Metro-Haul

METRO High bandwidth, 5G Application-aware optical network, with edge storage, compUte and low Latency

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Presenters for June 1st Meeting:

Filippo Cugini (CNIT), Ramon Casellas (CTTC)

Metro-Haul Main Objective

- **Architect and design cost-effective, energy-efficient, agile and programmable metro networks**
  - Scalable for 5G access and future requirements
  - Design of all-optical metro nodes (including full compute and storage capabilities)
  - Interface with both 5G access and multi-Tbit/s elastic core networks.

- **Challenges**:
  - *Optical challenge*, cost effective and agile, involving both the optical architecture and also innovative new optical component technologies -> disaggregated white boxes
  - *Network management challenge*. SDN/NFV control framework supporting 5G operational and both end-user and vertical oriented services, including slicing.
  - *Monitoring challenge*. Implementation & AI-based tools for interpreting vast amounts of data

- **Use Cases**
  - *Video Security for Smart Cities* - Intelligent video security based on automatic object/person identification and tracking.
    - 5G Berlin testbed coupled with DT's Berlin metro infrastructure.
  - *Crowdsourced Video Streaming* - Simultaneous sourcing of video from different individuals in an event with a large crowd.
  - Additional demonstrations will be planned to be showcased in relevant events.

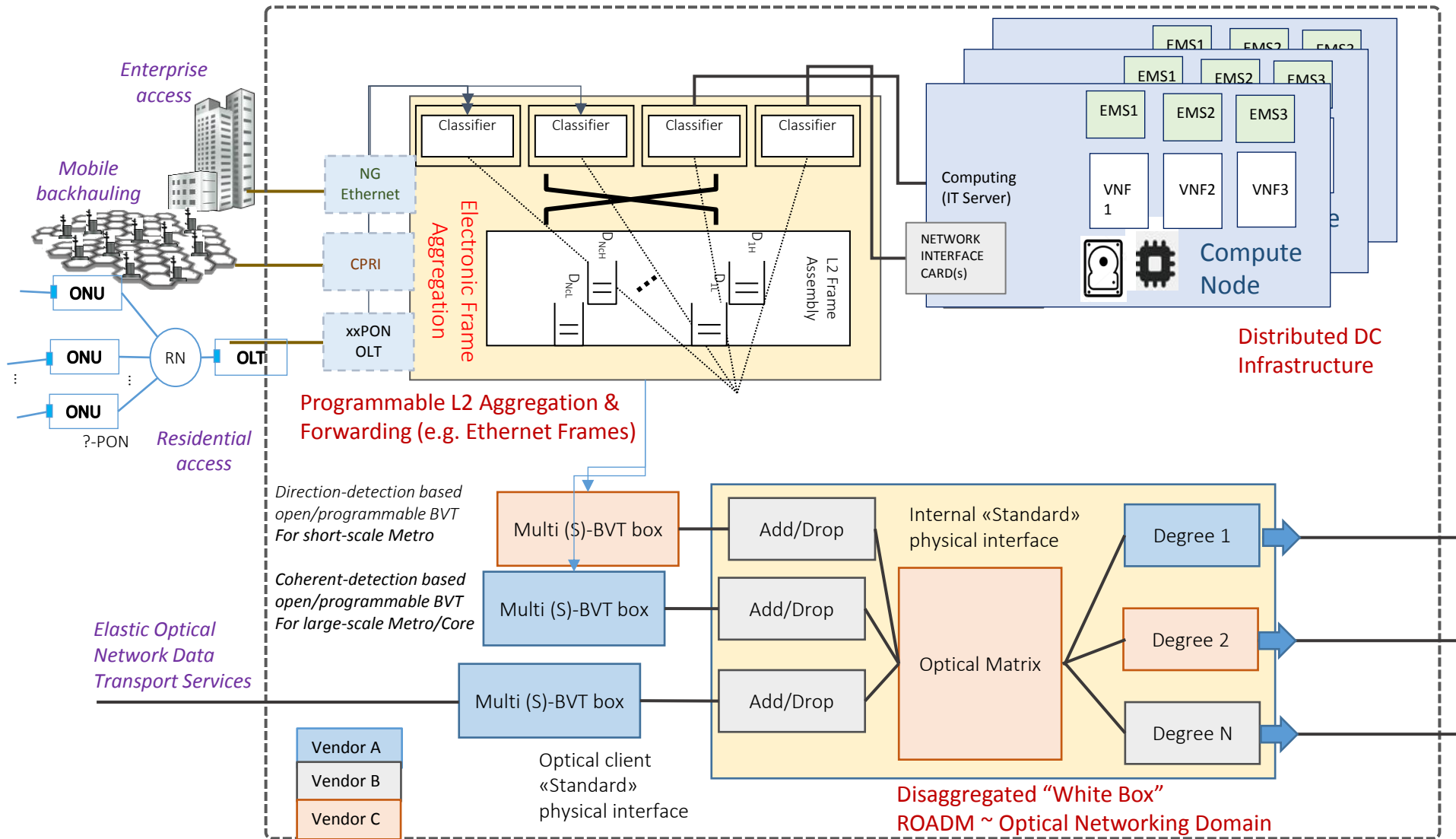# Metro-Haul architecture and scope
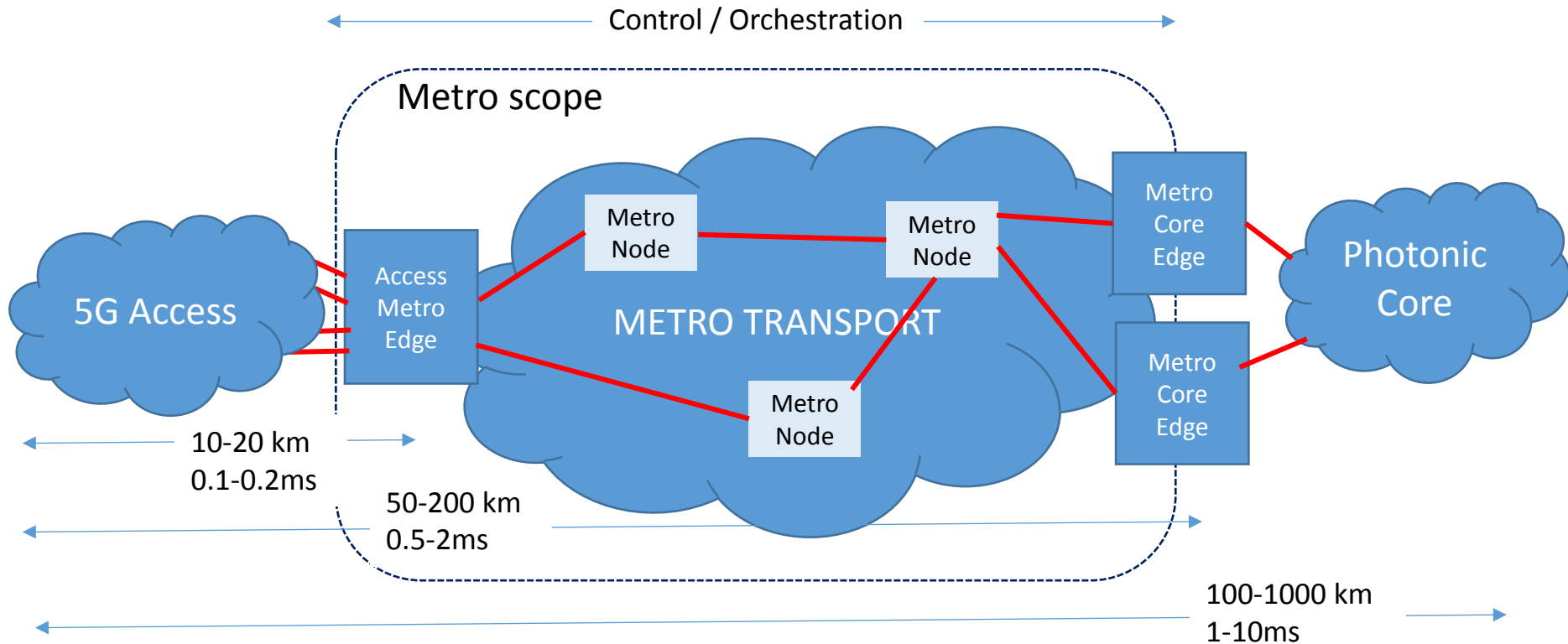
Access Metro Edge – multiple ubiquitous access technologies, cloud enabled (storage, compute)
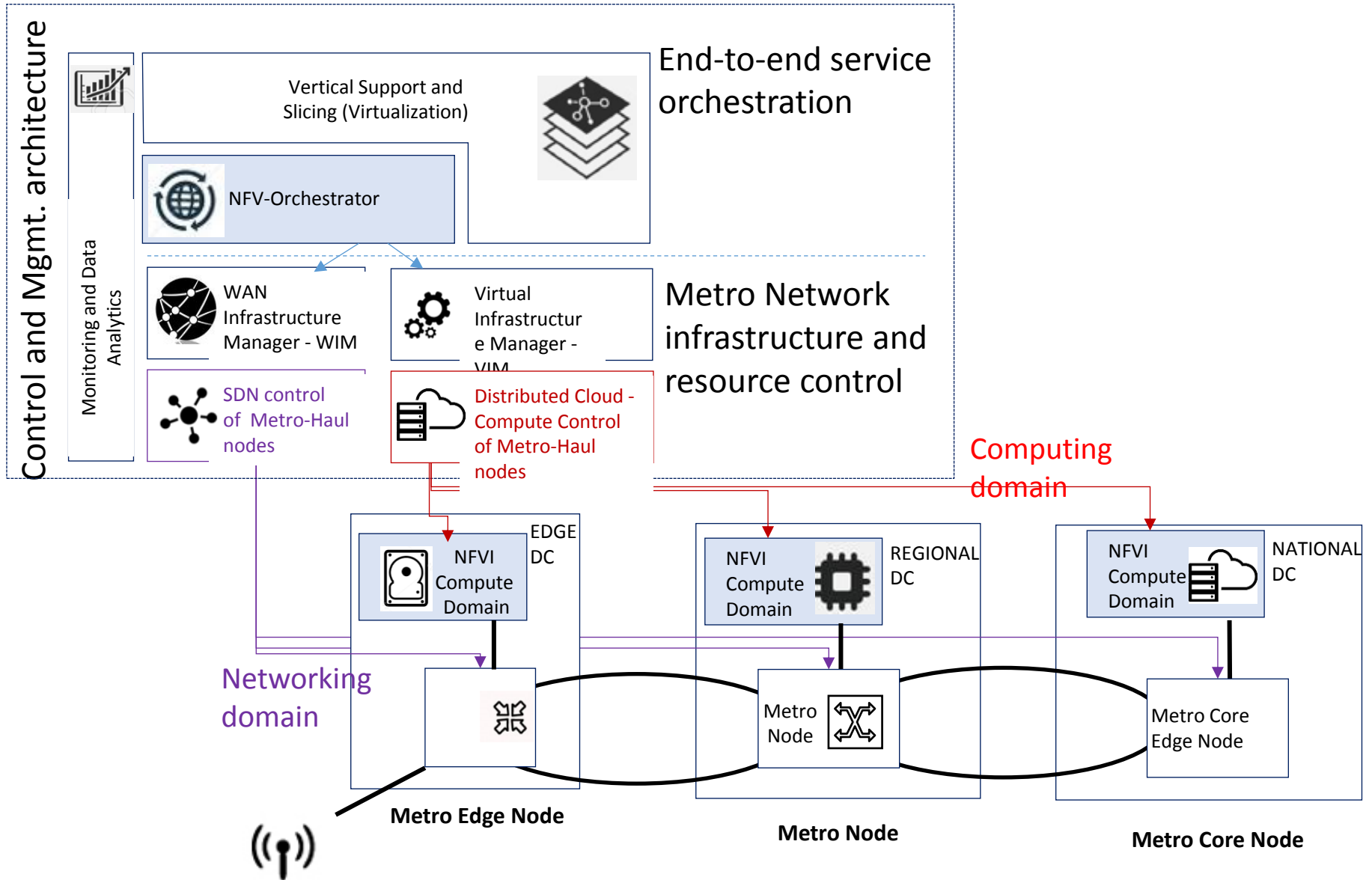**Metro Transport Network** – metro node: pure transport
Metro Core Edge – Larger cloud capabilities

Metro Control Plane – full orchestration

New Optical Node Architectures

Enterprise access

Mobile backhauling

Residential access

?-PON

Elastic Optical Network Data Transport Services

Classifier | Classifier | Classifier | Classifier

NG Ethernet

CPRI

xxPON OLT

ONU / RN / OLT / ONU / ONU

Electronic Frame Aggregation

D_{NcH} D_{NcL} ... D_{1L} D_{1H}

L2 Frame Assembly

Computing (IT Server)

NETWORK INTERFACE CARD(s)

EMS1 EMS2 EMS3
VNF1 VNF2 VNF3

Compute Node

Distributed DC Infrastructure

Programmable L2 Aggregation & Forwarding (e.g. Ethernet Frames)

Direction-detection based open/programmable BVT For short-scale Metro

Multi (S)-BVT box

Coherent-detection based open/programmable BVT For large-scale Metro/Core

Multi (S)-BVT box

Multi (S)-BVT box

Add/Drop

Add/Drop

Add/Drop

Internal «Standard» physical interface

Optical Matrix

Degree 1

Degree 2

Degree N

Vendor A
Vendor B
Vendor C

Optical client «Standard» physical interface

Disaggregated "White Box" ROADM ~ Optical Networking Domain

SDN/NFV Control, Management, Orchestration

Control and Mgmt. architecture

Monitoring and Data Analytics

Vertical Support and Slicing (Virtualization)

NFV-Orchestrator

WAN Infrastructure Manager - WIM

Virtual Infrastructure Manager - VIM

SDN control of Metro-Haul nodes

Distributed Cloud - Compute Control of Metro-Haul nodes

End-to-end service orchestration

Metro Network infrastructure and resource control

Computing domain

Networking domain

NFVI Compute Domain — EDGE DC

NFVI Compute Domain — REGIONAL DC

NFVI Compute Domain — NATIONAL DC

Metro Edge Node

Metro Node

Metro Node

Metro Core Edge Node

Metro Core Node

Impact on 5G KPIs

Implication of 5G KPIs on optical metro network:

- 100x more capacity supported over the same optical fiber infrastructure
- 10 times less energy consumption
- Latency-aware metro network
  - Latency-sensitive slices are handled at the metro edge
  - Metro network adds no additional latency

- End to end SDN-based control, management and orchestration enabling fast set-up for a range of operations
  - 1 minute for simple network path set-up
  - ~10 minutes for full installation of a new VNF
  - ~1 hour for setting up a new virtual network slice

- Reduction in CAPEX of a factor of 10, plus a reduction in OPEX of at least 20%.

Involvement with other projects & WGs

Projects:

- Direct optics interest such as:
  - IoRL, Bluespace, 5G-PHOS, 5G-Picture …
- SDN/NFV-based control and management (e.g. establishing standards)
  - 5G-Transformer, 5G-Tango

Working Groups:

- SDN/NFV WG
  - high interest
- 5G Architecture, Network Management and QoS, SME, Trials WGs
  - medium interest (to be discussed)
- Possible scope/interest for a new Optics-based WG ?

Project Coordinator: Andrew Lord – BT

Partners: BT, Telecom Italia, CTTC, Telefonica, University of Bristol, UPC, CNIT, NAUDIT, OpenLightComm, Lexden Technologies, Zeetta Networks, Fraunhofer HHI, Tech University Eindhoven, Coriant Portugal, Ericsson, Politechnic University of Milan, ADVA, Nokia, Old Dog Consulting, SeeTec

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