GARR-T Network Architecture
disaggregata ma troppo

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WORKSHOP GARR 2019

The GARR Network

IRU fiber footprint **16000+1500 km**

- **~9.000 km** of backbone
- **~7.000 km** of access links
- **+ 1500 km** of dedicated fibre for Metrology Application (INRIM)

About **1000 user sites** interconnected

- **> 1.5 Tbps** aggregated access capacity
- **~ 3.5 Tbps** Backbone Capacity
- ~ **90%** of the users via DF (limited xDWM)

DWDM/OTN/ROADM Network

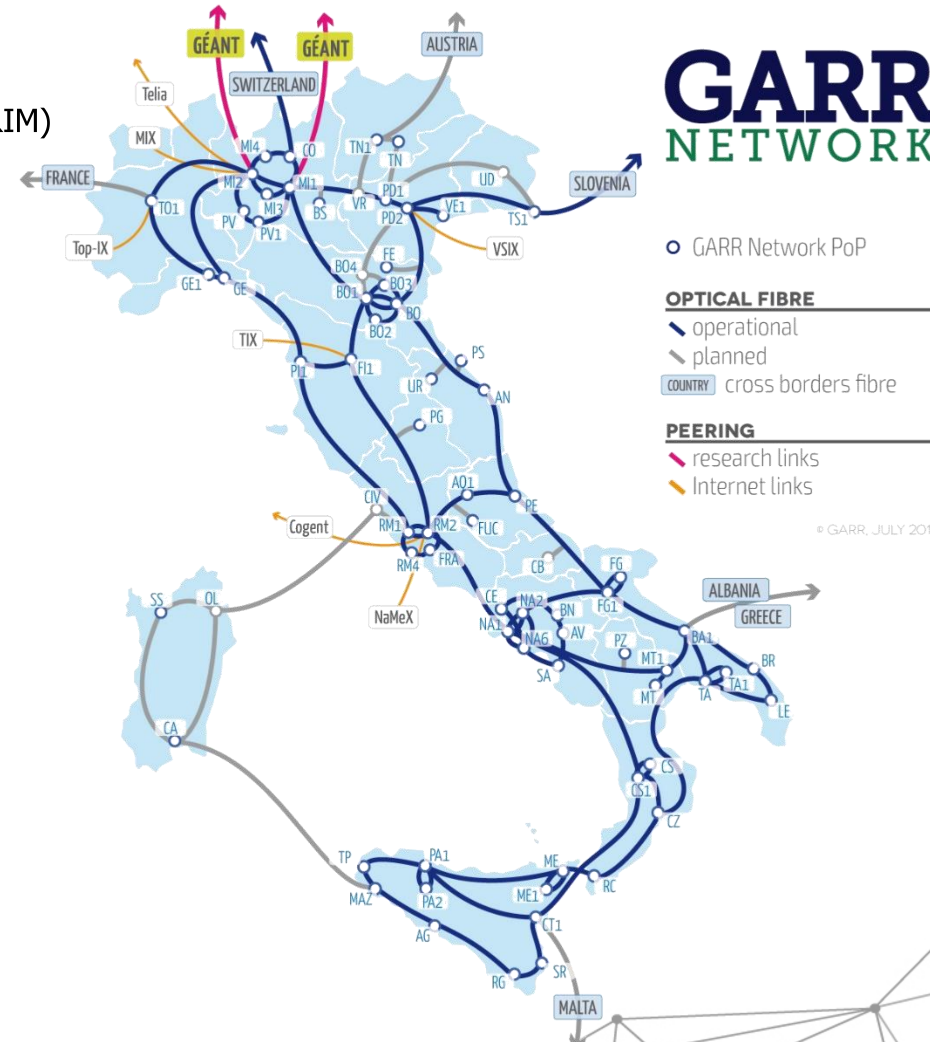
- (2011) Huawei 1/10 G
- (2015) Infinera 10/40/100 G
- (2017) Alien Waves 200G between Core PoPs
- (2018) **DCI** 1.2T (5x100G active) CINECA – CNAF

Core IP/MPLS network

- Juniper MX960/480/80

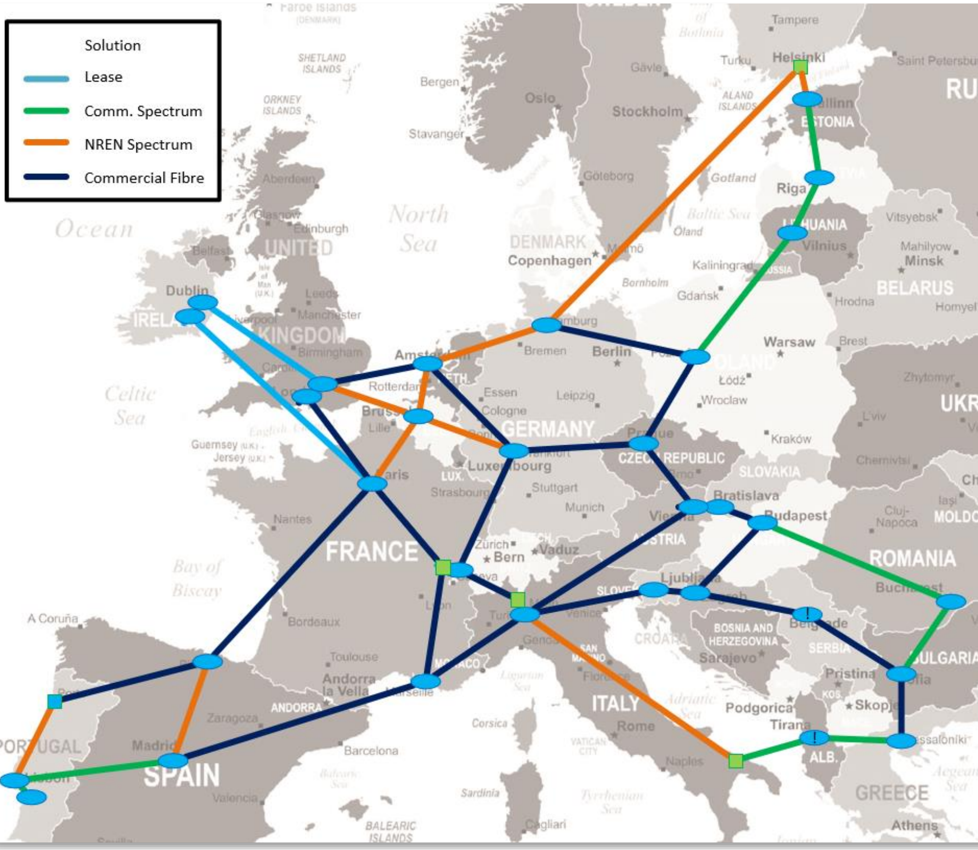
Metro/Aggregation

- Cisco ME3600/3400
- CPE Cisco 2900 series
- ISR-43xx, ISR-4451

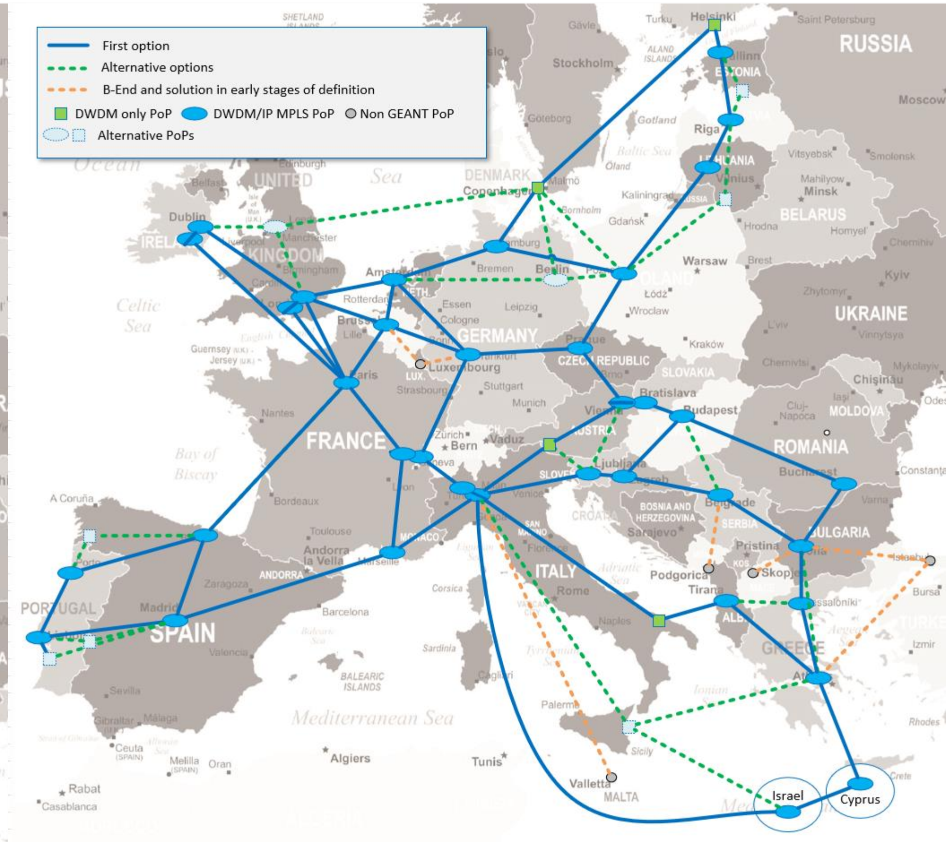


GEANT Network Footprint Evolution

Reference 2019



The Full engagement



I requisiti della comunità GARR

HTC

- High Speed Network
- Transport only
- World Wide Scale

Managed Services

- *Easy to Use*
- *IP Connectivity*
- *Security Management*

Advanced Services

- Network Application
- Infrastructure Integration
- High Availability Services
- Disaster Recovery
- Network Control

Consortium GARR
THE ITALIAN EDUCATION & RESEARCH NETWORK

Come Evolvere

Evoluzione Tecnologica

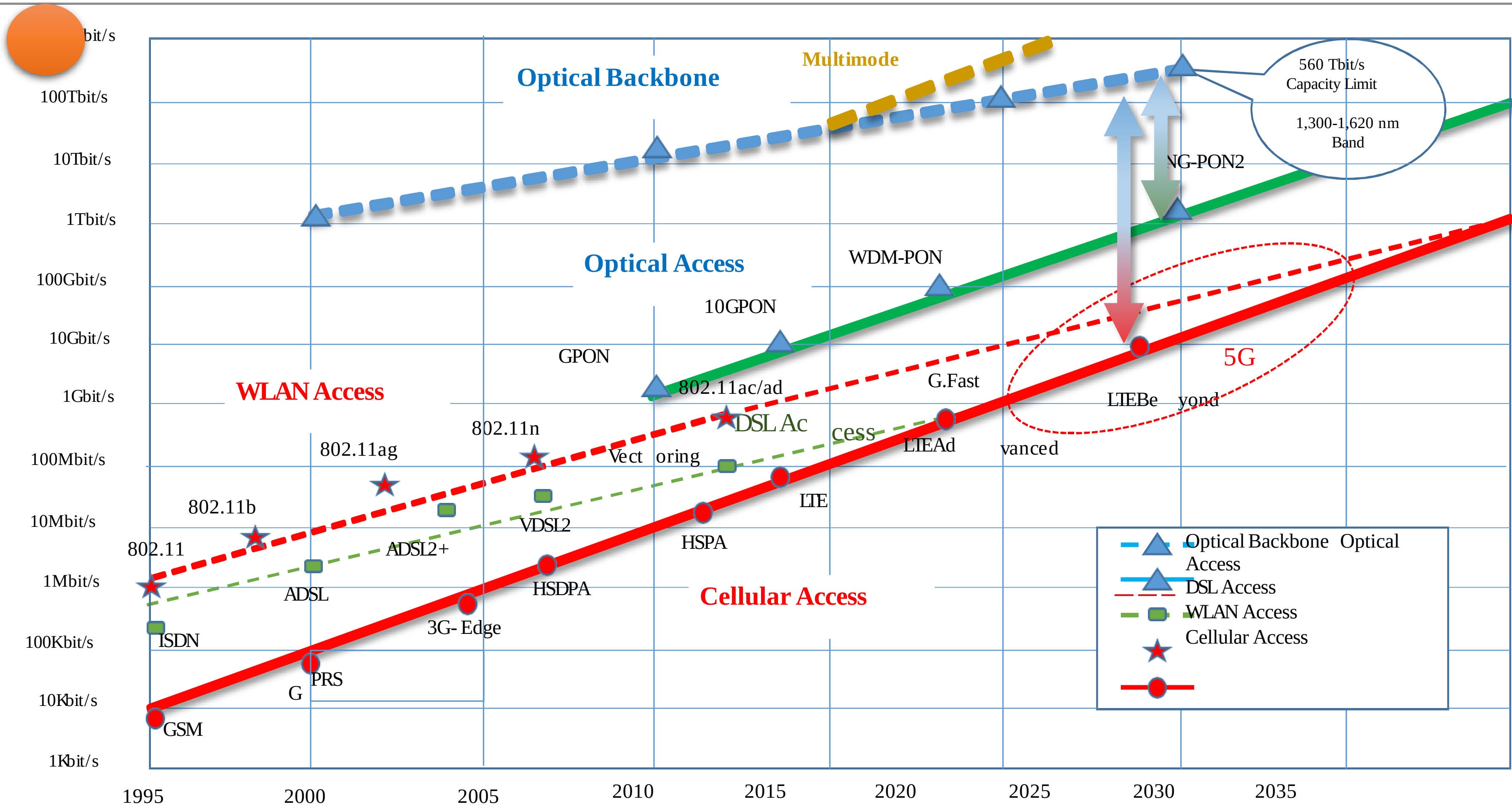
Fibre & Trasmission 1

2 Ethernet Roadmap

Packet 3

4 Software Glue

Benchmark of Wired and Wireless Technologies with Projections



Source: M. Dècina, 2014, based on data by Bell Labs, G. Fettweis, and others

DEIB–Politecnico di Milano

Maurizio Dècina, 5G Italy, Rome, December 13th, 2018

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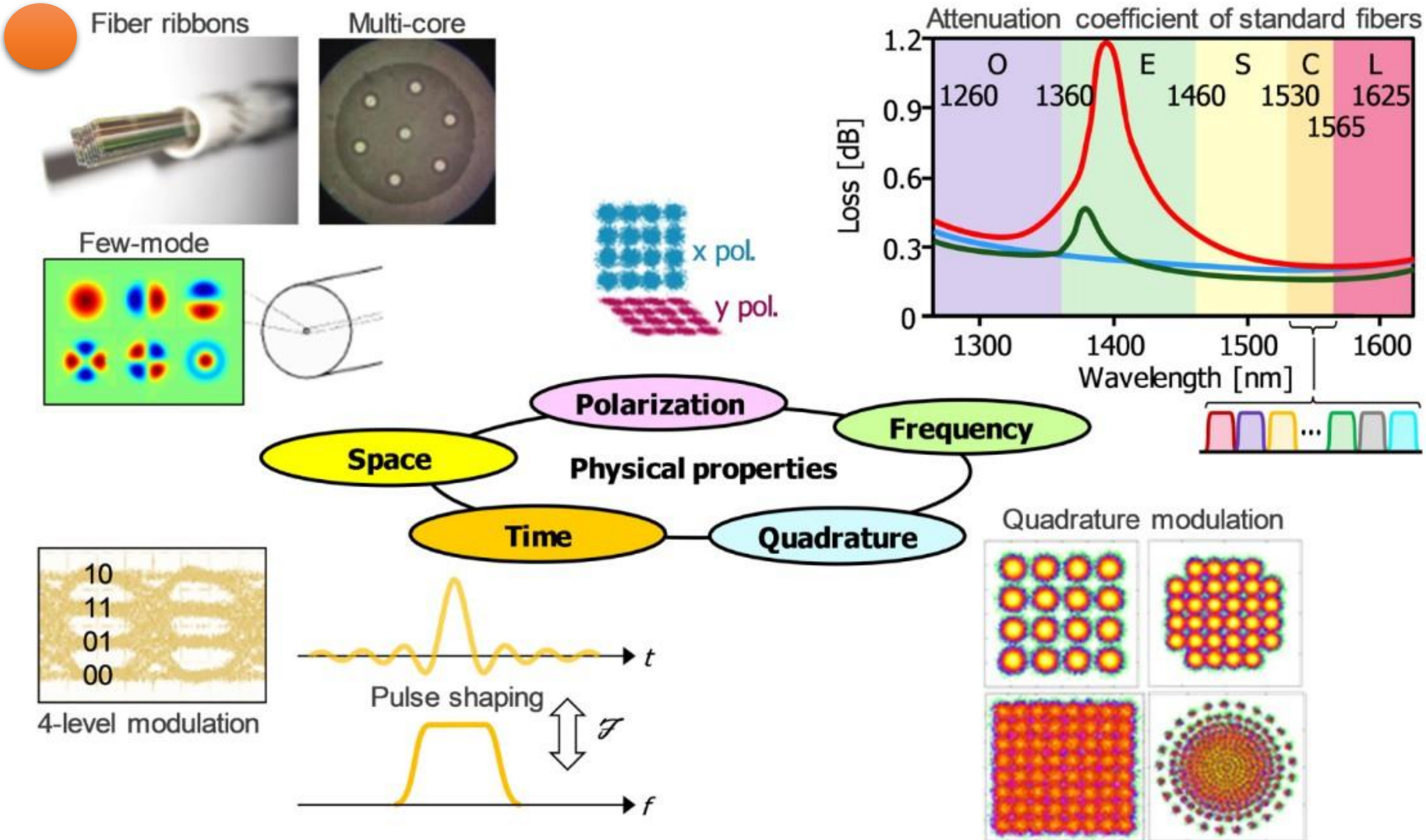
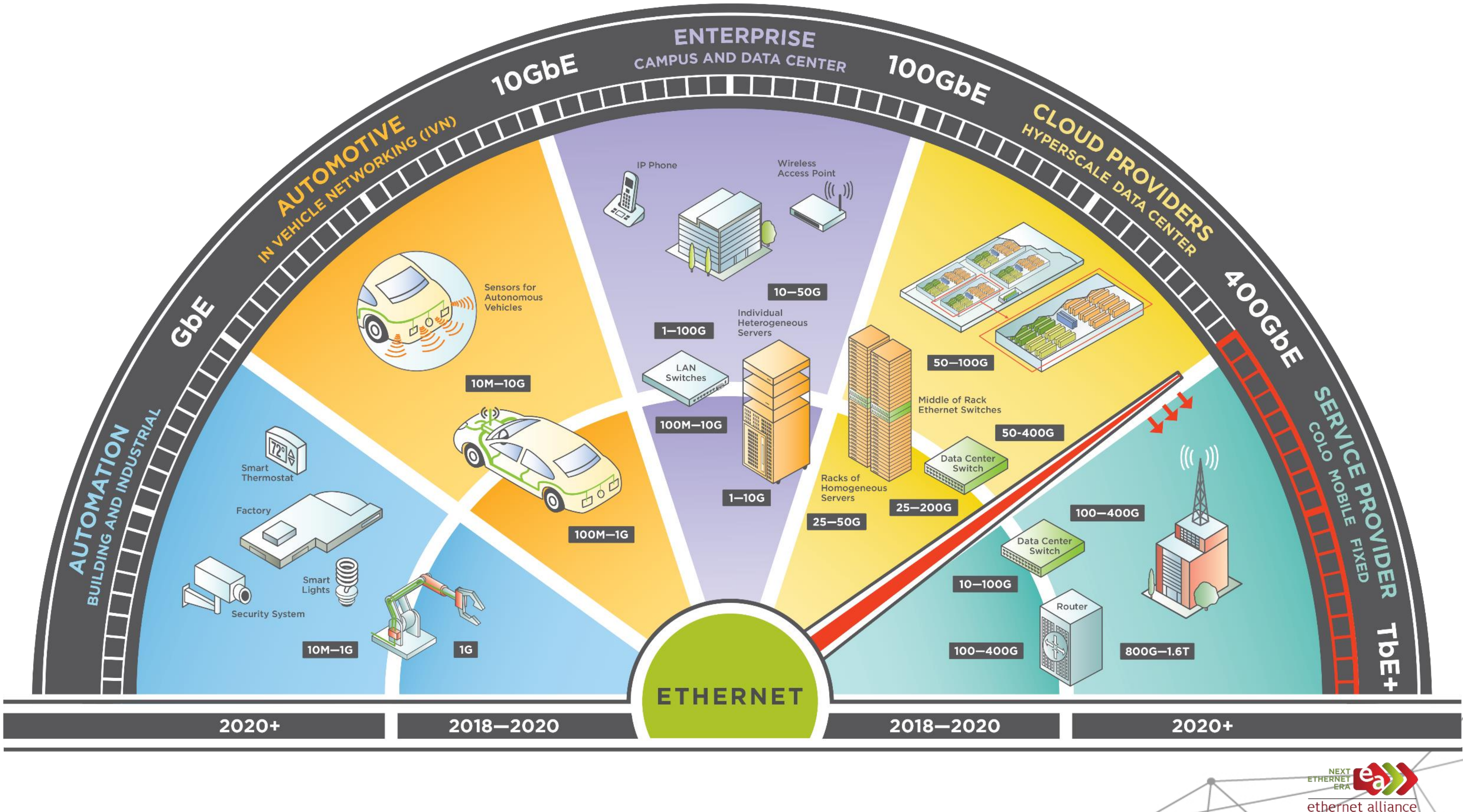
Evoluzione della fibra ottica e dei sistemi di modulazione



Ethernet Road Map



Emerging Interfaces and nomenclature

EMERGING INTERFACES AND NOMENCLATURE

	Electrical Interface	Backplane	Twinax Cable	Twisted Pair (1 Pair)	Twisted Pair (4 Pair)	MMF	500m PSM4	2km SMF	10km SMF	40km SMF	80km SMF
10BASE-		T1S?		T1S/T1L							
100BASE-				T1							
1000BASE-				T1	T						
2.5GBASE-		KX		T1S?	T						
5GBASE-		KR		T1S?	T						
10GBASE-				T1S?	T						
25GBASE-	25GAUI	KR	CR/CR-S		T	SR			LR	ER	
40GBASE-	XLAUI	KR4	CR4		T	SR4/eSR4	PSM4	FR	LR4	ER4	
50GBASE-	LAUI-2/50GAUI-2 50GAUI-1	KR	CR			SR		FR	LR	ER	
100GBASE-	CAUI/10 CAUI-4/100GAUI-4 100GAUI-2 100GAUI-1	KR4 KR2 KR1	CR10 CR4 CR2 CR1			SR10 SR4 SR2	PSM4 DR	10X10 CWDM4 CLR4 100G-FR	LR4 4WDM-10 100G-LR	ER4 4WDM-40 ?	?
200GBASE-	200GAUI-4 200GAUI-2	KR4 KR2	CR4 CR2			SR4	DR4	FR4	LR4	?	?
400GBASE-	400GAUI-16 400GAUI-8 400GAUI-4	KR4	CR4			SR16	DR4	FR8 400G-FR4	LR8 ?	?	?

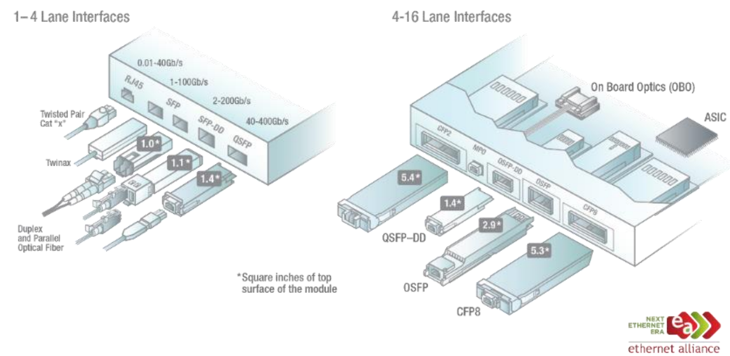
Gray Text = IEEE Standard   Red Text = In Standardization   Green Text = In Study Group
Blue Text = Non-IEEE standard but complies to IEEE electrical interfaces

NEXT ETHERNET ERA ethernet alliance

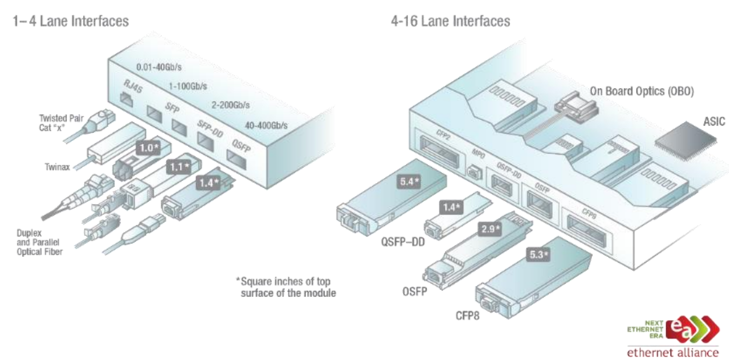
FORM FACTORS

This diagram shows the most common form factors used in Ethernet ports. Hundreds of millions of RJ45 ports are sold a year while tens of millions of SFP and millions of QSFP ports ship a year.

This diagram shows new form factors initially designed for 100GbE and 400GbE Ethernet ports. All have 4 or 8 lanes and the OBO has up to 16 lanes. The power consumption of the modules is proportional to the surface area of the module.



FORM FACTORS

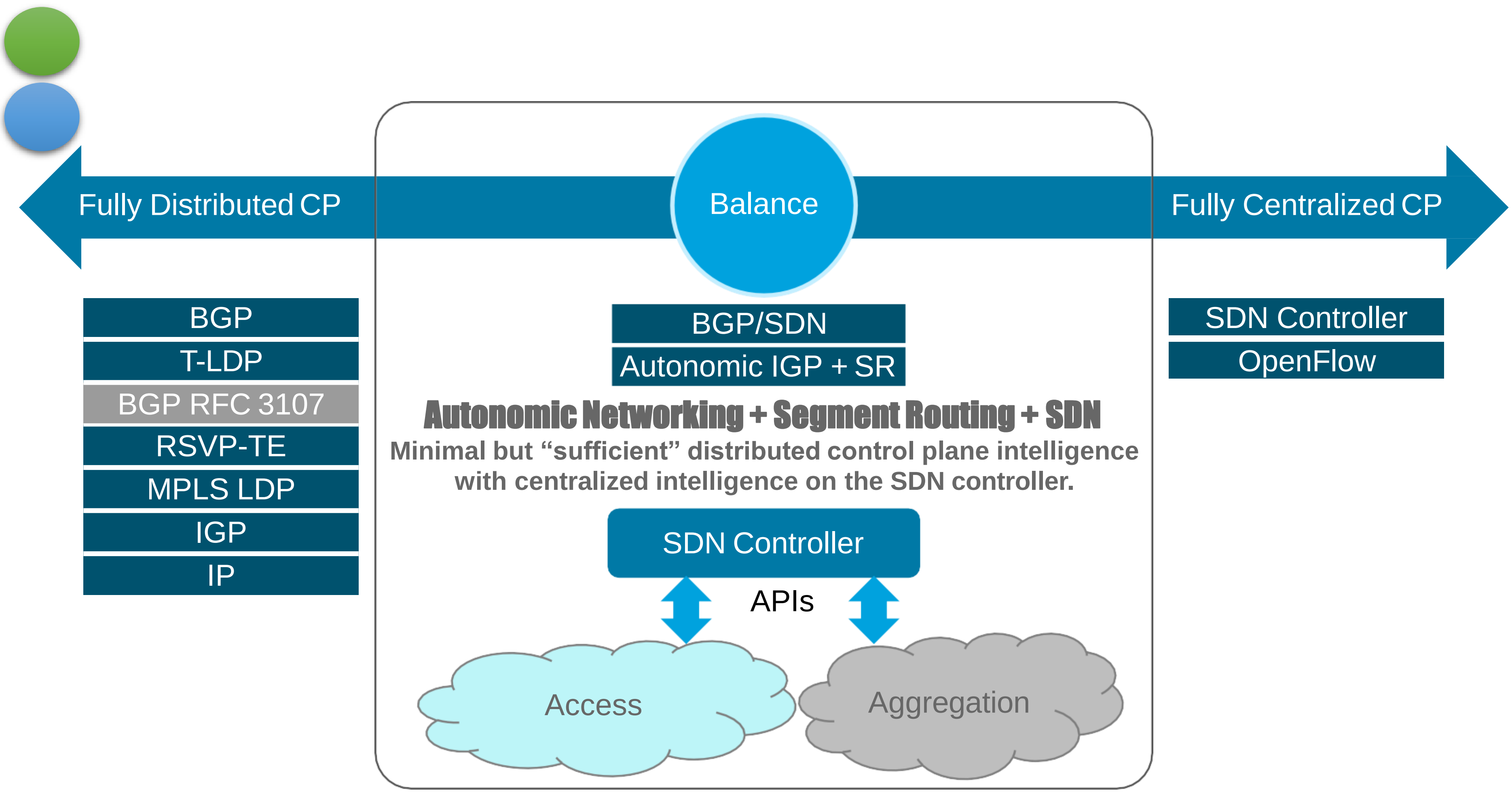


Many Technologies Support Carrier Ethernet

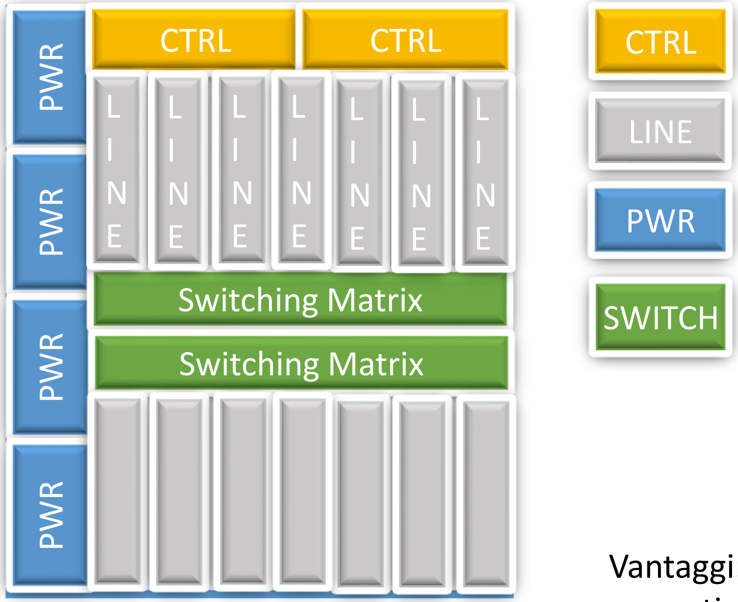
Transport Encapsulation	Control Plane
L0/L1 Transport (EoSONET/SDH, OTN, DWDM)	EMS/NMS + SNCP/MS-SPRing ASON/WSON, GMPLS
L2 Bridging (QinQ, 802.1ad, PBB)	xSTP, REP, others G.8031, G.8032
MPLS Switching (MPLS-TP, PW, VPLS, EVPN)	IP/MPLS (IGP, LDP, RSVP, BGP) SR, GMPLS, EMS/NMS

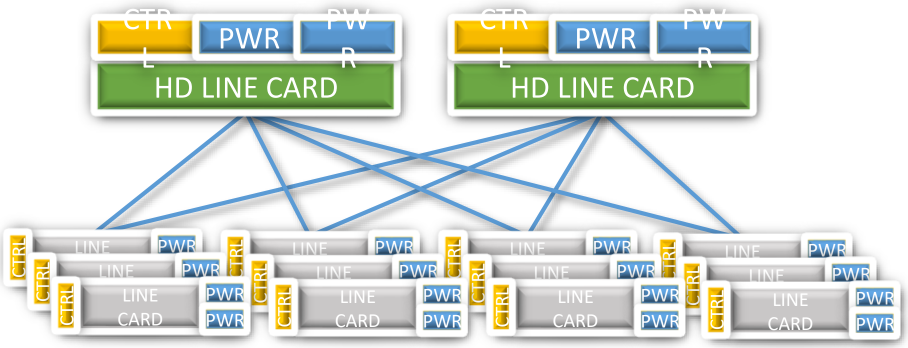
+ various access (wireless, wireline, cable) and tunneling technologies.

Agile Carrier Ethernet Networks



Disaggregated Network Components





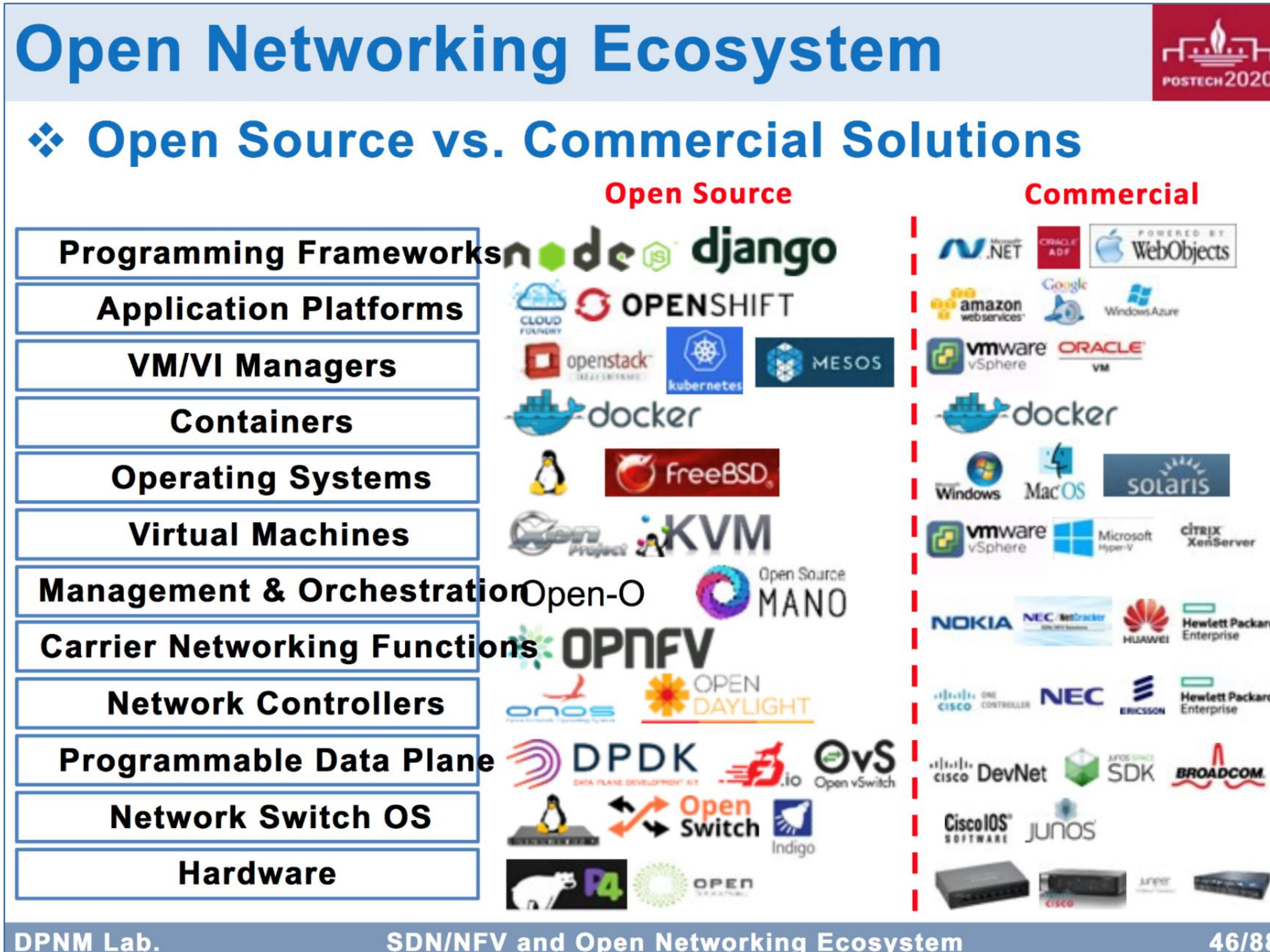
Vantaggi:

- costi minori
- maggiore resilienza ai guasti-aggiornamenti
- Affidabilità architetturale
- ciclo di vita definito

Svantaggi:

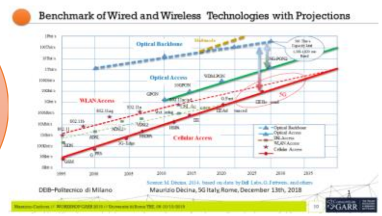
- Maggiore complessità

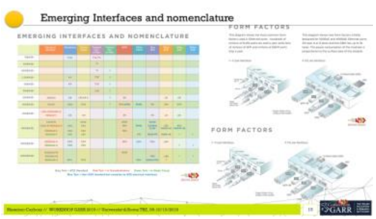
The Evolving Technologies



Evoluzione Tecnologica a supporto dell'evoluzione

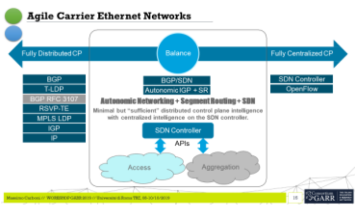
Fibre & Trasmission 1

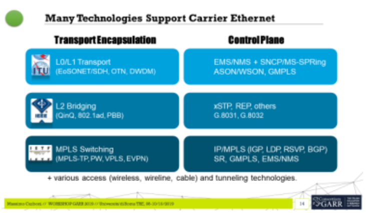


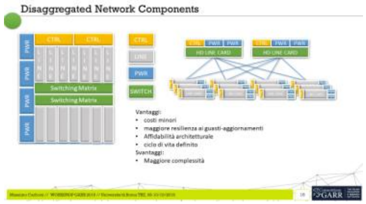


2 **Ethernet Roadmap**

Packet 3

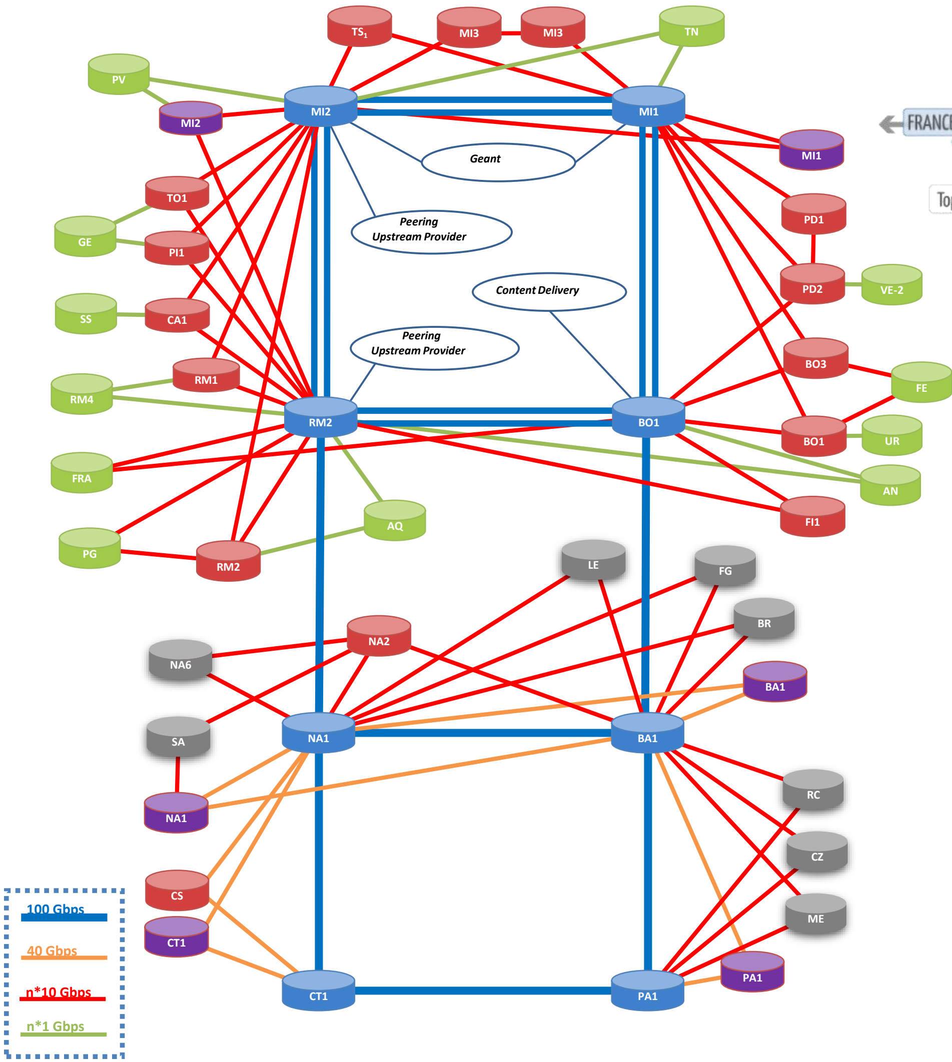




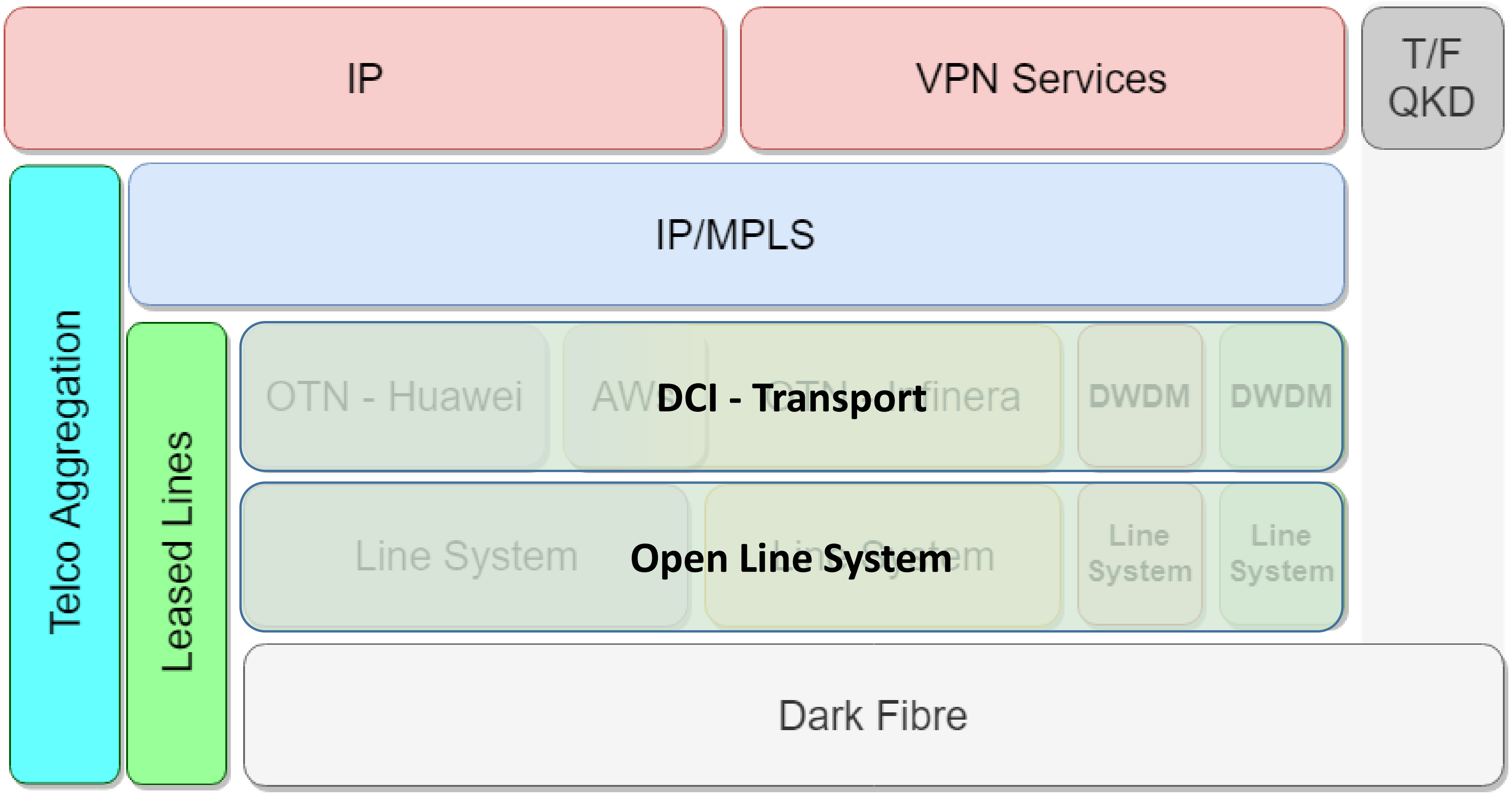


4 **Software Glue**

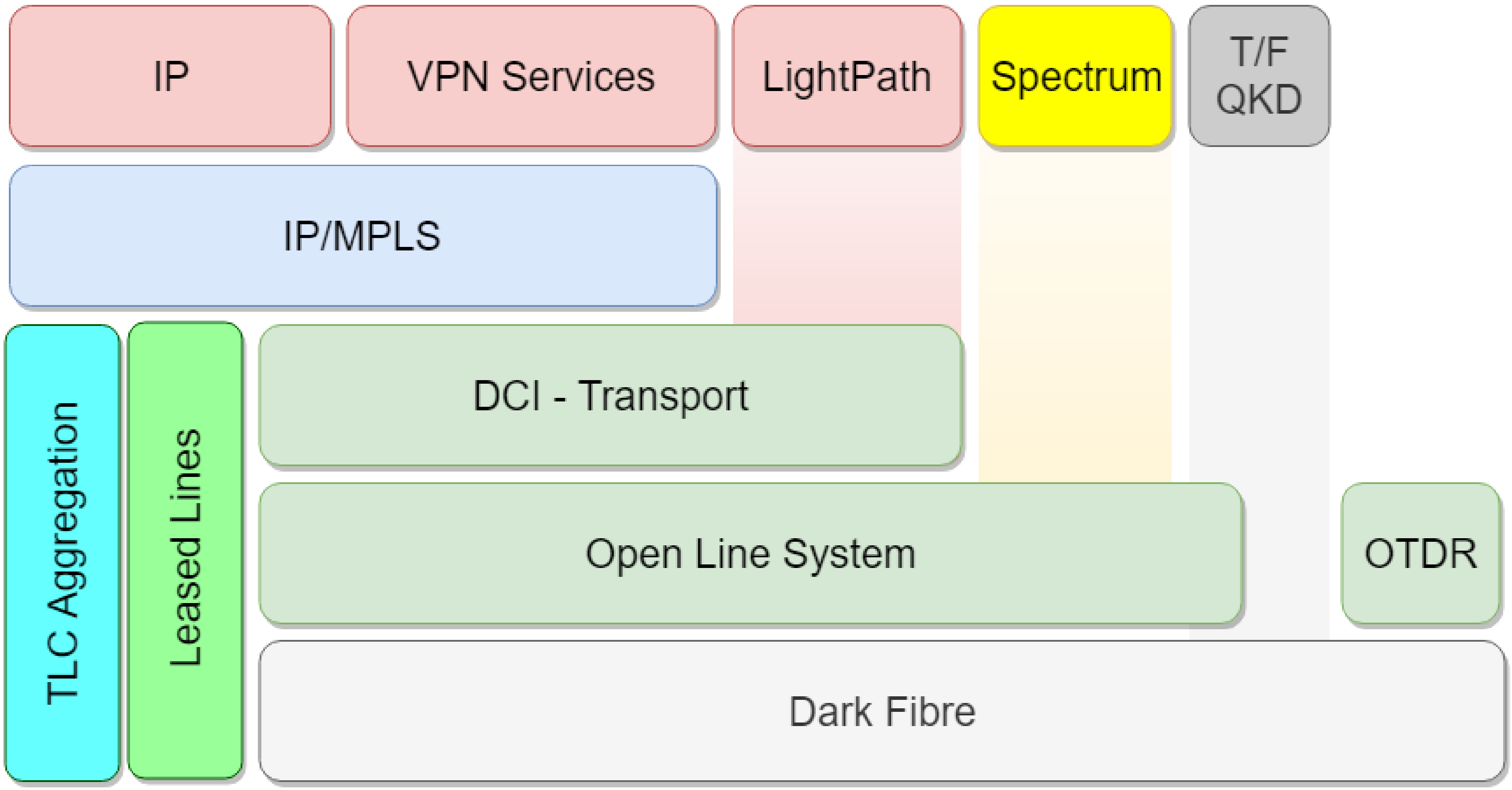
La Rete Attuale



GARR-X Network Architecture

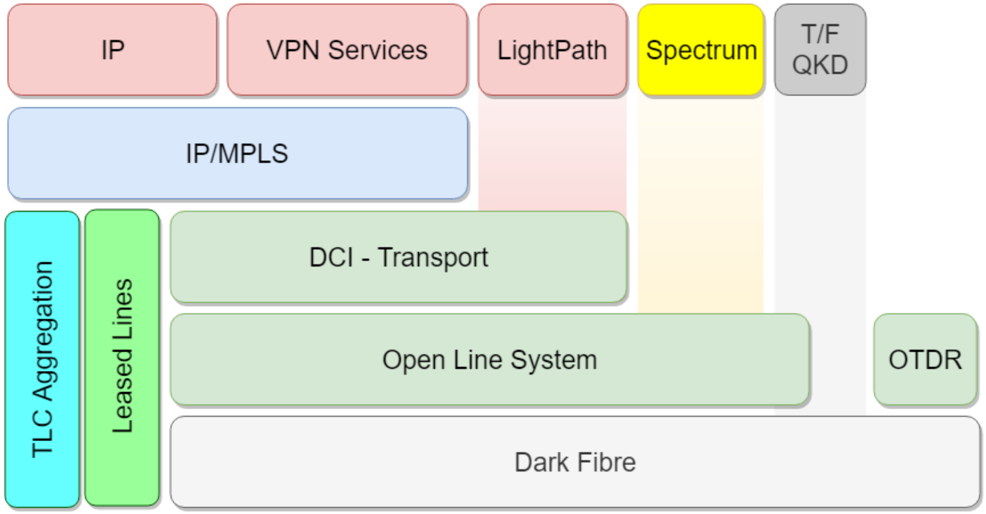


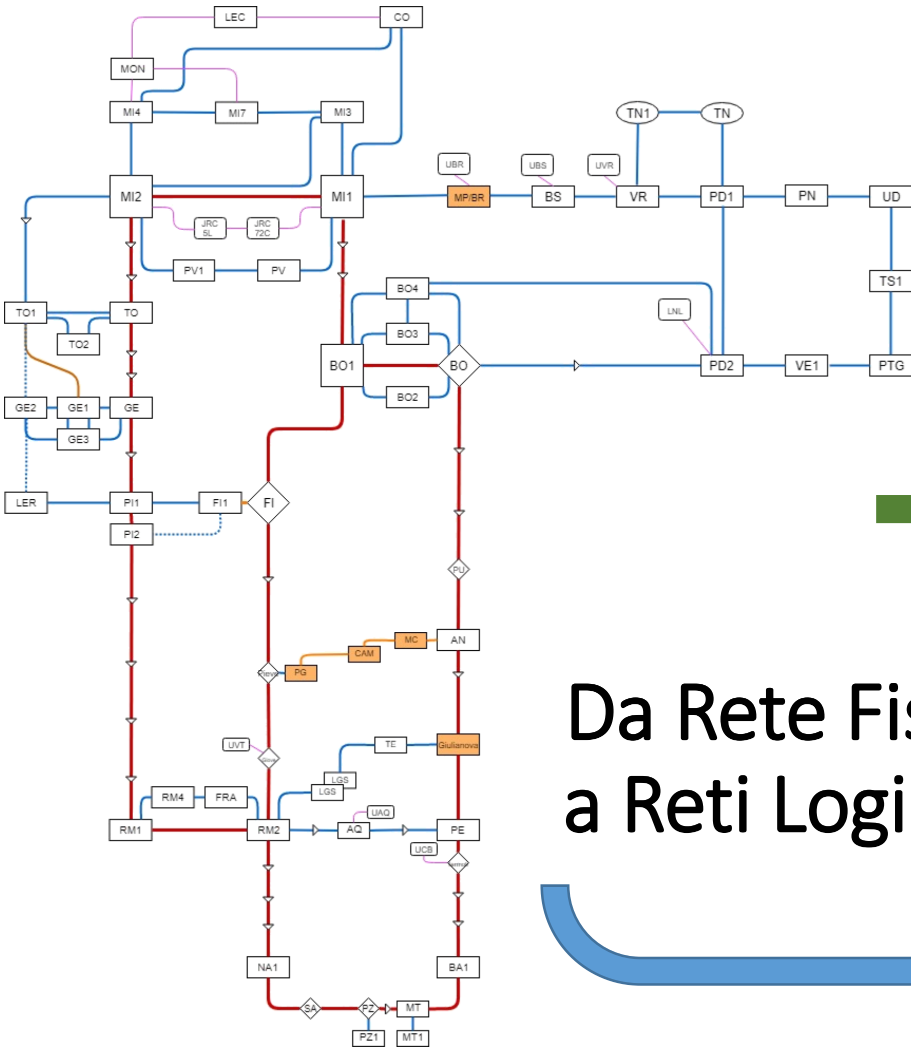
GARR-T High Level Network Architecture v-1.0

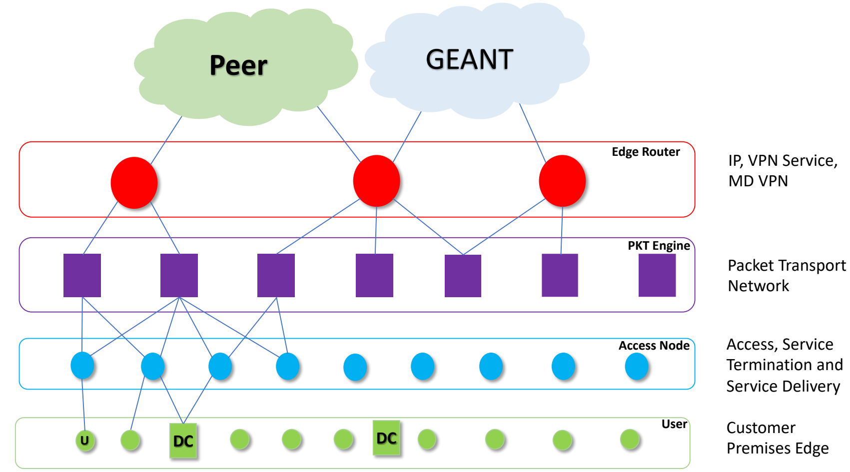


L'evoluzione di rete in pillole

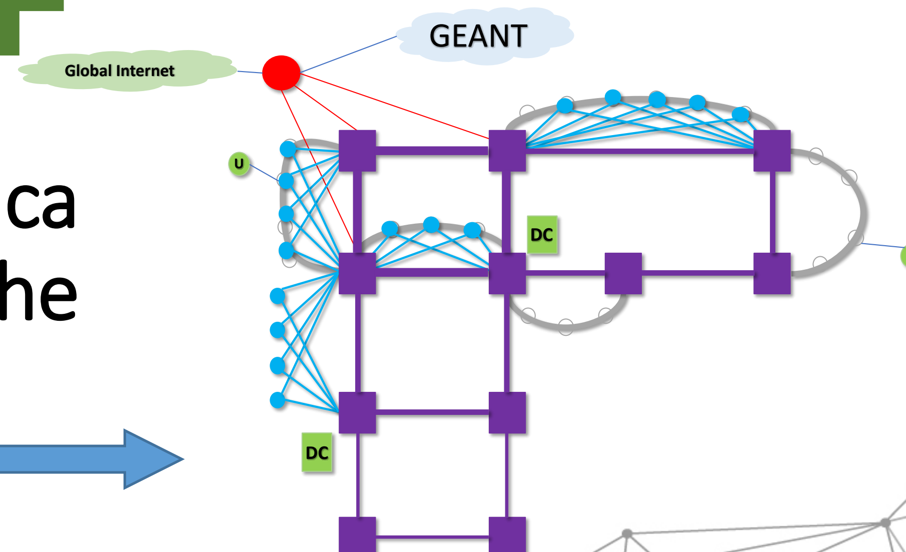
- Il disegno di rete pensato come "greenfield"
  - Fibra ottica di lunga distanza, sistemi ottici e apparati completamente nuovi
  - Introduzione della automazione su IP/MPLS network
- Packet layer
  - Servizi (IP, L2VPNs, L3VPNs, MDVPN etc.)
  - Fast rerouting and restoration
- Optical layer
  - Mette in comunicazione gli apparati di rete
  - Spectrum e cammini ottici p-t-p (100 Gbps+)
  - Nuovi Servizi: Time and frequency transfer
  - Migrazione in service





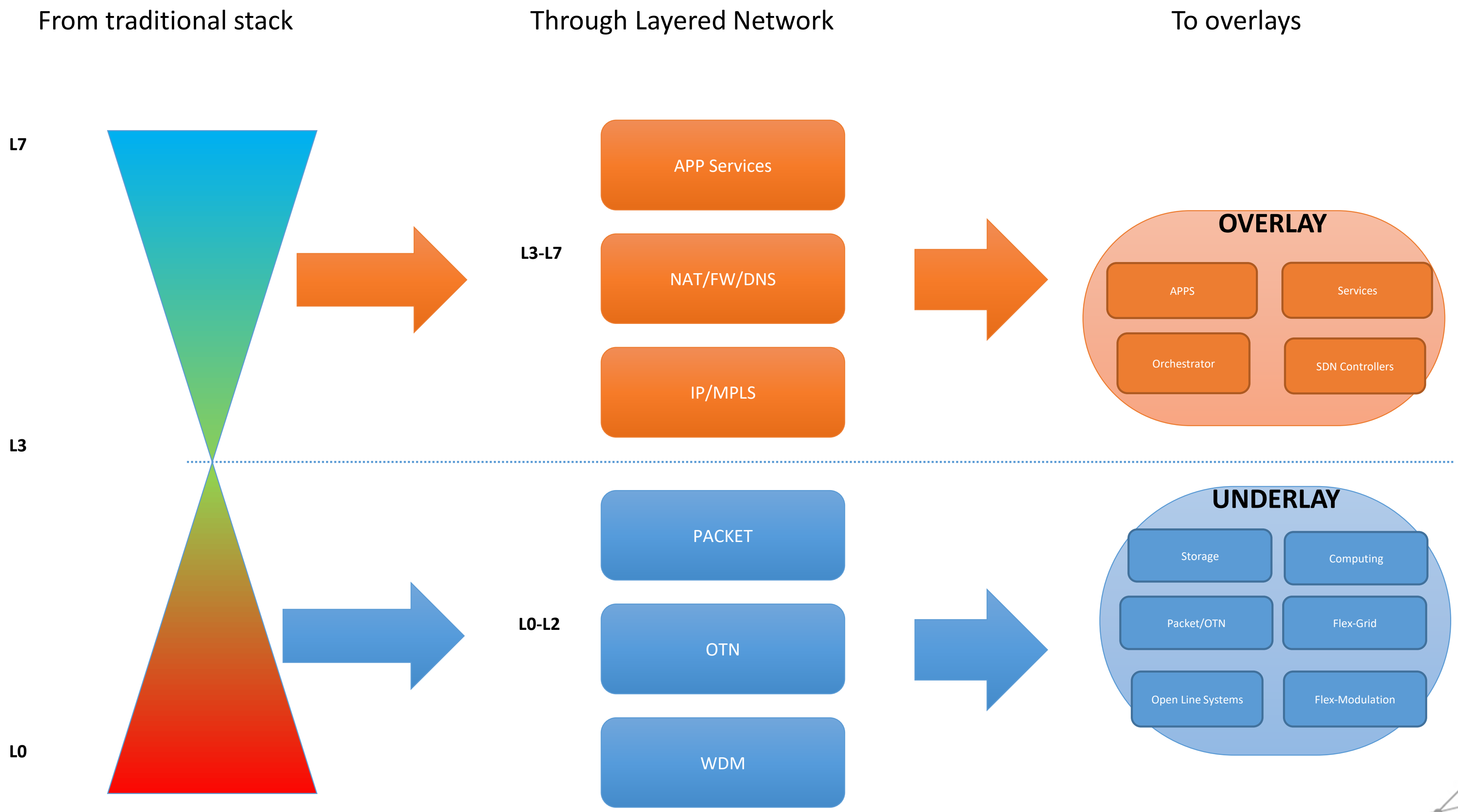


Da Rete Fisica a Reti Logiche

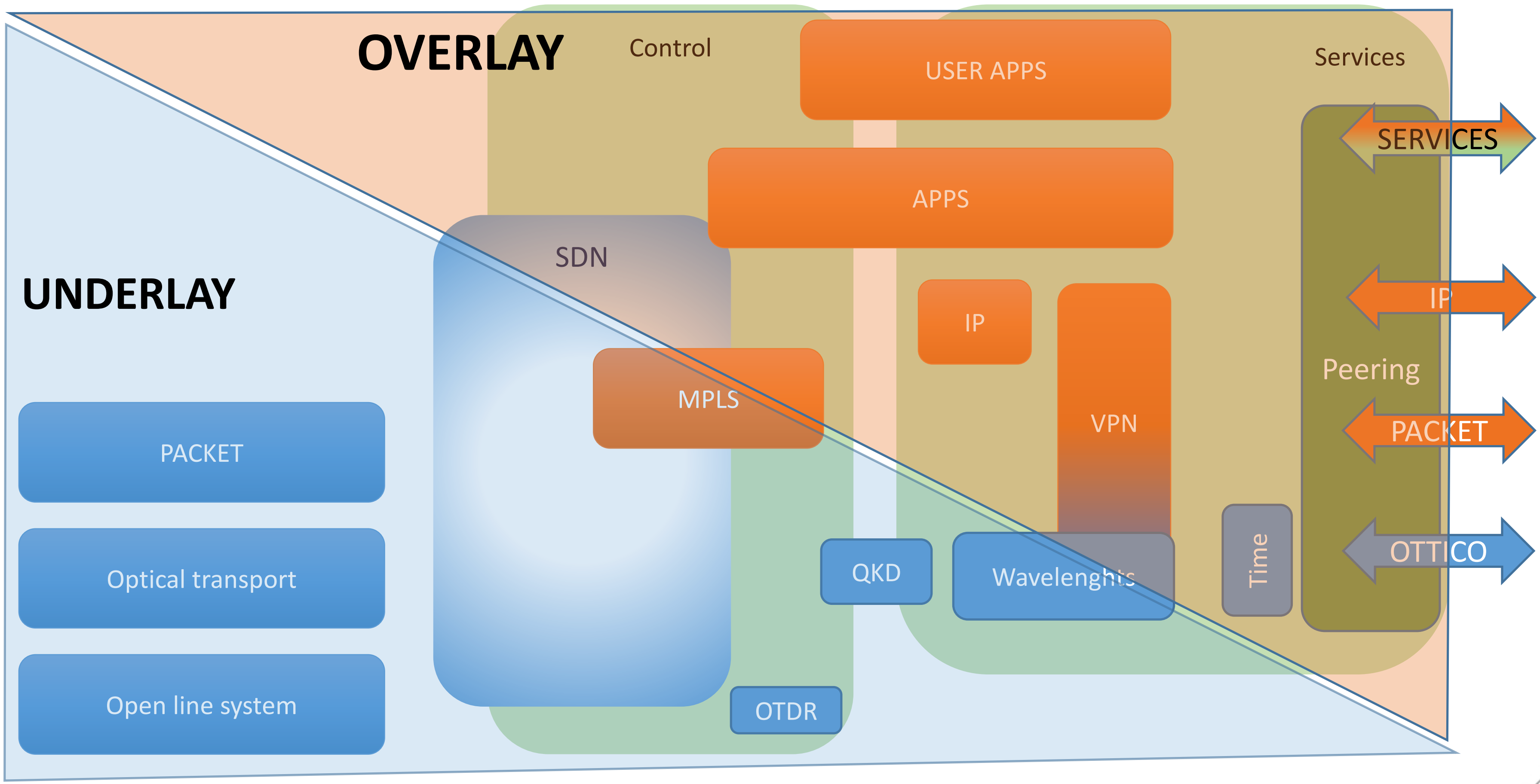


Come procediamo

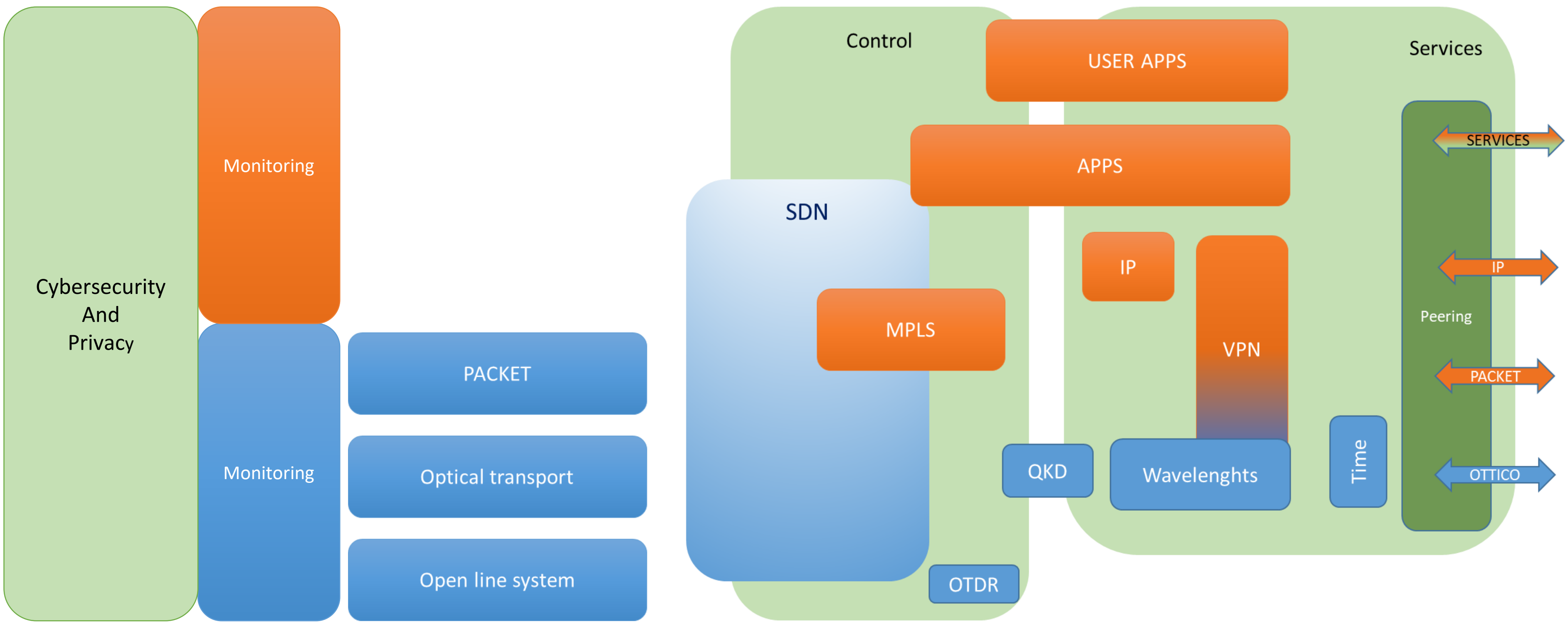
Network (and ICT) Evolution Trends



High Level Architecture + control + services



High Level Architecture + control + services + monitoring + Security



Conclusioni

Dobbiamo rispondere a **nuove sfide** che coinvolgono l'intero sistema di rete **GARR** come parte di un **network globale** via **GEANT**

Non solo **IP**

Elementi chiave **Infrastrutture fisiche** magliate, capillari e **condivisione di spettro**

La **disaggregazione** come building block per ridisegnare l'intero sistema

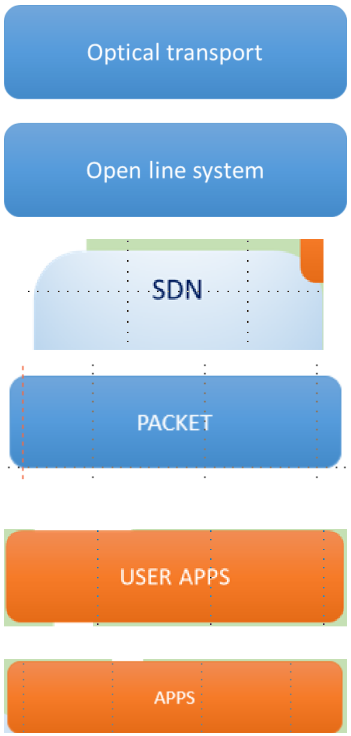
La **maggiore complessità** richiede una metodologia **devops** con le quali si «**disegnano**» le applicazioni ***Infrastructure as a Code***

Sviluppare competenze nella capacità di vedere quello che accade in modo dinamico con **tempi di reazione** non confrontabili con i processi «umani»

Superamento di SS7/SMTP: servono nuovi protocolli di comunicazione, certamente condivisi

Dobbiamo semplificare, collaborare, riusare, aggiornarsi e condividere

Rimandi a presentazioni che seguono HL Architecture



Gloria Vuagnin, GARR
Evoluzione dell'infrastruttura in fibra: esercizi di equilibrismo sulla rete

Paolo Bolletta, GARR
Rete ottica parzialmente disaggregata: un'infrastruttura a lunga conservazione

Giancalo Viola, GARR
The SD-WAN story. Un approccio alternativo per la rete d'accesso

Marco Marletta GARR
Nuovi scenari della rete IP: come cambiare la rete e vivere felici

Fabio Farina, GARR - SCRUM e scrum, o come massimizzare la spinta verso il futuro senza farsi (tro
Paolo Velati, GARR - Filesender
Gianni Marzulli, GARR - WebMeeting
Gianni Marzulli, GARR - SCARR
Pasquale Mandato, GARR - Eduroam as a (Self) Service
Lorenzo Chiarelli, GARR - VConf: Migrazione e sviluppi futuri
Silvia d'Ambrosio, GARR - Aggregazione e analisi centralizzate dei log di dorsale
Nino Ciurleo, GARR - Mitigazione dei DDoS in GARR: aggiornamento sulle attività
Federico Dossena, Università di Milano - LibreSpeed