GRUPPO TIM

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TIM FutureNet

A CORD based network demonstrator

Alessandro Capello, Carlo Cavazzoni, Anna Chiadò Piat, Maurizio De Paola, Marco Ferrero, Rosa La Sala, Giuseppe Longo, Roberto Morro, Elio Paschetta, Paolo Pellegrino, Alessandro Percelsi, Andrea Pinnola, Roberto Querio, Emilio Riccardi, Mauro Tilocca - TIM

Francesco Lucrezia, Guido Marchetto, Fulvio Risso – Politecnico di Torino

TIM

Summary

- Intro and motivation
- Architecture of network demonstrator
- Optical transport network implementation
- Enterprise service implementation
- TIM’s experience feedbacks
- Conclusions

TIM FutureNet: a CORD inspired initiative towards 5G

- Building–up on planned/under discussion short term evolutions and bringing the network into a step further – a **5G-enabled** infrastructure -, by borrowing the technologies and practices from the data center industry
- Aims to exploring the applicability of new technologies, **software-defined** control and management, **virtualization**, **open source** software and **disaggregation**, going beyond the early introduction today struggling with relative maturity and limited architectural consistency
- The **FutureNet** vision builds on the **CORD** technical approach, applying a blue sky approach to the design of Central Offices and PoPs
- In order to exploit the potential of the CORD approach and value proposition in production deployments, some issues still need to be sorted out

TIM FutureNet: What is really new?

- **All COs become Data Centers**: from access/aggregation to metro/edge PoPs, not only big core PoPs
- **Disaggregation** and **white box** approaches: no dedicated hardware in central office, neither for transport nor for optical. Virtualized control plane on general purpose servers, IP data plane on white box switches, optical data plane on disaggregated hardware (optical interfaces, ROADM, OLT,...) managed by SDN controllers. The geographical transport network becomes a data center interconnection network
- Mainly **open source** software to realize network functions
- Open platform for the integration of external elements

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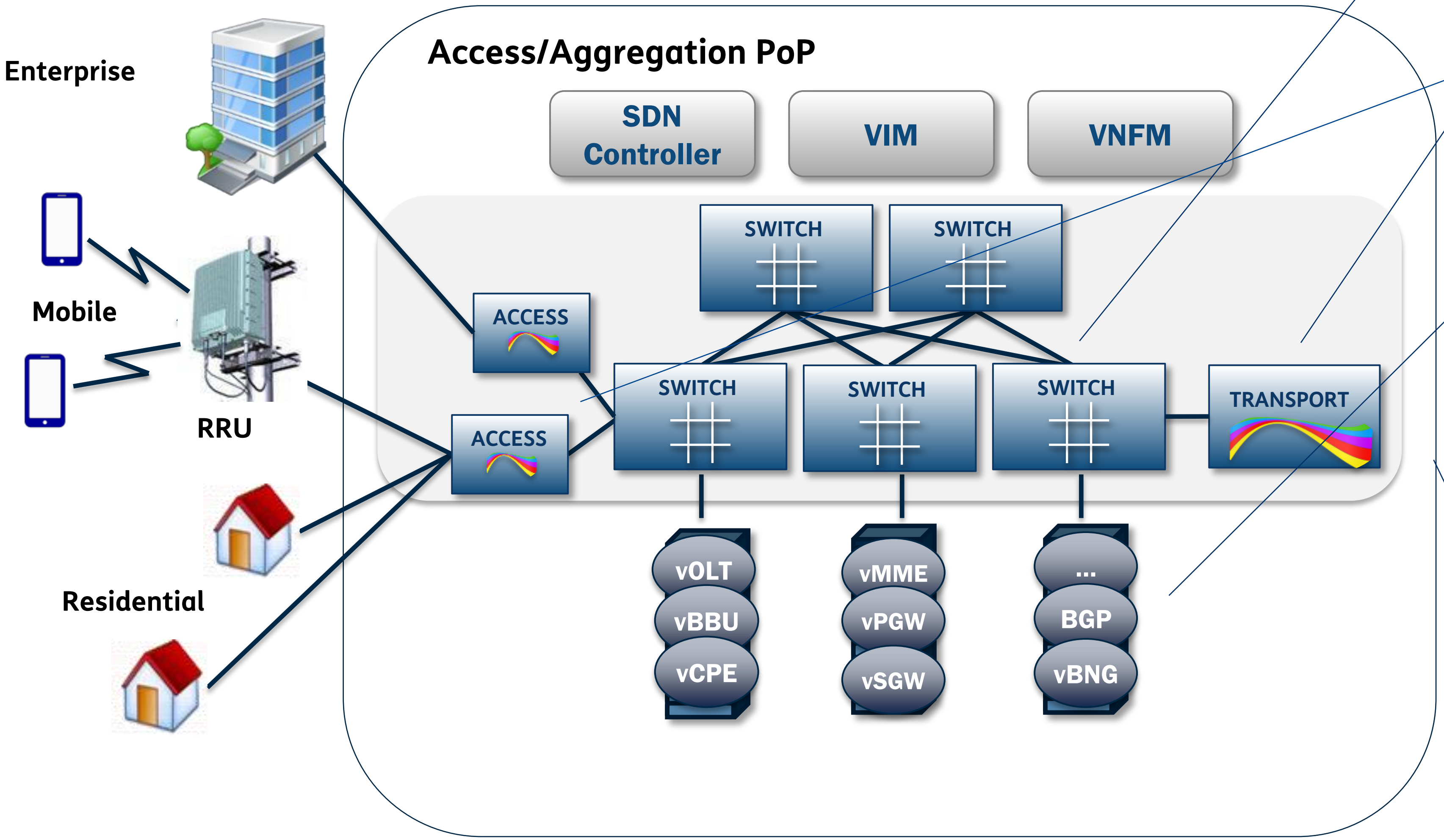
TIM FutureNet – Node architecture

A CORD based architecture



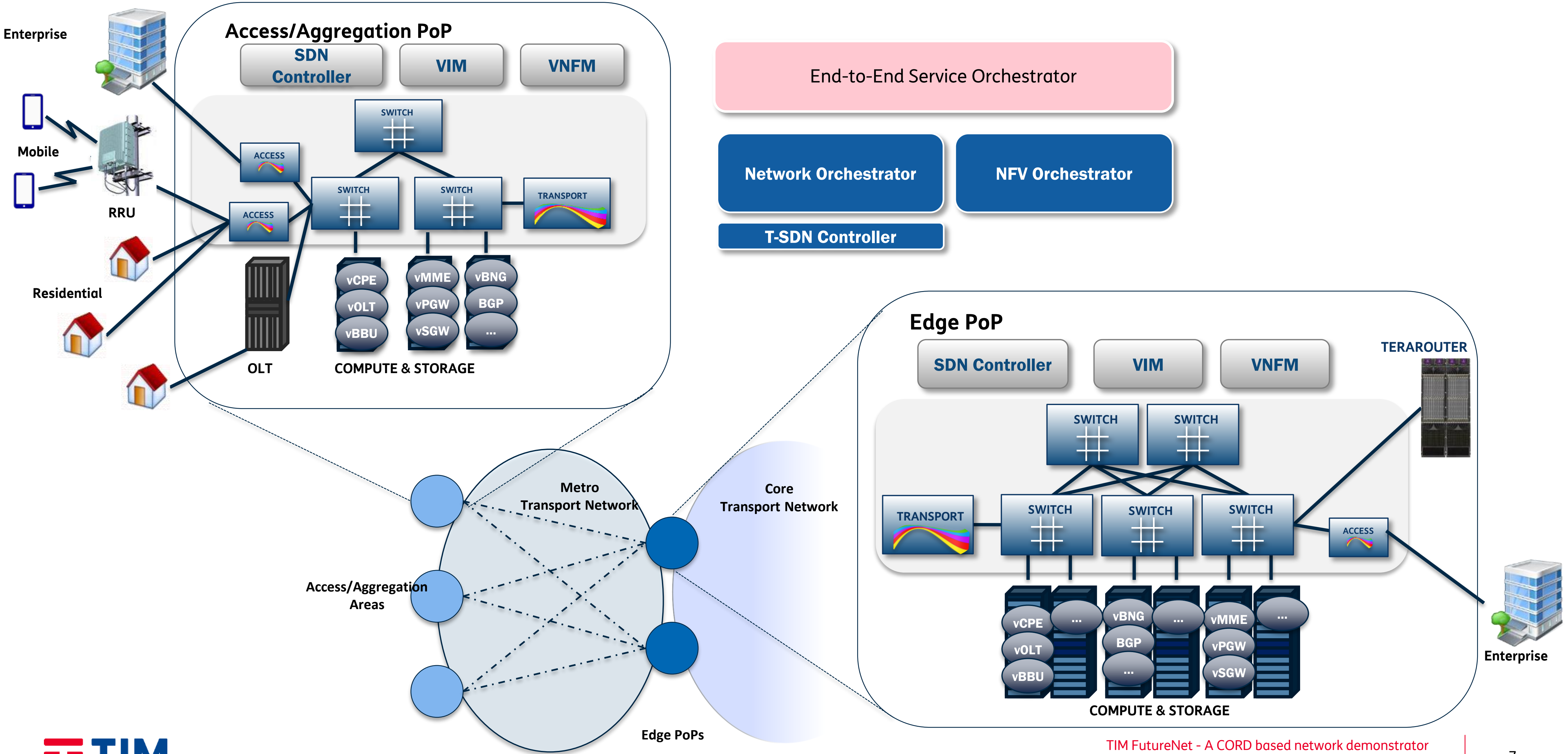
White box switches to perform packet switching and high speed packet functions

Transport and access network elements are completely disaggregated

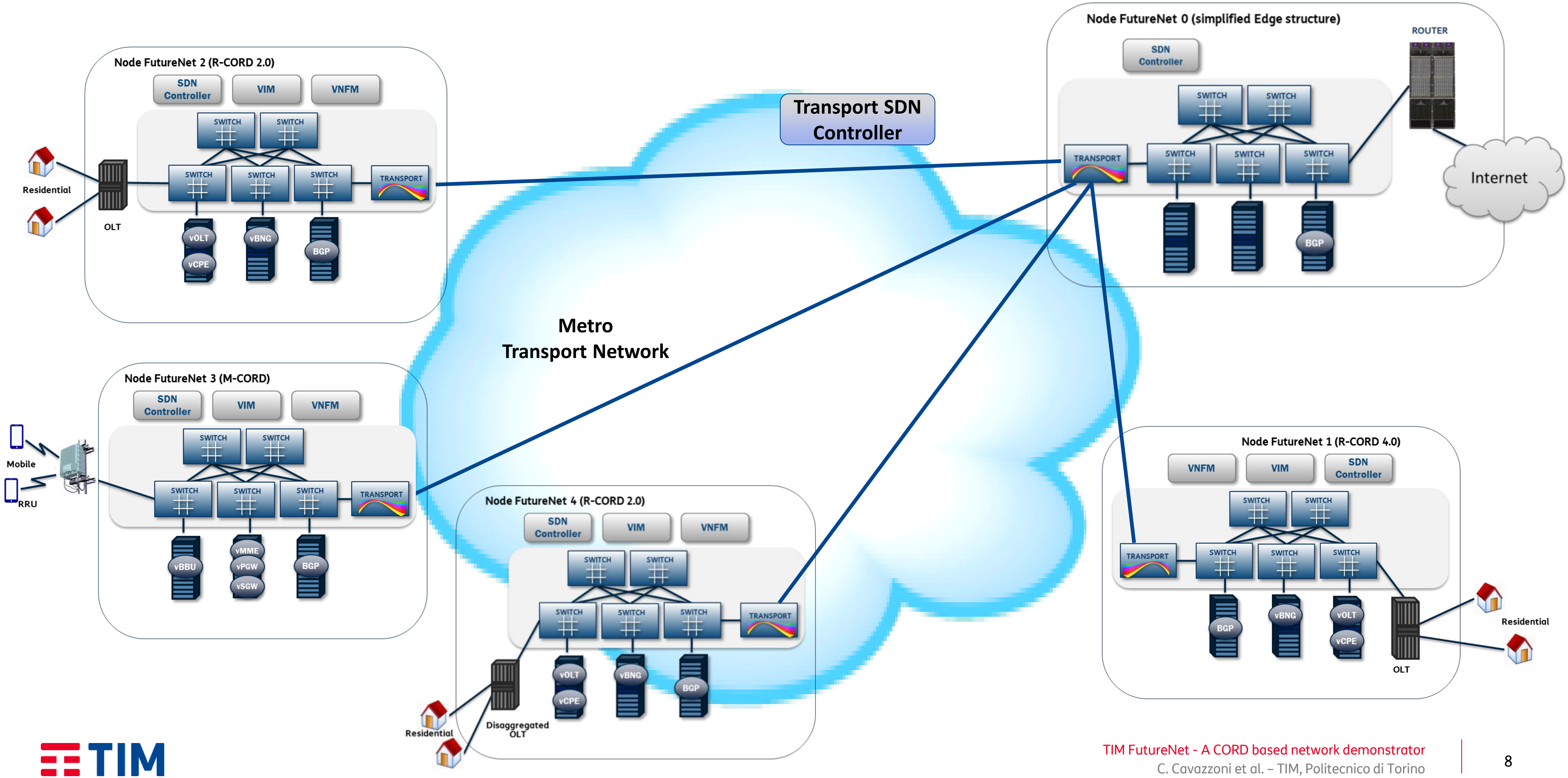
Compute and storage commodity hosting control plane and virtual network functions

Same architecture for all network nodes with growing size and complexity

TIM FutureNet: Network Architecture



TIM FutureNet - Today's Network



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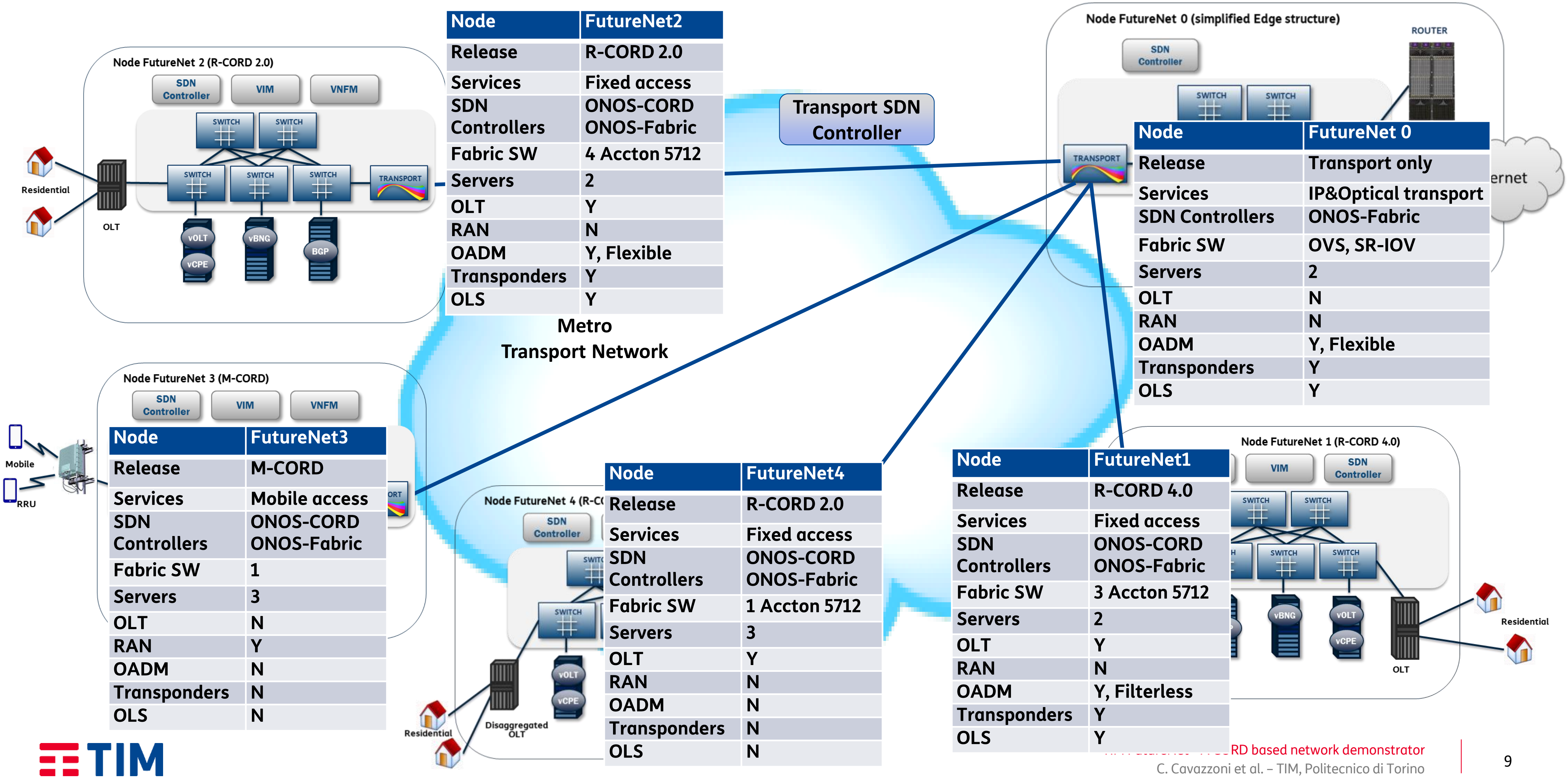
TIM FutureNet - Today's Network



Node	FutureNet2
Release	R-CORD 2.0
Services	Fixed access
SDN Controllers	ONOS-CORD ONOS-Fabric
Fabric SW	4 Accton 5712
Servers	2
OLT	Y
RAN	N
OADM	Y, Flexible
Transponders	Y
OLS	Y

Node	FutureNet 0
Release	Transport only
Services	IP&Optical transport
SDN Controllers	ONOS-Fabric
Fabric SW	OVS, SR-IOV
Servers	2
OLT	N
RAN	N
OADM	Y, Flexible
Transponders	Y
OLS	Y

Node	FutureNet3
Release	M-CORD
Services	Mobile access
SDN Controllers	ONOS-CORD ONOS-Fabric
Fabric SW	1
Servers	3
OLT	N
RAN	Y
OADM	N
Transponders	N
OLS	N

Node	FutureNet4
Release	R-CORD 2.0
Services	Fixed access
SDN Controllers	ONOS-CORD ONOS-Fabric
Fabric SW	1 Accton 5712
Servers	3
OLT	Y
RAN	N
OADM	N
Transponders	N
OLS	N

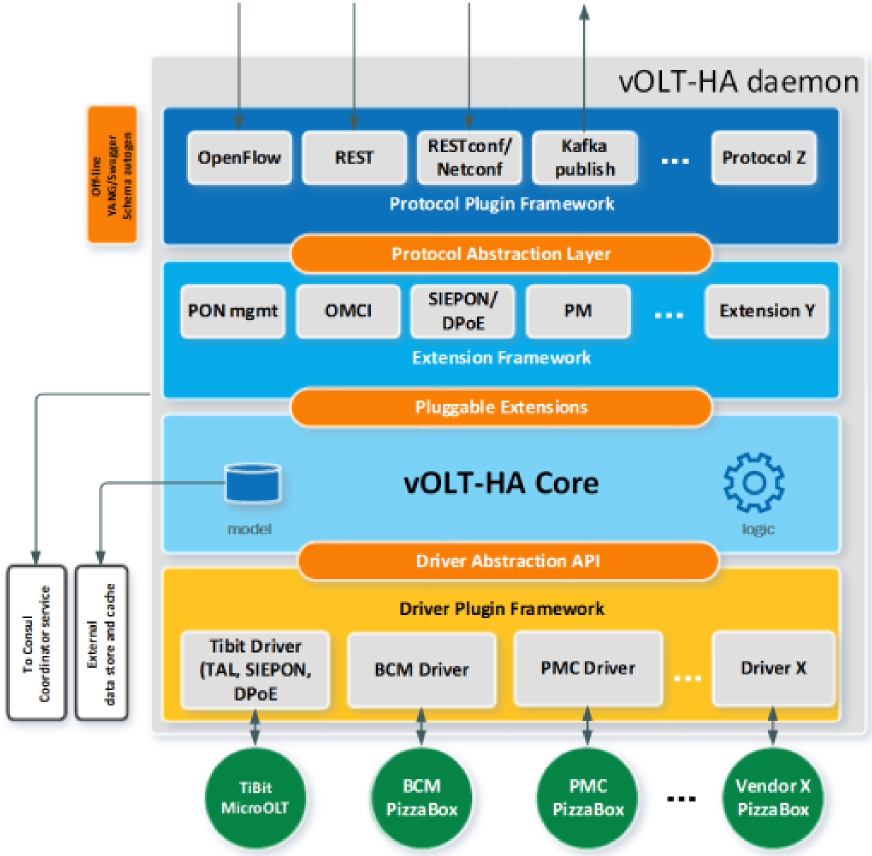
Node	FutureNet1
Release	R-CORD 4.0
Services	Fixed access
SDN Controllers	ONOS-CORD ONOS-Fabric
Fabric SW	3 Accton 5712
Servers	2
OLT	Y
RAN	N
OADM	Y, Filterless
Transponders	Y
OLS	Y

TIM

Fixed access innovation in FutureNet

We are working with some traditional and innovative vendors **to integrate their ONOS driven OLT prototypes in FutureNet**

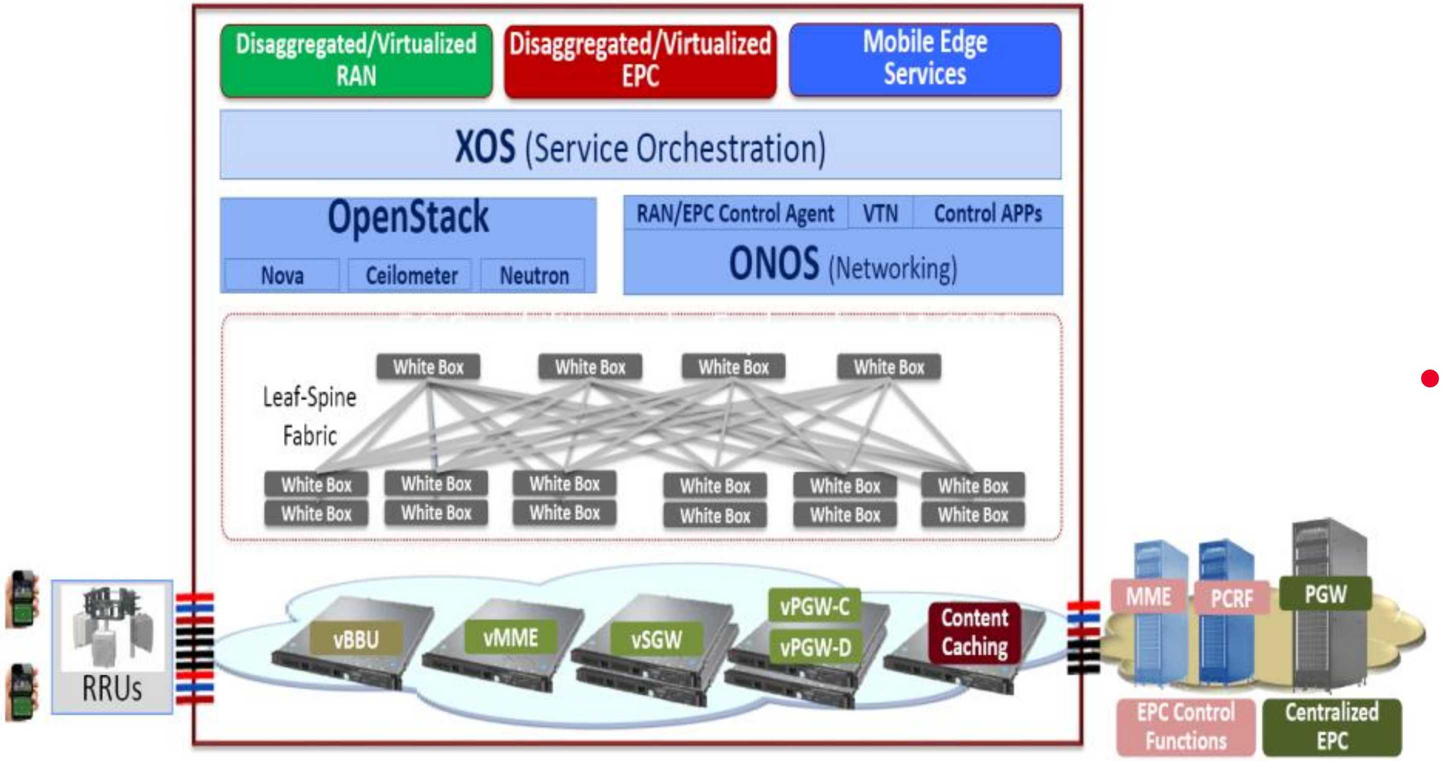
- Collaboration with **traditional vendors** should allow TIM to follow and possibly influence their SDN roadmaps even if not tailored to the CORD paradigm
- Collaboration with **innovative vendors involved directly in the CORD project** allows TIM to explore the whole potential of the new approach both in terms of new CO architecture and OLT disaggregation



- Objective: integrate the solutions of partner vendors in our FutureNet nodes. According to their contraints and requirements the best way of has to be found
- We are asking vendors to use preferably **vOLT-HA as abstraction layer** and producing **YANG data models** of their devices to be able to manage them by means of **NETCONF**
- Contributing also to the work of the recently initiated **Broadbad Access Abstraction** project

M-CORD – TIM evaluation of vRAN and vEPC based on CORD and Radisys

- **Objective:** to build a complete solution that includes all the components of a new **generation mobile network (VRAN, VBBU and VEPC)** placed in a Data Center at the edge of the network in fully virtualized mode



- **Architecture:** It is based on the CORD components or **OpenStack** as VIM, **ONOS** as controller SDN and **XOS** as local orchestrator of the individual components. Dedicated infrastructure created by Radisys with VRAN and vEPC
- **Test objective:**
  Evaluate the functionality and performance limits of a highly-pushed virtualized solution.
  Evaluation Object Features: **CPUP separation, VBBU, slicing, functionality disaggregation, IoT optimization**

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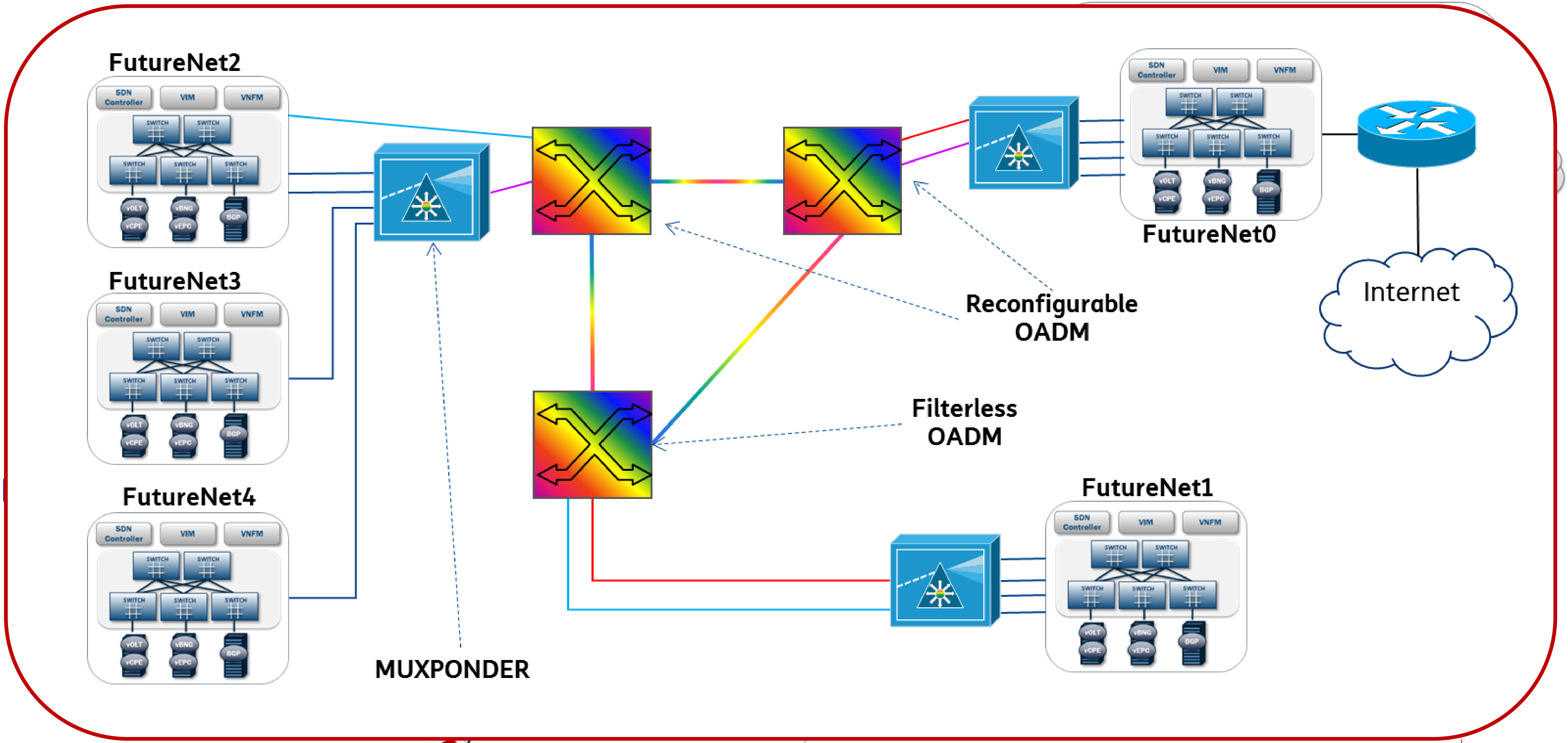
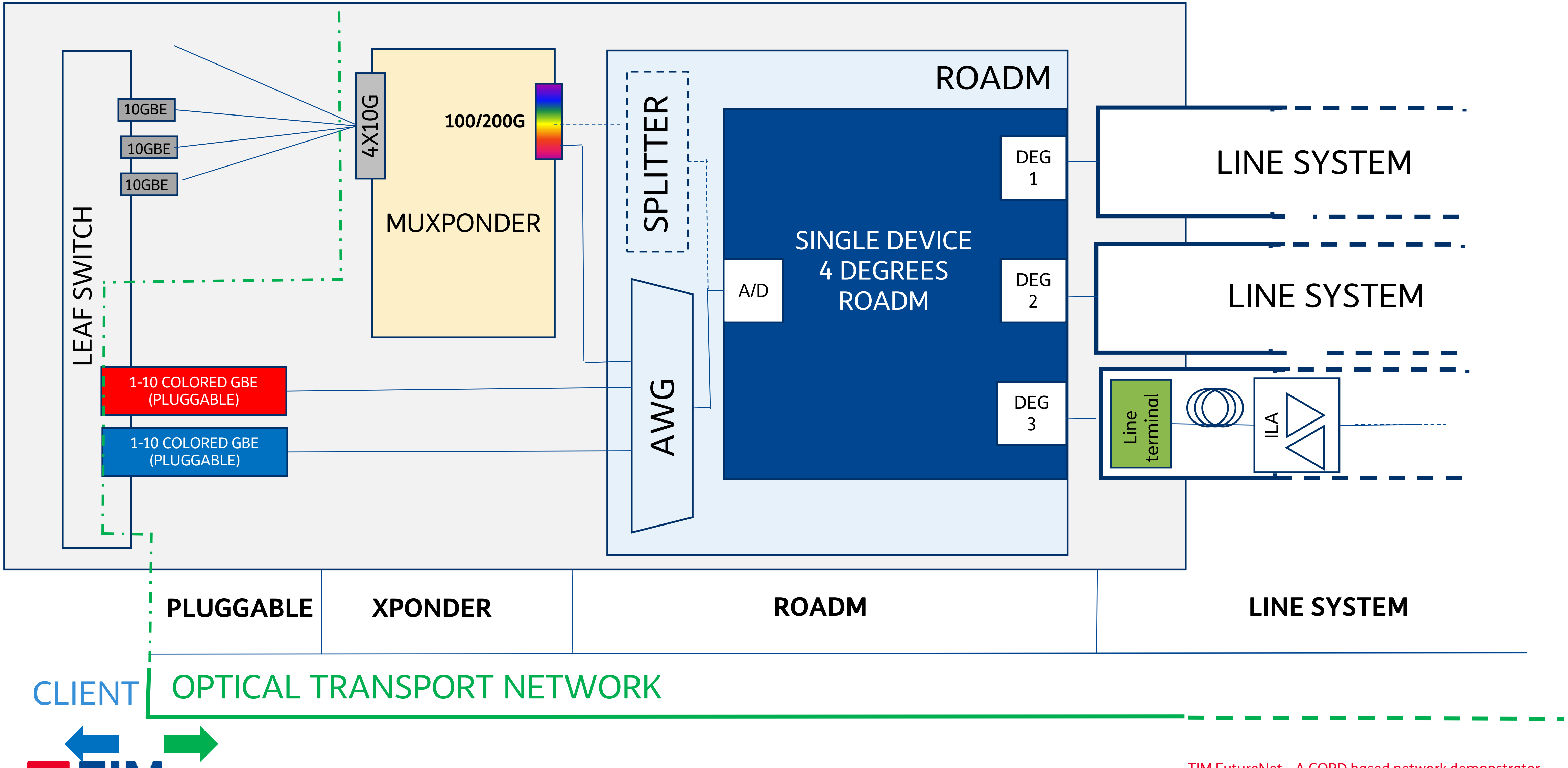
TIM FutureNet - Transport Network implementation

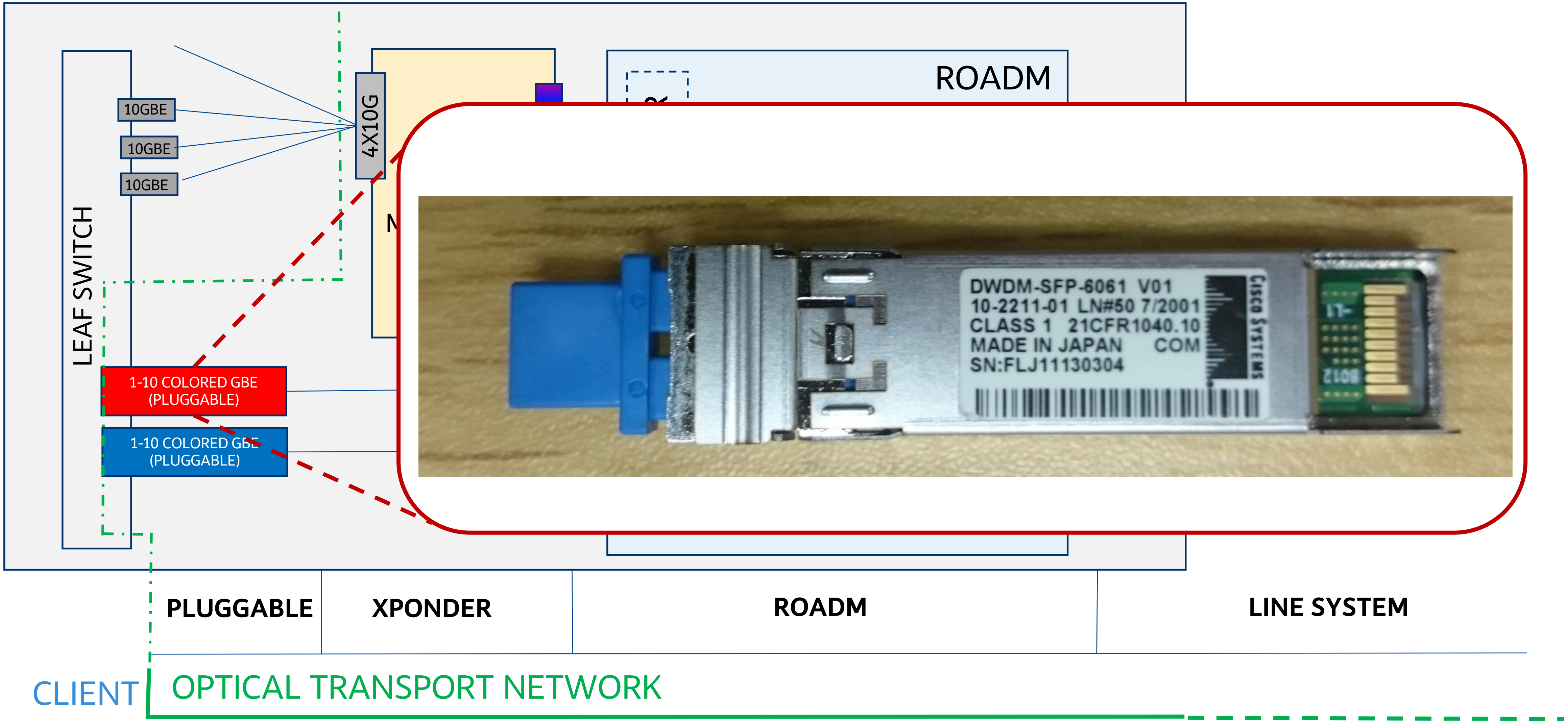


TIM FutureNet - Disaggregated Optical Transport Node



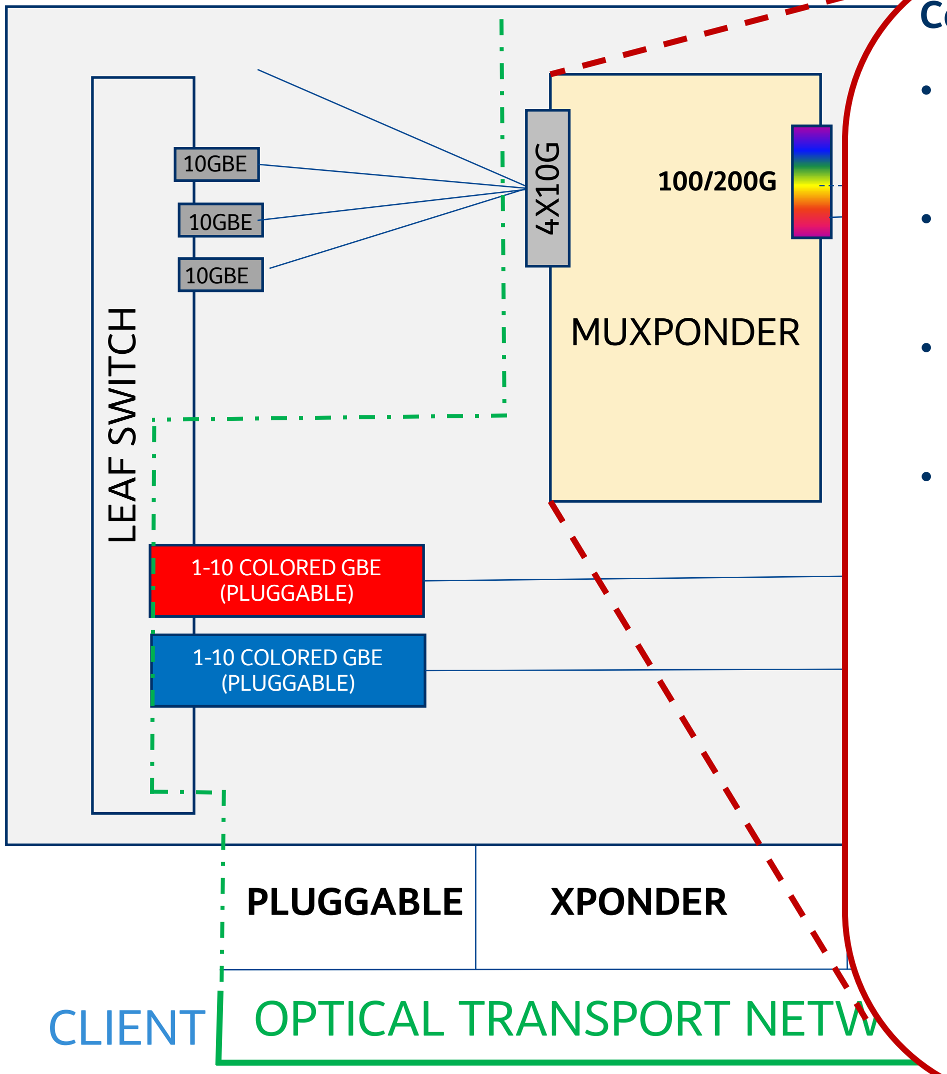
TIM FutureNet - Disaggregated Optical Transport Node

Pluggable 1-10GE SFP on fabric leaf switch



TIM FutureNet - Disaggregated Optical Transport Node

Muxponder

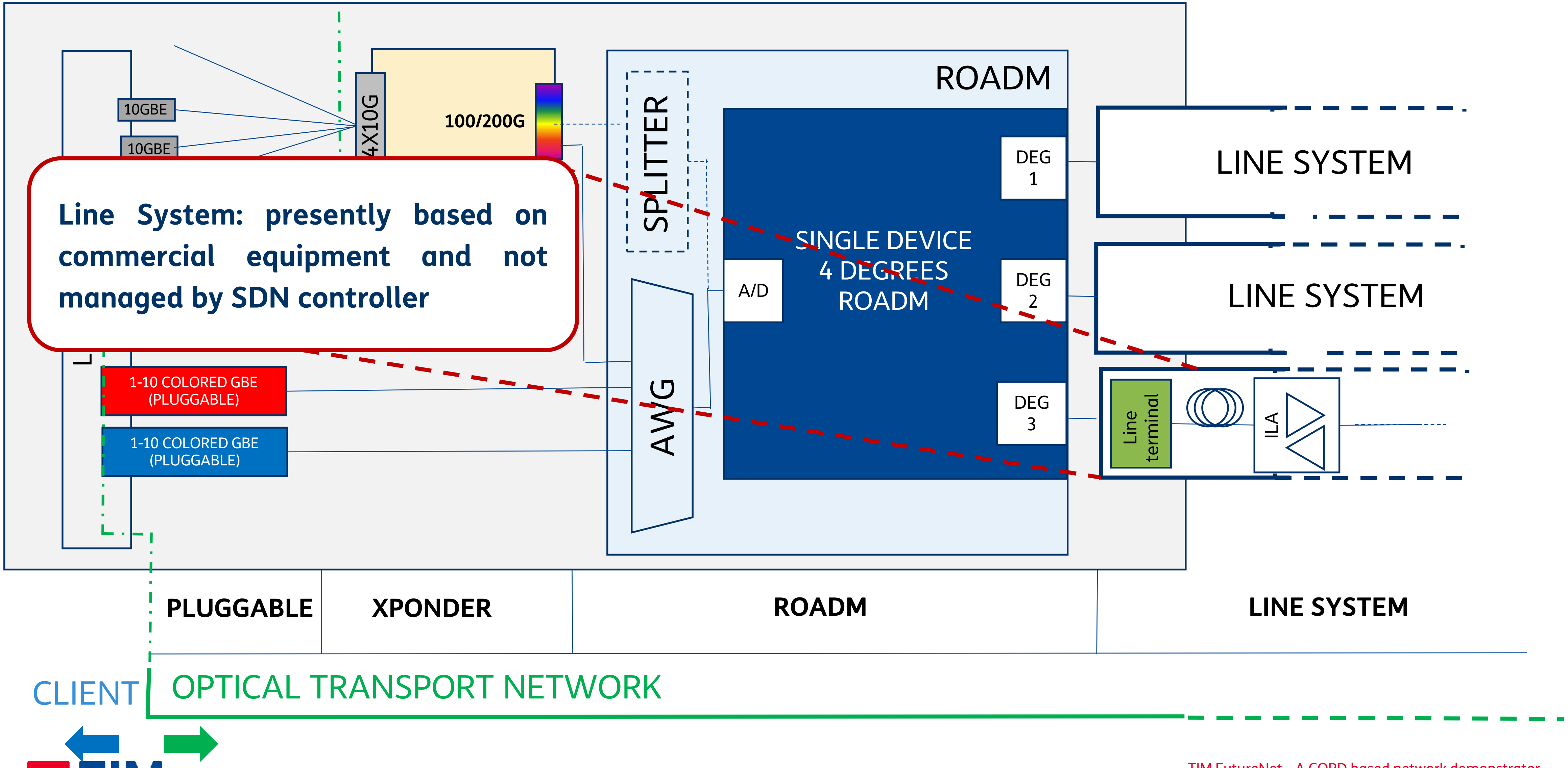


Coriant Groove G30

- Supports up to four field replaceable, individually configurable and hot-swappable 400G sleds (or field replaceable units).
- Each 400G sled can be equipped with up to two 200G line side interfaces (CFP2-ACO) and a mix of 10G, 40G, and 100G client interfaces
- Each of the eight line side ports can be independently configured as either 100G DP-QPSK, 150G DP-8QAM, or 200G DP-16QAM.
- Standards-based interfaces including support for open Northbound Interfaces (NBIs) and APIs: CLI, SNMP Fault Management, YANG model based NETCONF and RESTCONF APIs

TIM FutureNet - Disaggregated Optical Transport Node

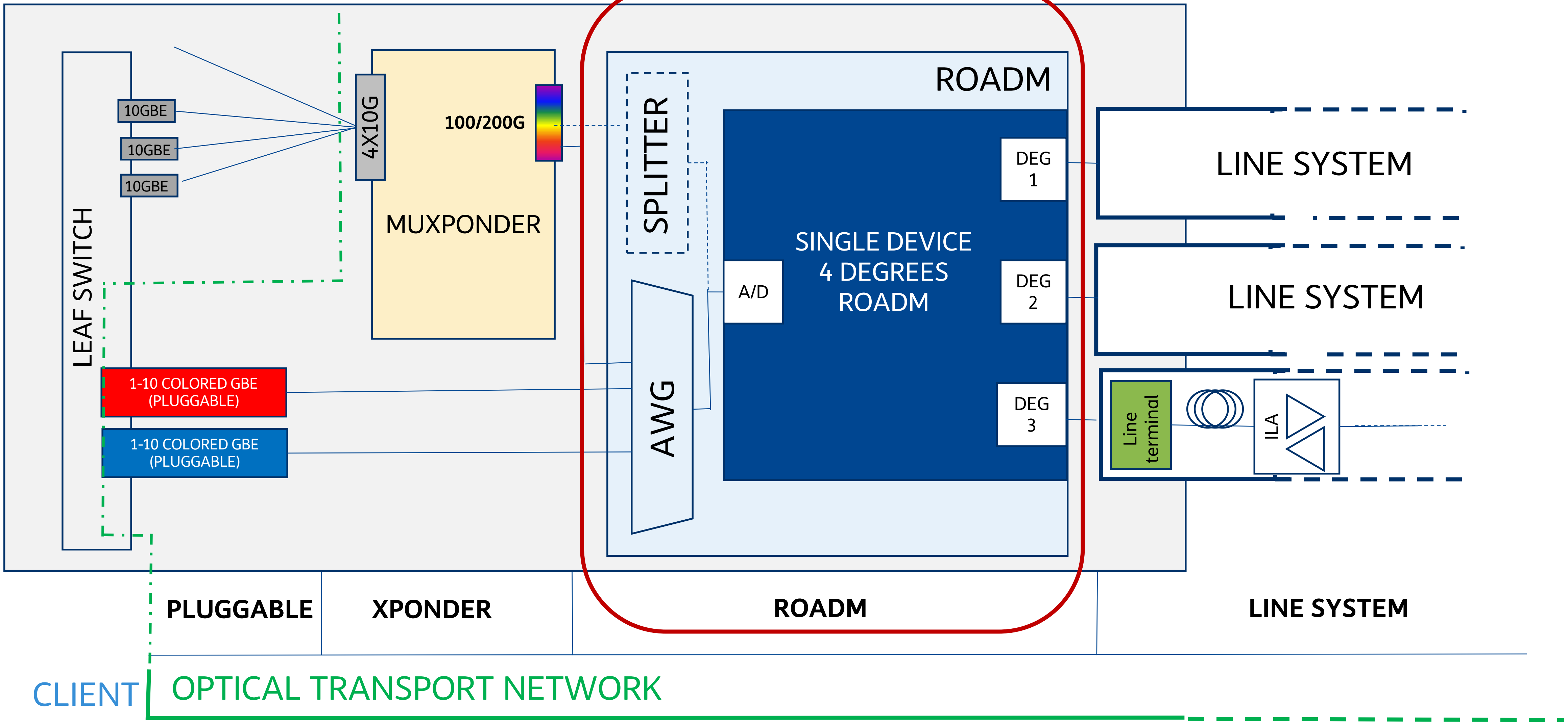
Line System



Line System: presently based on commercial equipment and not managed by SDN controller

TIM FutureNet - Disaggregated Optical Transport Node

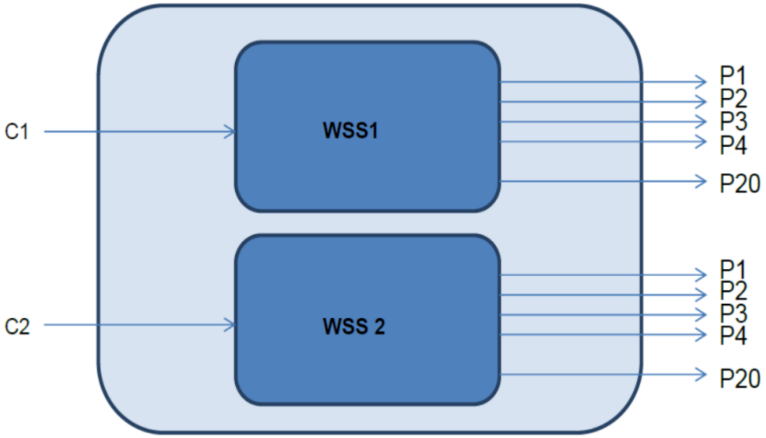
Four degree ROADM

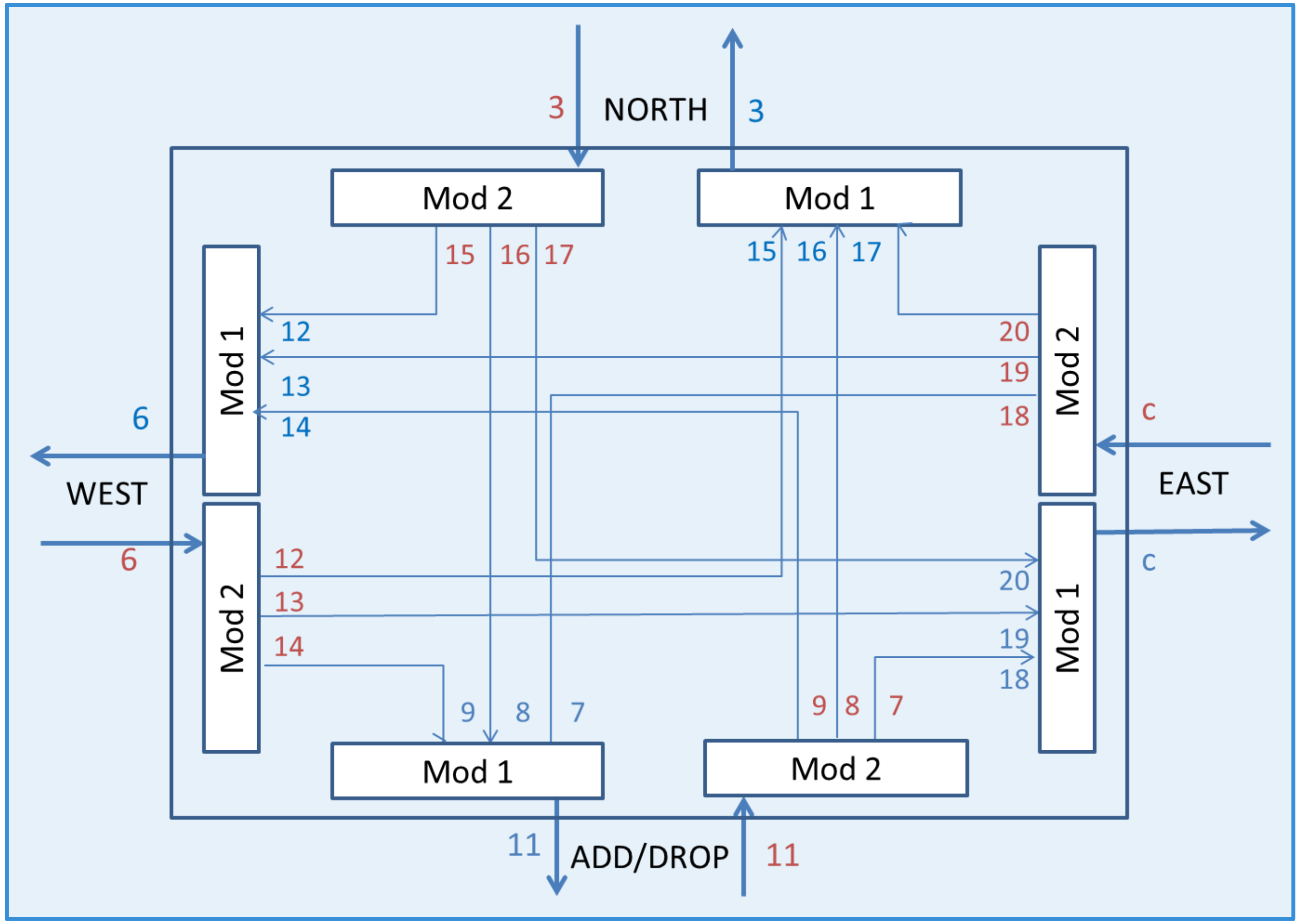


TIM FutureNet - Disaggregated Optical Transport Node

Four degree ROADM

Based on Lumentum TrueFlex Twin 1x20 WSS + evaluation board

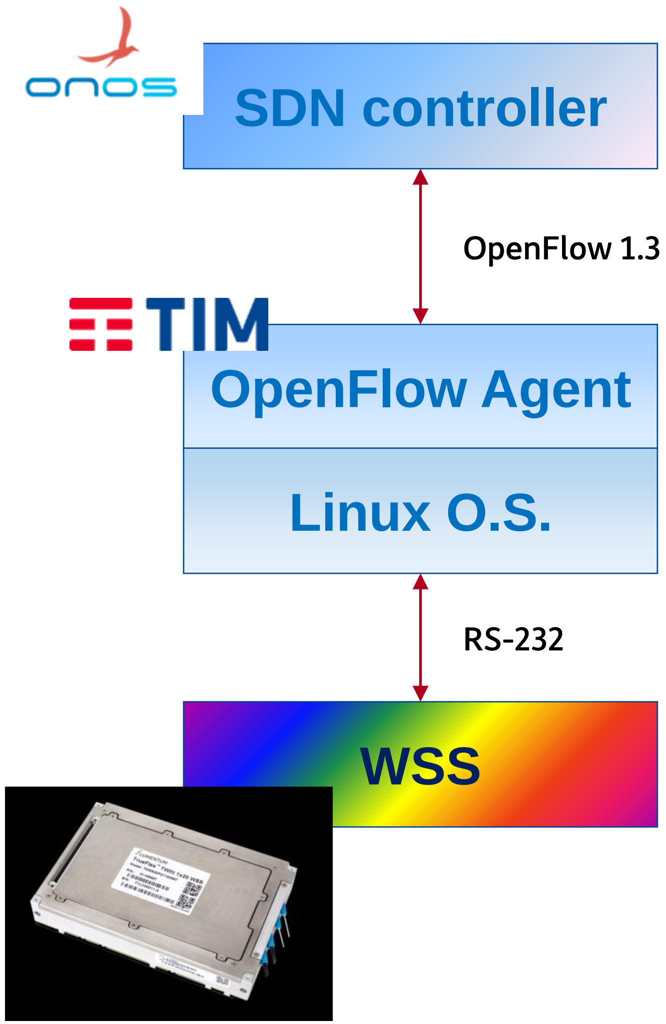




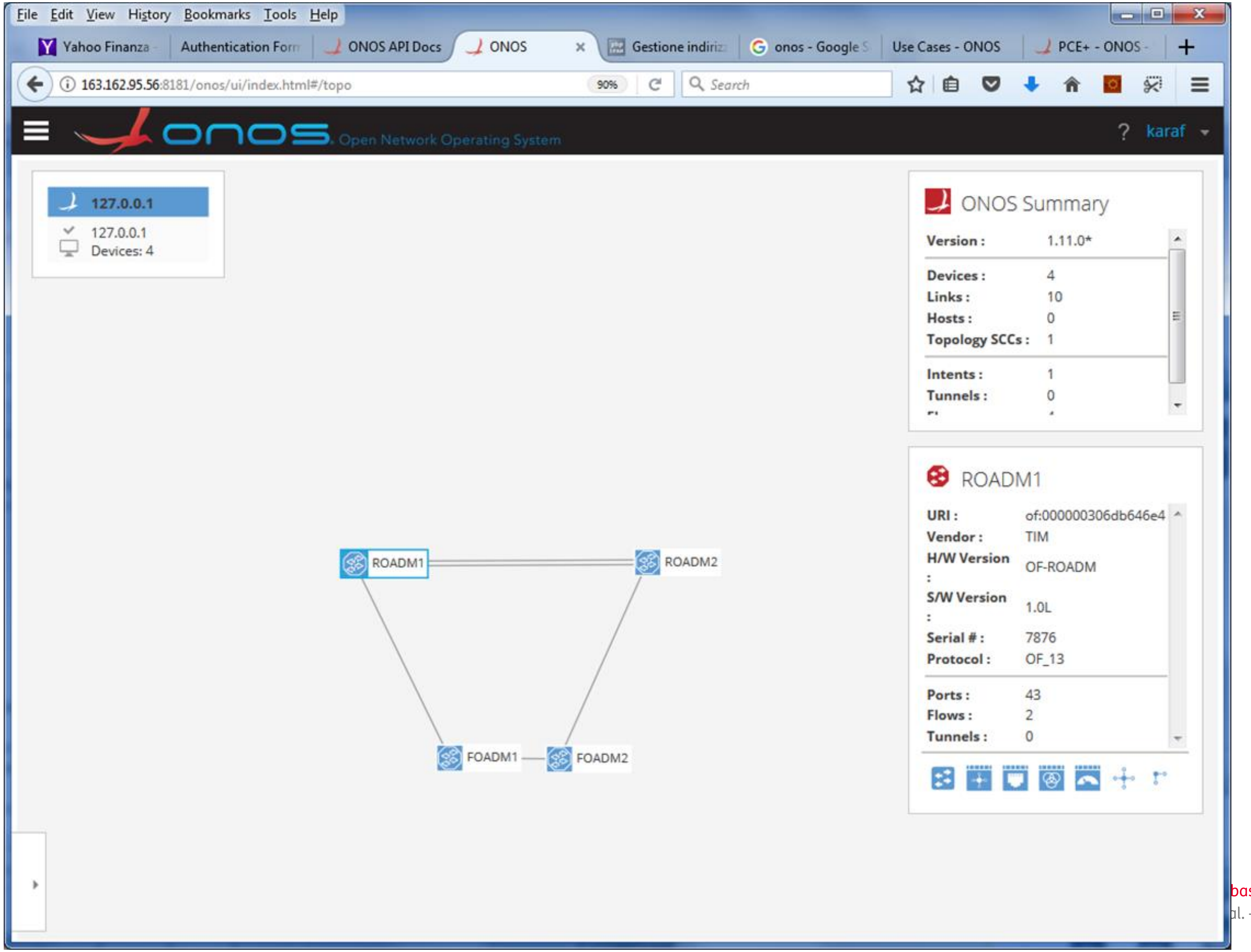
TIM FutureNet - Disaggregated Optical Transport Node

Four degree ROADM – OpenFlow Agent

- Running on Linux (tested on Ubuntu 14.04 and Fedora Core 3)
- OpenFlow 1.3 + Optical Transport Protocol Extensions (ONF TS-022)
- Implementation covers optical features (e.g. match, instructions, ...) only
- ROADM is controlled by sending appropriate commands to the WSS evaluation board through a RS-232 interface.
- Maintains status for installed flows, ROADM ports, OpenFlow sessions with (eventually) multiple controllers.



TIM FutureNet - ONOS Transport SDN Controller



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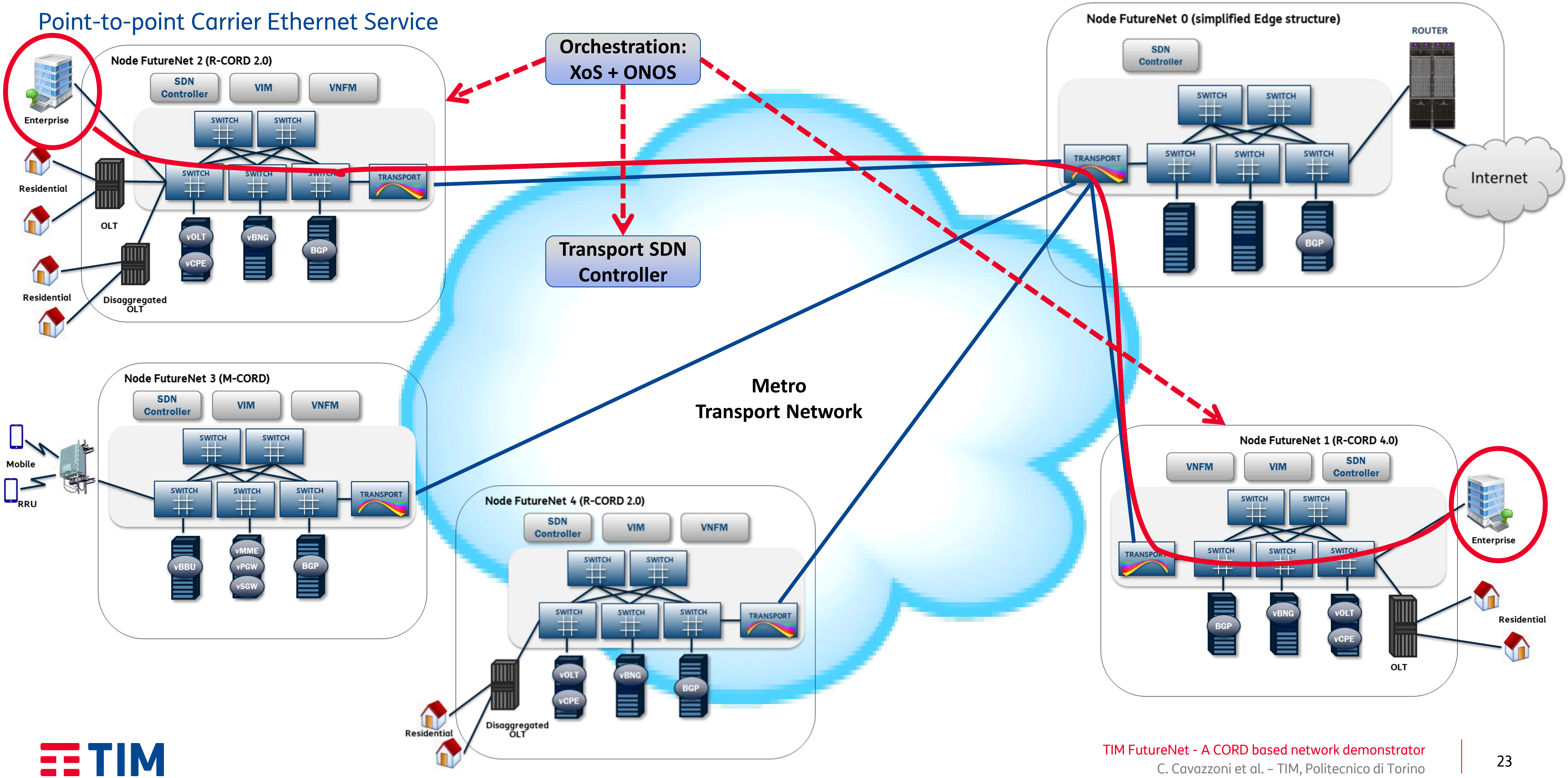
TIM FutureNet - E-CORD short term implementation

Point-to-point Carrier Ethernet Service



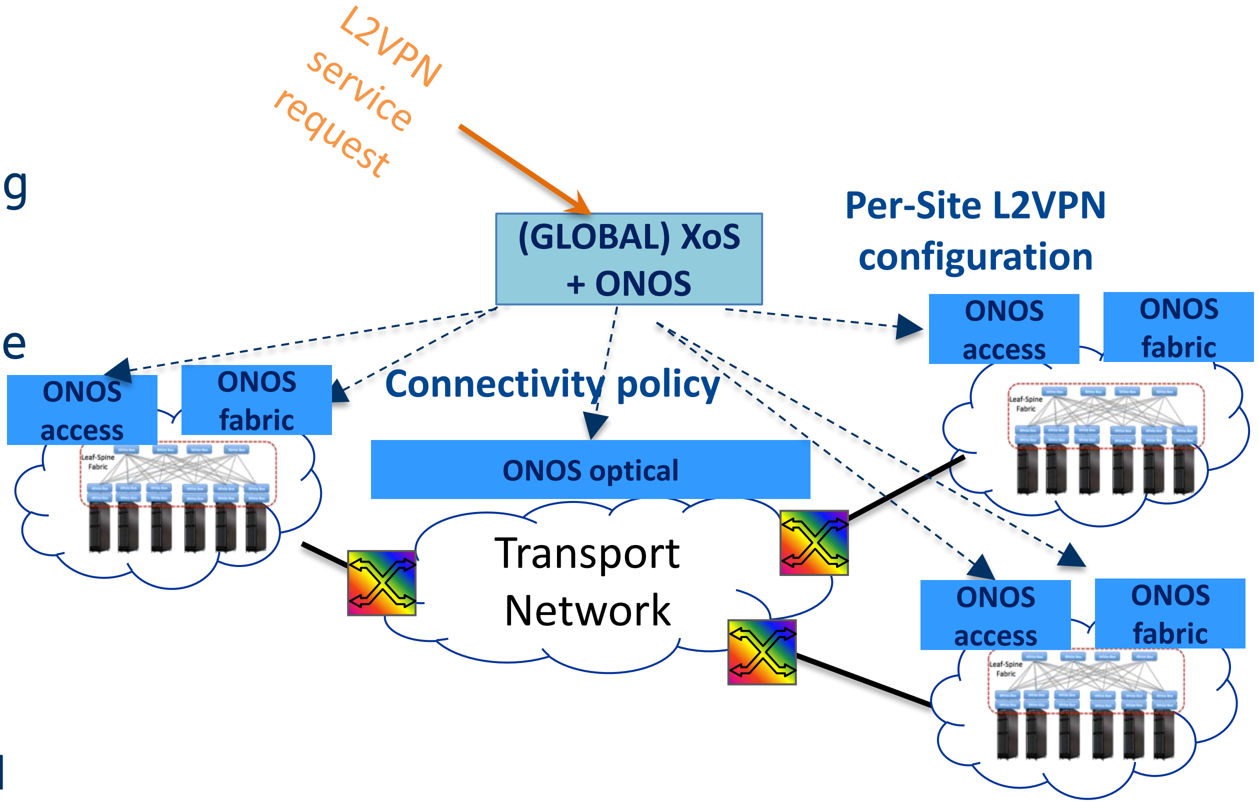
TIM FutureNet - E-CORD short term implementation

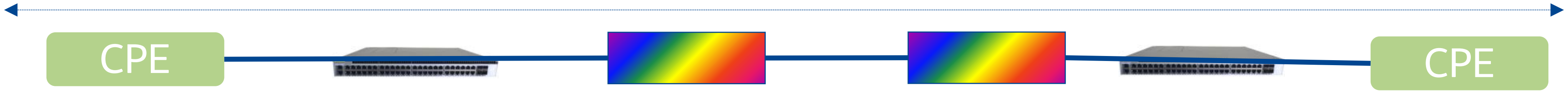
Point-to-point Carrier Ethernet Service

- The implementation will be based on the upcoming E-CORD release
- To the reference implementation of the release, we add the optical transport network control

Data-plane:

- Programmable CPE ea1000 Microsemi
- Central Office fabric Accton 5712 EdgeCore
- Transport Network Openflow-enabled ROADM





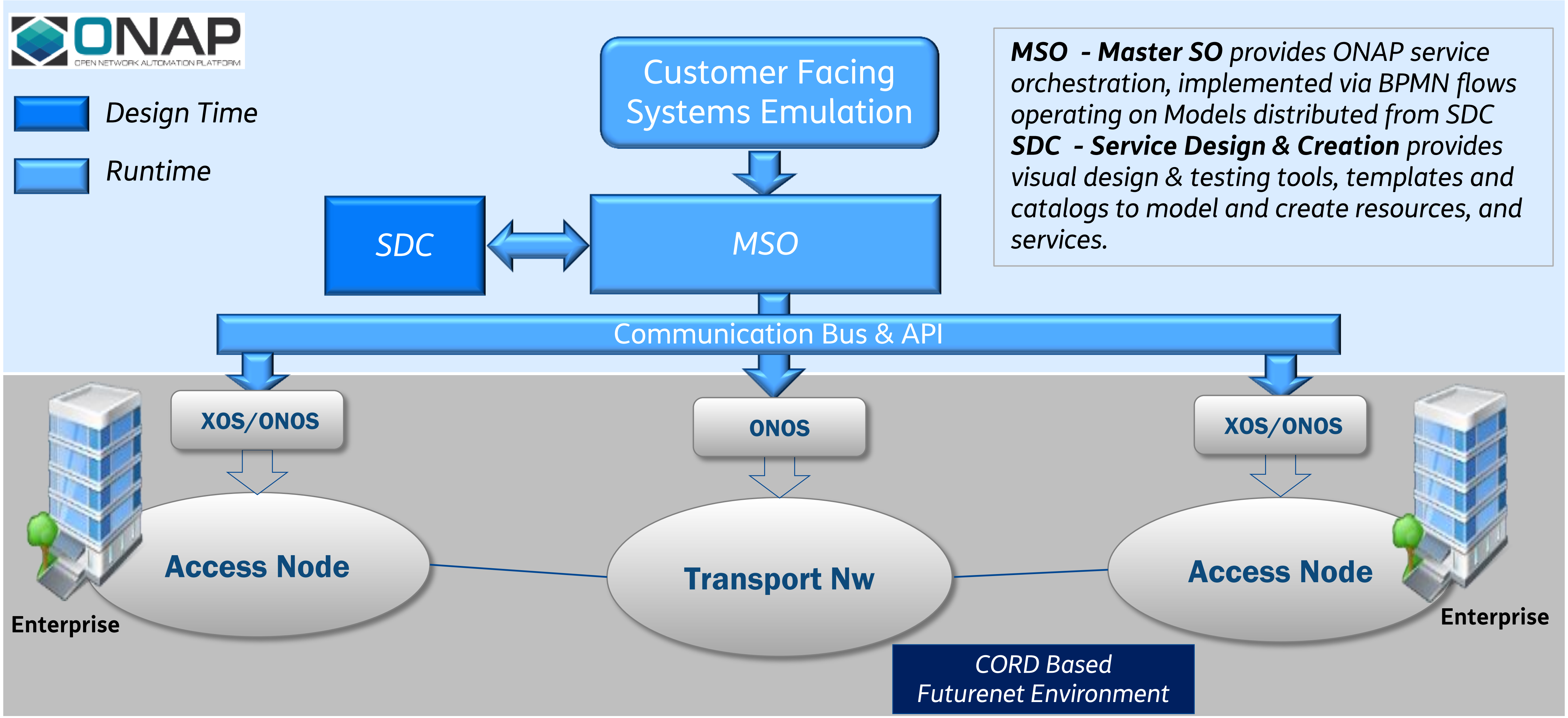
- Push/pop Service Tag
- QoS
- OAM

- CORD fabric cross-connect

- Ethernet circuit bundled into optical Transport Network

TIM FutureNet - E-CORD future implementation

Possible use case for CORD / ONAP Interworking



MSO - Master SO *provides ONAP service orchestration, implemented via BPMN flows operating on Models distributed from SDC*
SDC - Service Design & Creation *provides visual design & testing tools, templates and catalogs to model and create resources, and services.*

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TIM's experience feedbacks

A Service Provider perspective

Problem #1: installation behind a proxy server

- Many Telcos' lab facilities are closed environments that can access the Internet only through proxy servers
- The installation of CORD software behind a proxy is "not straightforward": it requires a lot of additional work with a trial and error approach that is heavily time consuming
- An experimental guide for installing CORD behind a proxy was originally released for CORD 1.0 but it was incomplete. Recently it has been updated but it focuses only on CORD-in-a-Box installation

TIM's experience feedbacks

A Service Provider perspective

Problem #2: software predictability

- The CORD installation process leverages live updates of most software packages, libraries, etc.
- This approach can lead to failures when newer versions of some software components have become incompatible with other components.
- We experienced this problem twice with CORD 2.0:
  - The new version of the networking-onos plugin for Neutron is not compatible with the Kilo release of Openstack used in CORD 2.0
  - A problem with release '1.21.1' of Python urllib3 was causing a malfunction in Nova
- Moreover, live updates in general lead to systems (servers/VMs/containers) that are slightly different from the others, potentially rising configuration bugs that are difficult to diagnose

Request for a solution

- We think that a self-contained installation package or repository, with all software needed in the right version, would prevent the problems described in the previous slides and it would guarantee:
  - fast and successful installations without needing to access the Internet
  - predictable systems with (almost) identical and stable configurations
- But maybe alternative solutions exist

Conclusions

- TIM is developing the FutureNet network demonstrator to evaluate the evolution of central offices towards a data center based architecture
- Virtualization, disaggregation, open source software, openness to external elements are key elements for this evolution
- Integration with other initiatives (e.g. ONAP) is fundamental
- The current CORD implementation is not mature for a real field deployment, many features have to be introduced but the improvements seen in the last year is promising and could lead to a stable, manageable and measureable implementation in a reasonable time frame

Thank you

TIM