



## Multi-site orchestration of end-to-end 5G networks

The 5G EVE approach for the inter-working of multiple 5G experiment facilities

Francesco Lombardo, Matteo Pergolesi (CNIT)

#### Outline

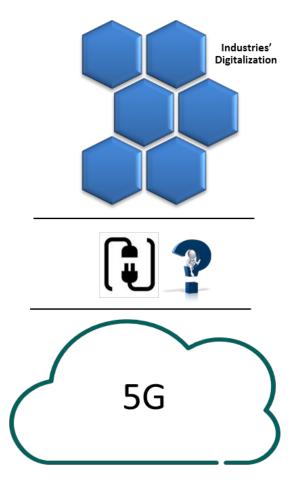


- The 5G EVE Project
- System architecture and trial sites
- Adaptation Layer
  - Multi-Site Catalogue SBI
  - MSO-LO interface
- Conclusion & Future Work

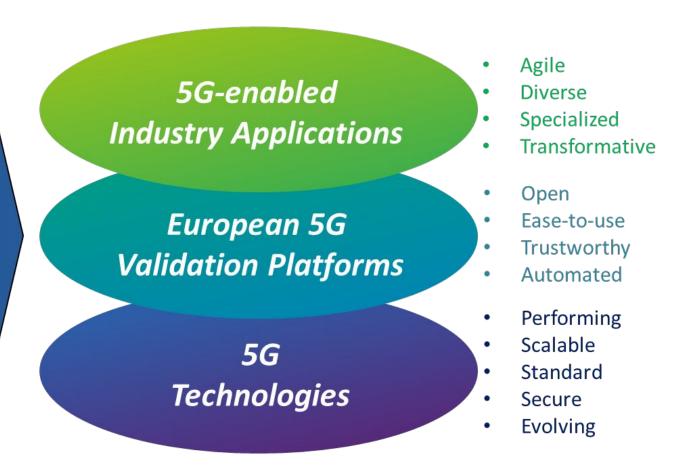
#### The 5G EVE vision



From: Two Worlds

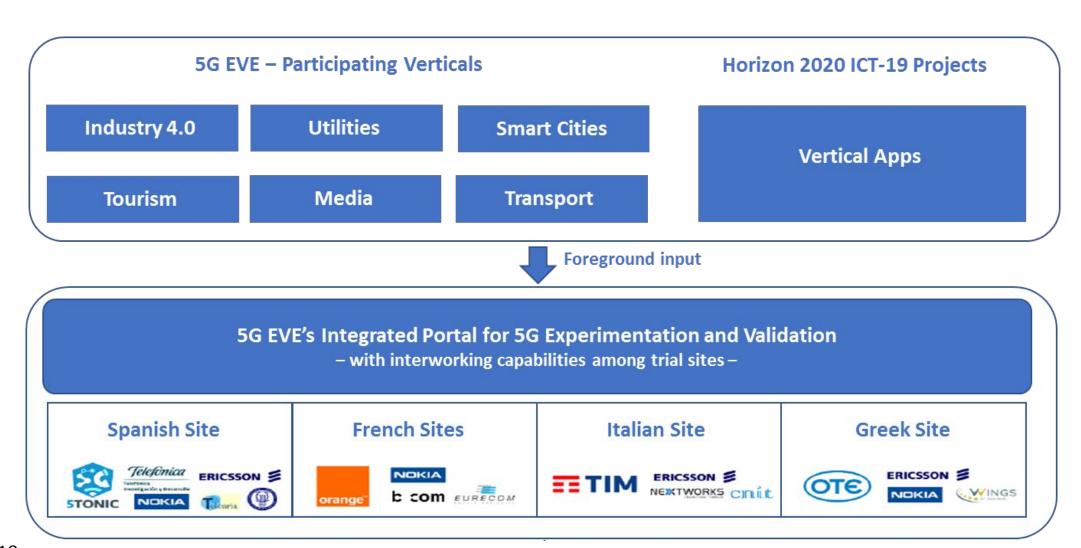


To: One Innovation Ecosystem



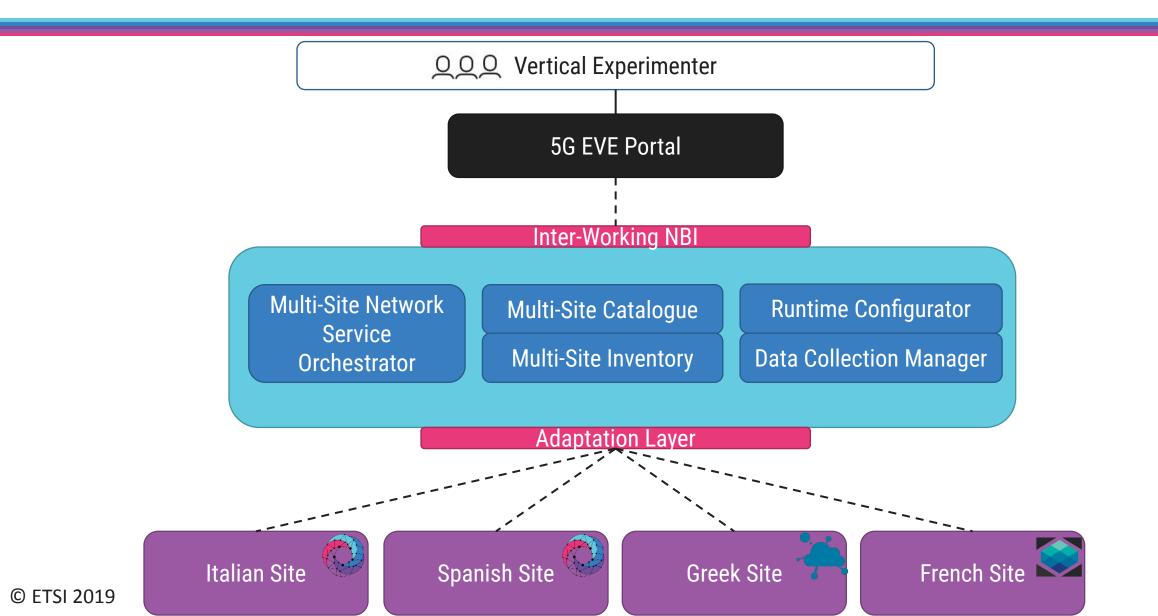
#### The 5G EVE platform





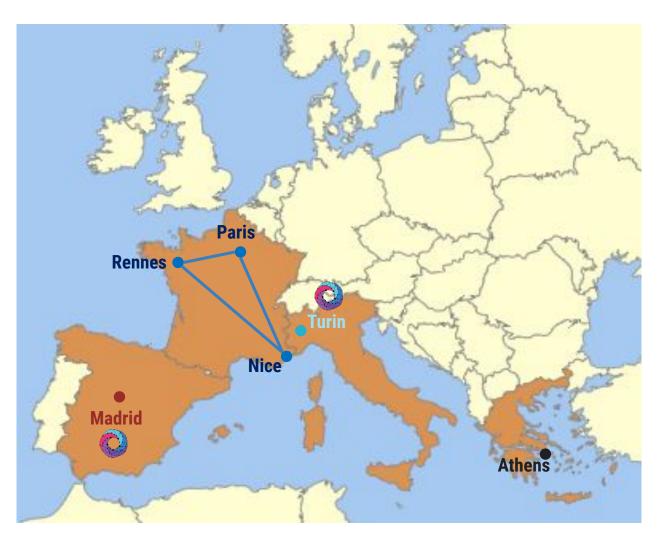
## System Architecture





#### Sites interconnection





 The 5G EVE site facility is composed of a cluster of sites facilities in several countries

#### France

- 4 nodes: Nokia Paris Saclay, b<>com Rennes, Eurécom Nice, Orange Paris
- Orchestrator: ONAP

#### Greece

- Athens with Ericsson, Nokia, Wings, OTE
- Orchestrator: commercial/proprietary

#### Italy

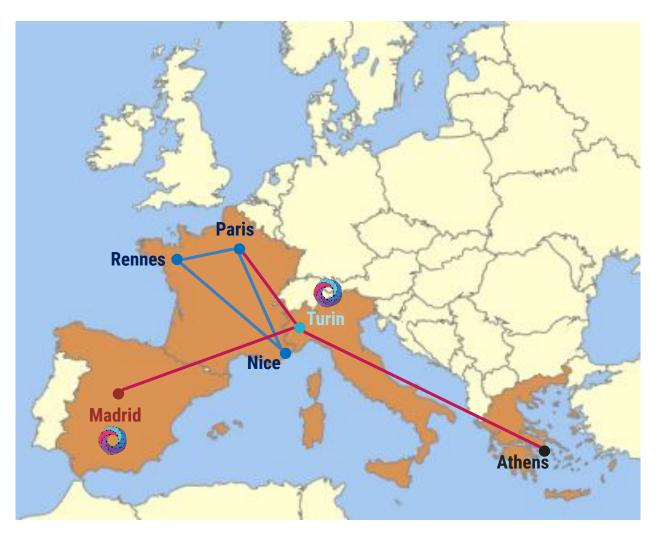
- Turin with Ericsson, Networks, A2T, CNIT, TIM
- Orchestrator: OSM, Ericsson

#### Spain

- Madrid with Ericsson, Nokia, UC3M, TID
- Orchestrator: OSM

#### Sites interconnection

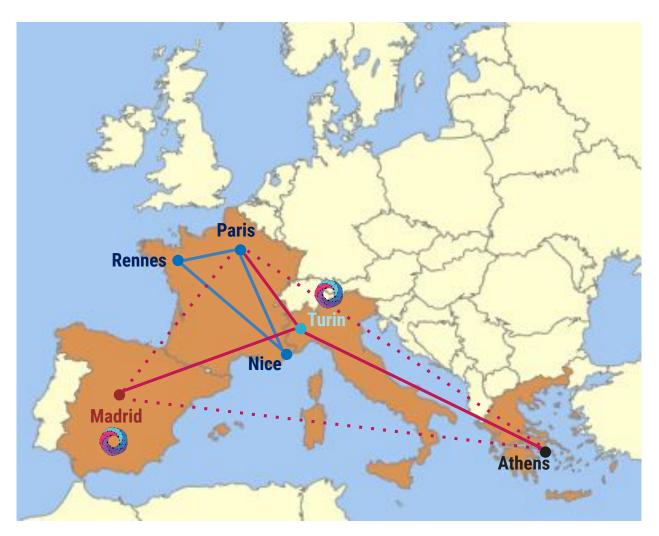




- Phase 1:
  - Star topology for both control and data plane
  - Center located in Turin
- Phase 2:
  - Star topology for control plane
  - Full or partial mesh for data plane
- Technology
  - S2S IPsec tunnels
  - routable private plan

#### Sites interconnection

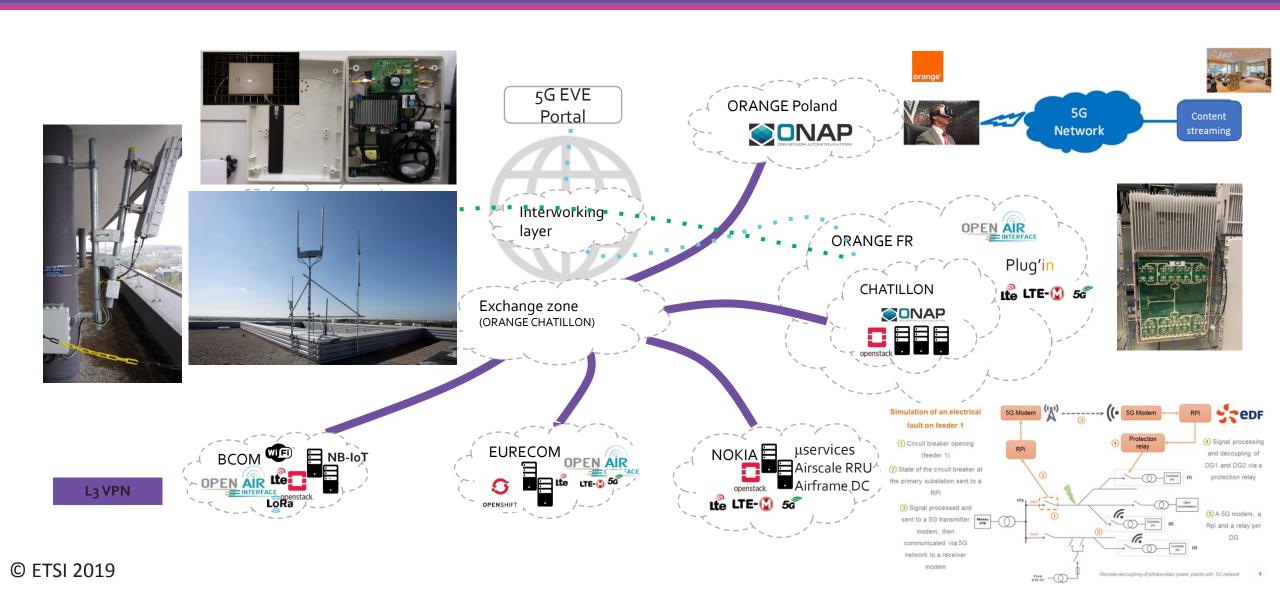




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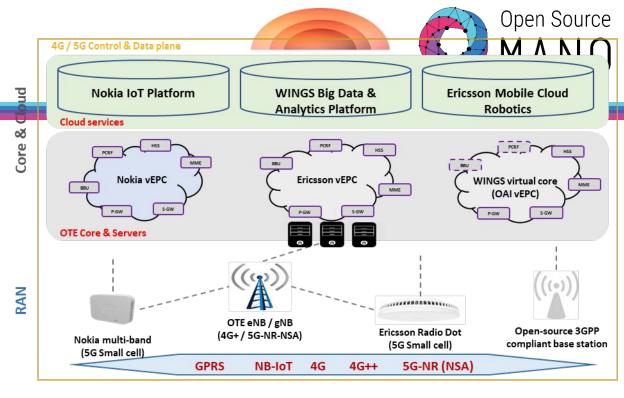
## French site facility

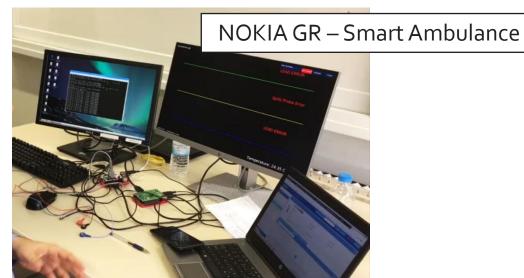




## Greek site facility





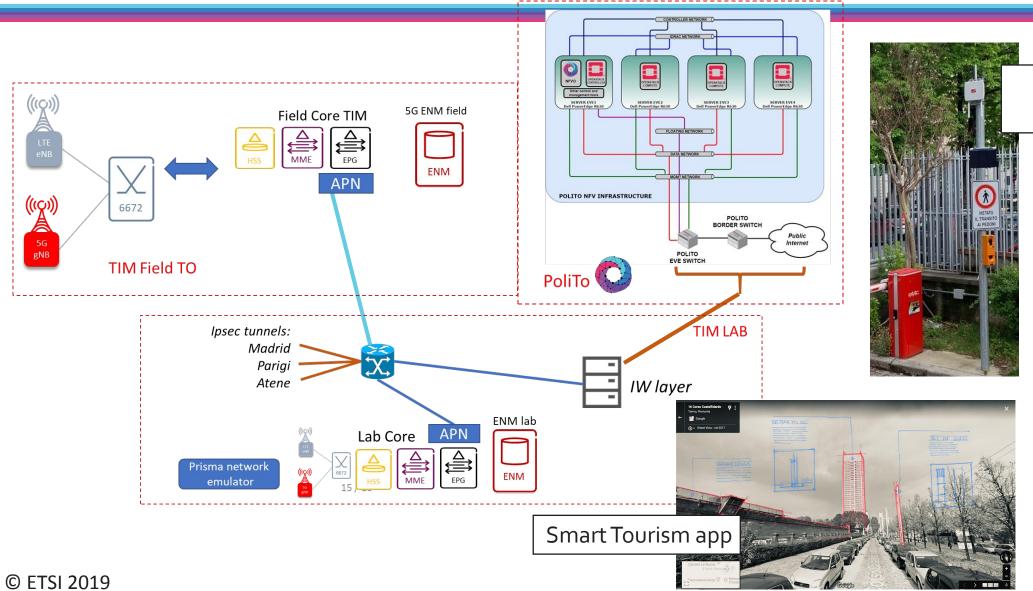




#### Italian site facility







Libellium WiFi Scanners

NSA 5G antennas

#### Spanish site facility

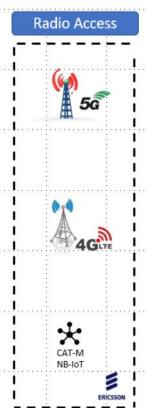


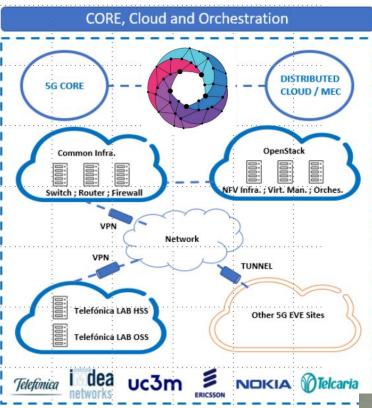




**VR/AR** Interaction









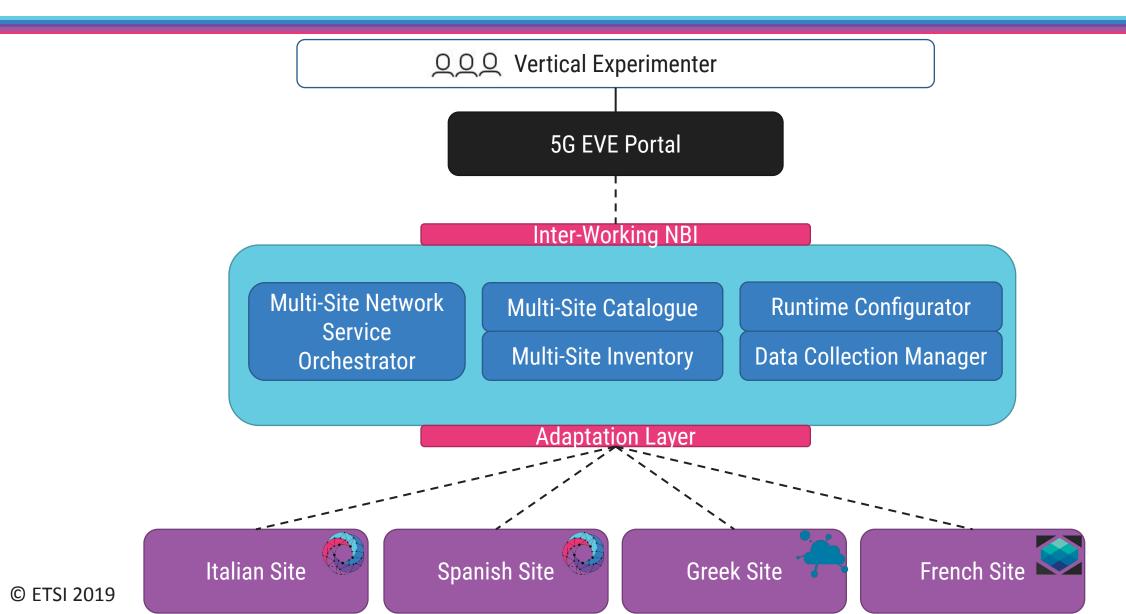






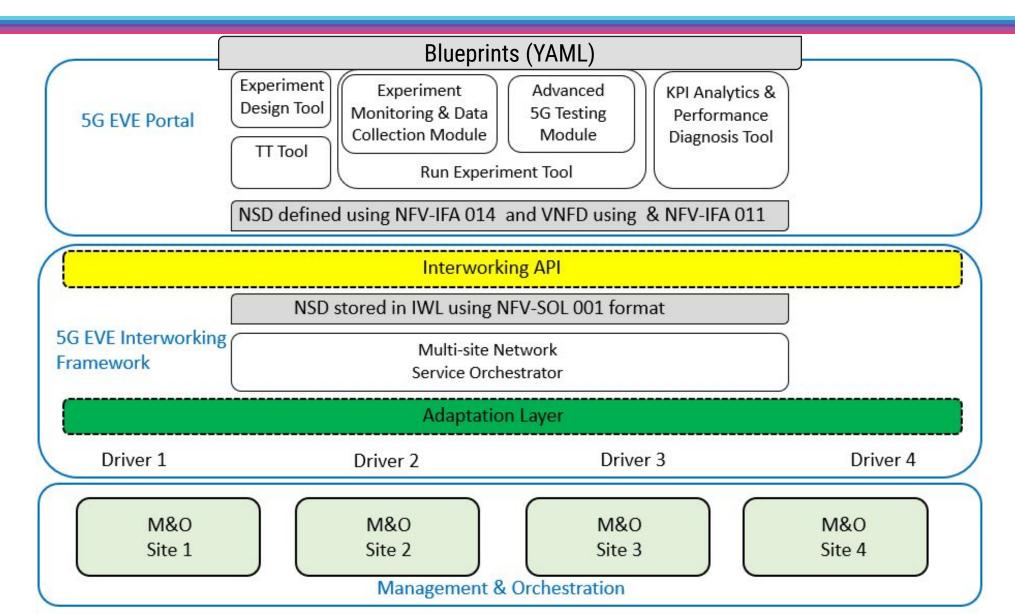
#### Inter-Working Layer components





## 5G EVE Inter-Working principles





#### Inter-Working Layer facts



- ETSI NFV compliant
  - VNFD, NSD: NFV-SOL 001
  - REST API interfaces: NFV-SOL 005



- To interact with local NFVOs we need:
  - Descriptors translation
  - API methods adaptation

## Multi-Site Catalogue

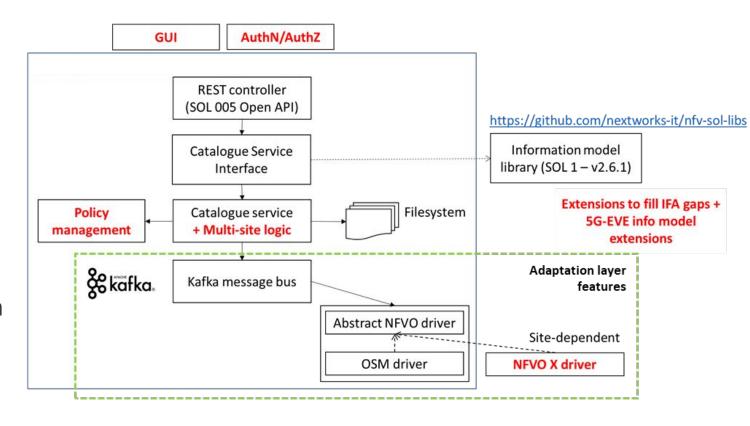


- Catalogue service for VNFDs, PNFDs and NSDs modelling single & multi-site experiments
  - Onboarding across multiple and heterogeneous per-site NFV catalogues
  - Standard, ETSI-compliant data models and APIs to address the fragmentation of per-site NFV MANOs
- Inter-working logic and procedures for automated multi-site catalogue population
  - Catalogues synchronization, to retrieve available NSDs and VNFDs from each site facility
  - VNF onboarding, for dynamic collection of new VNFDs on-boarded in the 5G EVE sites
  - VNF removal, for dynamic removal of VNFDs when VNFs are no longer available in the 5G EVE sites
  - NSD onboarding, to allow the 5G EVE portal to onboard new NSDs for single & multi-site experiments
  - **NSD removal**, to allow the 5G EVE portal to remove NSDs whenever single or multi-site experiments are no longer available in the 5G EVE platform

#### Multi-Site Catalogue prototype



- ETSI NFV SOL005 compliant REST API
- ETSI NFV SOL001 compliant data model
  - TOSCA NSDs, VNFDs, PNFDs
- Embedded inter-working adaptation features
  - NSDs, VNFDs, PNFDs translation
    - TOSCA <-> per-site NFVOs data models
    - Mapping of IDs for multi-site orchestration
  - Adaptation to per-site NFVOs catalogue REST APIs
    - OSM driver for R3, R4, R5, R6
    - Planned ONAP driver



code available at: <a href="https://github.com/nextworks-it/5g-catalogue/tree/v3.0">https://github.com/nextworks-it/5g-catalogue/tree/v3.0</a>

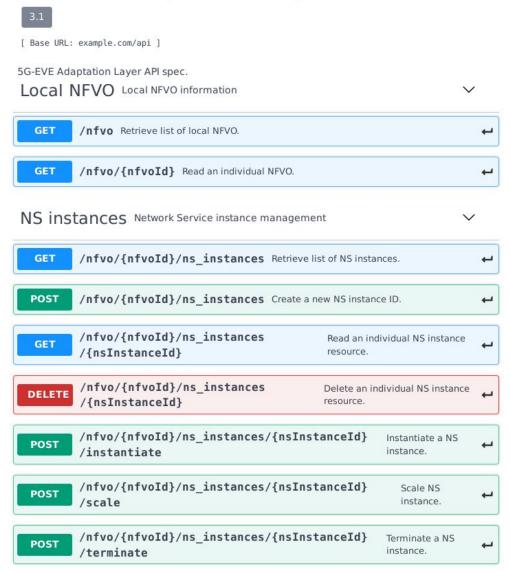
#### MSO-LO interface



## REST API inspired by SOL 005 with

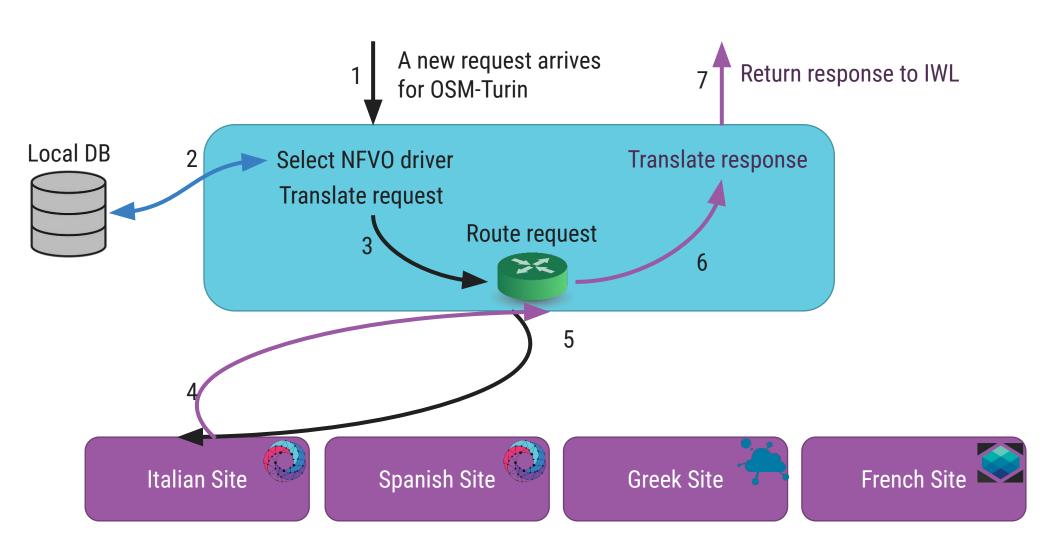
- Operations to retrieve information about local NFVOs registered with the 5G EVE platform.
- Operations to retrieve, create, instantiate, scale, terminate, and delete NS instances.
- Operations to retrieve, create, and delete subscriptions to notifications about the status of one or more NS instance.

#### 5G-EVE Adaptation Layer API



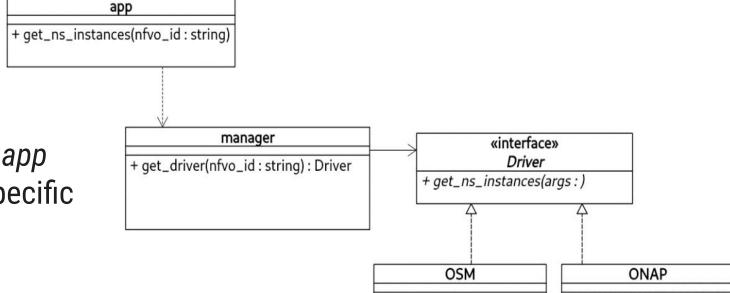
#### MSO-LO interface





#### MSO-LO interface





+ get\_ns\_instances(args:)

+ get\_ns\_instances(args:)

- Factory method design pattern: the app module stays separated from the specific driver implementation
- The *Driver* abstract class realizes a contract for the driver implementation

#### Conclusion & Future Work



- Easy-to-use, intent-based blueprints for describing services and experiments
- Realization of an open VNF framework
- Multi-domain orchestration and slicing
- Contribution to ETSI standards
- Contribution to OSM compliance

# Thank you! Any questions?

https://www.5g-eve.eu/





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## The 5G EVE Project



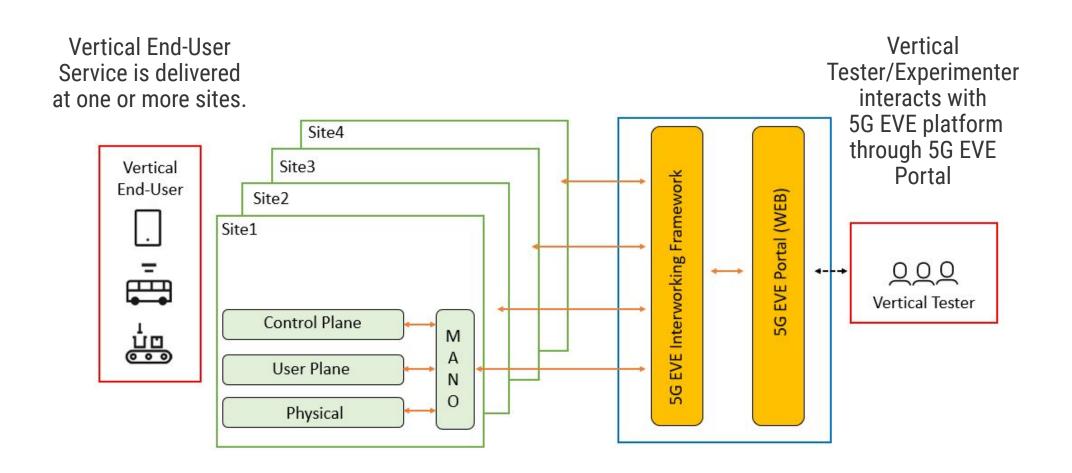




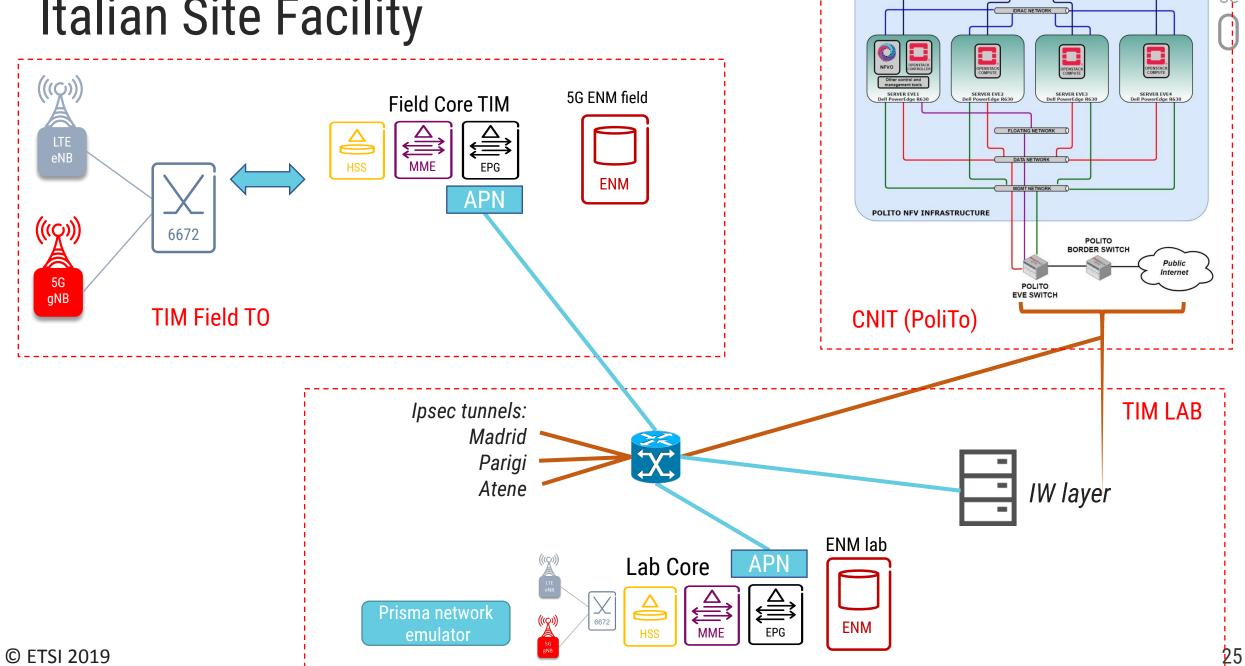
Title	5G EVE 5G European Validation platform for Extensive trials
Horizon 2020 - Call	H2020-ICT-2017
Start date	1/7/2018
Duration	36 Months
Website	https://www.5g-eve.eu/
Social	<u>@5G_EVE</u>

#### Platform architecture



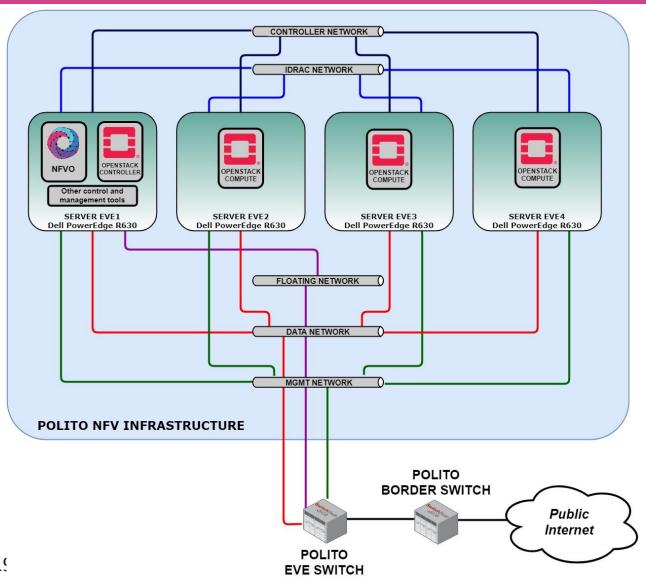


## Italian Site Facility



## Italian Site Facility



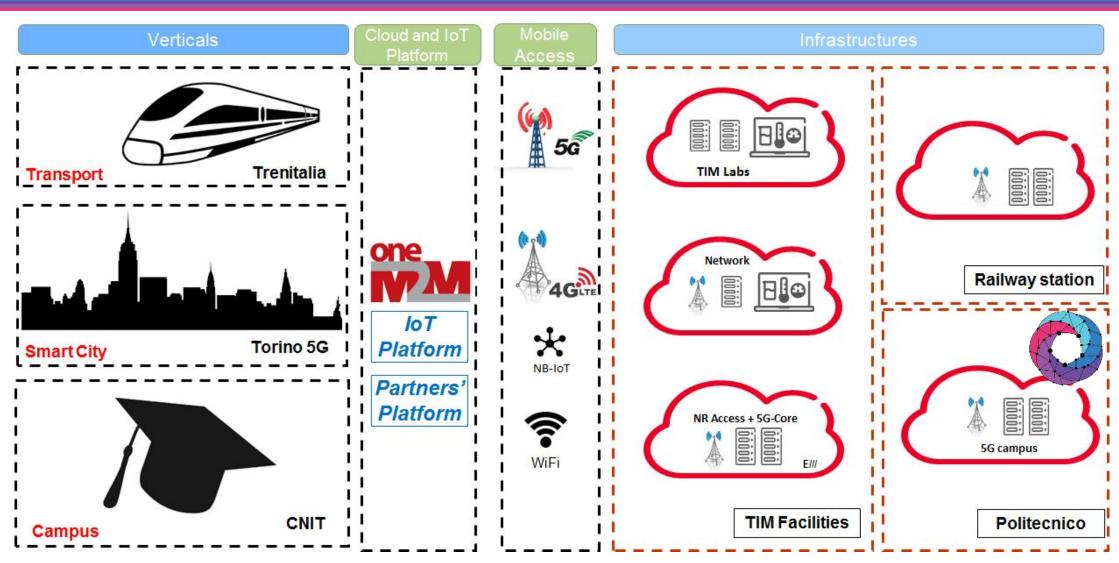


#### Four physical servers available

- 3 Openstack compute nodes
- 1 dedicated for control/management
  - NFV Orchestrator: OpenSource MANO
  - Openstack controller

## **Italian Site Facility**





#### Spanish Site Facility







