Consortium GARR
THE ITALIAN EDUCATION & RESEARCH NETWORK

GARR-T
Network and Evolution

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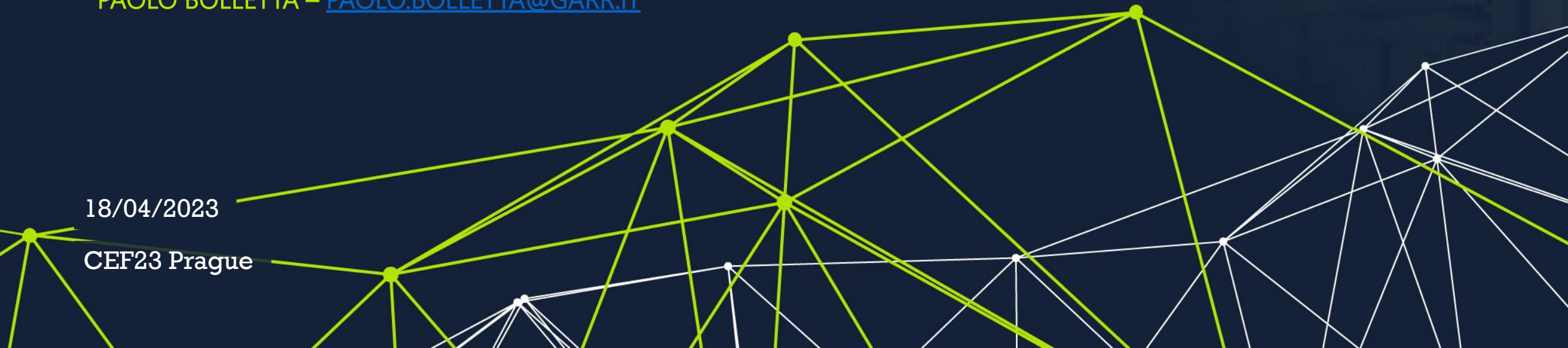


18/04/2023

CEF23 Prague

GARR-T cornerstones

Terabit/s

Automation and programmability

Widely spread

Next-gen Control and Monitoring

Resiliency

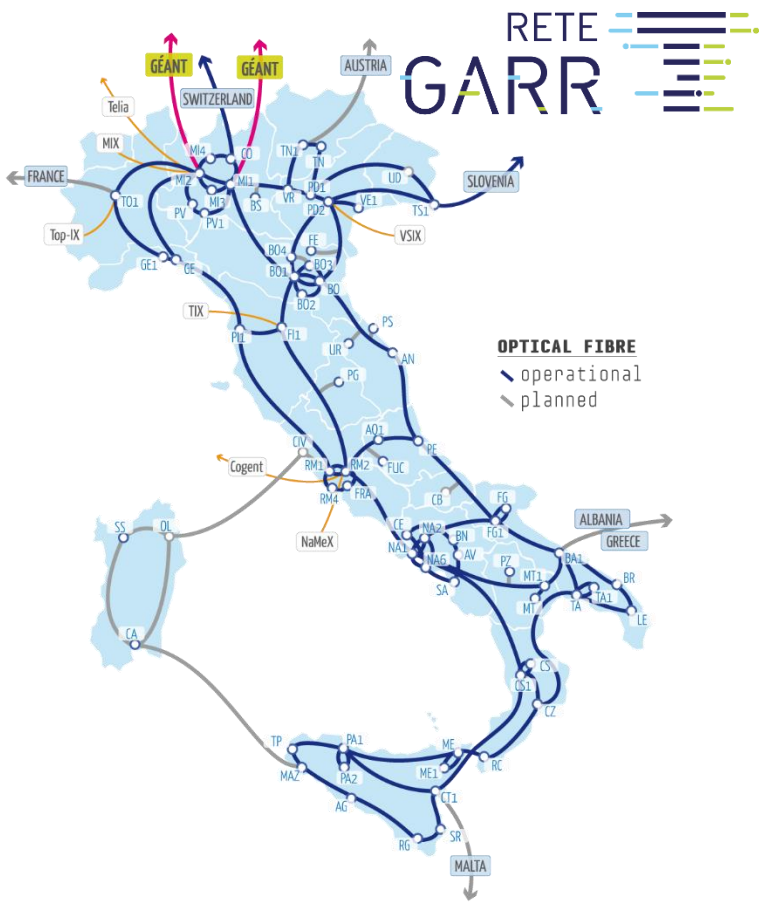
High end services

Resources optimization

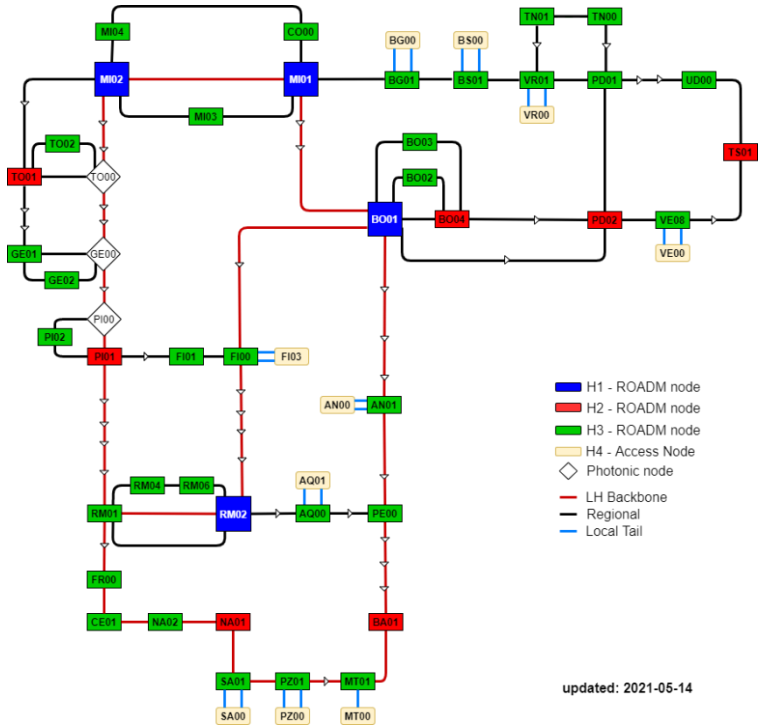
Lower Power and Space footprint

GARR-T - network overview

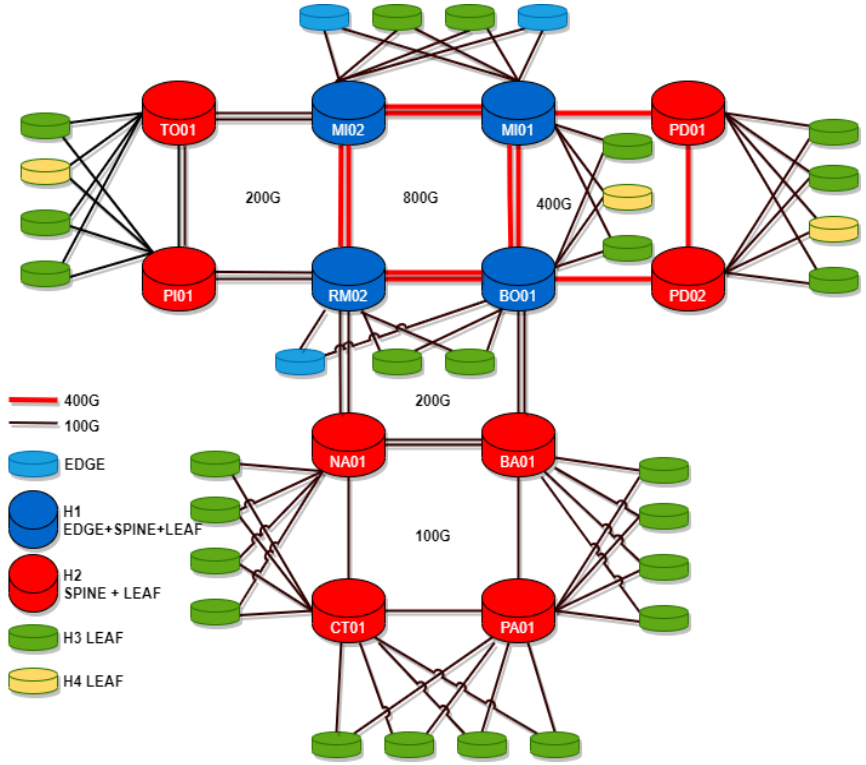
Backbone topology



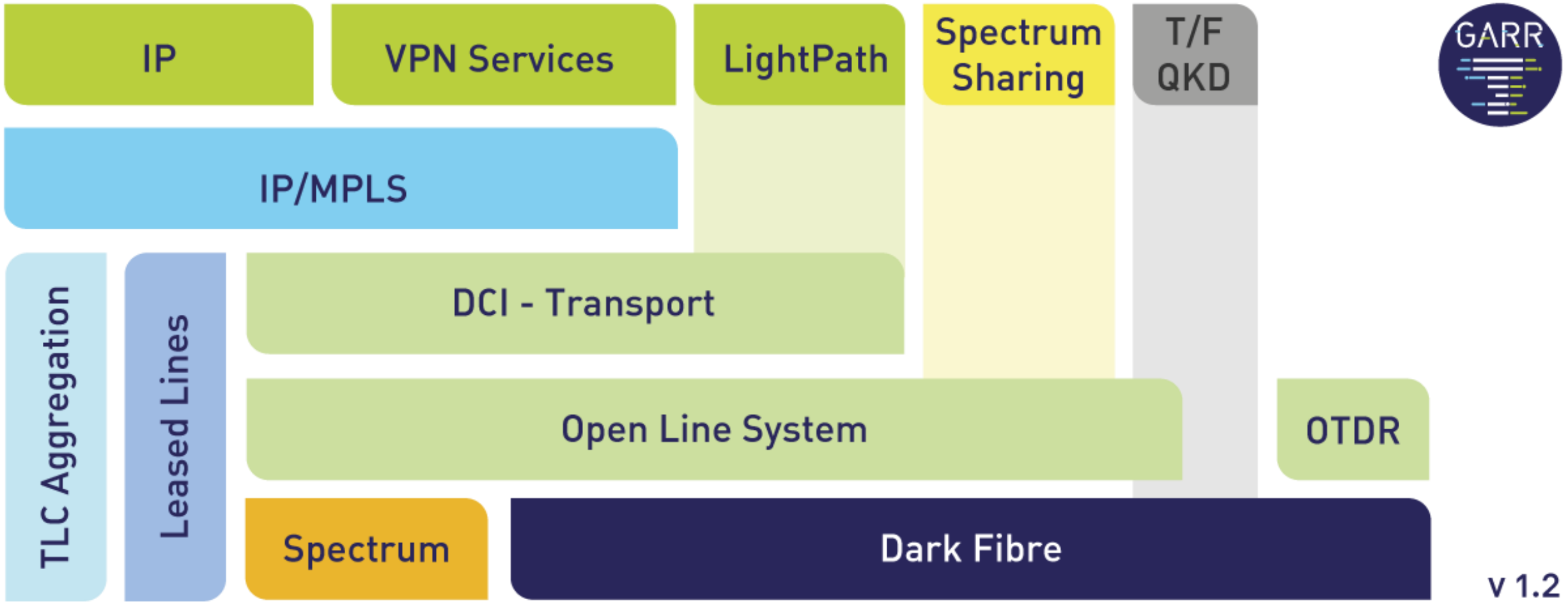
Optical Transport Layer



Packet Layer



GARR-T - network evolution



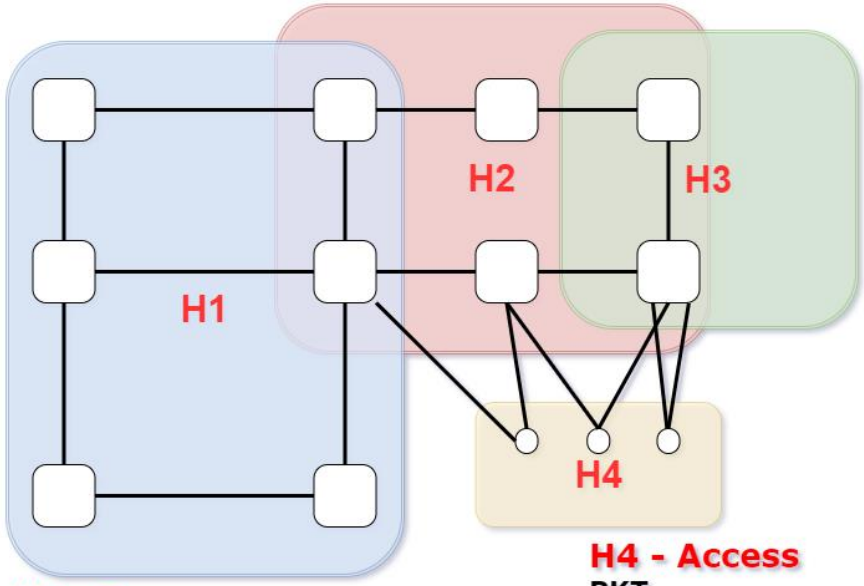
Architecture

Architecture
Blue Print
Revision v0.5

H2 - Regional - Metro

PKT
- Leaf + Spine Nodes
- backbone rate: 100/400GEth

OPT
- link length: from 80 to 300 km
- capacity: 100Gbps to nx100Gbps
- spectrum: flex-grid
- A/D: Colorless + Colorless/Directionless



H3 - Aggregation

PKT
- Leaf Node
- backbone rate: 100GEth

OPT
- link length: from 10 to 100 km
- capacity: 100Gbps
- spectrum: flex-grid
- A/D: Colorless

H1 - Core

PKT
- Leaf + Spine + Edge Nodes
- backbone rate: 100/400GEth

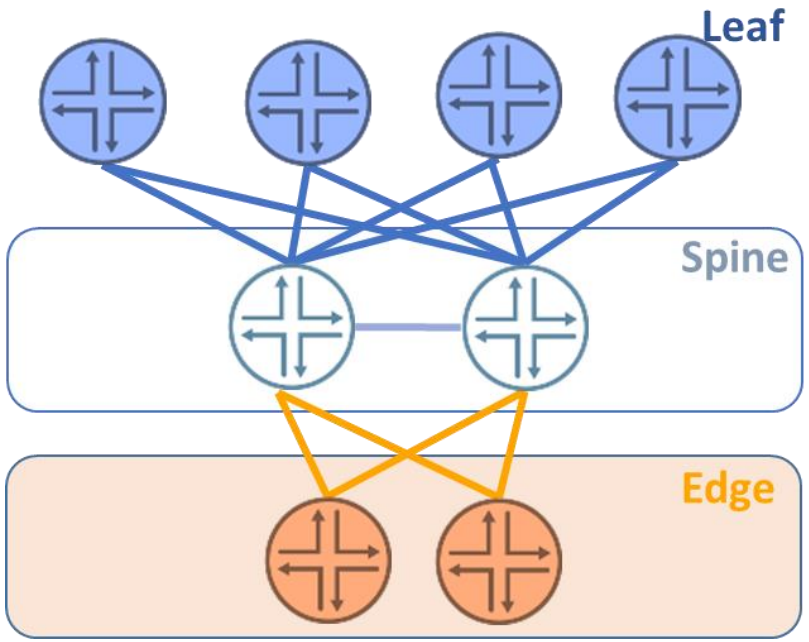
OPT
- link length: from 300 to 1500 km
- capacity: 100Gbps to 1Tbps
- spectrum: flex-grid
- A/D: Colorless + Colorless/Directionless

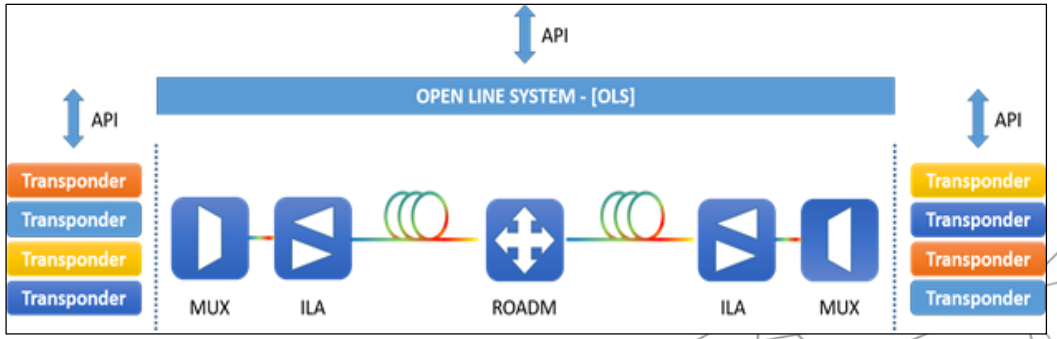
H4 - Access

PKT
- Leaf / CPE

OPT
- link length: from 10 to 40 km
- capacity: 100Gbps
- spectrum: grey, CWDM, 1-8 DWDM channel
- link rate: nx10GEth to 100GEth

CLOS



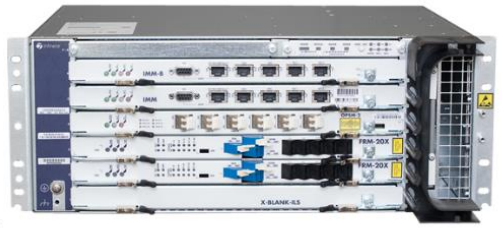


Optical Technology

Infinera

Open Line System

FlexILS



Data Center Interconnect

Groove G30

CHM1 CHM2T

400G

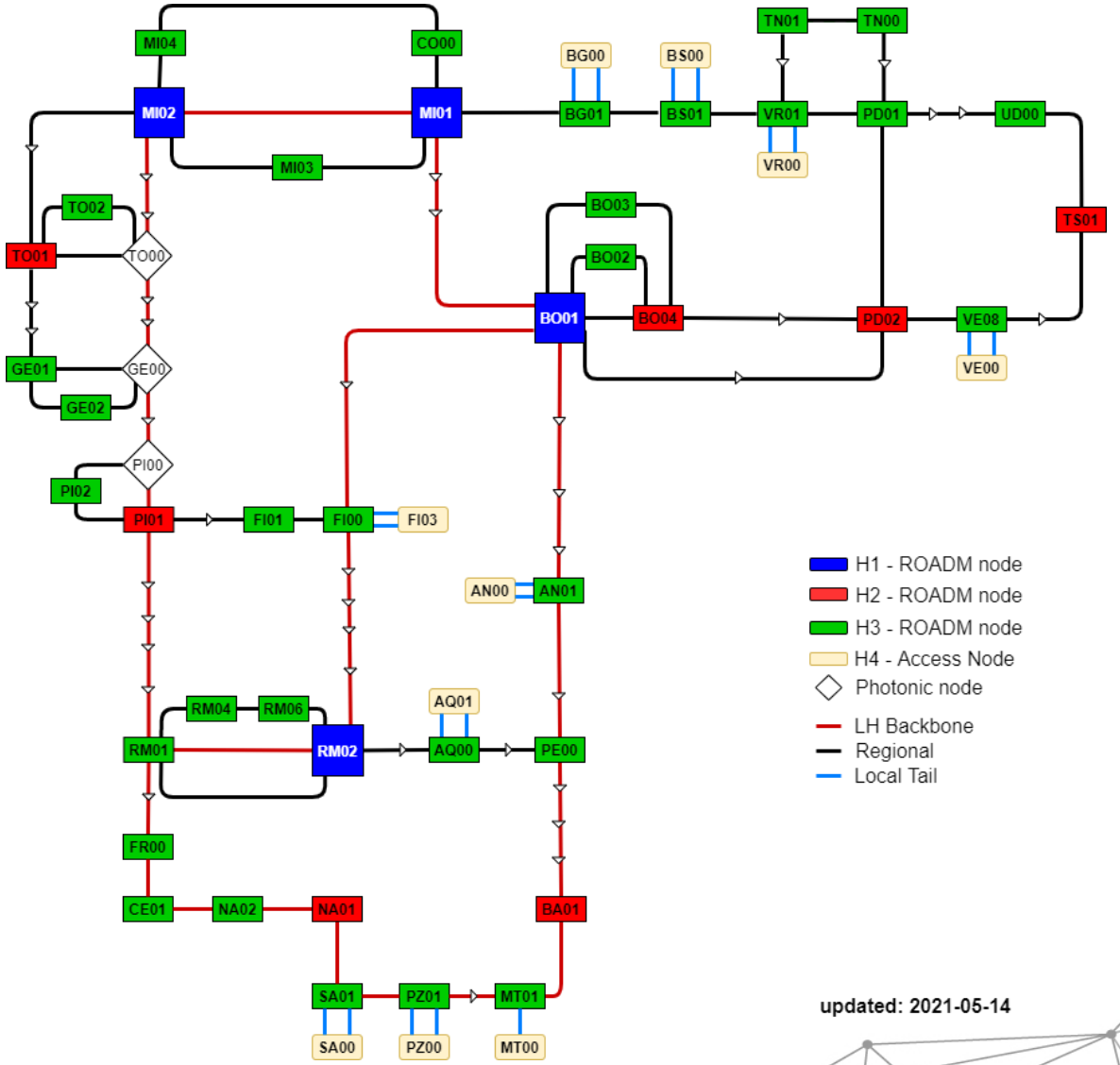
1.2T

Line System

- FlexGrid wavelength switching con granularità di 6.25 GHz
- Extended C-band 4.8 THz
- Scalabile (ROADM a C a CDC)
- Open Line System (OLS)
- OTDR integrato

Transponder

- Fino a 2.4 Tbps per RU
- Interfacce client 100 e 400 Gbps
- gRPC, RESTCONF, OpenConfig

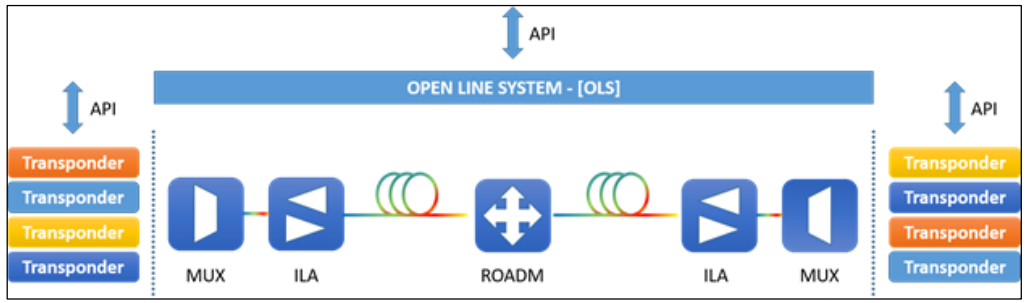


updated: 2021-05-14

GARR-T … some numbers on ongoing deployments

OPTICAL Network

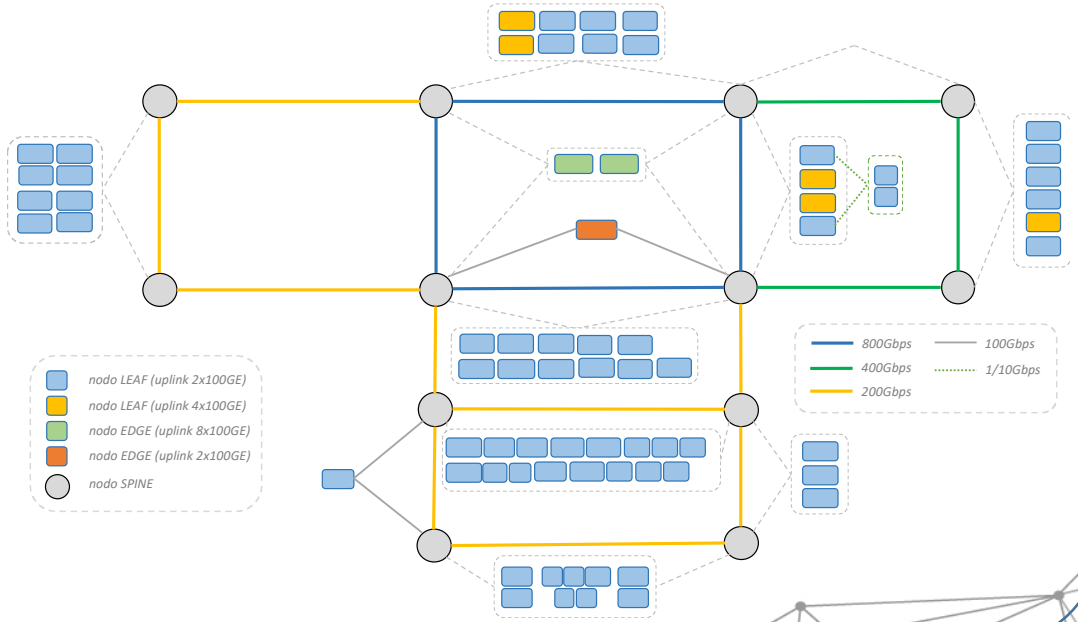
Fiber network	**6155 km**
New optical fiber infrastructure	**740 km**
line system directions	**128**
PoP ROADM	**42**
In Line Amplifier (ILA)	**35**
New Metro POP	**9**
Doubling POP in some City	**6**
100GEth Services	**130**
400GEth Services	**11**
Day1 backbone capacity	**17.4 Tbps**



PACKET Network

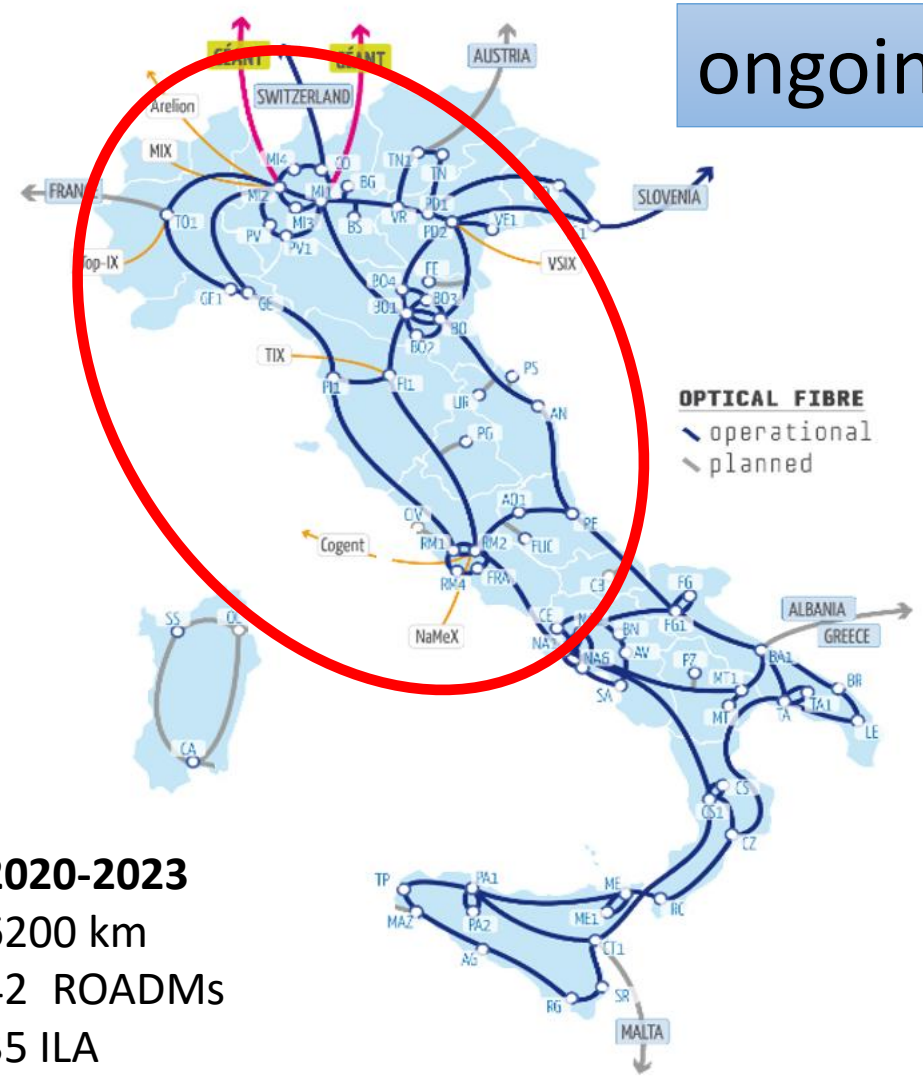
Device Capacity	Capacity MAX	Day 1 Capacity
Total LEAF/EDGE/CSD	144.6 Tbps	61.28 Tbps
Total SPINE	307.2 Tbps	108.8 Tbps

Backbone					End user Acces		
400G	100G	40G	10G	1G	100G	10G	1G
34	**622**	**32**	**265**	**59**	**67**	**290**	**876**



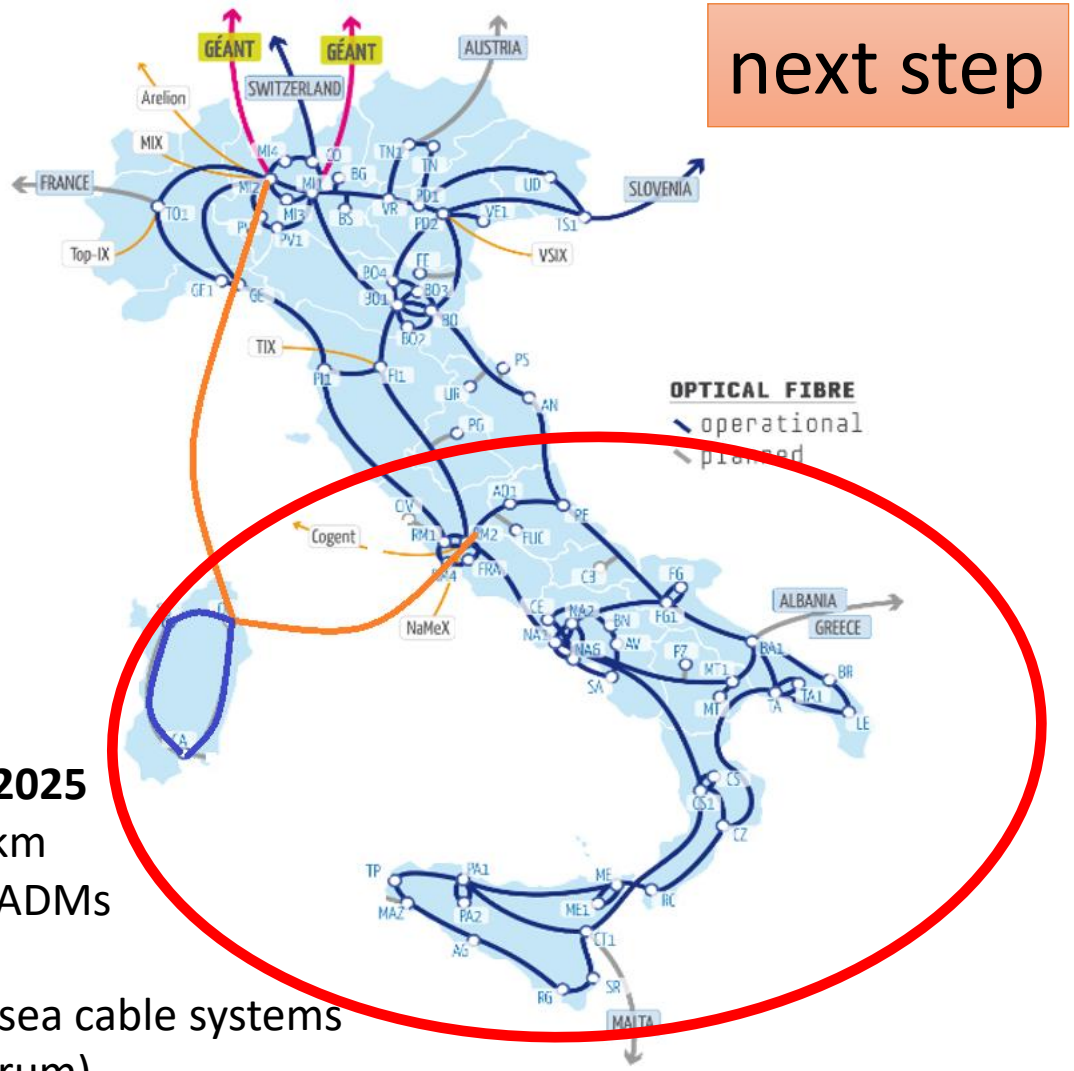
GARR-T: FLexILS + GX current deployment and evolution

ongoing



2020-2023
6200 km
42 ROADMs
35 ILA
18 Tbps day1 client capacity

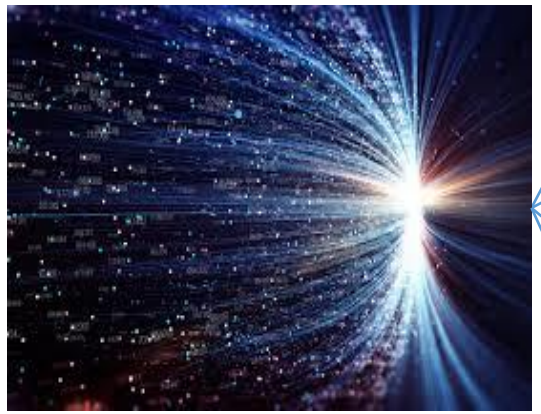
next step

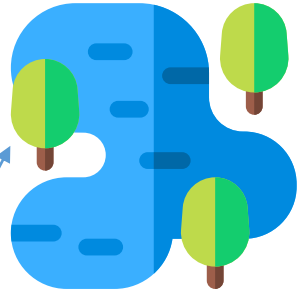


2023-2025
5000 km
35 ROADMs
38 ILA
2 sub-sea cable systems (spectrum)
16 Tbps day1 client capacity

Achievements so far …

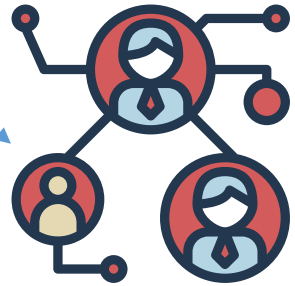
RETE GARR



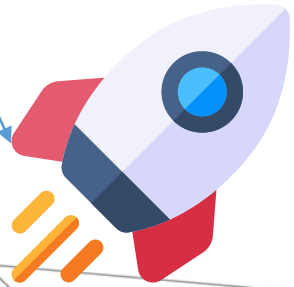


Access to the Optical Layer
Dynamic DCI for Data Lakes for Science

NREN to share infrastructure
Spectrum Sharing at European Level

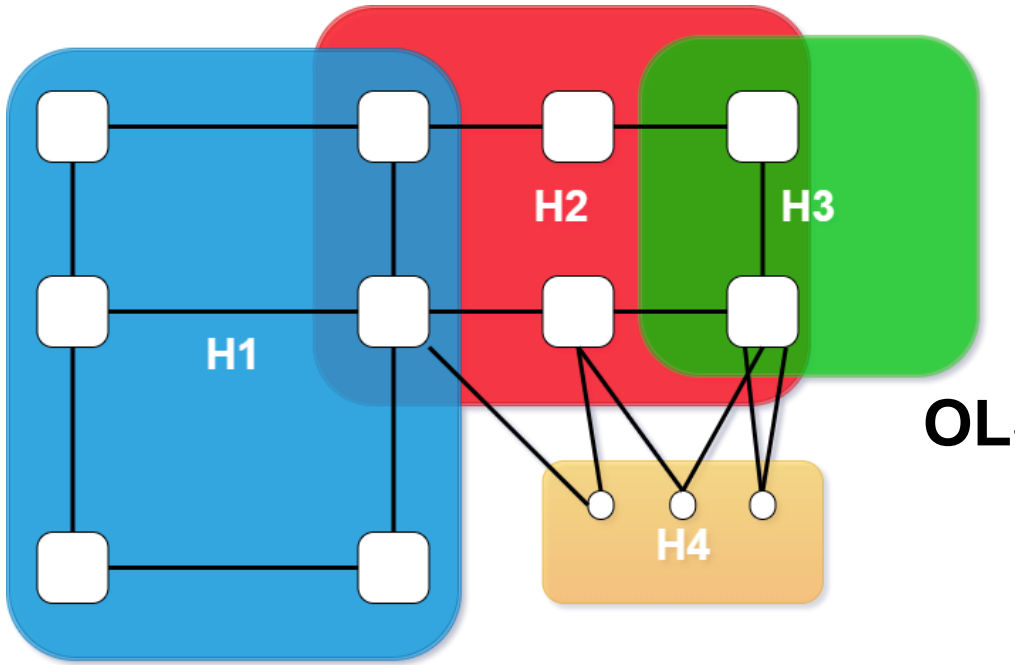


Widespread coverage
Simple/small foot-print node with full OLS feature set



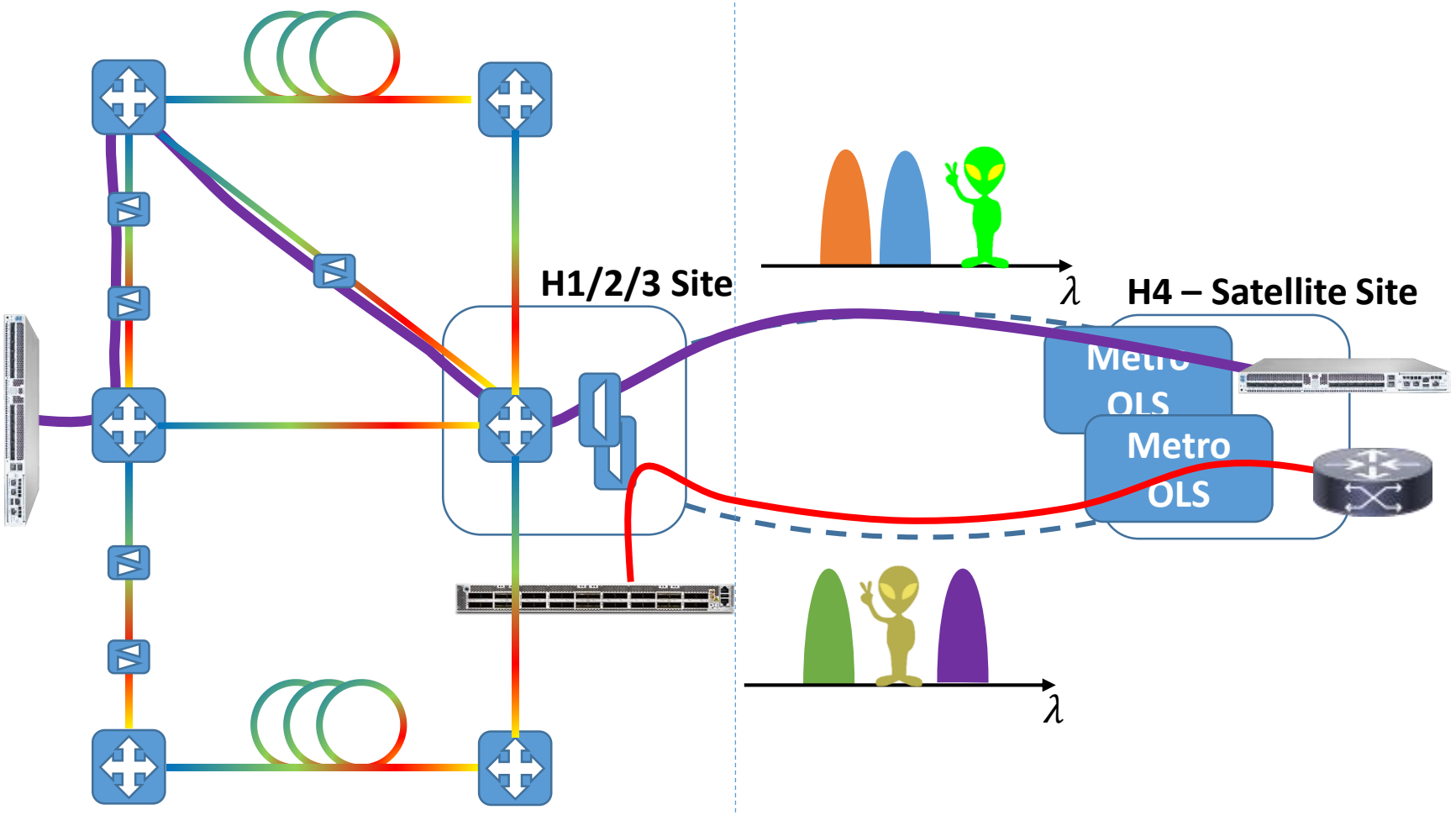
High-end Performance
1Tbps Scale interconnection

Network hierarchy and node complexity



	H1 (edge+spine+leaf)	H2 (spine+leaf)	H3 (leaf)	H4 (leaf)
PKT	[9, 17] kW	[3.5, 8] kW	[0.3, 5] kW	0.3 kW
	[12, 30] RU	[4, 19] RU	[1, 11] RU	1 RU
OLS+DCI	[4.5, 5] kW	[1.6, 2.9] kW	[1, 2.3] kW	[0.5, 1] kW
	[38, 40] RU	[15, 27] RU	[15, 22] RU	3 RU

Optical Network **Satellite** Sites (H4)



- **Scale down preserving functionalities**
- Metro OLS elements integrated in the LH network
- Unique photonic domain
- PoP sites or High end user sites
- Same functions of the optical core network
- Scalable and low footprint
  - 4-8 RU
  - 1-1.5 kW

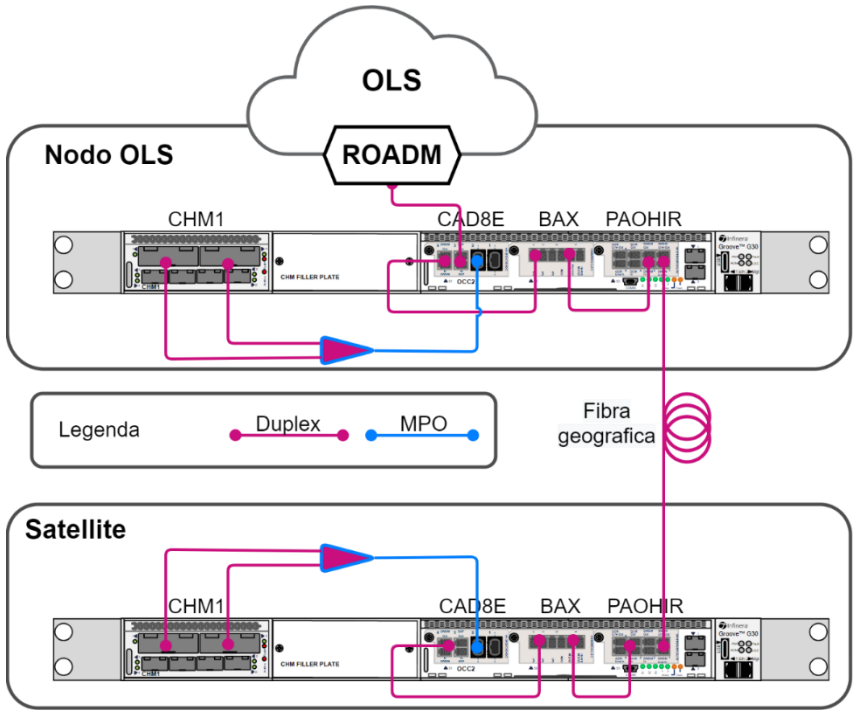
Long Haul Network scale

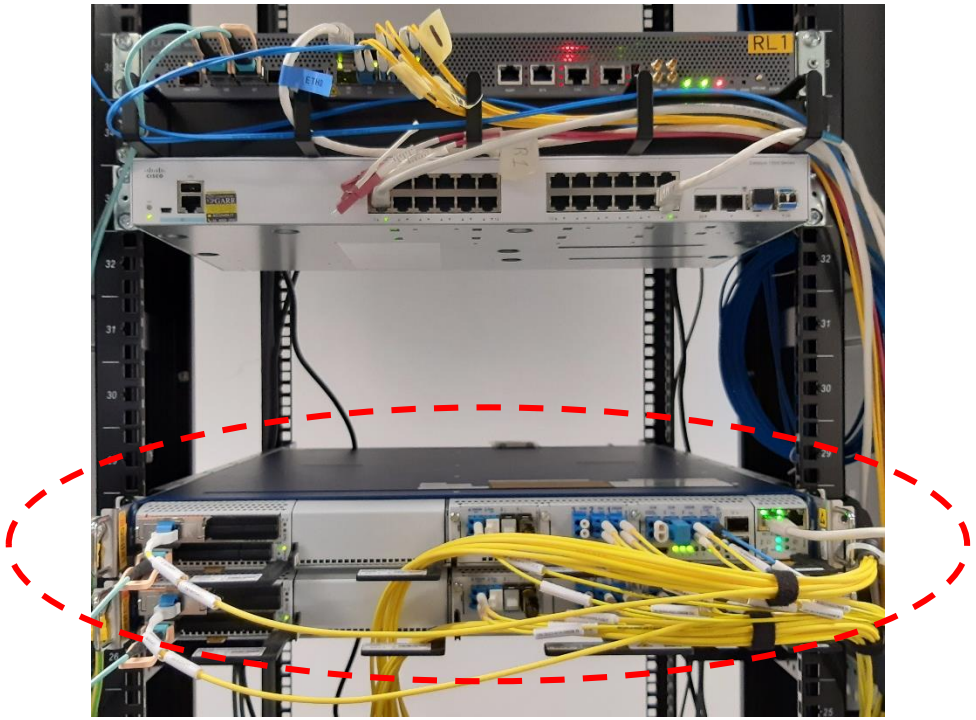
Metro Network scale 5-30 km

Optical Network **Satellite** Sites (H4)

OLS and Satellite Nodes
for each degree:

- ✓ Chassis G30
- ✓ Colorless (DE)MUX
- ✓ Booster EDFA + Preamp EDFA
- ✓ Transponder CHM1 [optional on OLS node]





- ✓ OSC and automatic gain control supported
- ✓ 2RU solution
- ✓ Open Line System: can host 3rd party transponders
- ✓ Can Scale up 1.6Tbps capacty without adding extra chassis
- ✓ Up to 16 colorless A/D ports ready to use

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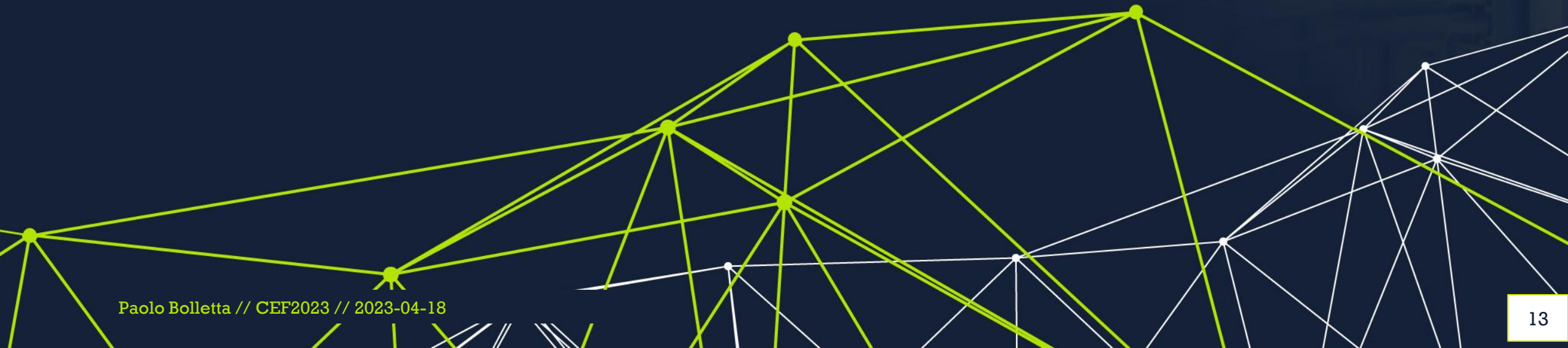
Next steps and future challenges



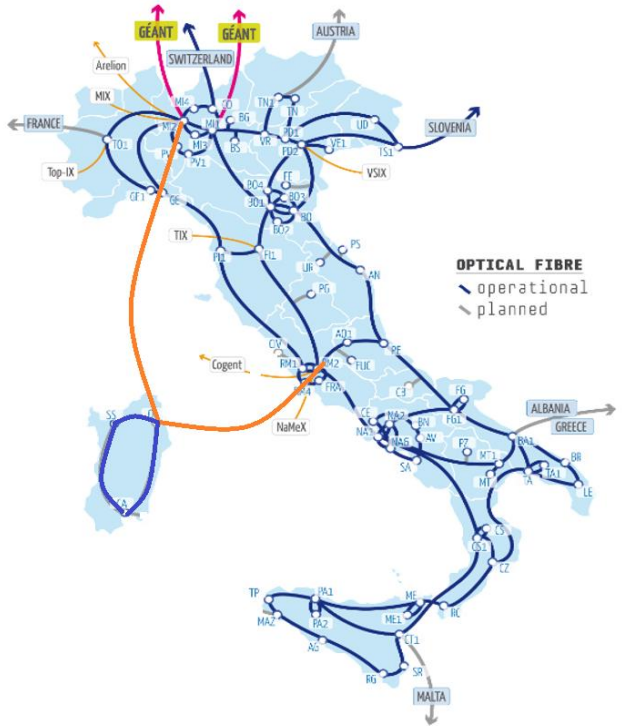
GARR-T new developments: 2 new projects (2023-2025)

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 can reach the goal to become a fully unified and pervasive network for R&E community in the whole country



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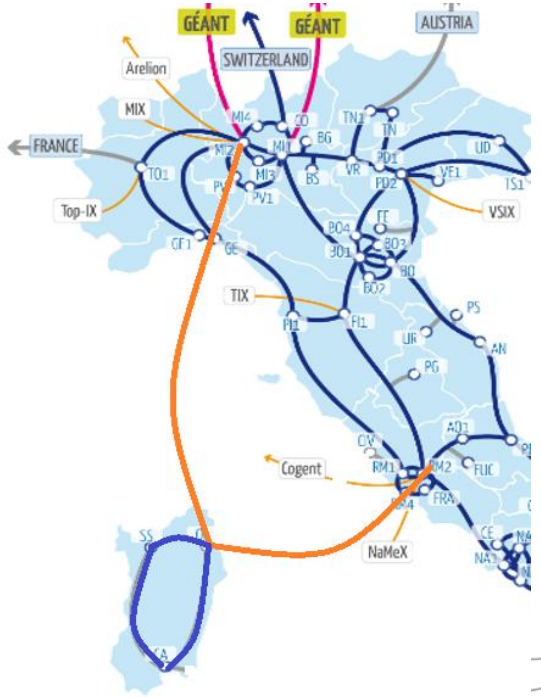
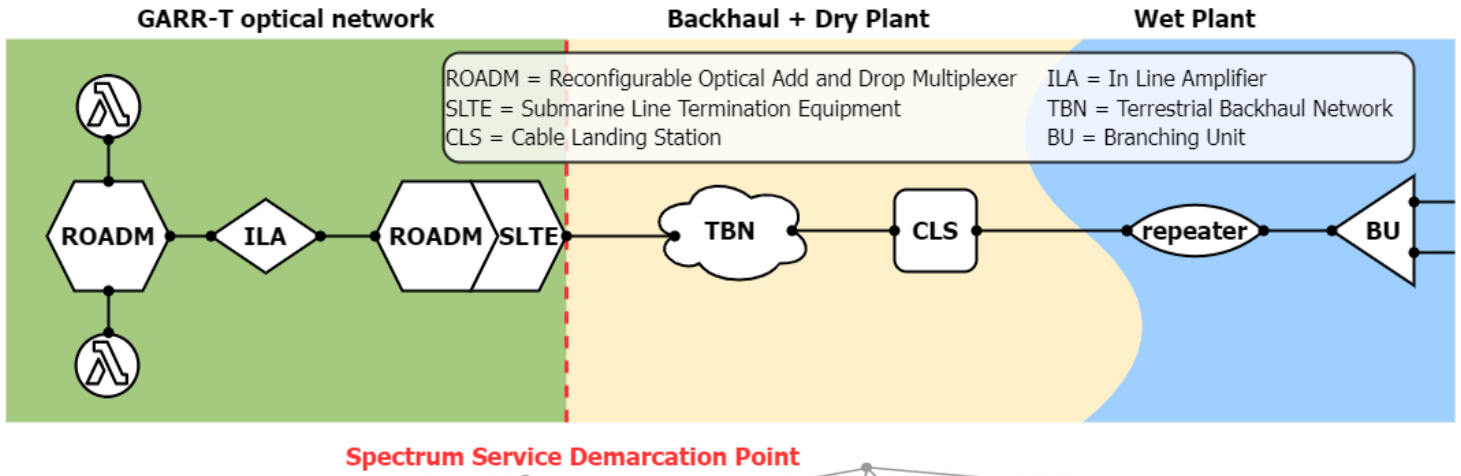
New playground: Spectrum over Subsea Open Cable

GARR-T aims to complete a unified infrastructure all over Italy reaching also Sardinia through subsea cables.

- 200GHz of spectrum over Open Cable Subsea System
- Direct interconnection between Sardinia and Rome and Sardinia and Milan (Core Nodes)
- 20 years IRU
- nx400GEth interconnections





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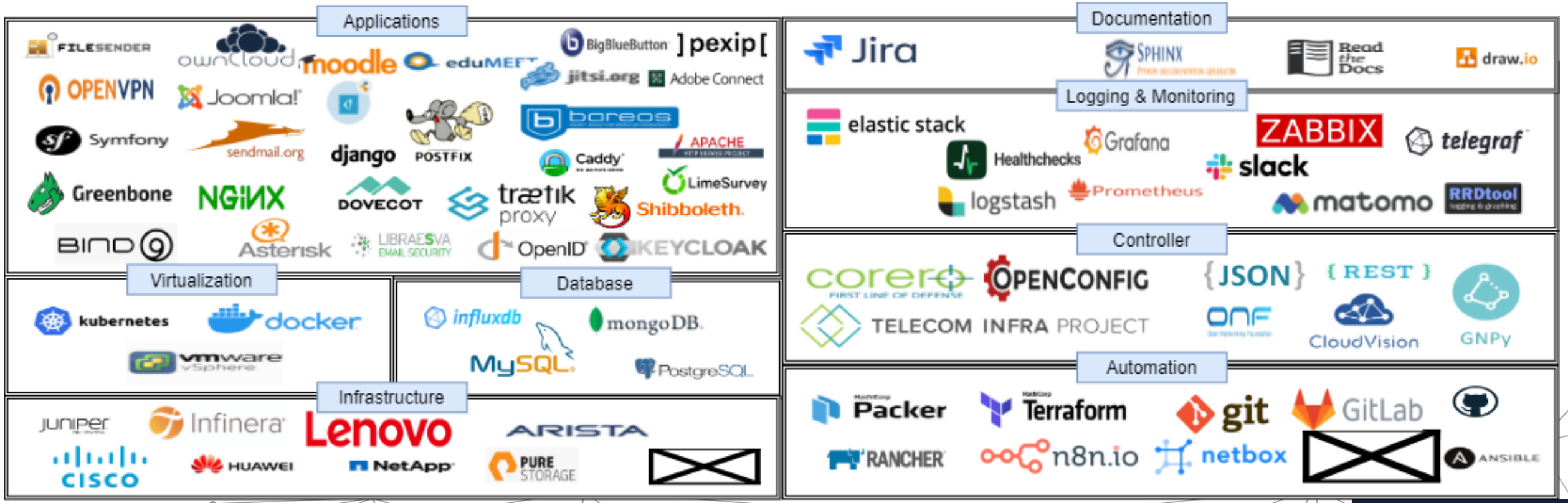
New Toolset…

Integrate

"~~Buy~~ good tools as you can afford them and you'll never regret it"

Zen and the Art of Motorcycle Maintenance by Robert Pirsig



Management and Control – state of art and developments

infinera TNMS

ONF

OPENCONFIG

< REST CONF />

gRPC

netbox

Automatic Inventory

Streaming telemetry

influxdb

Alerts

Developments and opportunities to catch up

Network Visibility

- Performance Monitoring and log/event management

Network Automation

- Provisioning / network lifecycle management

AW and Spectrum Sharing

- Share infrastructure and open access to the photonic layer

Open Network Design and Planning (GNpy)

- Planning tool for multi-domain and multi-vendor environment

Beyond Data Services (GN5-1)

- Time&Frequency distribution / QKD / Seismology

Conclusion

Pillars:

- Terabit
- Flexibility
- Performances

Opportunities:

- Integration of open tools and frameworks
- GNpy + ODL Transport PCE
- Match high-end community use cases

Challenges:

- Time requirements
- Shortage
- Spectrum Over Open Cables

Q&A

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