Metro-haul Project Vertical Service Demo: Video Surveillance Real-time Low-latency Object Tracking

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March 9, 2020

Metro-haul project

Joint demo of project partners:
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Centre Tecnològic de Telecomunicacions de Catalunya
Universitat Politècnica de Catalunya
University of Bristol
Universidad Politécnica de Cartagena
Telecom Italia
Politecnico di Milano
ADVA Optical Networking
Qognify
Fraunhofer Heinrich Hertz Institute
Naudit High Performance Computing and Networking, S.L
Consorzio Nazionale Interuniversitario per le Telecomunicazioni
Technical University of Eindhoven
Zeetta Networks

This work has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 761727 (METRO-HAUL).

Overview

1 Motivation

2 Vertical use-case of the demo

3 Hardware setup

4 Software architecture, components and interfaces

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Motivation

Motivation – smart & safe cities

Video is a key element in initiatives for

- Surveillance of traffic
- Prevent crime in public places
- Anti-terror and crime investigation

Used currently only by few cities

Used currently only in certain places

➔ **Increased deployment of video surveillance**

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Motivation – storage and bandwidth

Physical connection to the network:

- Bandwidth for one camera using H.264: 2 to 6 Mbit/s per camera
- Approximately 400 GB storage per camera for 10 days
- Camera numbers between 100 and 100.000 (e.g. in Asian Cities)

➔ **hundreds of Gbit/s and Petabytes of storage**

In future:

- Mobile cameras (Police cars, Bodycams, …

➔ **requirement for bandwidth and storage becomes more and more dynamic**

Motivation – low latency

Low latency between camera and control/analytic functions is required:

Manual remote controlling of a camera

- Person with a Joystick → immediate feedback of camera required

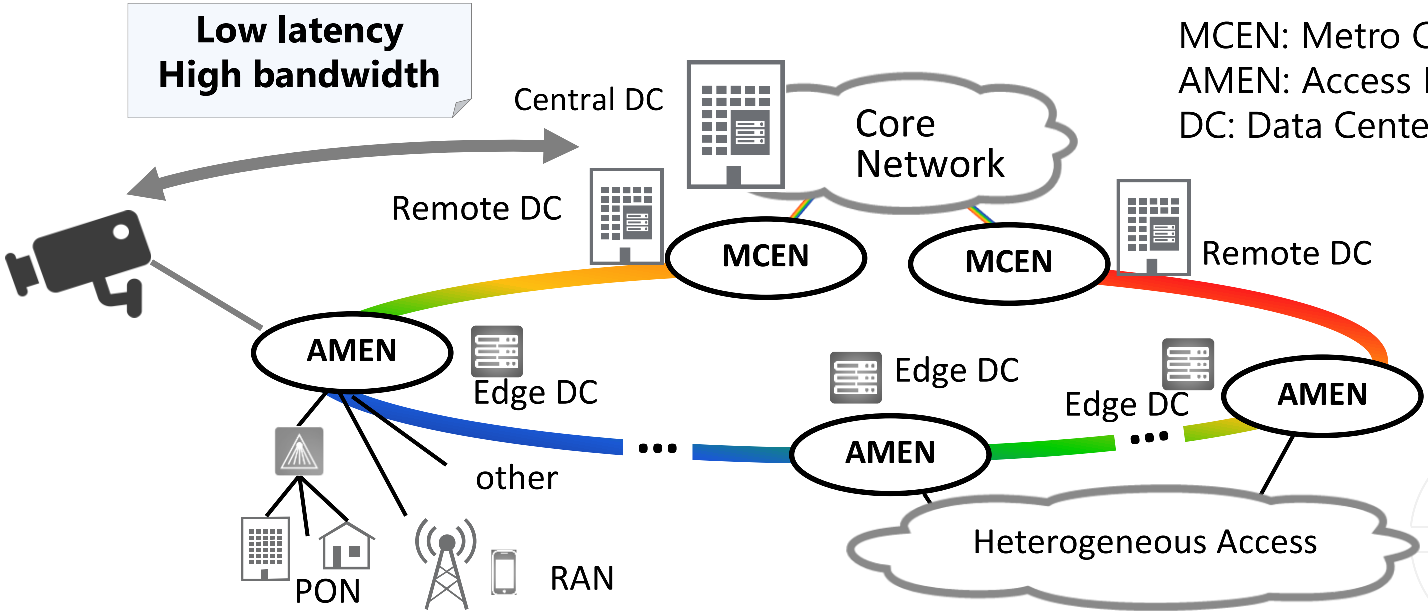
Automatic controlling camera

- through video analytics algorithm running on a different camera or on a remote server

Alarms and reaction, if certain conditions are detected

- e.g. person on rails at railway station

Motivation – infrastructural requirements

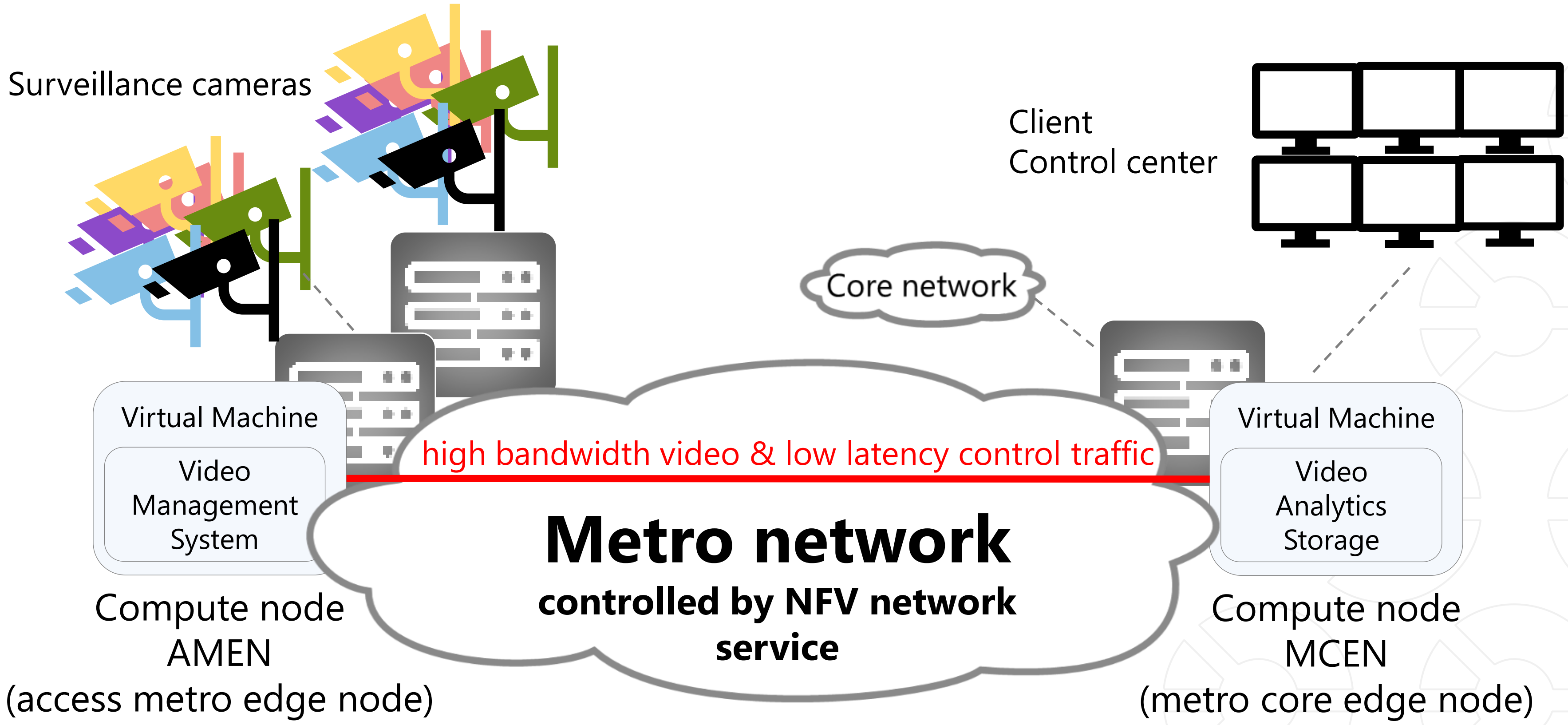


MCEN: Metro Core Edge Node
AMEN: Access Metro Edge Node
DC: Data Center

Move time critical functions close to user: Edge DC
Higher allowed latency, higher computational effort, higher storage: Remote DC/Central DC

Vertical use case of the demo

Vertical use-case in demo application



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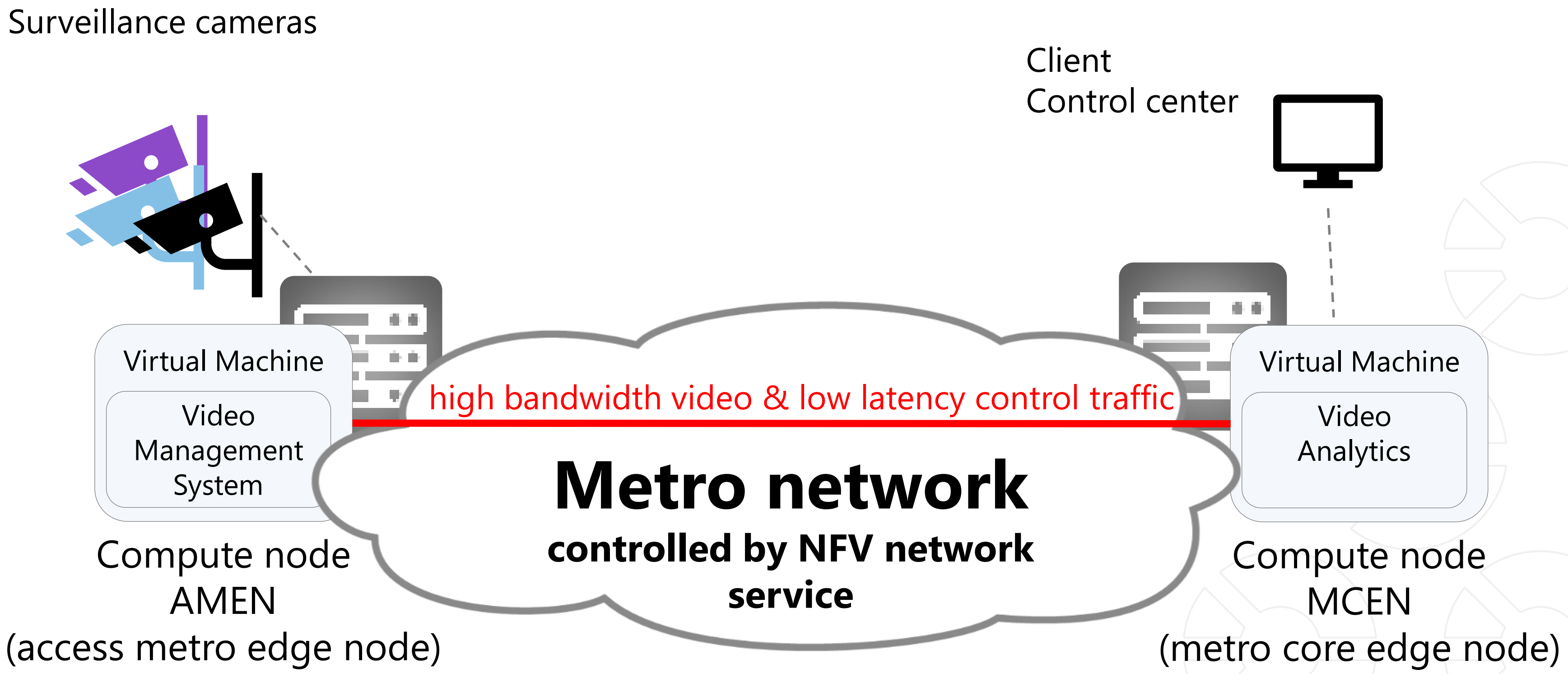
Vertical use-case in demo application



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Use case demonstration options

Fix camera detects object/person
Triggers zoom of pan tilt zoom (PTZ) camera
Client watches video streams
Client takes over control for manual steering of PTZ
Analytics run on cameras

➔ Low latency for remote control of cameras

➔ High data rate for video transmission (for huge amount of cameras)

Thermal camera detects object/person
Object/person is tracked, seen by client
Alarm is triggered
Client starts manual control of PTZ
Analytics run on remote compute node (MCEN)

➔ Low latency for remote control of cameras and for analytics

➔ High data rate for video transmission (for huge amount of cameras)

Transmission of data and management signals over dynamically created optical slice!

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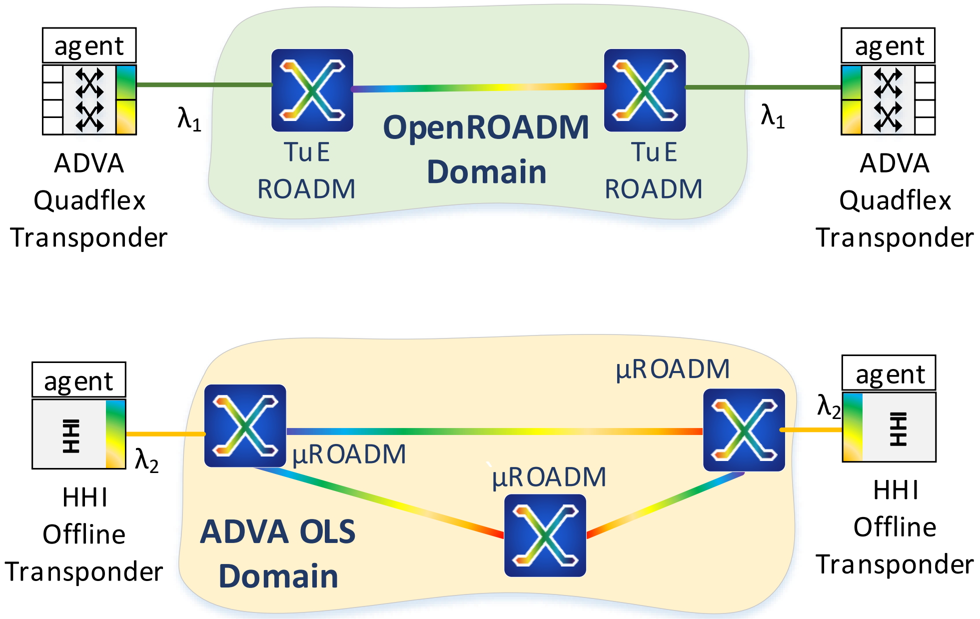
Ansicht
9/19/2019 5:51:59 PM
administrator
Overview
Alarm search
iSearch
Thermal-Q1942E 9/19/2019 5:44:47 PM
Home
iSearch
Dome-Q6125-LE 9/19/2019 5:44:47 PM
Archive player
1:1
5:40 PM
9/19/2019 5:44:47 PM
5:50 PM
Dome-Q6125-LE
Thermal-Q1942E
1


Ansicht
9/19/2019 8:35:05 PM
administrator
Overview
Alarm search
iSearch
Thermal-Q1942E 9/19/2019 8:29:21 PM
Home
iSearch
Dome-Q6125-LE 9/19/2019 8:29:21 PM
Archive player
1:1
8:25 PM
9/19/2019 8:29:21 PM
8:35 PM
Dome-Q6125-LE
Thermal-Q1942E

Hardware setup

Hardware Setup – Optical line system



Two types of transponders:

- ADVA: commercially available, with OpenConfig interface
- HHI: Offline processed data, but with OpenConfig agent

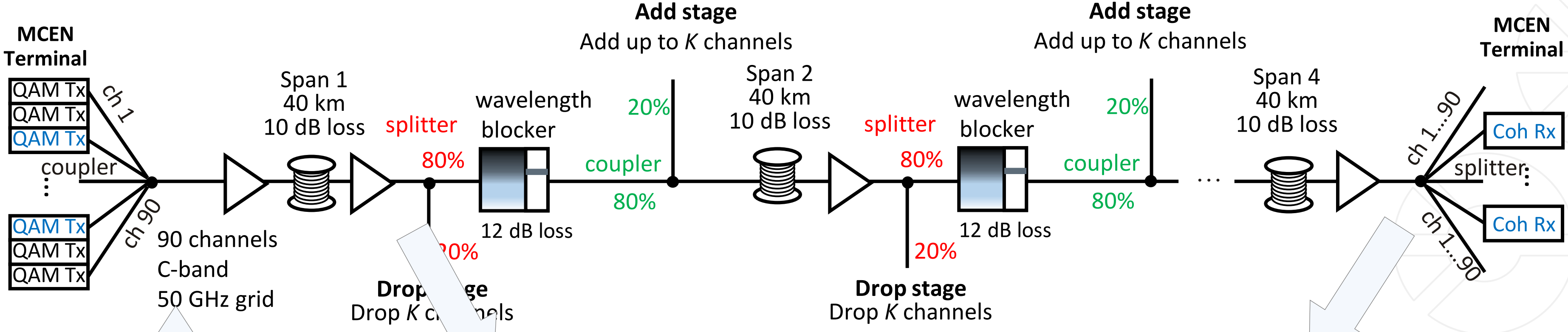
➔ Both: coherent transmission of multi-level modulation

Two types of OLS:

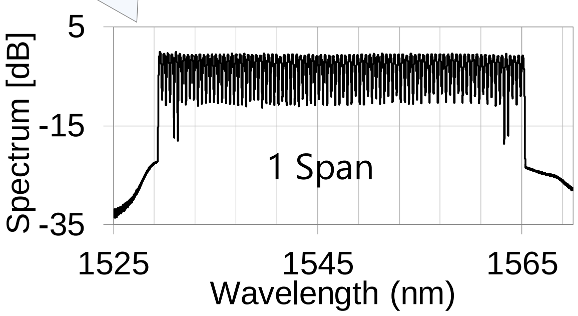
- OpenROADM controlled, ROADMs from TU Eindhoven
- ADVA OLS with ADVA's microROADM solution

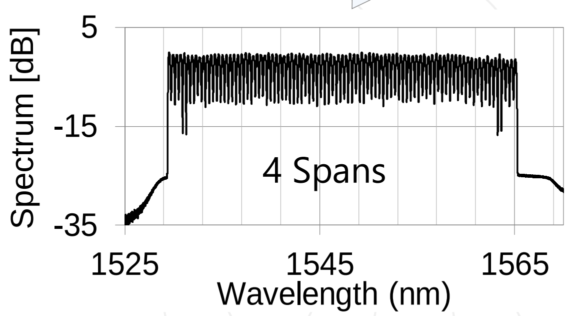
➔ Both: ROADMs based on wavelength blockers (WB) and splitters, no filtering applied!

Experimental setup



5th and 85th channel:
DP-QPSK/DP16QAM at 100/200 Gbit/s
88 channels: shaped ASE noise
$OSNR_{Tx,N}$ can be varied





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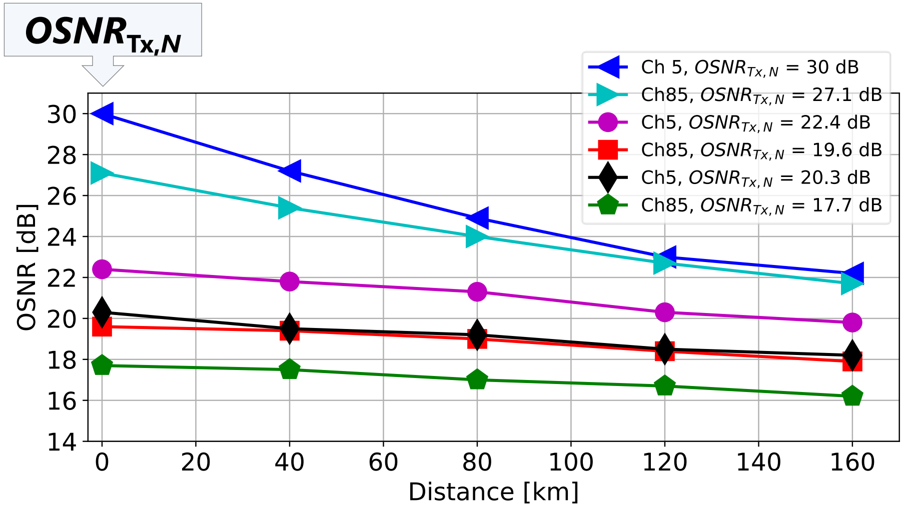
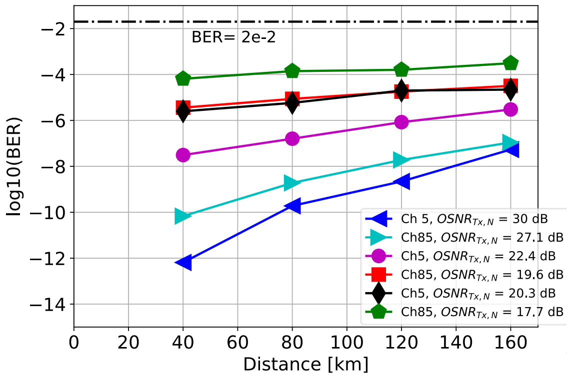
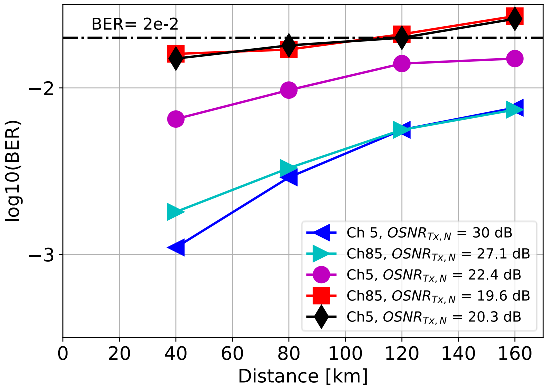
OLS – transmission results



100 Gbit/s DP-QPSK

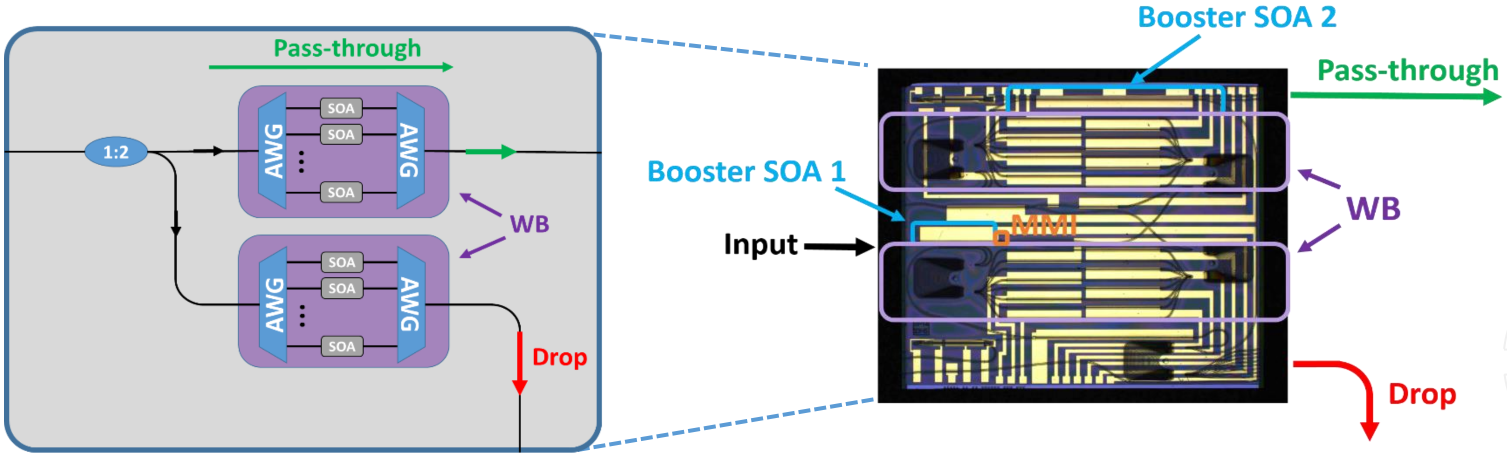


200 Gbit/s DP-16QAM



A. Dochhan et al., Flexible metro network architecture based on wavelength blockers and coherent transmission, ECOC 2019

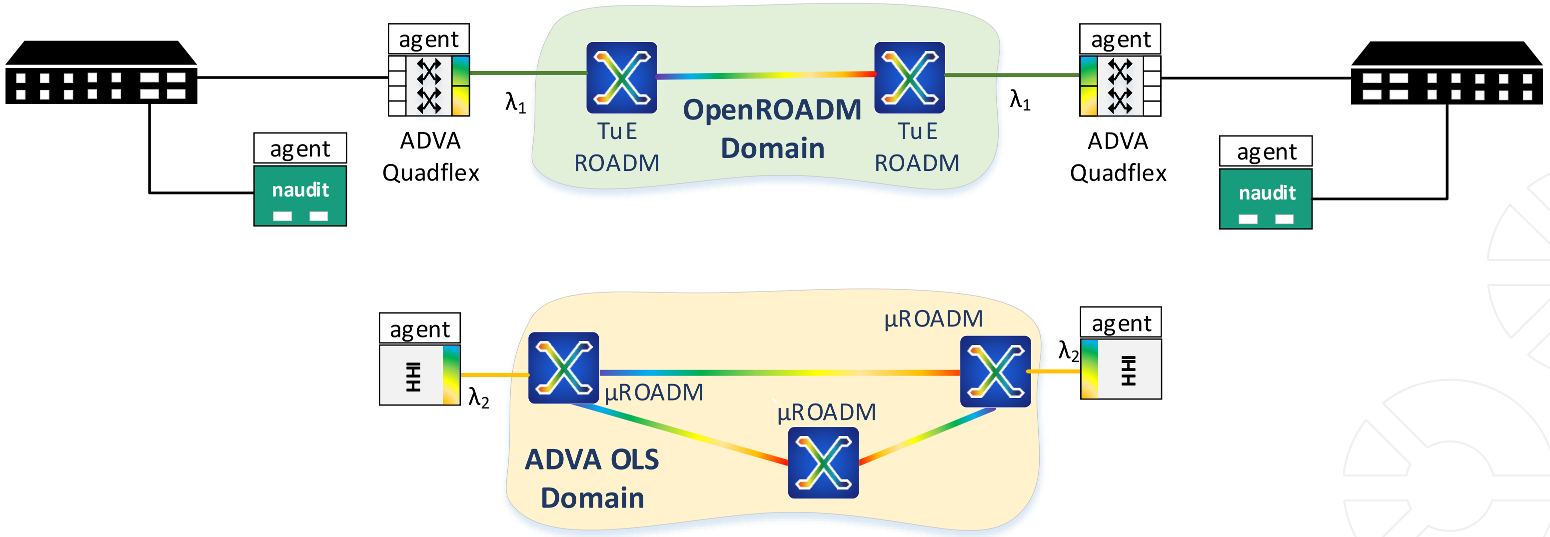
OLS – TU Eindhoven’s SOA-based WB ROADM



- Low-cost SOA based 2-degree ROADM with functions of switching and amplification
- SOA gates inside the ROADM can be turned on and off by the FPGA based O/E/O interface to make each single wavelength pass/stop or drop & continue
- SDN-enabled network solution with OpenROADM agent to drive metro-access node

W. Miao, et al., “Low Latency Optical Label Switched Add-Drop Node for Multi-Tb/s Data Center Interconnect Metro Networks”, ECOC 2016
N. Tessema, et al. “SDN enabled dynamically re-configurable low-cost ROADM nodes for metro networks”, OECC/PSC 2019

Hardware setup - probes



Active and passive probes for latency measurements and channel monitoring

Hardware setup – active probes

Fig. 2 Active network probe implemented in a small factor server. FPGA is placed in the bottom corner, with both QSFP28 interfaces connected. Management interfaces are on the left.

Optical paths created dynamically by SDN infrastructure can be checked before they are put in operation

FPGA-enabled link measurement with ns accuracy of

- path capacity
- round trip time
- jitter
- packet loss

Demonstrated: depoyed optical path is measured after it has been setup up → not meeting KPIs → torn down and re-deployed until KPIs are met

Jorge E. López de Vergara, et al., "Demonstration of 100 Gbit/s active measurements in dynamically provisioned optical paths", Demo at ECOC 2019

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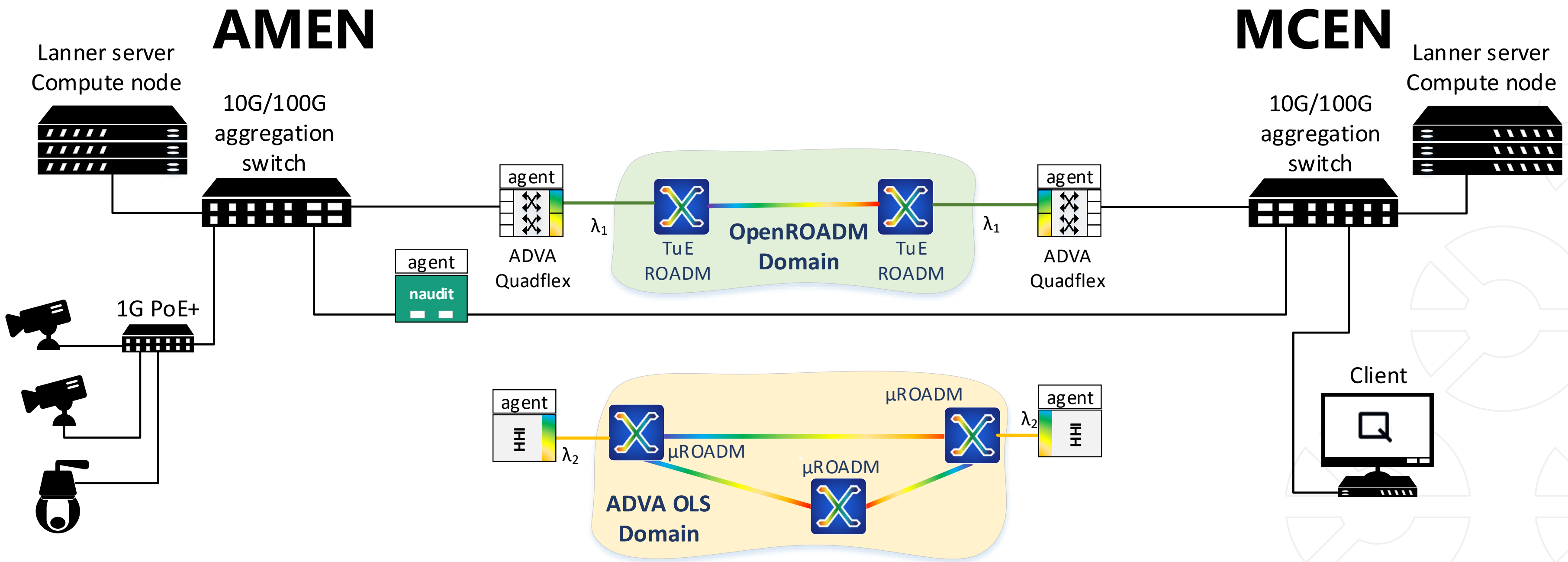
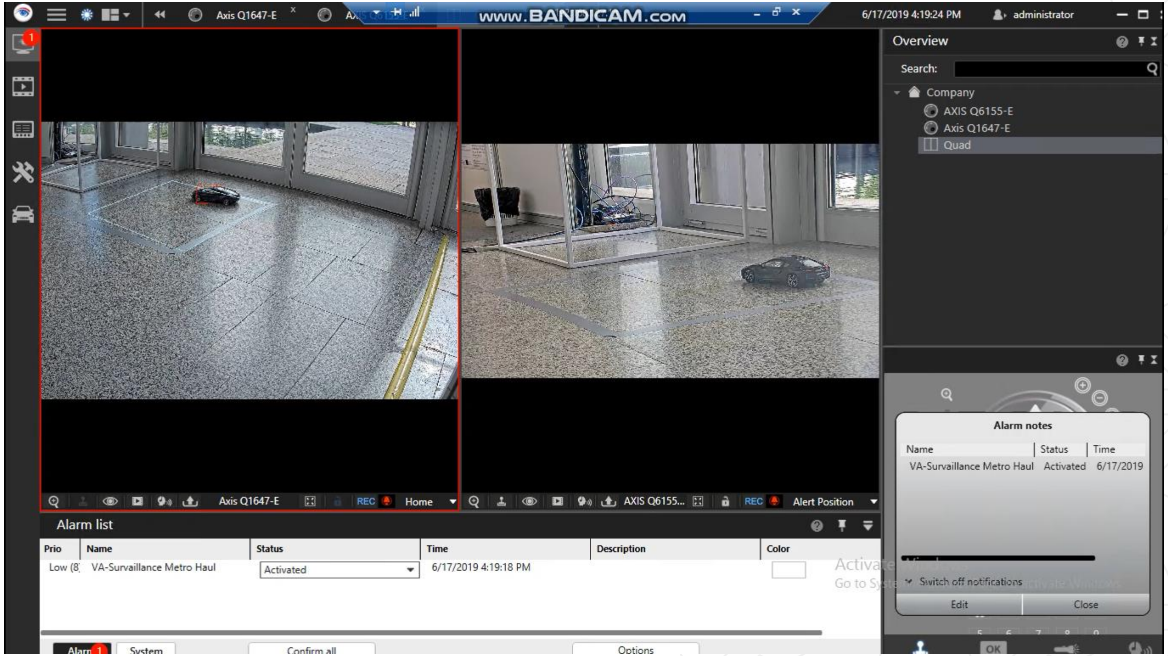
Hardware setup – compute nodes



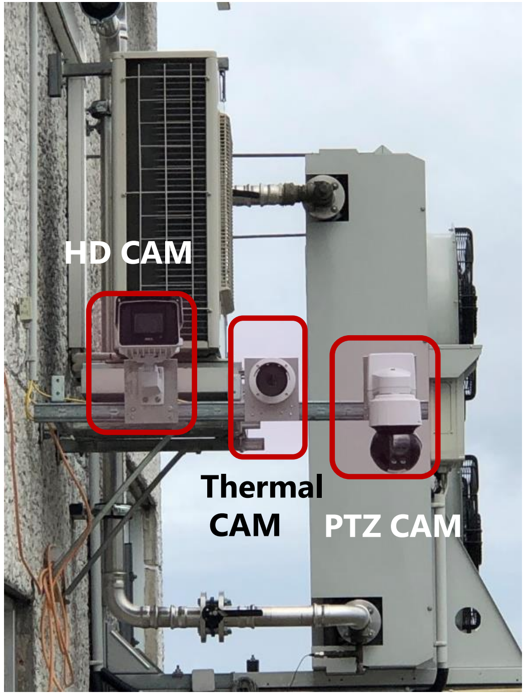
Compute nodes and cameras are connected via switches
Real-time traffic either through OpenROADM or ADVA OLS domain

Compute nodes and cameras @ EUCnC

Metro-haul partners: "Leveraging multi-layer network slicing for improving public safety", demo at EUCnC 2029

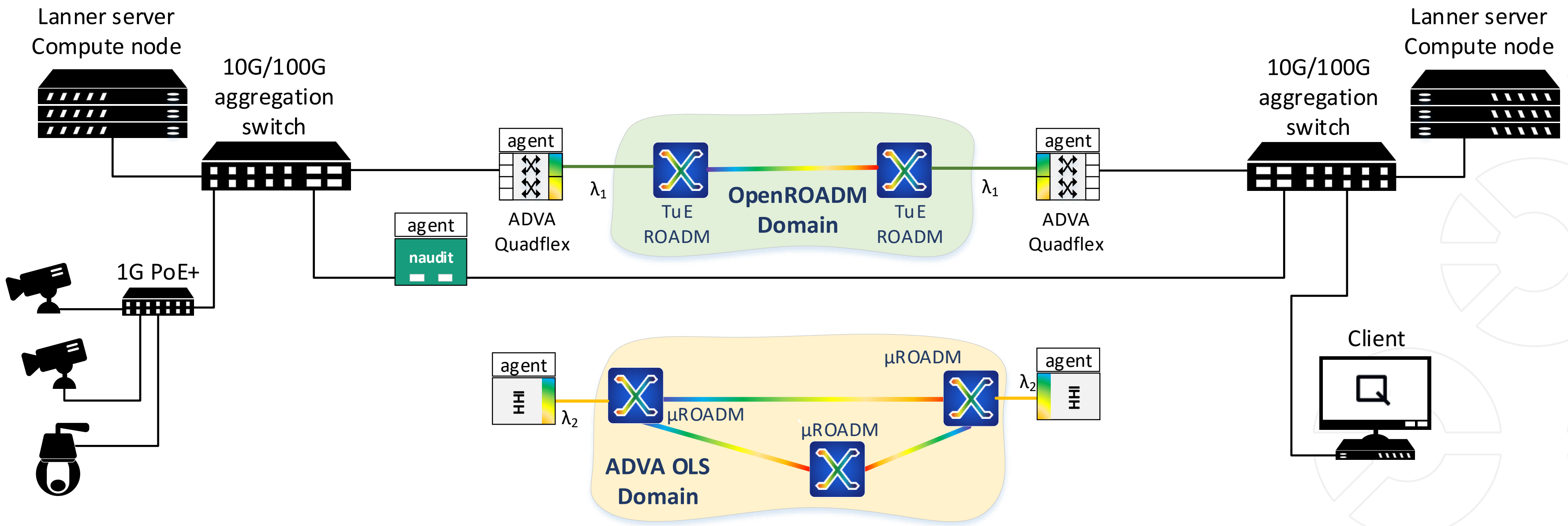


Hardware Setup – Cameras for final demo

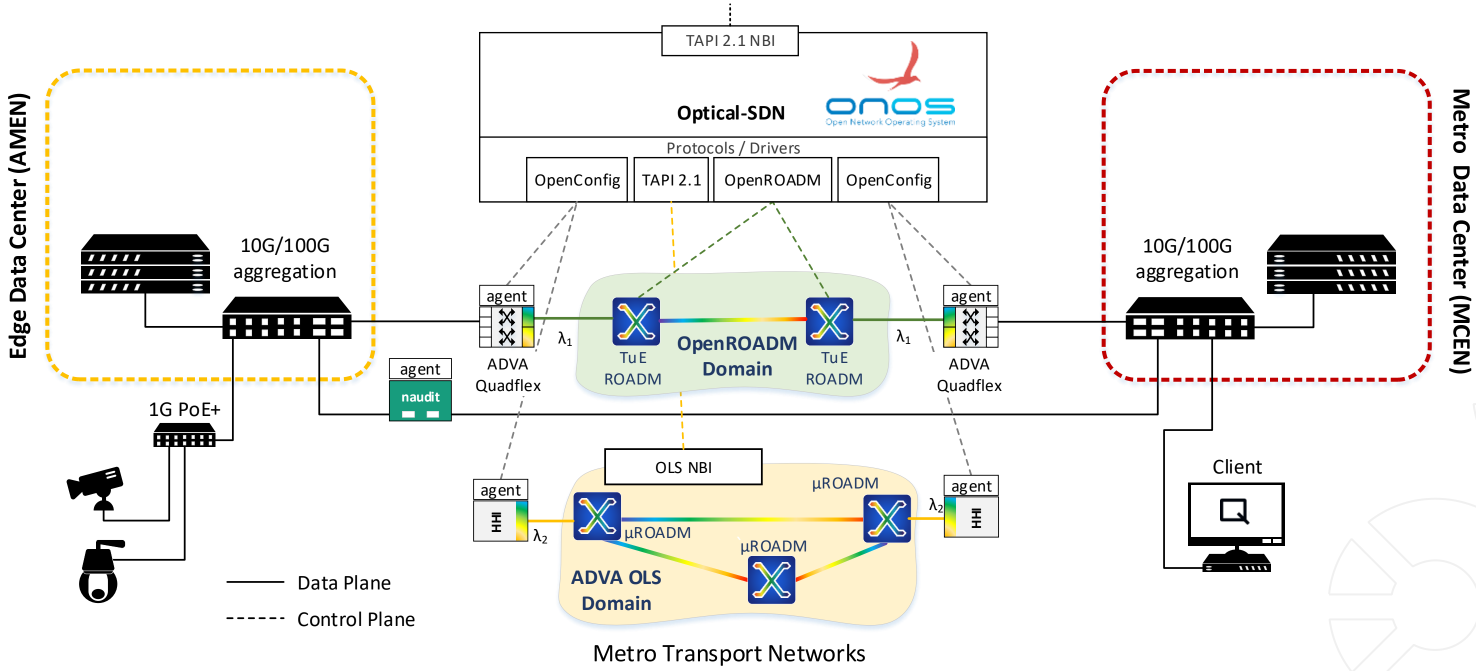


Software architecture, components and interfaces

Optical SDN controller



Optical SDN controller



Optical controller: ONOS

OpenConfig driver for HHI offline transponder and ADVA transponder

OpenROADM driver/agent for TU Eindhoven ROADMs, ADVA OLS controlled by ADVA controller, ONF Transport API interface northbound

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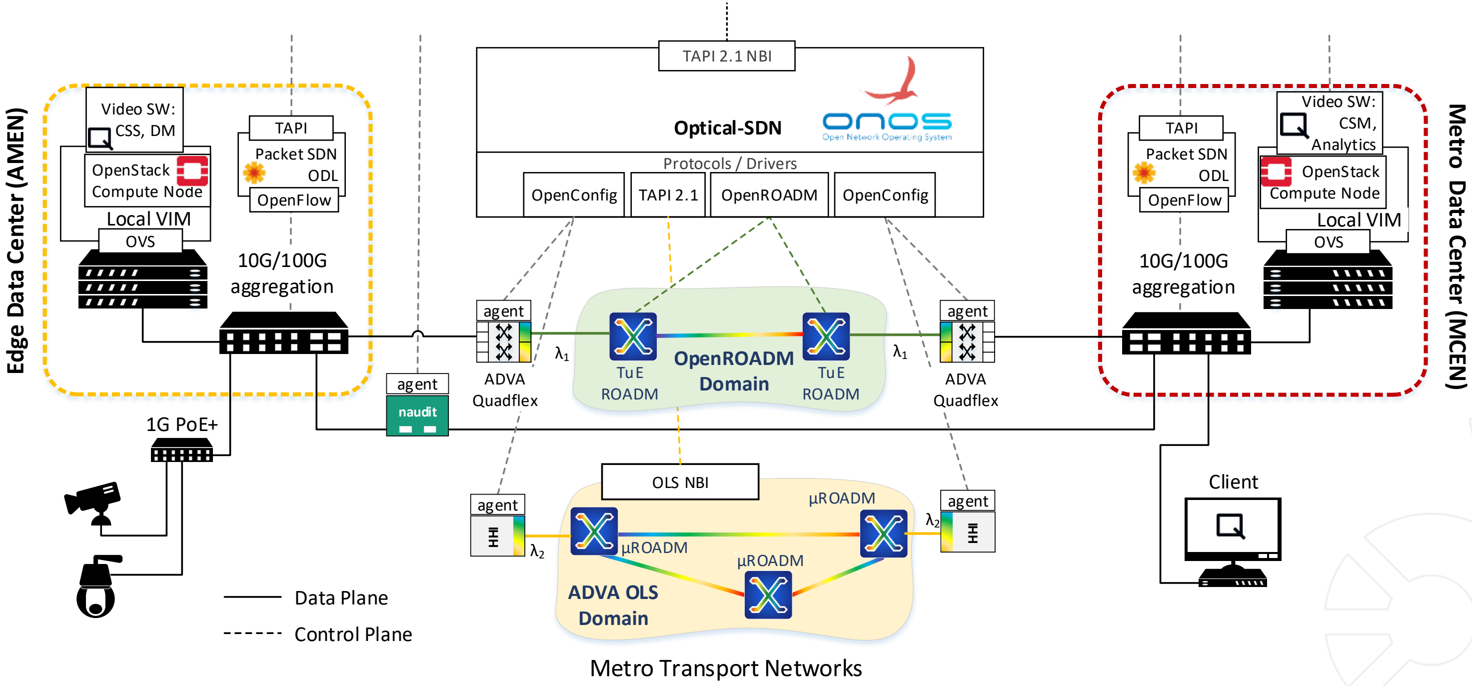
Compute nodes – OpenStack

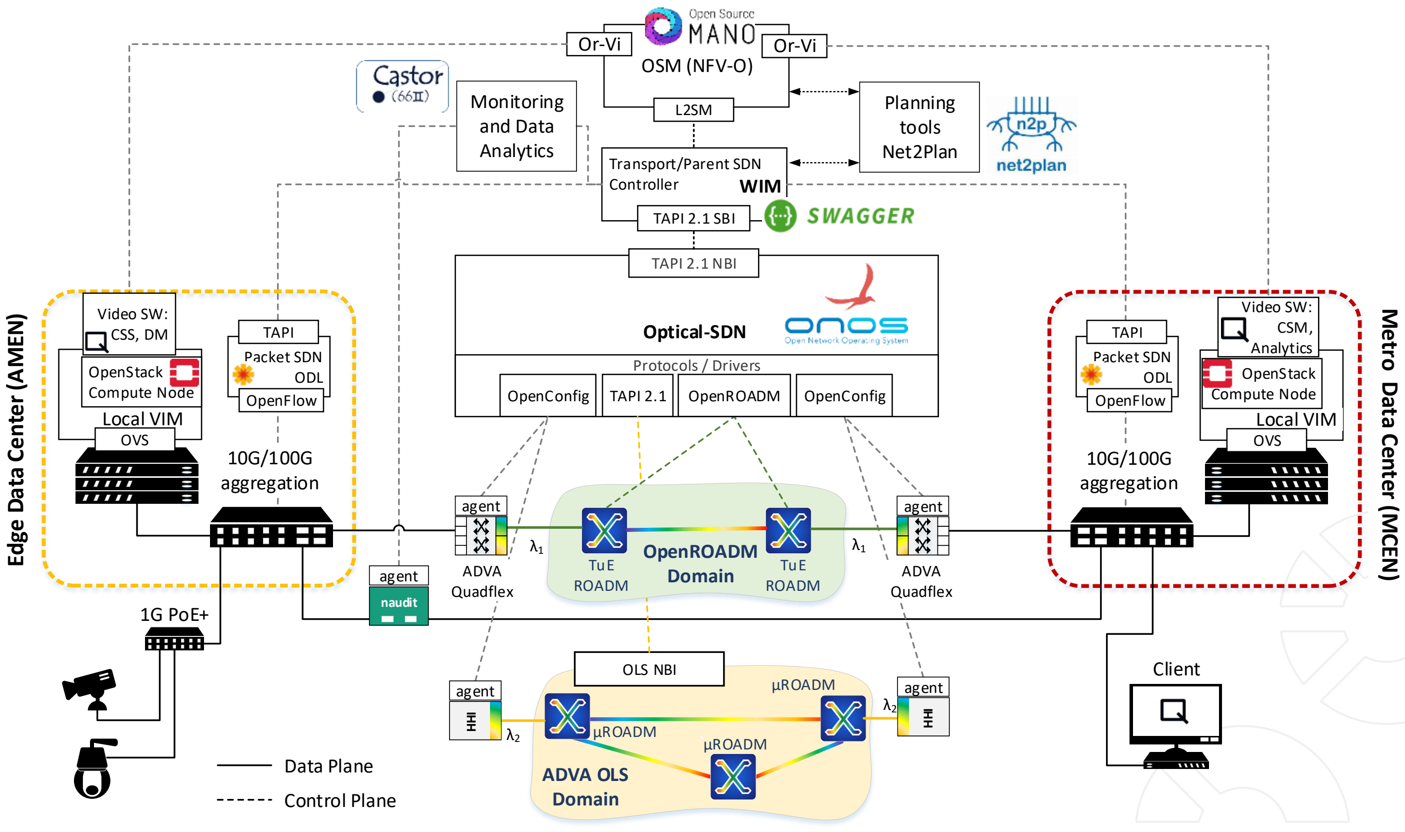


Compute Nodes run OpenStack

Virtual network function with Windows operating system to run Qognify software

Both compute nodes must be in the same network → enable by virtual links

Open Source MANO (OSM) and parent SDN controller



Metro Transport Networks

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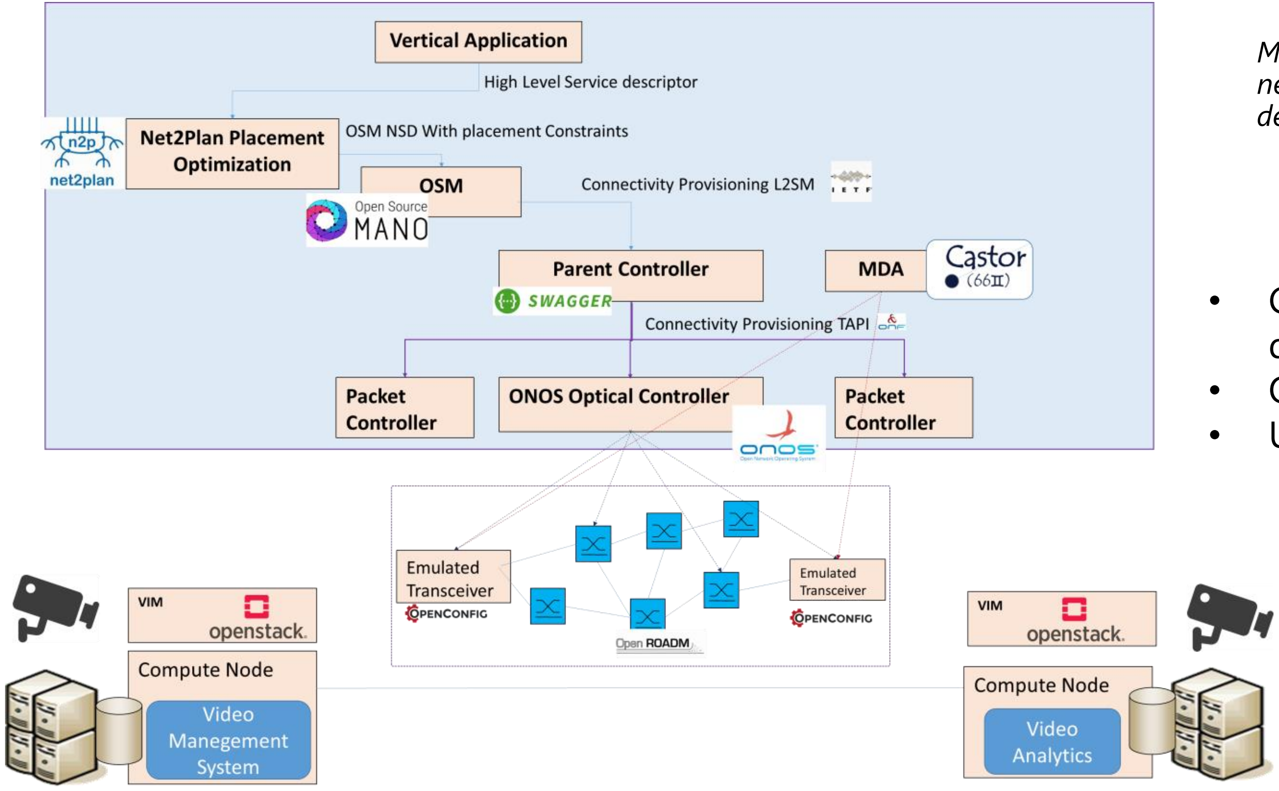
Control plane demo at EUCnC



Metro-haul partners: "Leveraging multi-layer network slicing for improving public safety", demo at EUCnC 2029

- Control plane already demonstrated
- Optical network was emulated
- Use case was shown separately

Summary

Summary

Metro-Haul will demonstrate low-latency object tracking in a multi-layer metro optical network scenario

- real-time surveillance and analytics require the optical metro network to provide flexibly low latency and high bandwidth connections
- network slicing is leveraged to allocate certain computational resources to run the video management and analytics on remote servers
- control plane architecture enables the flexible deployment of a network slice instance, implemented in terms of an ETSI NFV network service

Currently: integrations of hardware and software ongoing, final demonstration will be shown in April/may

Thank you

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