

Metro-Haul

5th OSM Hackfest – 5G Day

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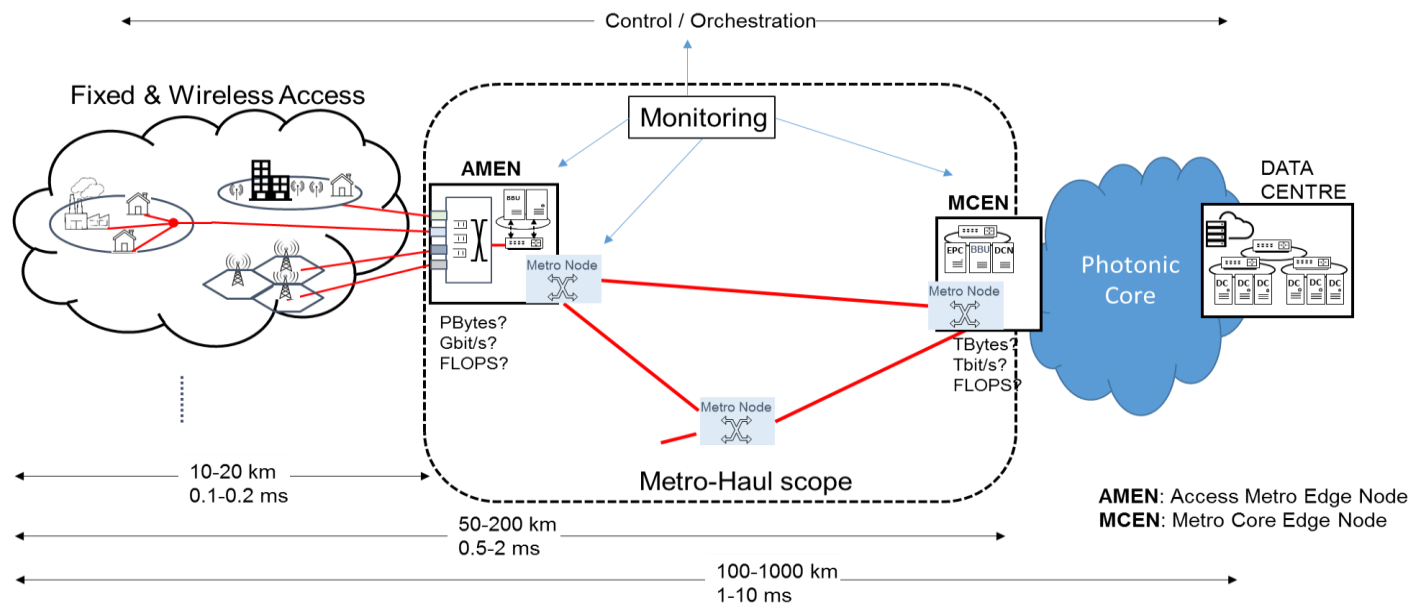
<http://metro-haul.eu>

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

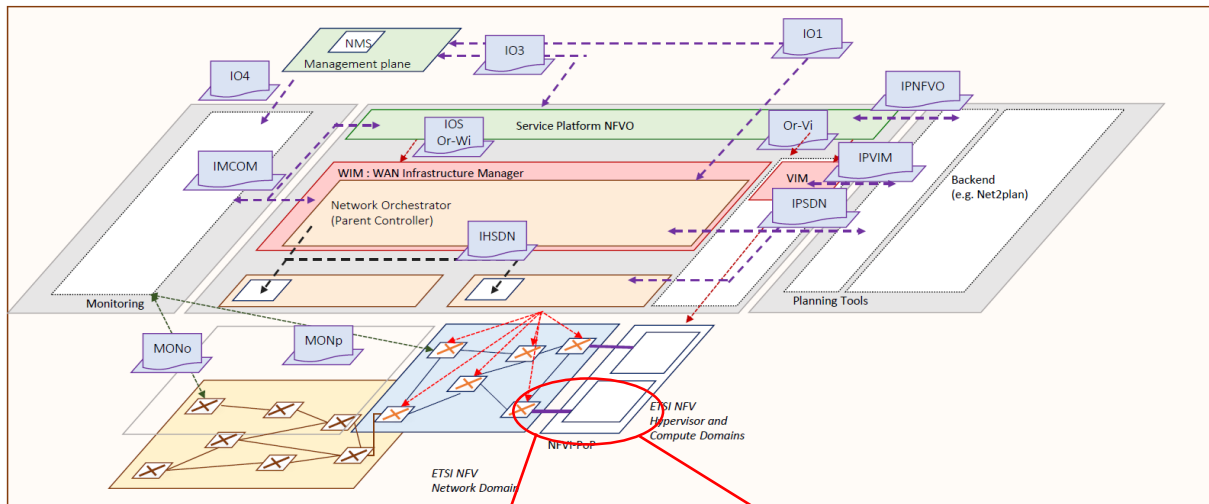
H2020-ICT-2016-2 Metro-Haul Grant No. 761727

❖ Nodes:

- ❑ Access Metro Edge Nodes (AMEN): Computing, Storage and Networking resources
 - ✓ Designed to integrate with fixed and wireless access technologies.
- ❑ Metro Core Edge Nodes (MCEN): Facing the elastic optical core network
 - ✓ Multi-degree devices for higher throughput compared to AMENs.
- ❑ Control and Orchestration of the whole network:
 - ✓ Control layer to allocate resources and provide services as per the monitoring information and user requirements.

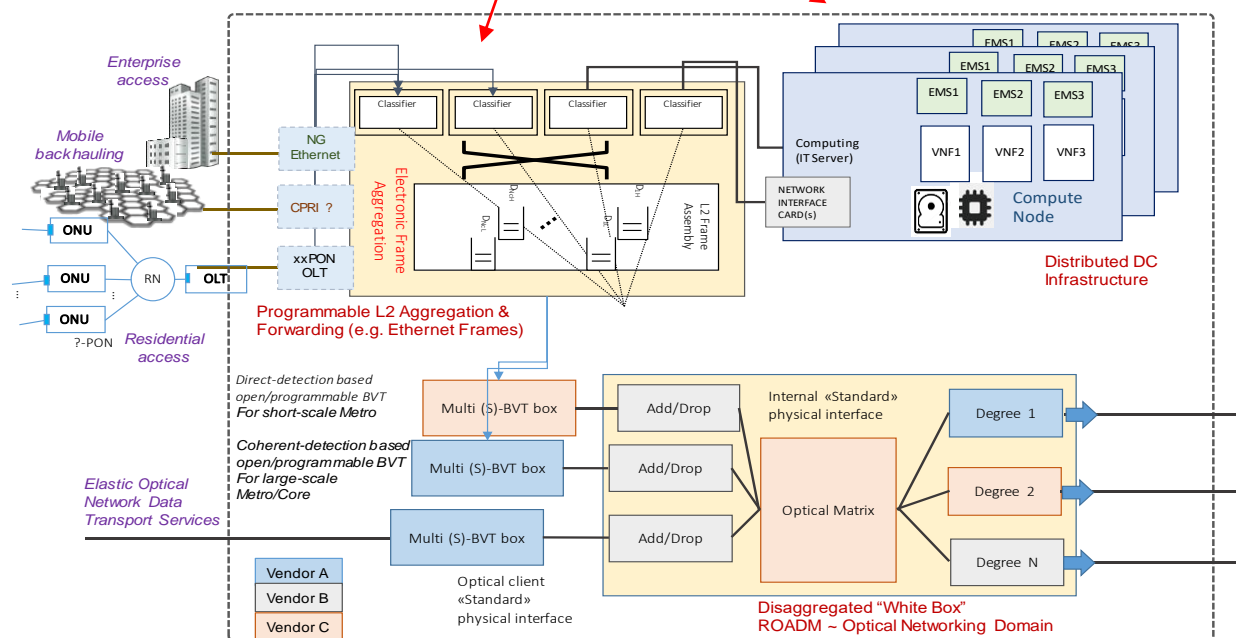


Metro-Haul: Network Service Platform Architecture



Metro-Haul Network Service Platform Architecture:

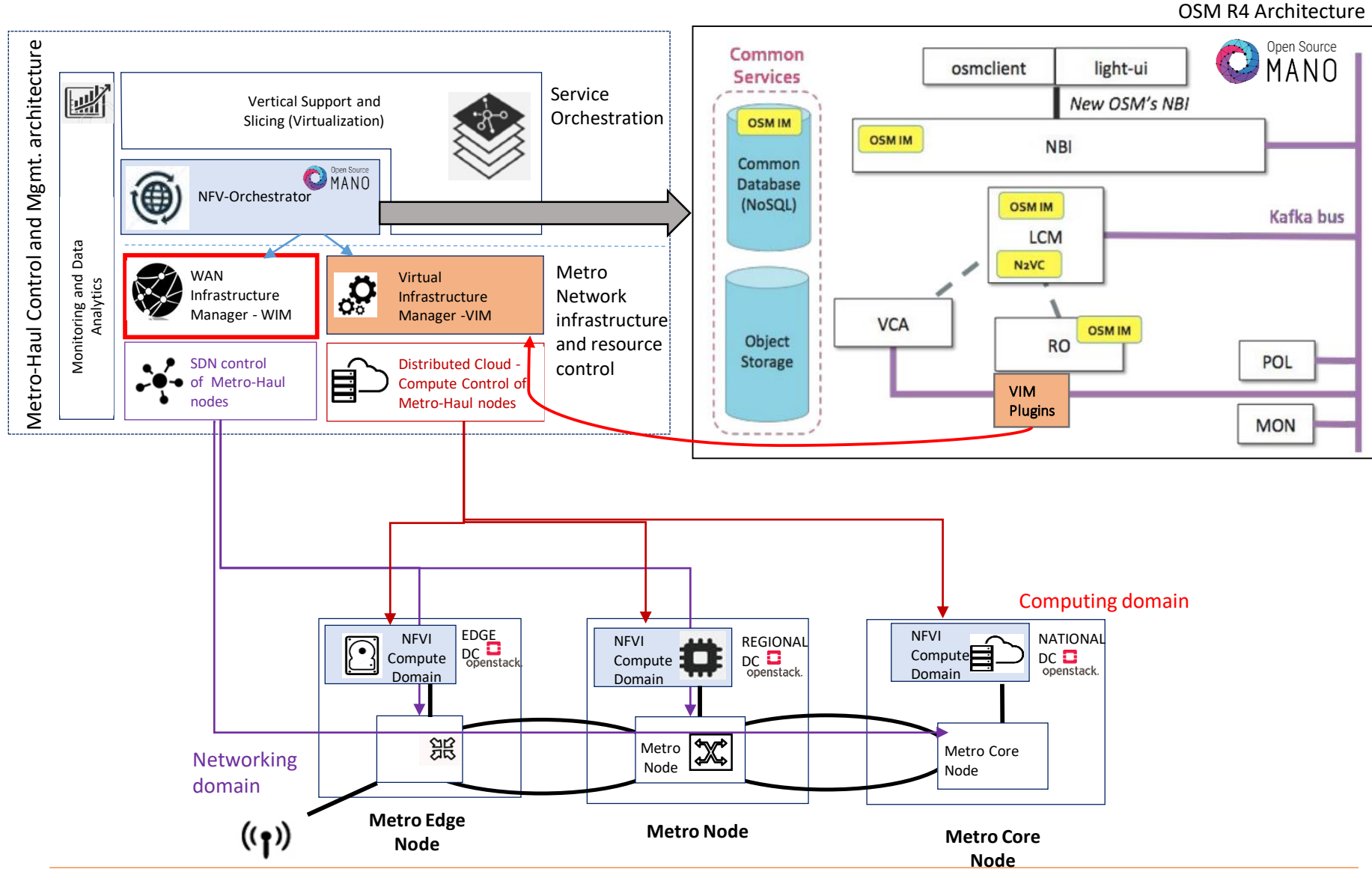
- Multi Layer Architecture for end-to-end orchestration.
- Include Monitoring, Orchestration and Planning tools across the metro network and compute infrastructure



Metro-Haul Disaggregated Central Office Architecture: AMEN/MCEN

- Distributed Datacentres.
- Distributed and connected across Access, Metro and Core nodes.
- Multiple underlying SDN controllers controlling various optical and networking devices.

Macro-View: Metro-Haul Control and Orchestration

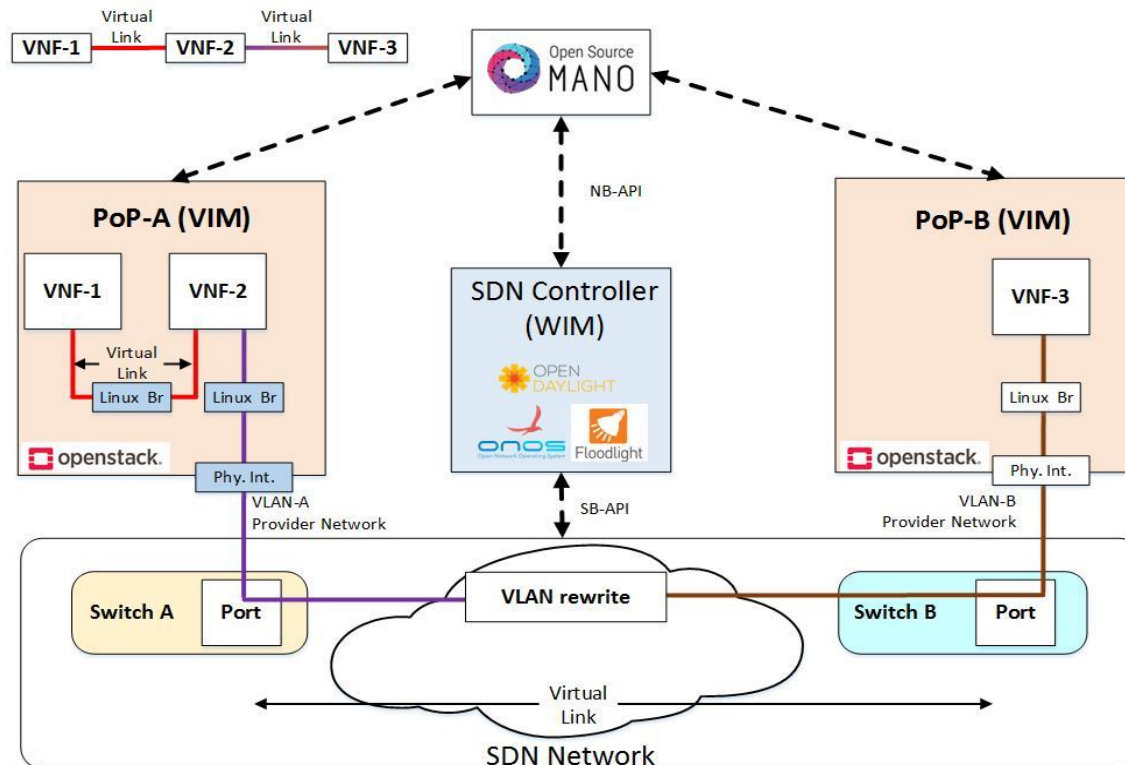


OSM R4 Gaps and Metro-Haul Contribution

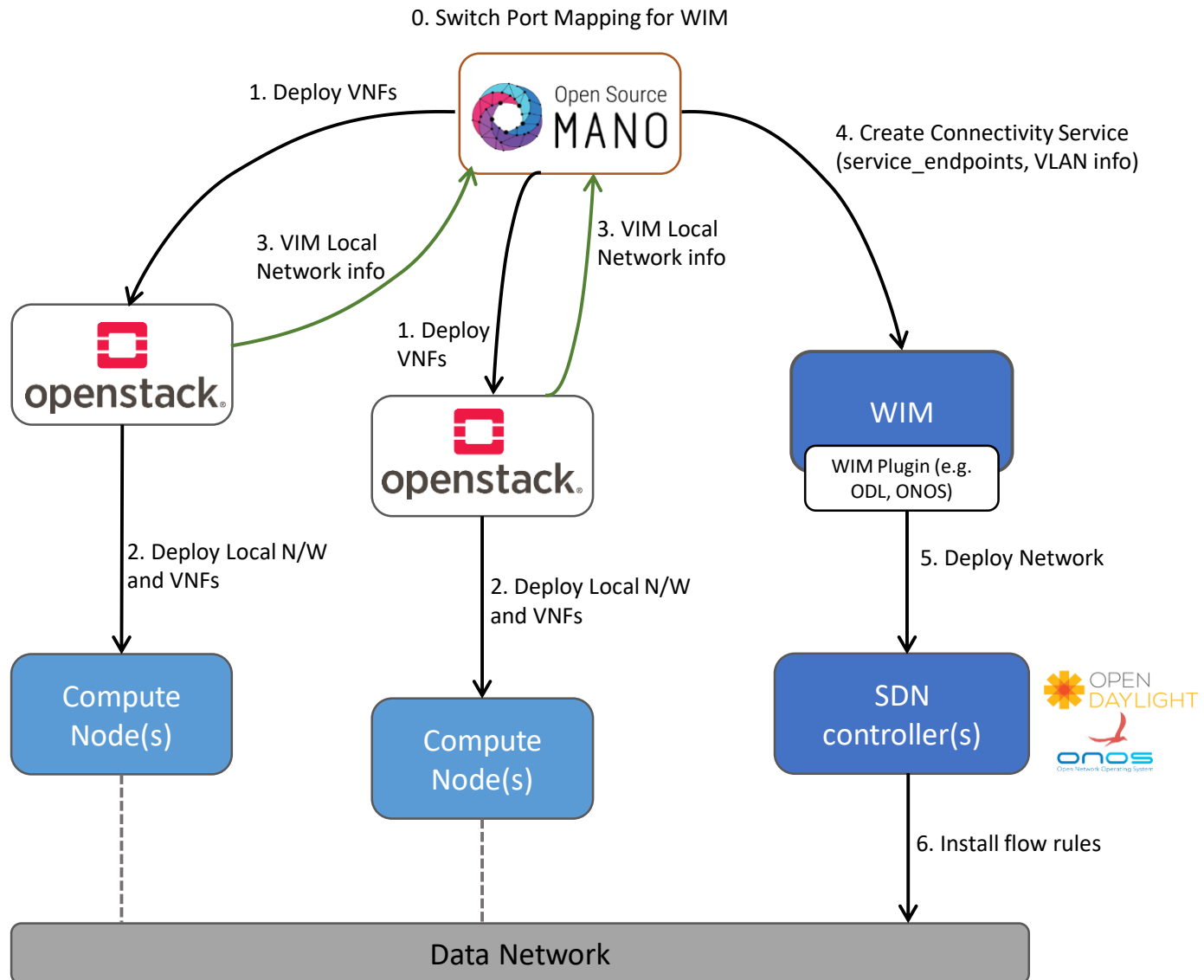
High-Level Requirements (Metro-Haul)	Feature Required	OSM Release 4	OSM Release 5
End-to-End Orchestration of Network Services over distributed datacentres	Virtual Infrastructure Manager(VIM) Plugin → To deploy VMs in the compute infrastructure.	Plugins for VIMs like Openstack, OpenVIM etc. are available	Plugins for VIMs like Openstack, OpenVIM etc. are available.
	Wide Area Network Infrastructure Manager (WIM) → To create and provision network across the multiple datacentres.	Not Available	Metro-Haul contribution in form of WIM Connector.
	Support to utilize SDN controllers to manage the underlying disaggregated optical network.	Not Available	WIM Connector with the plugin architecture to support SDN controllers and custom plugins (e.g. T-API based connectors).

❖ OSM is the orchestrator in Metro-Haul

- ❑ Deploy, manage and orchestrate the Network services across disaggregated datacentres.
- ❑ Design and development of Wide Area Network Infrastructure Manager (WIM) in OSM
 - ✓ Deploy VNFs across multiple datacentres in a Network Service.
 - ✓ Create L2 VLANs over the underlying network infrastructure.
 - ✓ Protocol-Agnostic systems allowing variety of SDN technologies to work with.



OSM R5: WIM Workflow



OSM-R5: WIM Connector: Features and Opportunities

❖ WIM Connector Features:

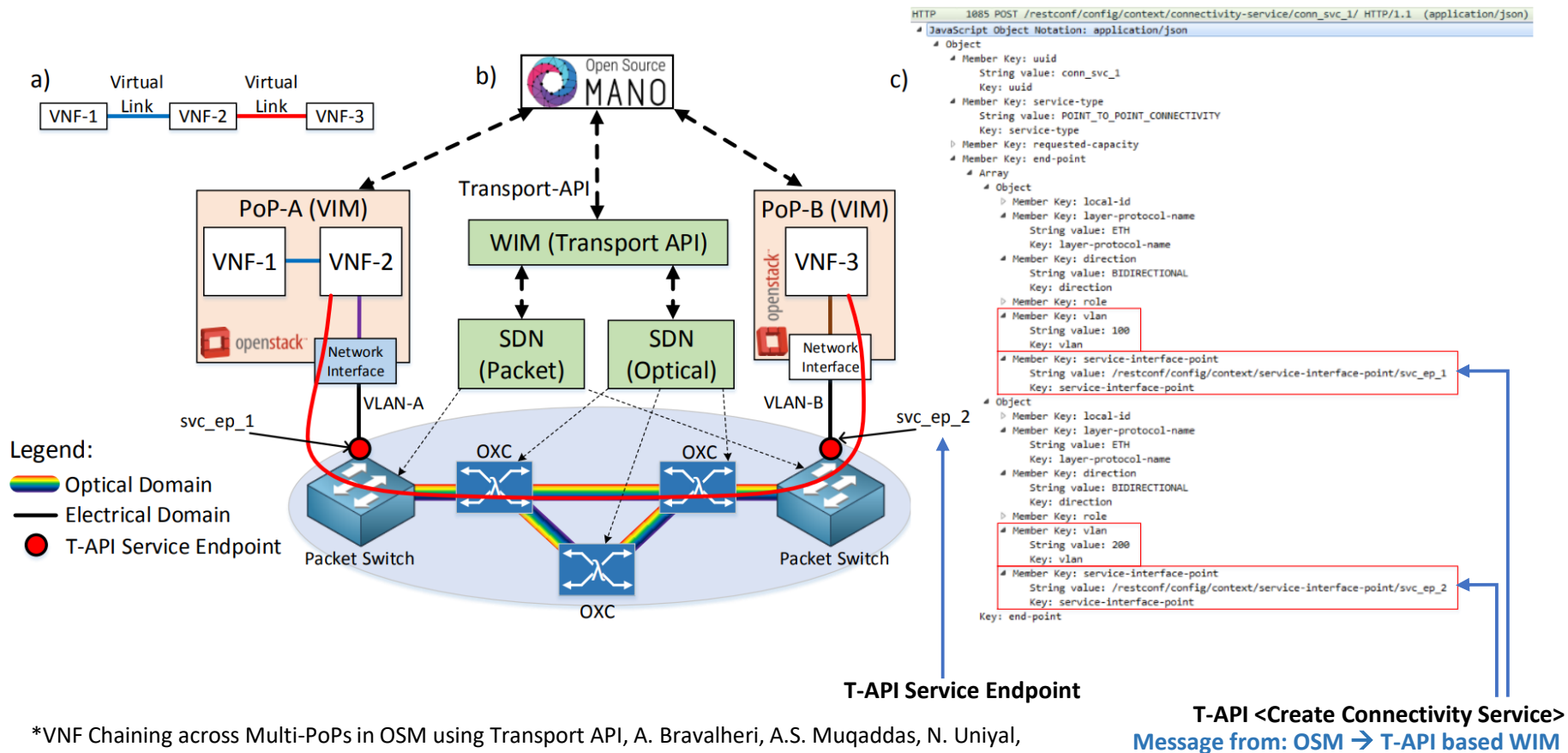
- ❑ Plug-in Architecture supporting multiple SDN Controllers
 - ✓ ODL, ONOS, NetOS, etc.
- ❑ Follows the existing OSM model of Port-Mapping:
 - ✓ SDN Switch Port Mapping to be done prior to creating inter-DC Network Services.
- ❑ Create end-to-end L2 Network:
 - ✓ VLAN separated network.
 - ✓ Use underlying SDN controller to insert flow rules.
 - ✓ Creating end-to-end network slice between multi-DCs.

❖ Opportunities:

- ❑ To create the Layer-3 based solution:
 - ✓ SD-WAN
 - ✓ L3 VLANs
 - ✓ VxLANs etc.
- ❑ To create plugins for specific use-case:
 - ✓ T-API based interfaces for OSM operability with optical layer.

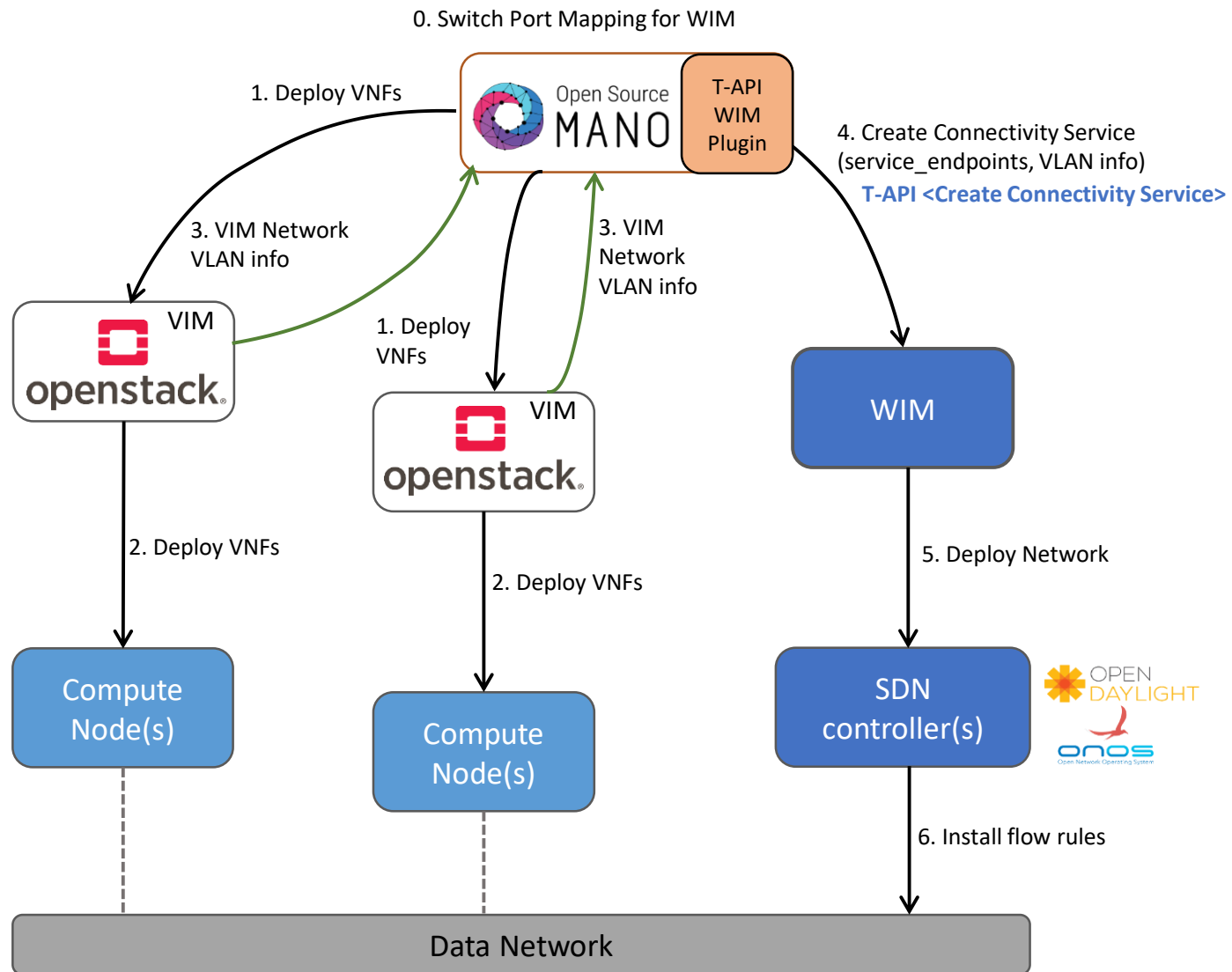
❖ Transport API(T-API) as WIM Northbound API:

- ✓ Defined and supported by ONF.
- ✓ Has common standardized North Bound Interface(NBI) across multiple SDN controllers.



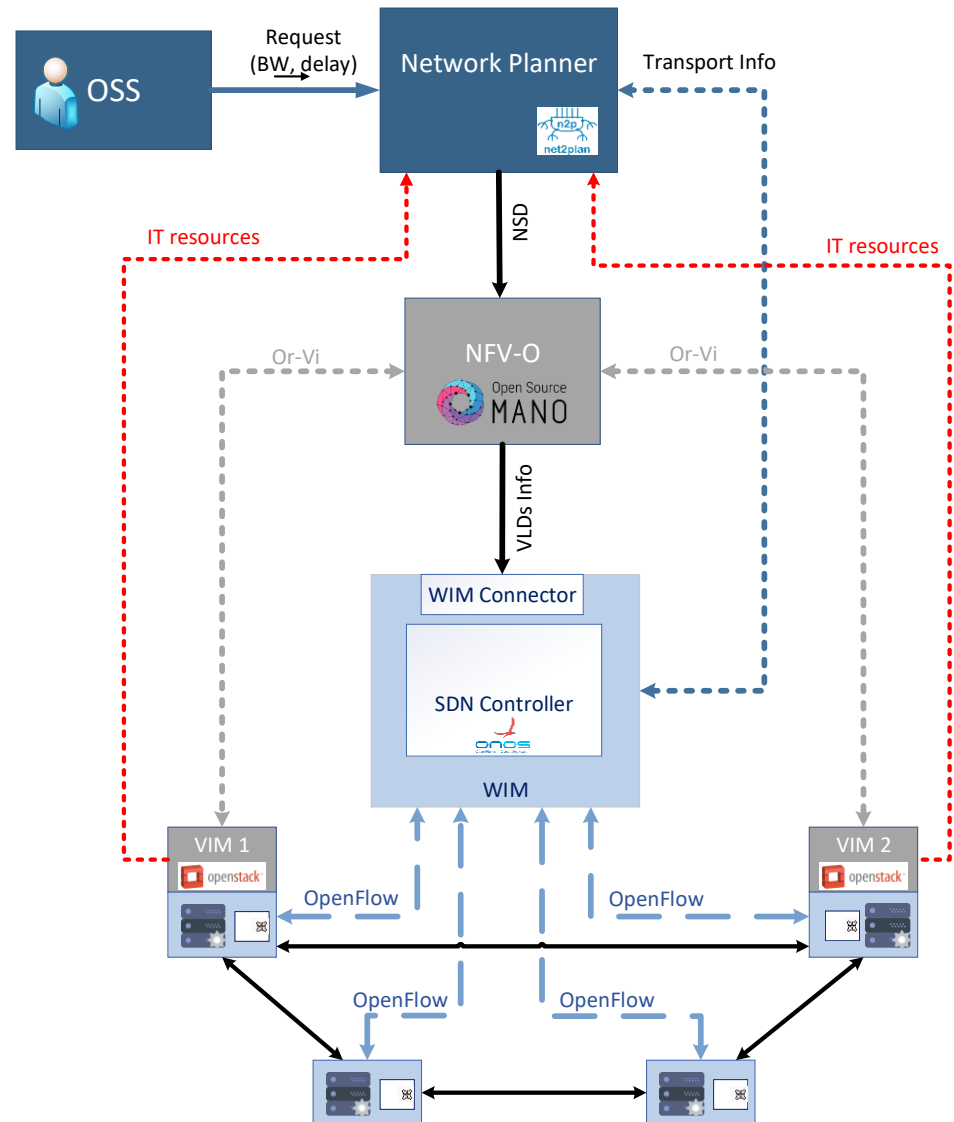
*VNF Chaining across Multi-PoPs in OSM using Transport API, A. Bravalheri, A.S. Muqaddas, N. Uniyal, R. Casellas, R. Nejabati, D. Simeonidou, OFC 2019 (Accepted)

OSM Release 5: Current and future Role in M-H

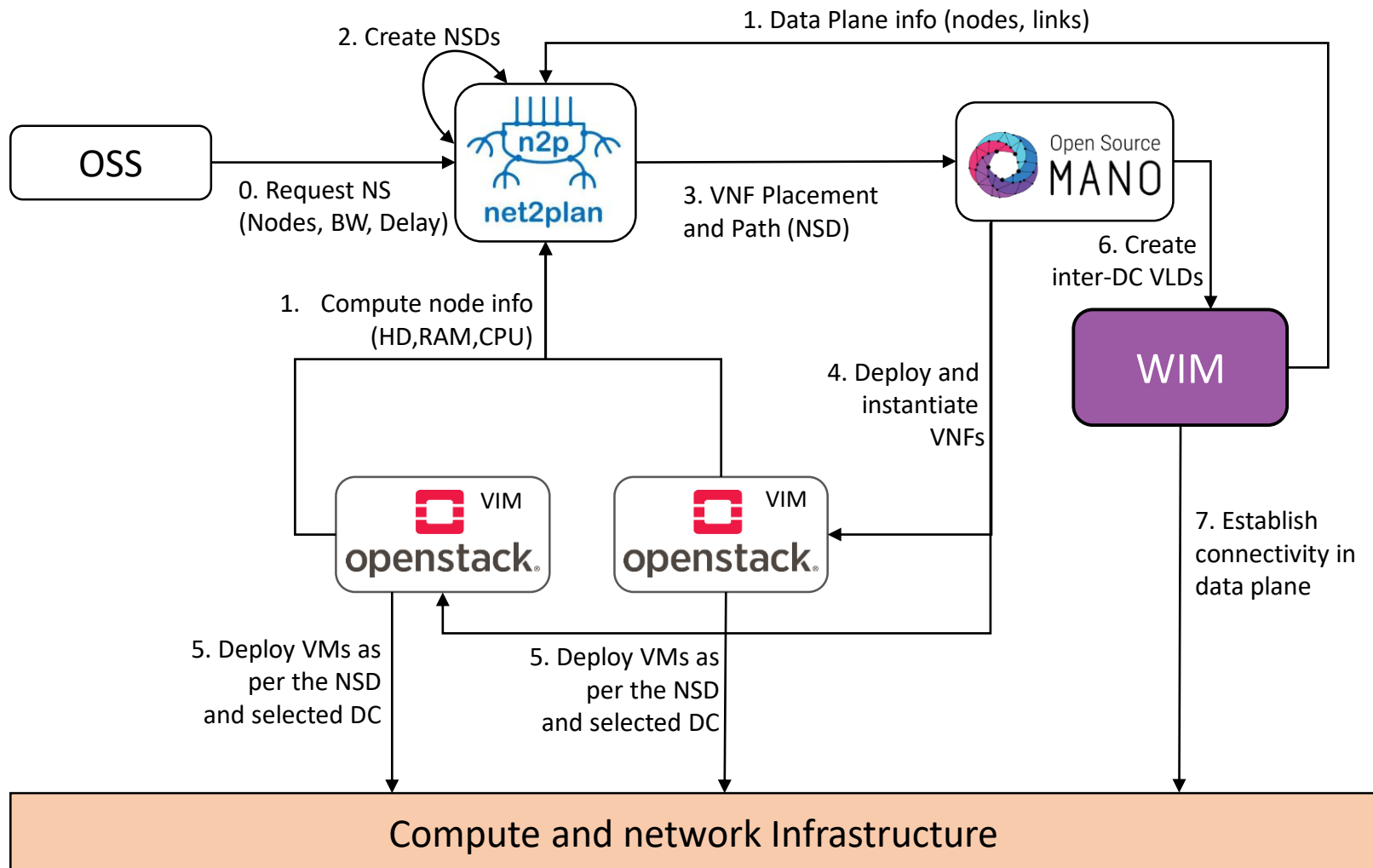


- ❖ Network and Compute aware VNF placement
 - ❑ WIM provides Transport Network Status
 - ✓ Network Endpoints, links etc. using underlying SDN Controller.
 - ❑ VIM provides Compute status
 - ✓ RAM, Storage, CPU etc.
 - ❑ Allows Experimental platform to run VNF placement algorithms.
- ❖ Planning and Placement Tool: Net2Plan
 - ❑ Provide framework to integrate ML and Heuristics based VNF Placement and optimization algorithms.
 - ❑ Integration with the Optical layer
 - ✓ Get monitoring data from the optical layer.
 - ✓ Plugged-in Placement algorithms can utilize the data for VNF placement optimization.

**Courtesy UPCT for this content*

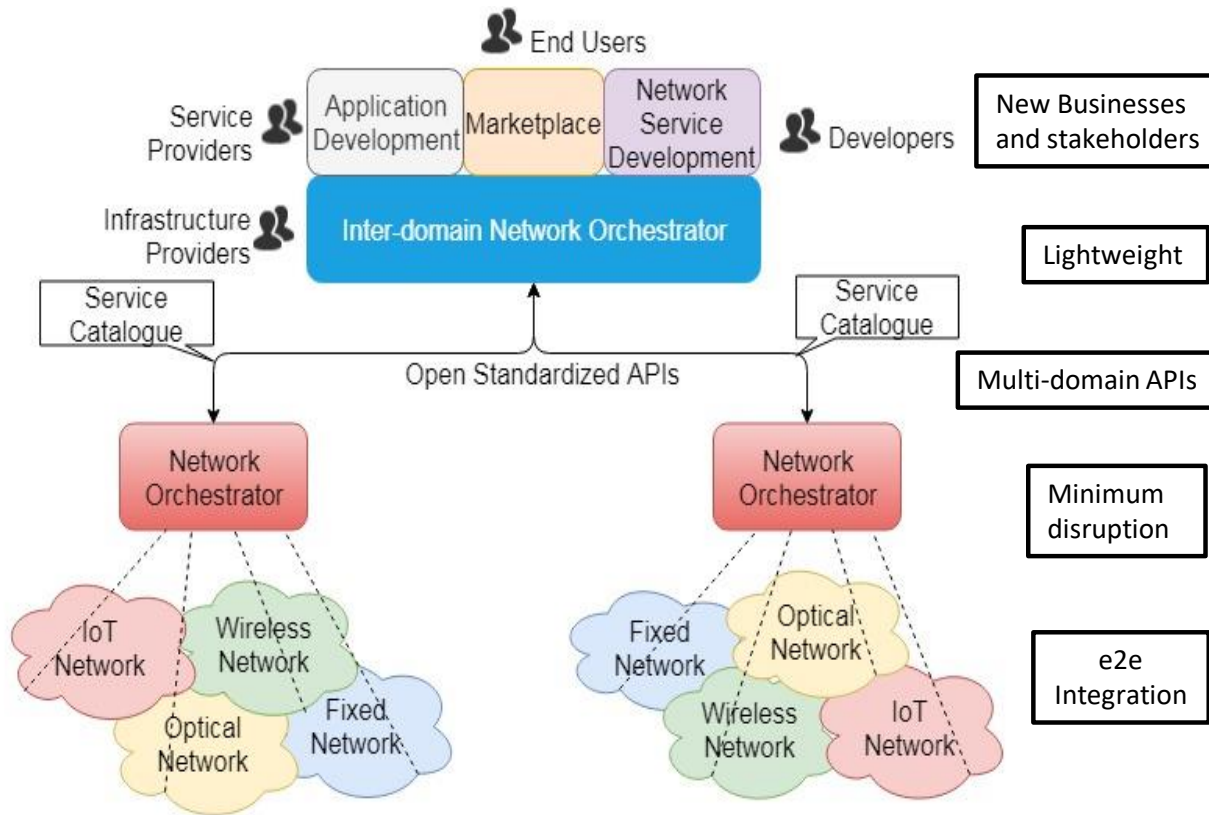


Net2Plan: Planning and placement in Metro-Haul



Metro-Haul Demos and role of OSM

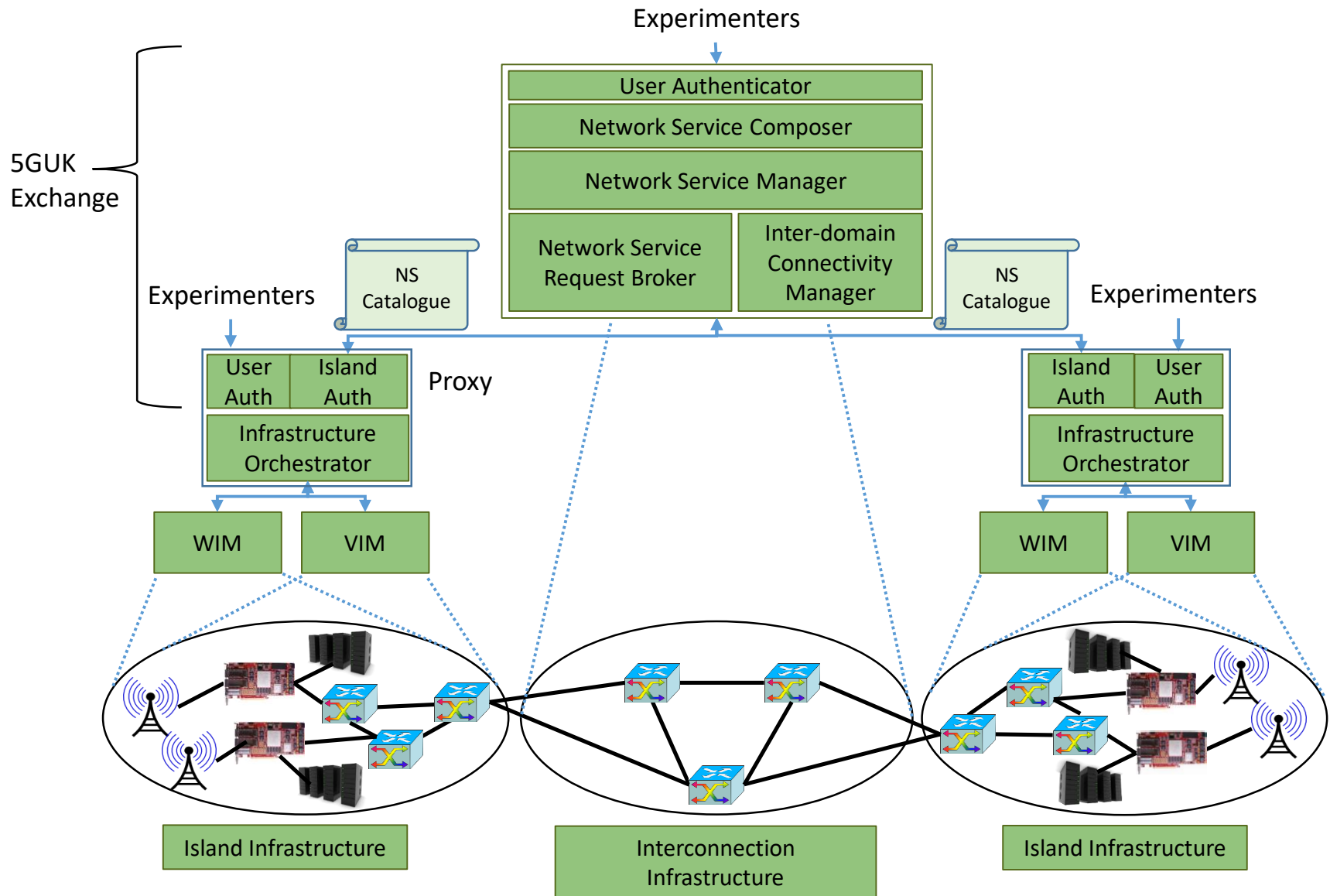
- ❖ Multi-site orchestration with OSM R5 over disaggregated optical networks:
 - ❑ Over the Metro, Core and Access Networks.
 - ❑ Over Optical network and devices.
 - ❑ Integration of Physical devices and distributed datacentres
 - ✓ WIM to integrate the Multi-DCs.
 - ✓ OSM R5 PNF Integration would potentially allow integration of FPGAs and other physical devices in the topology.
 - ❑ Disaggregated Optical Networks:
 - ✓ T-API Based WIM connector for underlying SDN Controller
- ❖ Slicing and PNF integration:
 - ❑ With WIM end-to-end L2 slicing can be done using VLANs.
 - ❑ OSM R5 Slicing Manager would be an interesting prospect to explore in Metro-Haul.
 - ❑ PNF integration(available in OSM R5) would be interesting to experiment with.



❖ 5GUK Exchange:

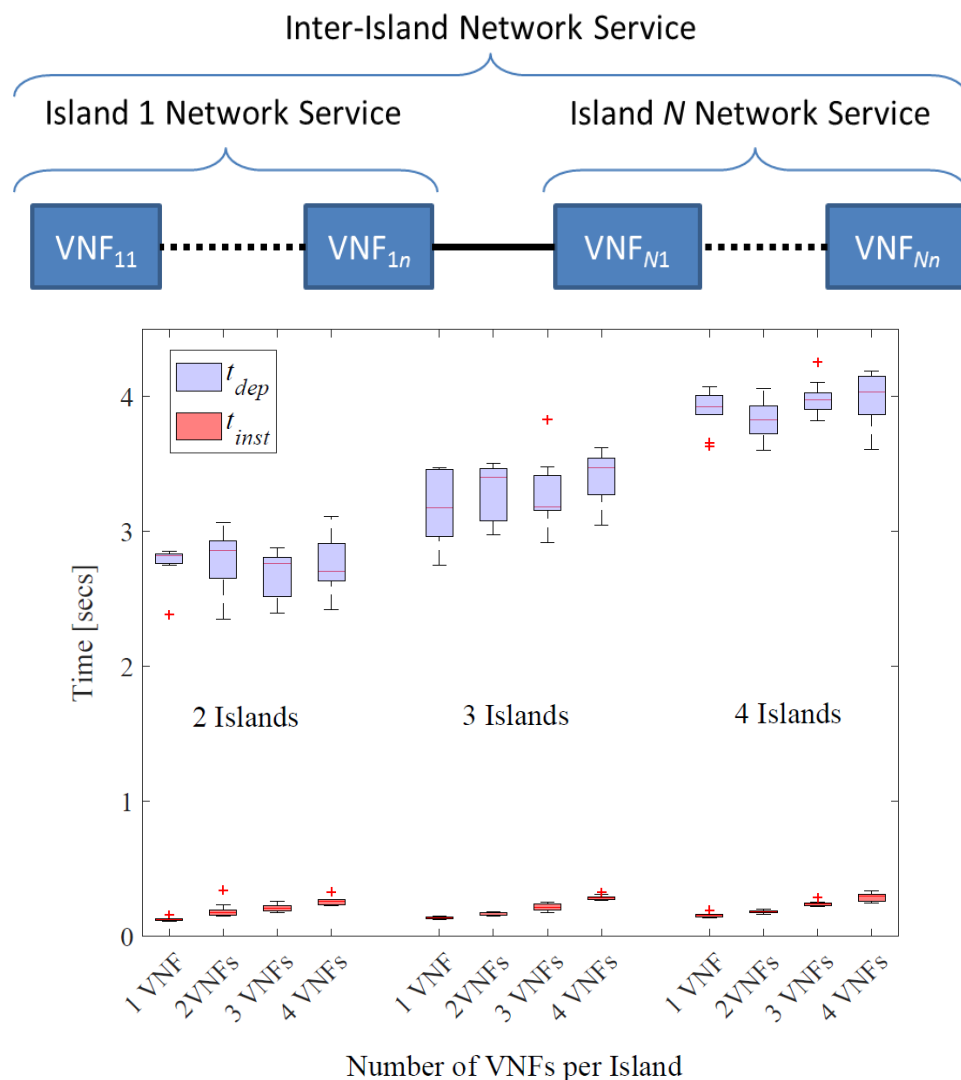
- ❑ Hierarchical architecture for end-to-end multi-domain orchestration and coordination
- ❑ Allow operators to maintain full control of their infrastructure and integrate using their existing MANO systems.
- ❑ Multi-domain API based on standardized models of MANO systems.
- ❑ Coordinate the end-to-end service orchestration and interconnection.

5GUK Exchange Architecture



- ❖ t_{inst} is the VNF instantiation time
- ❖ t_{dep} is the VNF deployment time
- ❖ In contrast to the activation time the t_{inst} and t_{dep} times are minimal.

Number of VNFs n per Island	Time till activation [sec]
27.10	1.04
43.25	1.40
64.66	2.24
89.59	1.56

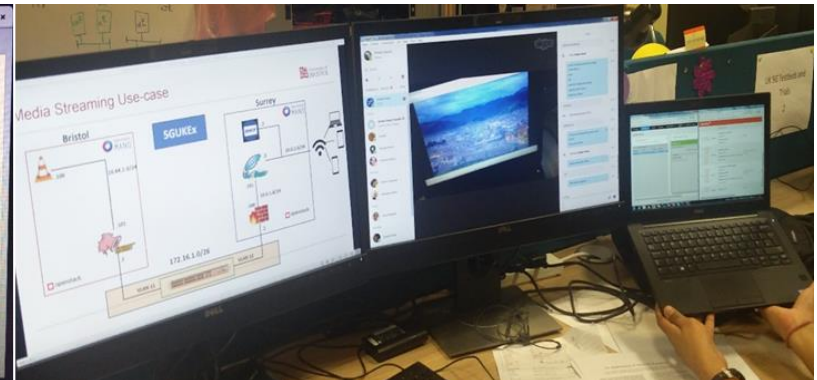


- ❖ Trials between two testbeds in U.K. Connected to the multi-domain framework using their MANO system

No Frame Loss

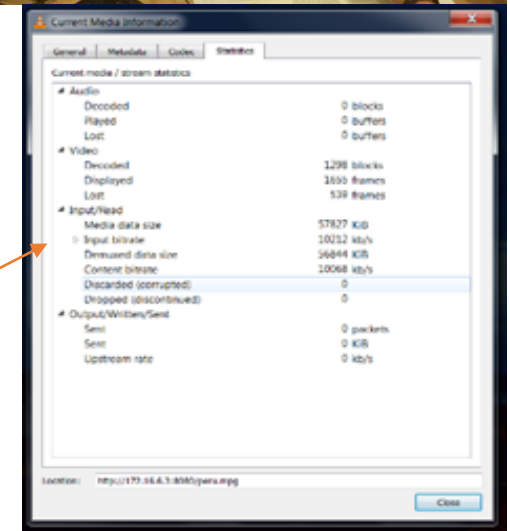


Current media / stream statistics	
Audio	
Decoded	0 blocks
Played	0 buffers
Lost	0 buffers
Video	
Decoded	4337 blocks
Displayed	4642 frames
Lost	0 frames
Input/Read	
Media data size	48080 Kib
Input bitrate	4909 Kib/s
Demuxed data size	47922 Kib
Container bitrate	5069 Kib/s
Discarded (corrupted)	0
Dropped (discontinued)	0
Output/Write/Sent	
Sent	0 packets
Sent	0 Kib
Upstream rate	0 Kib/s



- ❖ L2 Network Slicing- using VLANs
- ❖ 4K Video transmission
- ❖ All components run as virtualized functions.

High data rate



Current media / stream statistics	
Audio	
Decoded	0 blocks
Played	0 buffers
Lost	0 buffers
Video	
Decoded	1298 blocks
Displayed	1650 frames
Lost	539 frames
Input/Read	
Media data size	57827 Kib
Input bitrate	10032 Kib/s
Demuxed data size	56844 Kib
Container bitrate	10068 Kib/s
Discarded (corrupted)	0
Dropped (discontinued)	0
Output/Write/Sent	
Sent	0 packets
Sent	0 Kib
Upstream rate	0 Kib/s

❖ Monitoring framework

- ❑ To monitor Network and Compute KPIs for end-to-end system (using and extending OSM monitoring APIs).
- ❑ To provide an online system for end-to-end network view.

❖ Ecosystem based on OSM and other ETSI based MANO systems

- ❑ To allow interoperability and research platform.
- ❑ Interoperability study to support TOSCA based MANO systems.

❖ Trials on interconnecting multiple OSM based testbeds across UK

- ❑ Currently 4 testbeds (3 universities and 1 research lab) are interconnected with few more to join.
- ❑ Planned use-cases across multi-domain using OSM as the MANO solution.

Thank you and Acknowledgement



I would like to thank all the partners for the contribution.



<http://metro-haul.eu>

Other Projects/Research at HPN Lab (UoBristol)

