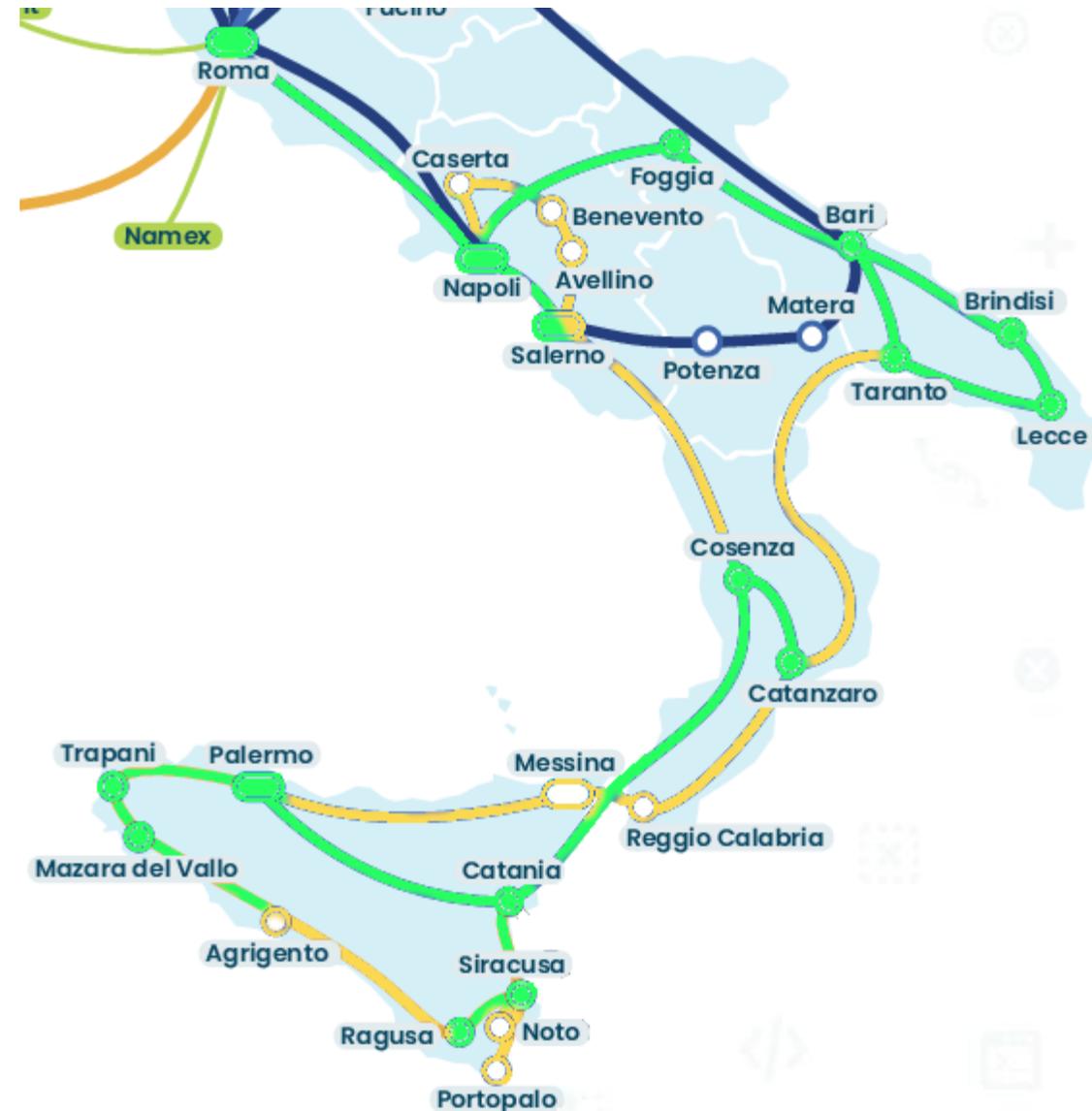
Disaggregated Approach:

- Hybrid Line System Platform operations
- STEP1: Line system migration
- STEP2: Turn-up of the new capacity
- STEP3: decommissioning legacy OTN layer

First node migrated May 2024

Current Status:

- A/D nodes migrated: 16/23
- ILA nodes migrated: 17/34
- Planned 6 Satellite nodes (H4) migration



GARR-T: Packet Network current status

2023-2025

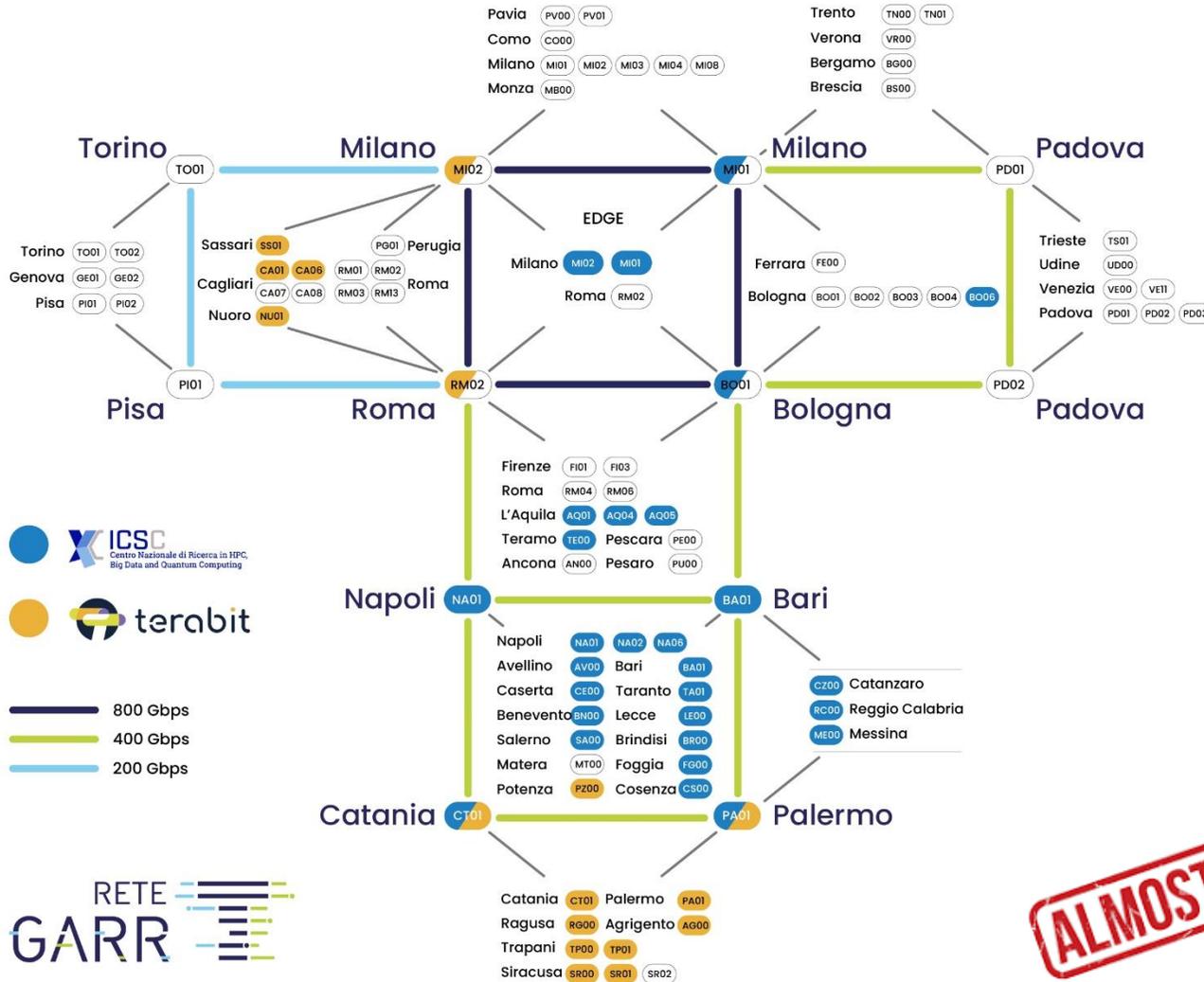
- 60+Tbps packet platform upgrade
- 17 new nodes
- 400GEth user interface on packet service platform

Spine-Leaf Architecture

- Juniper MX for leaf and edge nodes (MX204, MX304, MX480, MX1k3)
- Juniper PTX for spine nodes (PTX10k1-36MR, PTX10k4)
- Juniper Virtual Router Reflector vRR (JRR200)

- AQ04 – AQ05 (LNGS) planned within November
- NU01 (Sos Enattos) on hold for site consolidation

ALMOST DONE



GARR-T network visibility

Telemetry based network visibility:

- **T**elegraf**I**nflux**G**rafana stack for telemetry:
 - 180K time series operational spanning from optical to data center layer, from packet to applications
 - 180 monitoring dashboards
 - 31 alerting rules
 - 51 different Data Lakes
 - Time Series for streaming telemetry
 - ElasticSearch and OpenSearch for logs and text data
 - MySQL and Zabbix legacy and appliance



GARR-T network control

Packet Network Control:

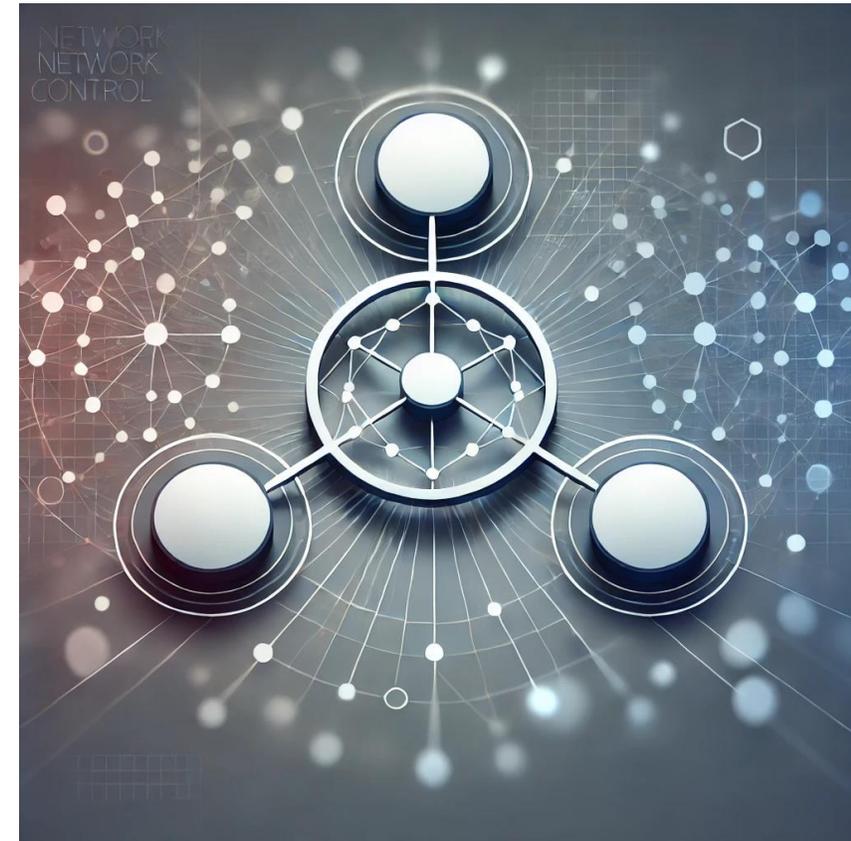
- Juniper Paragon as Network Management System and TE-PCE
- PACMAN: Ansible-based tool for automating and managing packet network configurations

Optical Network Control:

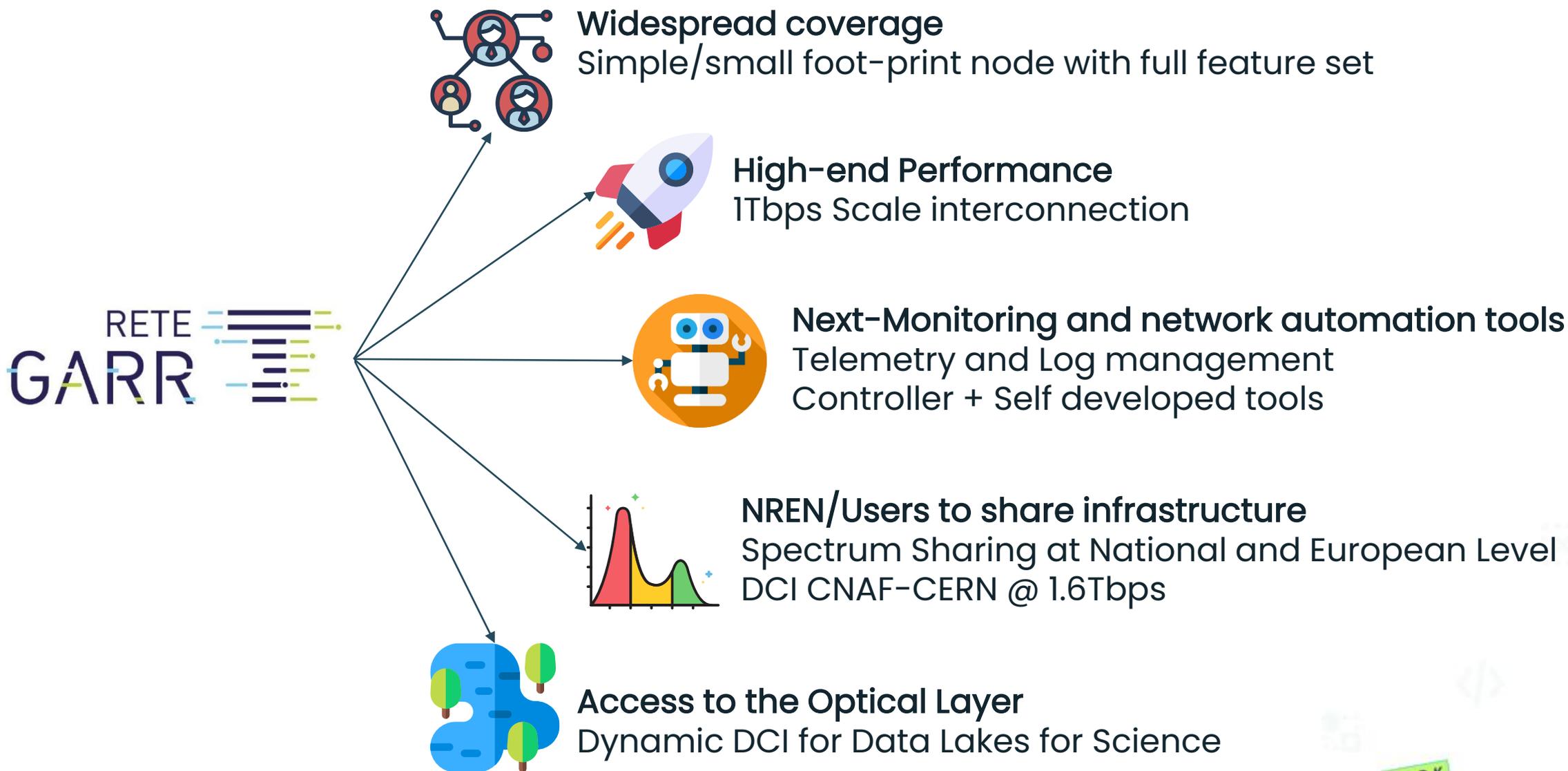
- TRANCENT: Infinera's optical domain controller for provisioning
- AWX + Ansible for network-wide configuration and software updates

Next Step:

- Cross-layer, vendor-agnostic orchestration



Achievement so far...



Exploiting the Potential of GARR-T: Next Steps



Network Data and Digital Twin

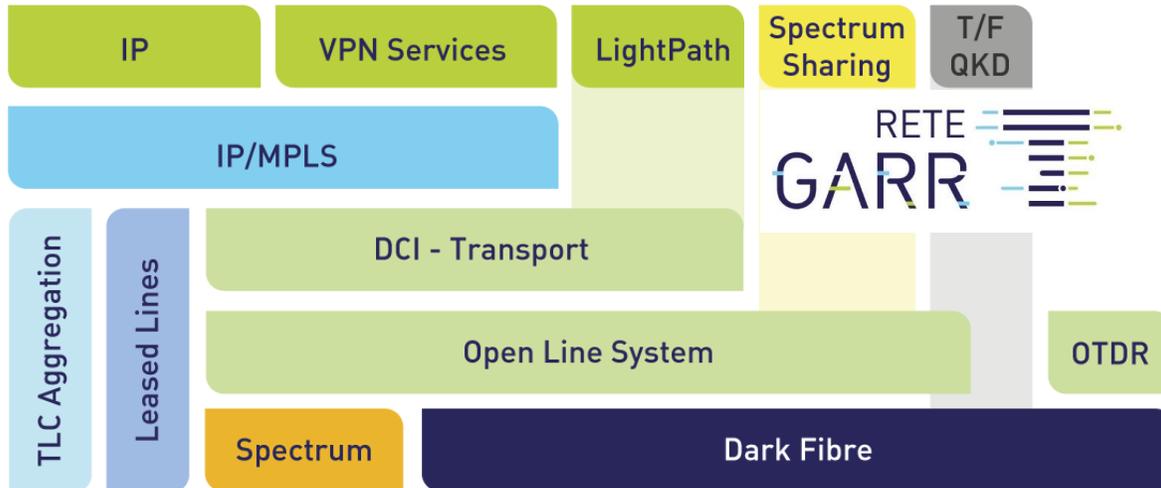
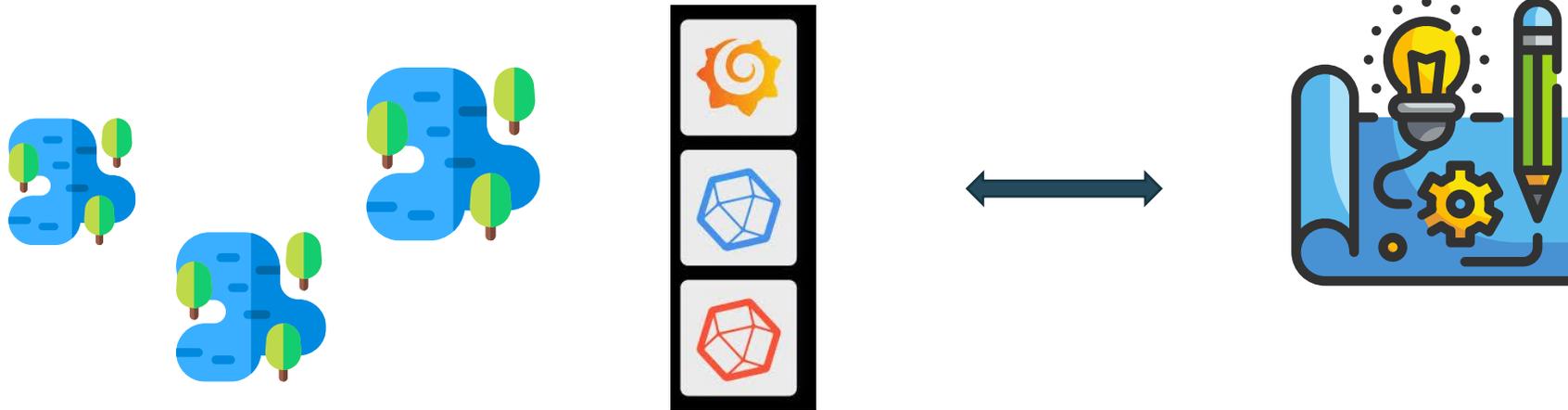
Enhanced orchestration and self-service portal



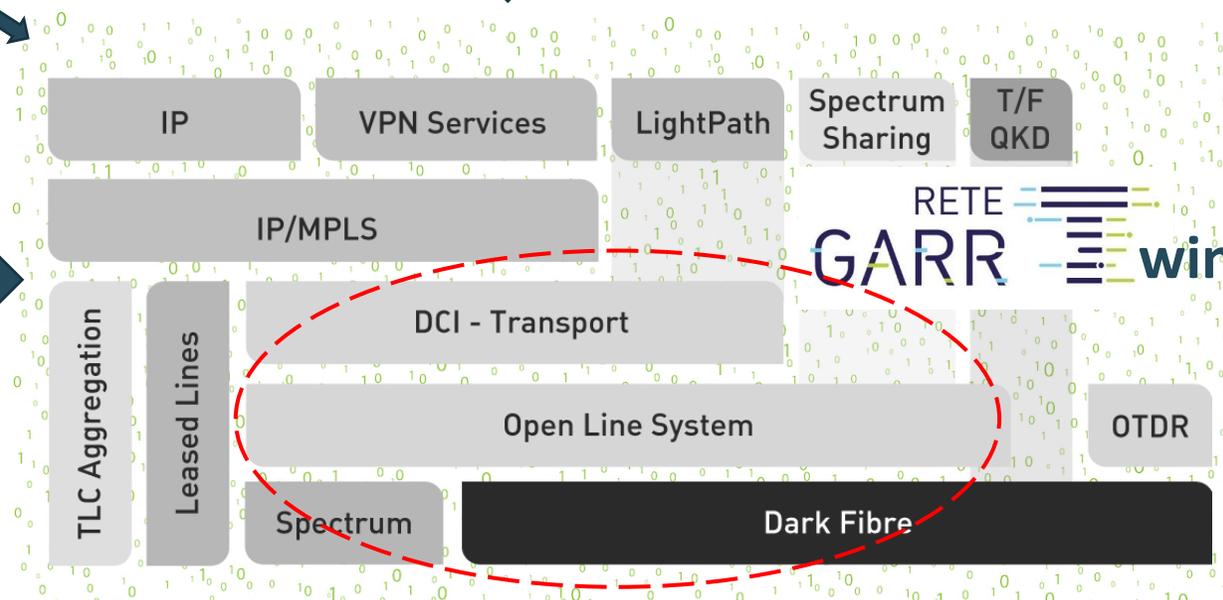
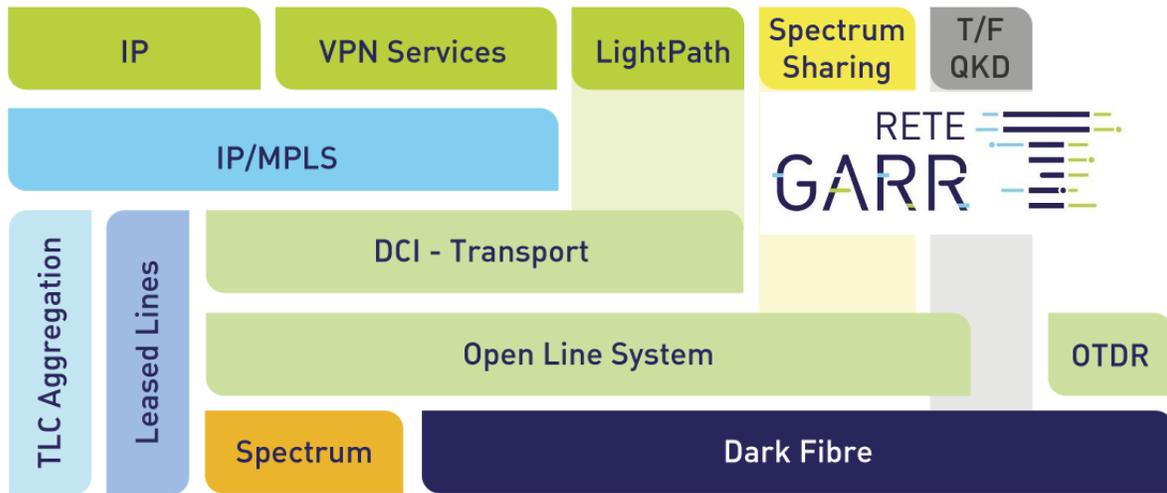
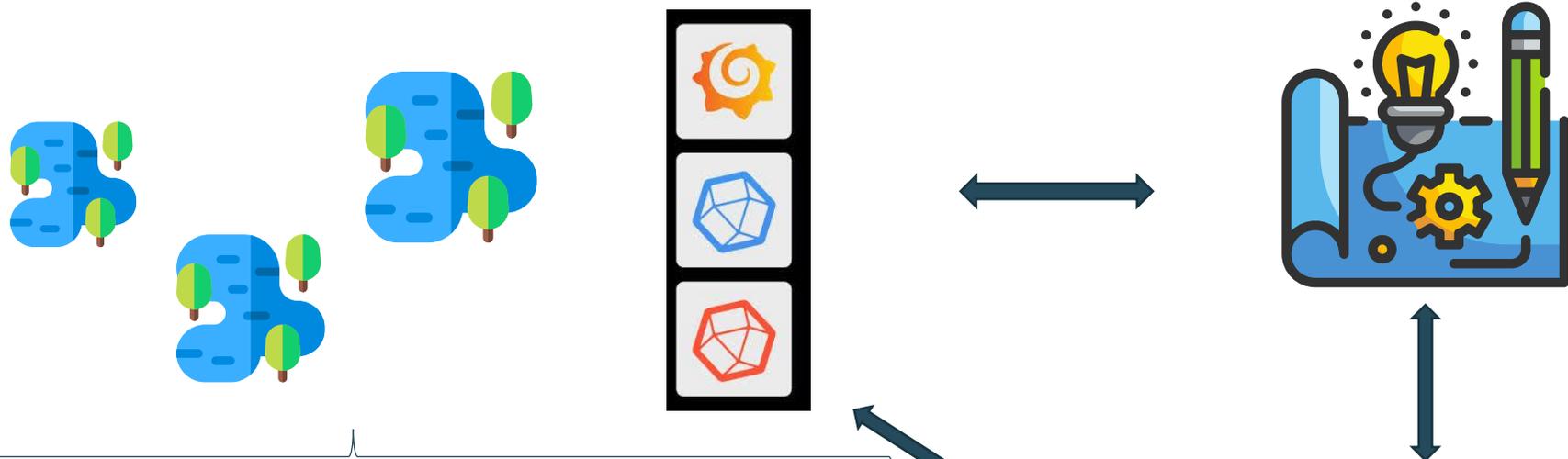
Beyond Data Services



GARR-T Network Data and Digital Twins



GARR-T Network Data and Digital Twins

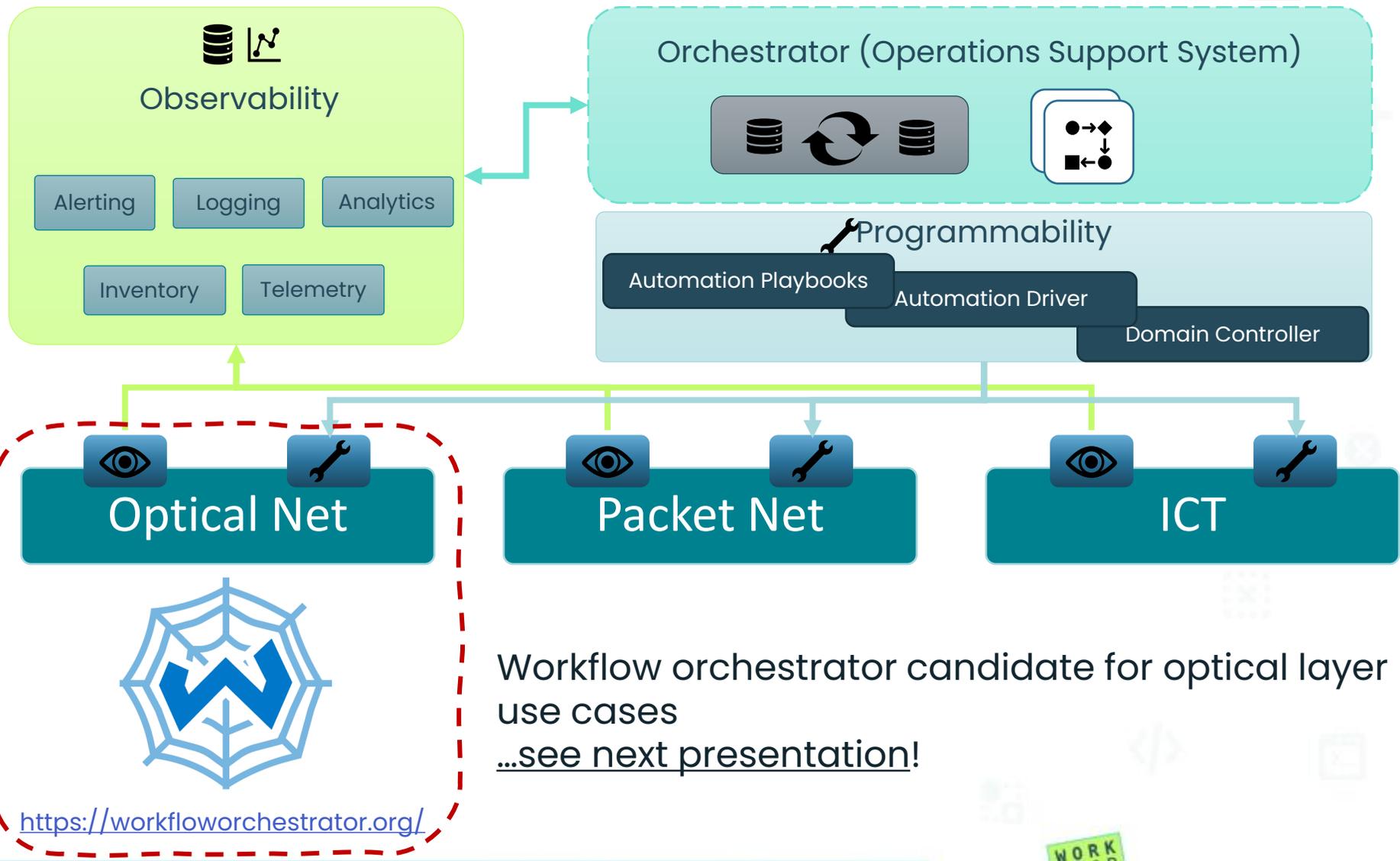


Orchestrator



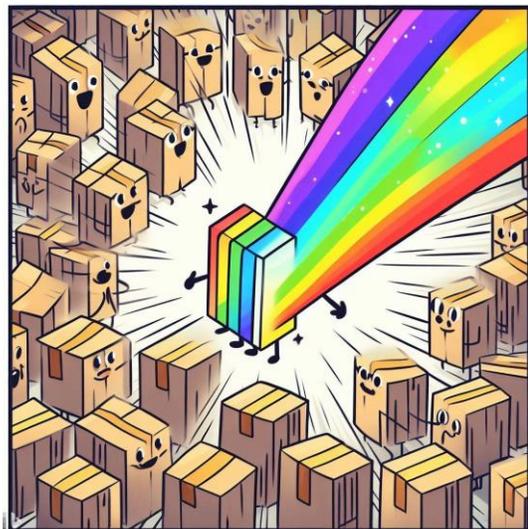
Orchestration and Automation Pilot Use Cases:

- 1. Optical Circuits provision
- 2. Dark Spectrum provisioning



Workflow orchestrator candidate for optical layer use cases
...see next presentation!

Beyond Data Service: Investigation and Developments



20.000 km of fiber infrastructure



120 PoP



L band available



Spectrum Sharing

- CNAF-CERN DCI pilot (Multidomain GARR+GEANT)
- Spectrum Sharing Service testing and rollout



Time and Frequency

- White Rabbit over DWDM
- Pan-European Infrastructure GN5.2 TFN
- SIG-TFN



Sensing

- Sensing over Subsea Cables
- GEANT GN5.2 Incubator activity
- SENSEI Project



Quantum Technologies (QKD)

- University of Padua: QKD + Data link field trial
- Quantum Initiative
- Quantum Communication over dedicated fiber



Conclusion



Achievements:

- GARR-T roll out and migration ongoing
- Enhanced new services (e.g. multidomain 1.6Tbps DCI)
- Telemetry and Automation

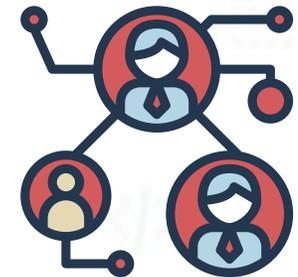


Opportunities:

- Expansion in new areas
- Complete GARR-T as a unified network platform
- Spectrum over subsea cables

Next Steps:

- Network Data and Digital Twin
- Orchestrator and Self-Service Portal
- Beyond Data Services





NET MAKERS

grazie!
Q&A!

Slide credits:

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Fabio Farina

Ettore Tamiro

Massimo Valiante

Carlo Volpe

Gloria Vuagnin



Per domande:
wooclap.com code WSGARR24