5G-VICTORI verticals experimented in Romania on top of open-source 5G platforms

VertIcal demos over Common large scale field Trials fOr Rail, energy and media Industries

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Cristian Patachia

European Commission
Horizon 2020
European Union funding
for Research & Innovation
5G PPP

Agenda

- **ORO innovation ecosystem**
- **Key objectives of 5G-VICTORI and innovations**
- **5G-VICTORI use cases**
- **5G-VICTORI RO use cases supported by Mosaic5G**
- **FR/RO Cluster facility implementation and planning**

theother
capital
ALBA
IULIA
WELCOME TO
THE LARGEST CITADEL
IN ROMANIA

MATILDA

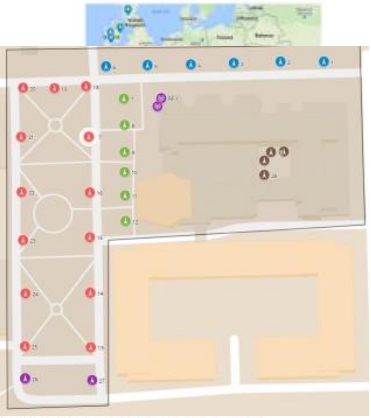
Physical Network Functions

- Networking
- Firewalls
- Load Balancers
- Physical BNG

Virtualized Infrastructure

- Control Node
- Compute Nodes
- Shared Storage

SLICENET



UNICORE

Wireless 5G vRAN Network Function Virtualisation	vCPE – Network Function Virtualisation	vBNG – BNG Network Function Virtualisation
Scope	**Scope**	**Scope**
Move VNFs to Unikernels: -4G/5G vRANs -MEC Apps	Dynamically provision network components and services to customers	Move current monolithic BNG to Unikernels
ORO Exploitation: 5G RAN	**ORO Exploitation: VHBB/B2C**	**ORO Exploitation: VHBB/B2B**
-Better HW resources management -Better Power Consumption -Higher Efficiency in compute nodes -Improved MEC deployments	-Fast deployment of vCPEs (minutes versus days/weeks) -Fast, secure and cheap deployment of services to customers	-Run each PPPoE session in an isolated, secure unikernel -Performance and efficiency substantial increase -Better power consumption -Better HW resources management

5G-VICTORI

UC1: Digital transportation
On-demand network creation for emergency services

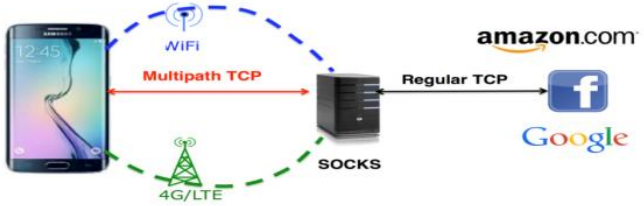
UC2: Smart energy metering

Facilitate the smart energy operation on Low Voltage circuits

5G-EVE

5G Track for start-ups & academia

4.5G service based on MPTCP



RESISTO

NEXES

5G-VI
ICT-19

5G Open Lab & Bucharest

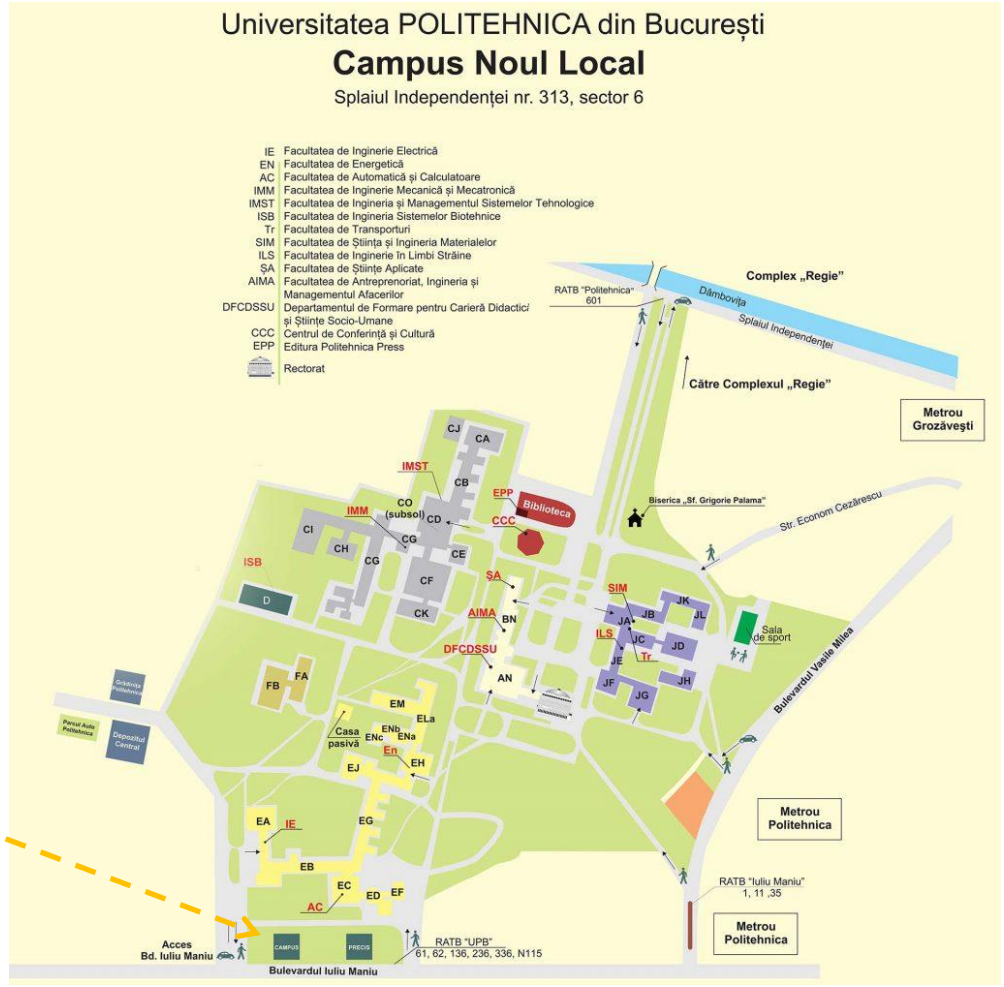
managing use cases to prove 5G and IoT benefits

PoC definition, validation, deployment and monitoring

infrastructure and engineering team

support for performance evaluation

Horizon Europe collaboration



Launch Orange 5G Open Lab in collaboration with Politehnica University of Bucharest to target academic research labs, start-ups, SMEs and large companies that design, develop and use innovative 5G services and solutions.

Location: UPB Research Center CAMPUS (Center for Advanced Research on New Materials, Products and Innovative Processes)

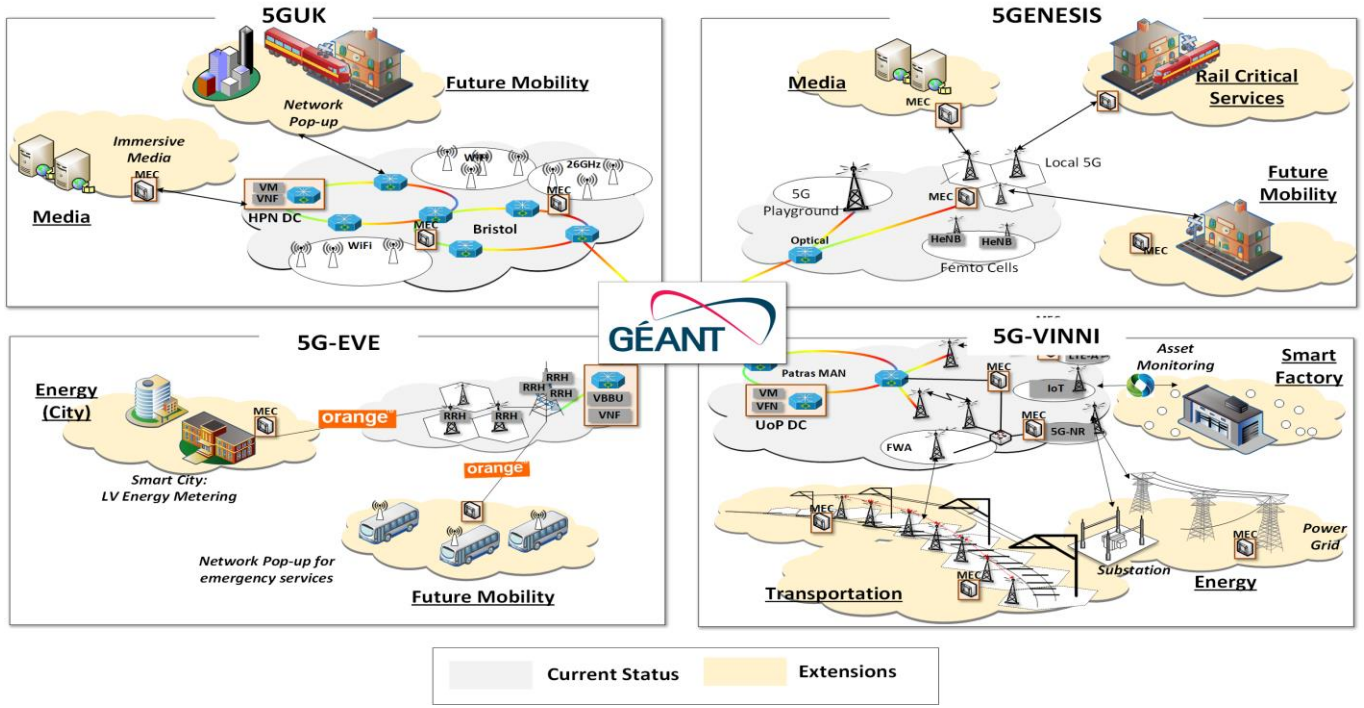
Key objectives of 5G-VICTORI

- Design and prototype an open 5G infrastructure capable of instantiating and co-hosting various vertical sectors
- Integration of commercially relevant, operational environments required for the demonstration of the large variety of 5G-VICTORI vertical and cross-vertical use cases
- Transform current closed, purposely developed and dedicated infrastructures into open environments where resources and functions are exposed to the telecom and the vertical industries through common repositories

5G-VICTORI Concept

- 5G-VICTORI ***interconnects main sites of all ICT-17 infrastructures***, i.e. **5G-VINNI, 5GENESIS and 5G-EVE** and the ***5G UK test-bed*** in a ***Pan-European Network Infrastructure***
- The 5G-VICTORI platform aims to ***transform*** current ***closed, purposely developed and dedicated infrastructures*** into ***open environments***
- 5G-VICTORI is developing a ***thin inter-domain orchestration layer*** on top of the orchestration solutions of the individual facility sites
- 5G-VICTORI is also developing an ***open data management platform*** for ***scalable data collection, aggregation and processing*** across the various project infrastructure sites

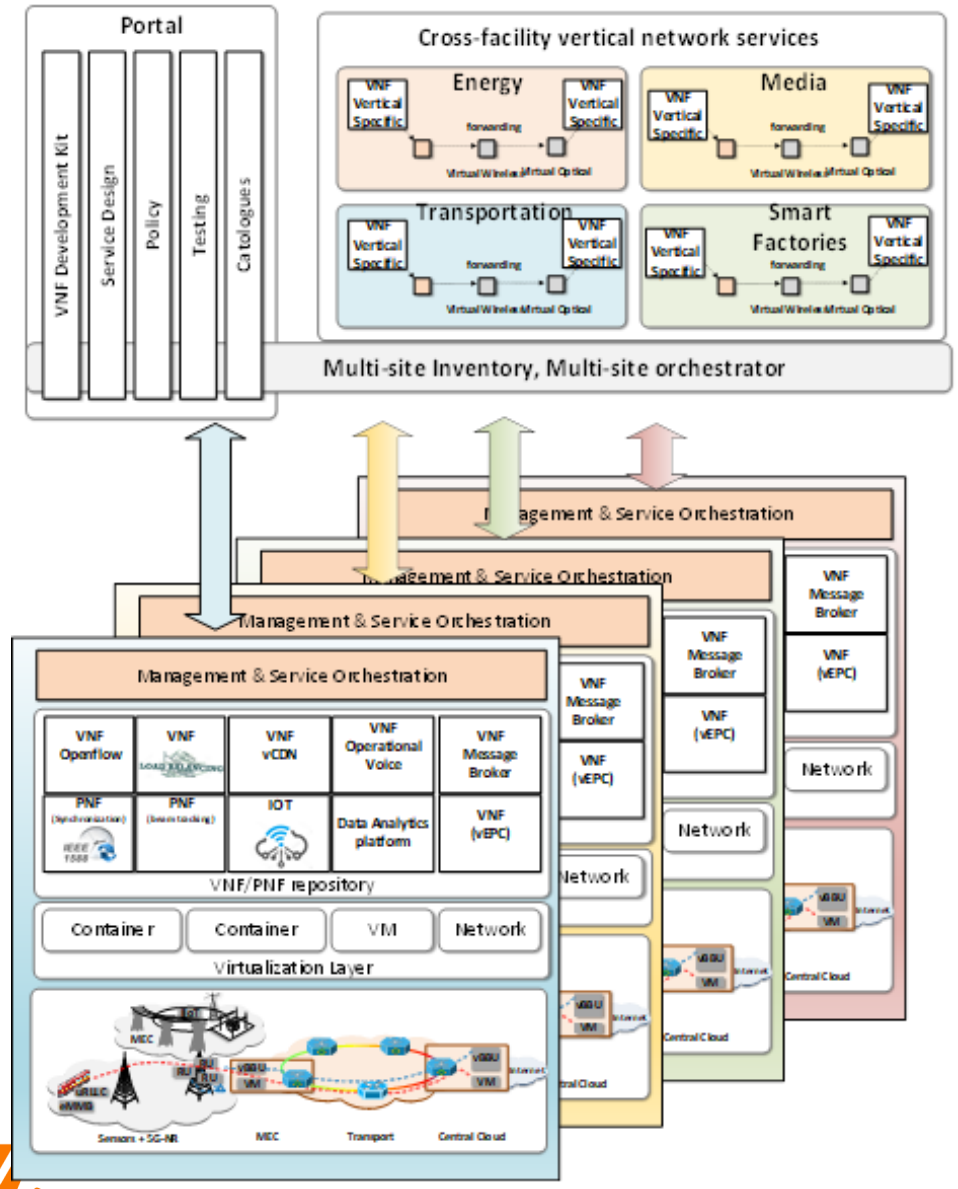
5G-VICTORI facility sites

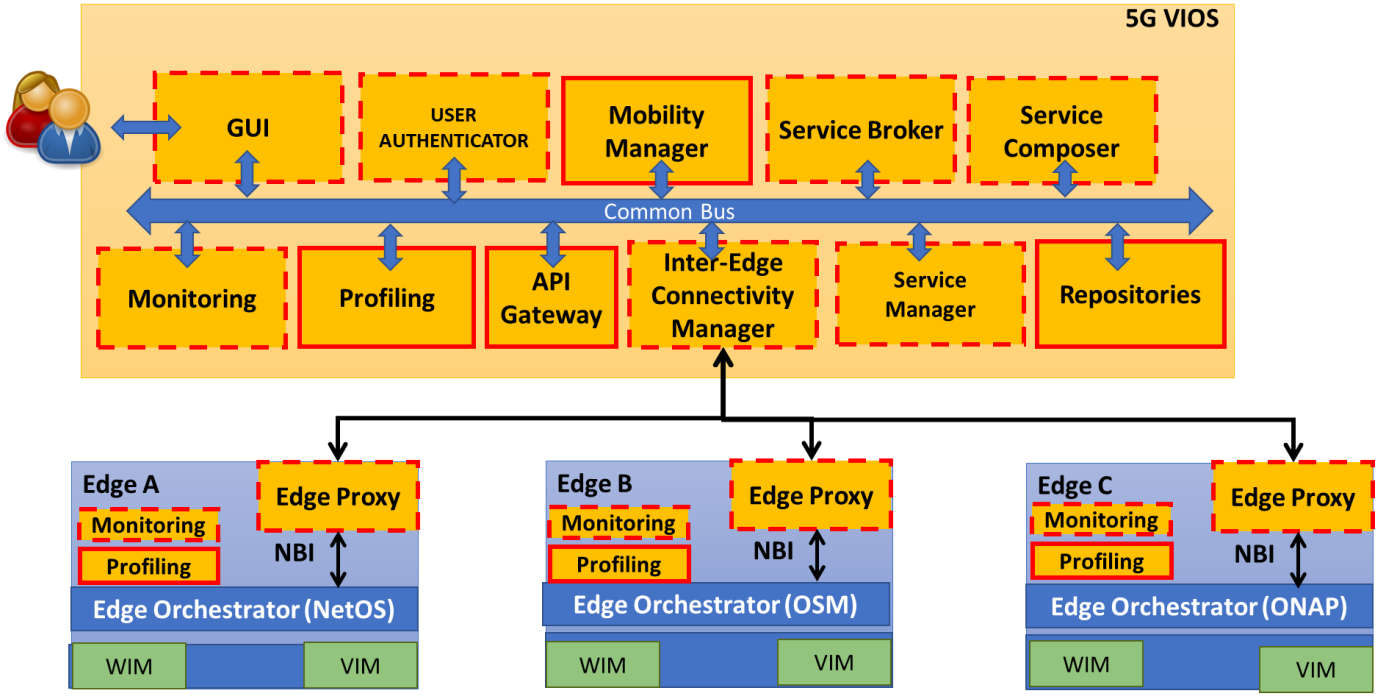


Exploit extensively the existing **ICT-17 5G infrastructures** **interconnecting main sites of all ICT-17 infrastructures:**

- **5G-VINNI, 5GENESIS and 5G-EVE** and the **5G UK test-bed**
- provide **minor enhancements of existing infrastructures** for the demonstration of the vertical and cross-vertical use cases

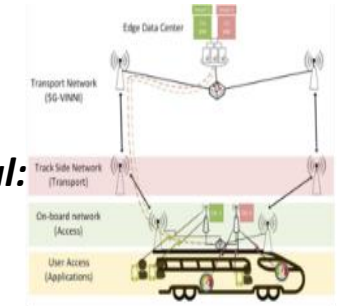
5G-VICTORI Functional Architecture



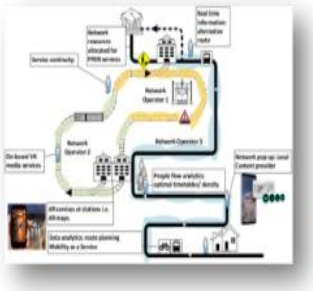


5G-VICTORI Key Innovations Vertical

- *"Enhanced Mobile broadband under high speed mobility"*, ***Vertical: Transportation – Rail .***
- *"Digital Mobility"*, ***Cross-Vertical - Transportation and Media***.
- *"Critical services for railway systems"*, ***Vertical: Rail.***
- *"Smart Energy Metering"*, ***Cross-Vertical: Energy and Rail***.
- *"Digitization of Power Plants"*, ***Vertical: Smart Factory***.
- *"CDN services in dense, static and mobile environments"*, ***Cross-Vertical: Media and Transportation.***



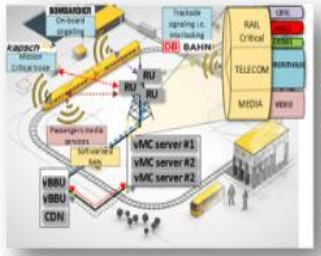
Transportation
Enhanced mobile broadband under high speed mobility in Rail environments



Transportation
Digital Mobility

Transportation
Immersive media

Transportation
Network creation for emergency services



Transportation
Critical services for railways system

Factories of the Future
High density massive connections

Media Use Case
CDN services in dense, static and mobile environments,

Energy Metering
Use case Energy Metering for HV & LV

03/12/2019

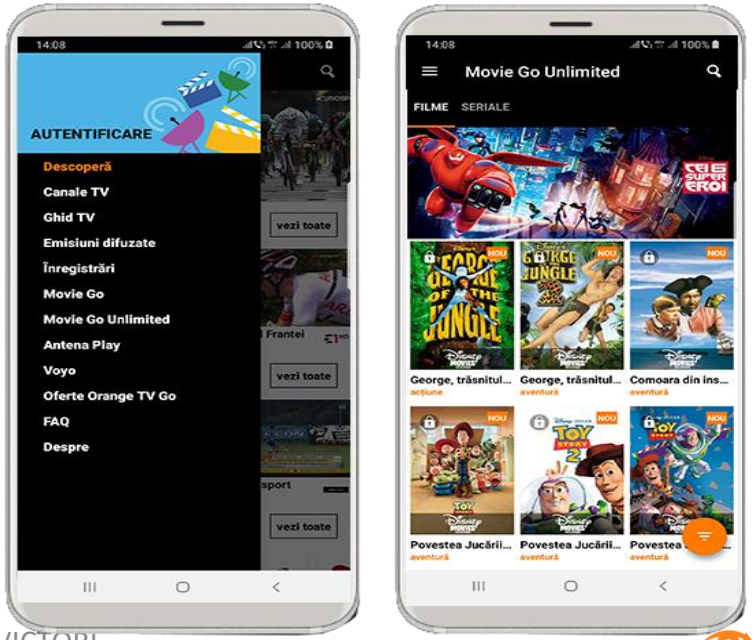
5G-VICTORI
RO use cases supported by Mosaic5G

Media service use case 5G-EVE – Alba Iulia App1:

Infotainment/ video services in dense, static and mobile environment

Real time infotainment services will be delivered displaying municipality information and public interest: surveys, alerts, tourist information. The captive portal will be connected through 5G infrastructure to the AIM public traffic management center for real-time communication.

1. captive portal services: authentication, surveys conducted by AIM, links to download specific mobile apps, general information about the city and its landmarks
2. video services: content available from YouTube or Orange TV Go mobile app (or similar app)



Status & next steps:

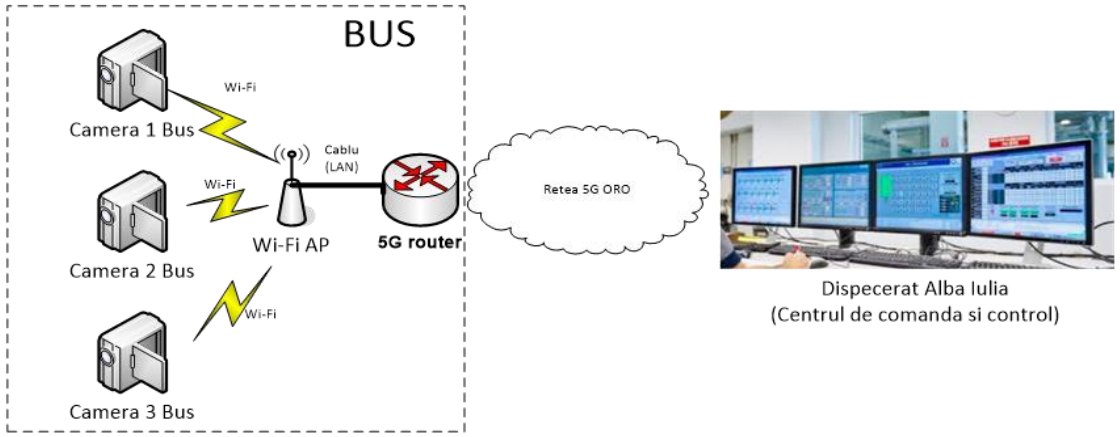
- *test bed components, configuration and test scenarios evaluation*
- *site survey to determine facility requirements (devices locations, radio sites deployments, radio design and coverage)*
- portal application deployment
- E2E infrastructure deployment (including 5G-EVE integration)
- UCs demonstrations at RO/Alba Iulia facility

Media service use case 5G-EVE – Alba Iulia App2:

AI recognition and identification of emergency situation

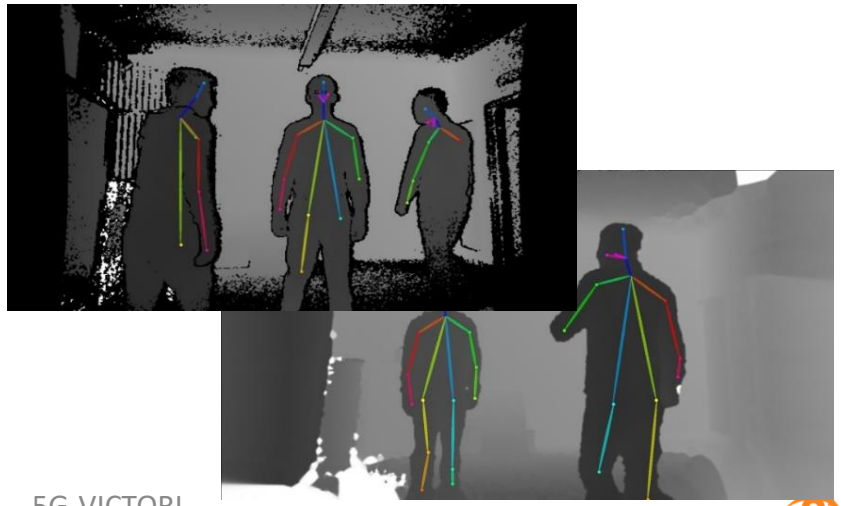
In depth assisted pose estimation through different convolutional neural net models, and training data sets for recognition and identification of emergency situation.

1. face recognition algorithm running on 5G MEC are used to analyze collected images from CCTV camera(s) installed in the public buses
2. track events on board and routes of public buses via the CCTV video feed. Trigger alerts in case of threats or driving events and send to Command and Control Center



Status & next steps:

- *test bed components, configuration and test scenarios evaluation*
- *public transport surveys for use case infrastructure deployment/equipment acquisition*
- trial test (limited functionalities)
- E2E infrastructure deployment (including 5G-EVE integration)
- surveillance application deployment



Media service use case 5G-EVE – Alba Iulia App3:

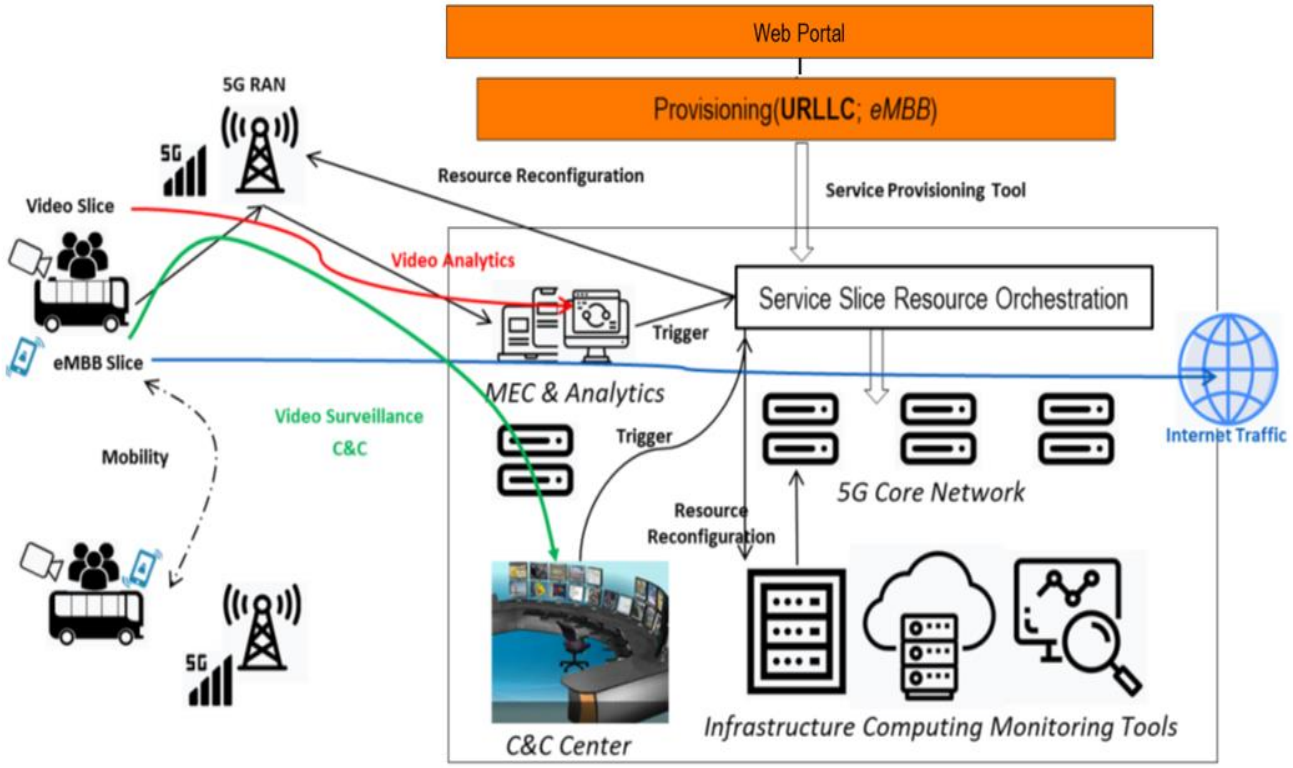
Prioritized communication to command and control center

Public safety critical service - allocating on the spot the appropriate requested resources as a new dedicated slice over 5G infrastructure, triggered emergency situation detected with AI scenario (thefts/healthcare emergency/lost items)

1. end to end slice prioritization over 5G infrastructure, triggered by emergency situation detected with AI use case (thefts/healthcare emergency/lost items)

Status & next steps:

- *use case network service design*
- *test bed components, configuration and test scenarios evaluatio*
- *network capabilities and coverage UC compliance test*
- lab testing and initial validation of services per UC
- configure and validate the network services and slices, blueprint
- E2E infrastructure deployment (including 5G-EVE integration)



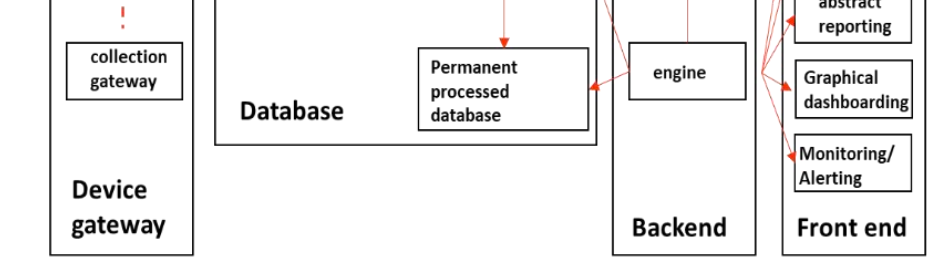
Energy metering usecase-5G-EVE-Alba Iulia- App1:

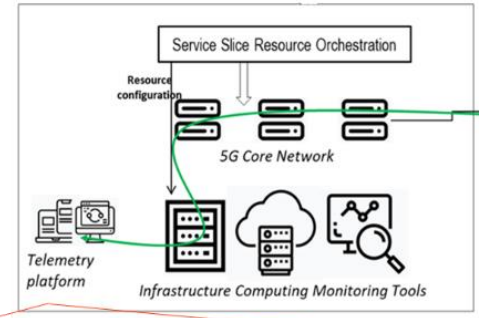
Real-time LV energy metering services for designated points of interests

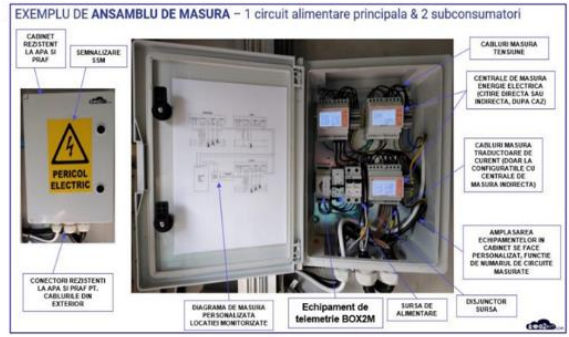
Metering data collection from endpoints scattered across a city up to 10k devices per 10 km2. Collected measurements will be transferred to the 5G-VICTORI central cloud facilities to be stored, processed and analyzed by the telemetry platform.

1. real-time LV energy metering sensors data logging from AIM sites
2. data sensor collection consistency - 5G platform end to end connectivity test

UC's will be demonstrated over the 5G-EVE infrastructure providing energy metering services for energy consumers like public buildings and street lighting in the Alba Iulia.







LV energy metering device

Status & next steps:

- *Site survey to evaluate facility requirements - ORO/AIM*
- Metering deployment application
- E2E infrastructure deployment including 5G-EVE integration
- UCs demonstrations at RO/Alba Iulia facility

Energy metering usecase-5G-EVE-Alba Iulia App2:

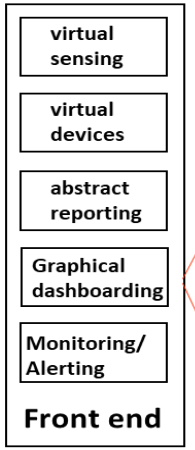
Energy Analytics for predictive and proactive maintenance for designated points of interest

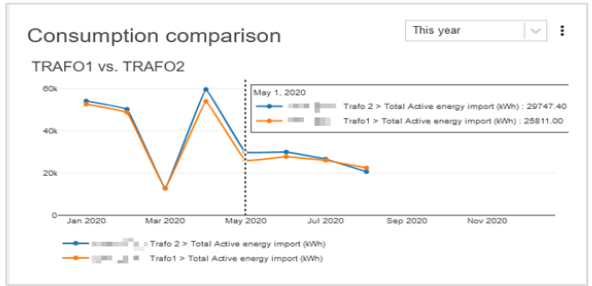
Energy analytics application development for real time & historical view and reporting of status and parameters, real time energy audit & potential fraud detection. Advanced reports about usage, running cycles & times, operational status for AIM LV devices will be developed.

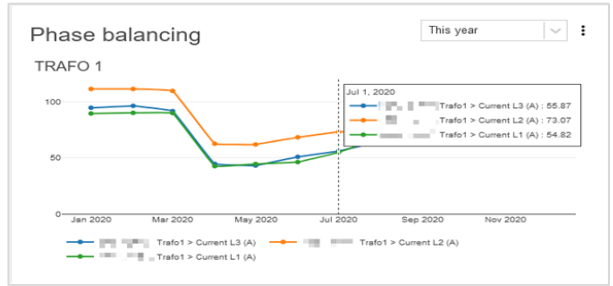
1. Graphical visualization and reporting based on LV energy sensor collected data
2. Alerting events and incidents real time trigger, based on measured parameters and predefined threshold
3. Data analysis, prediction and profiling based datasets gathered from LV energy devices deployed on AIM premises

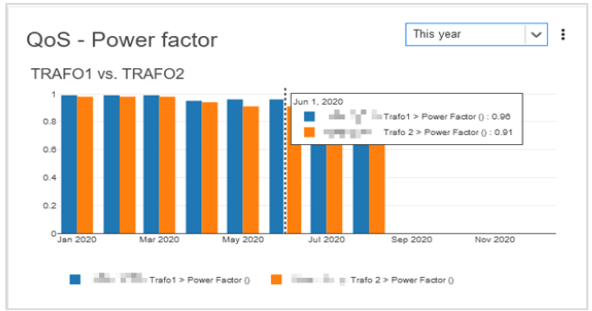
Status & next steps:

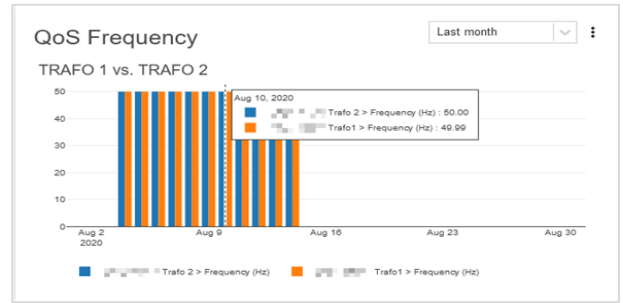
- *site survey to evaluate facility requirements - ORO/AIM*
- lab testing and initial validation of services per UC
- platform analytics deployment
- on-board application, test trial











FR/RO Cluster Facility Implementation and Planning

FR/RO Cluster Facility Planning (I)

Short summary what has been achieved so far

- FR/RO facility stems from 5G-EVE cluster located in France
- Cluster support UC#1.2 and UC#4.2
  - **OpenAirInterface(5G software alliance), Mosaic-5G, ONAP**
- 5G-EVE capabilities extension to Romanian cluster
- Infrastructure requirements definition(hardware and software)
- cluster facility planning and preliminary execution timeline

Use Cases and Apps

- UC # 1.2: Transportation, a critical service application that addresses URLLC feature requirements.
- UC # 4.2: Low Voltage (LV) energy metering UC, addressing mMTC capabilities

Time Plan & Next Steps

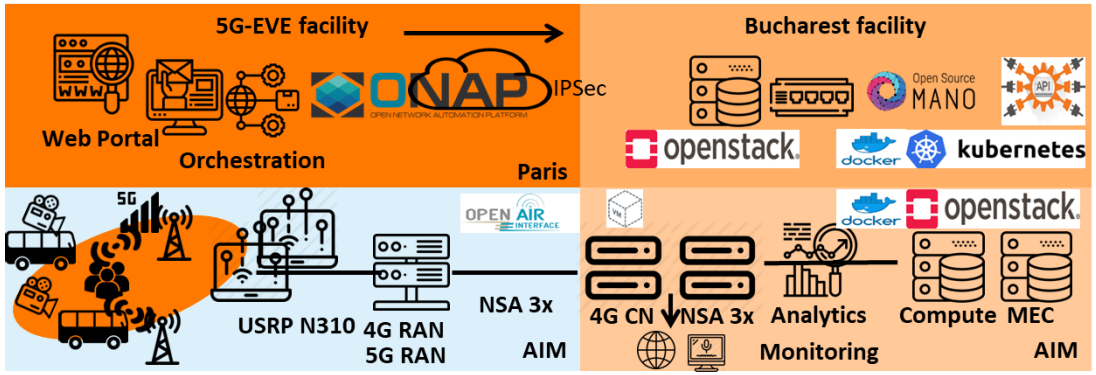
1. Plan activity (Agreed by 5G-EVE consortium) 2. Features and Requirements capture 3. Site survey 4. Procurement process	Done
5. 5G NSA Option 3x LAB validation 6. Network slice design 7. Install and commission additional network entities 8. Configure and validate the network slices 9. Infrastructure testing and use case validation	Ongoing

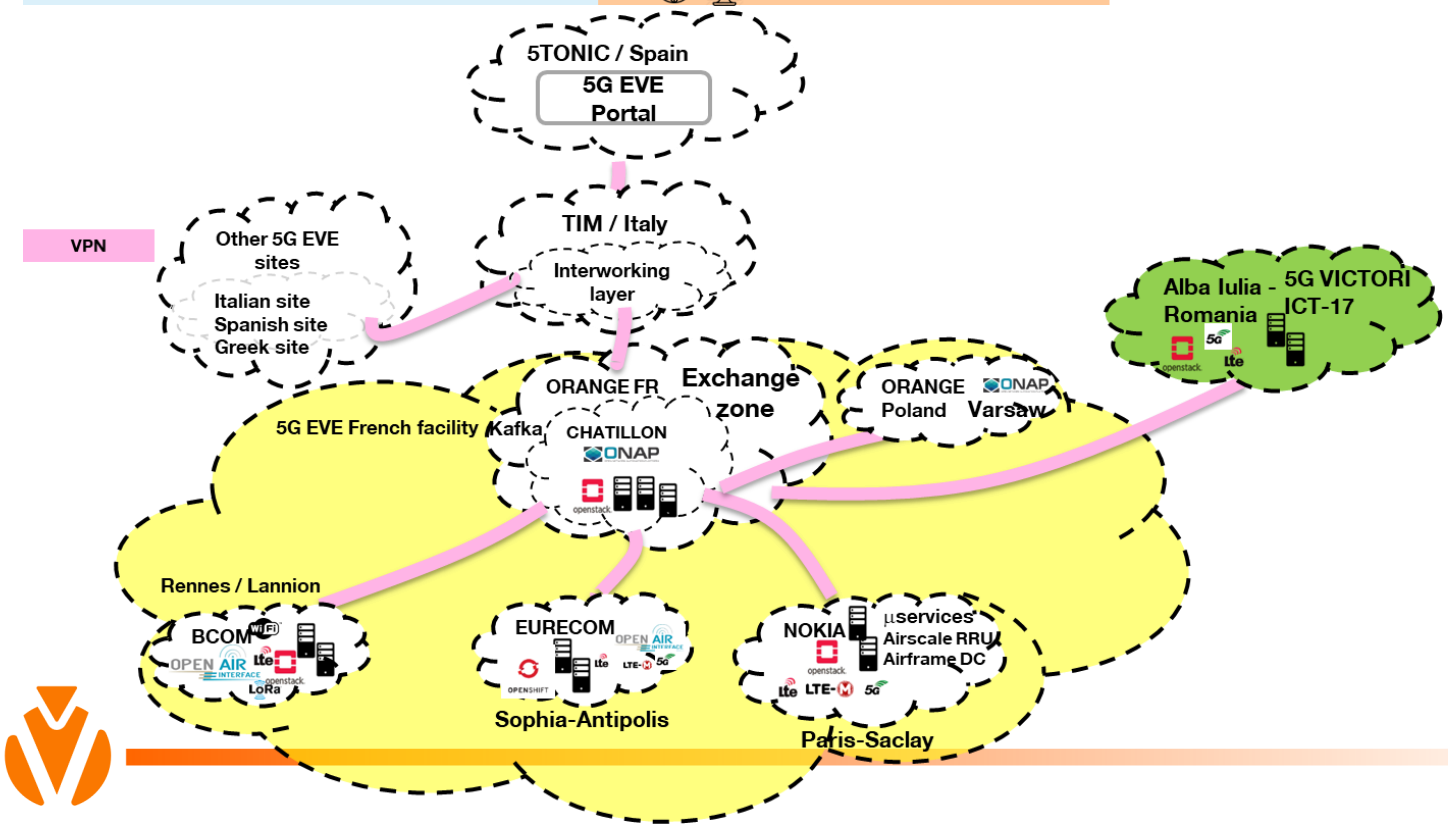
Challenges / Issues faced

- Extended the 5G-EVE facility capabilities to RO
  - Orchestration, ONAP onboarding and deployment
  - 5G-EVE – 5G-VIOS interoperability and monitoring; Proxy Edge adaptation and 5G-EVE orchestration
- 5G-EVE support for UCs validation
- Lockdown due to COVID, delays in field testing

FR/RO Cluster Facility Planning (II)

5G-EVE French Cluster graphic of the facility





Activities description

Extension of 5G-EVE infrastructure and test-bed integration with the project platform for experimentation
Platform analysis enhancements to support the use case requirements

Development and integration of AIM use cases in the platform

The test network will be used to carry different network and resources configuration for the use cases experimentation in the field; 5G-EVE facility capabilities will be extended to Romanian cluster

Specific measurements of use cases metrics and KPIs

The test-bed will integrate several technical architectural components RAN/Core and Orchestration

Infrastructure architectural components:
- 3GPP OAI RAN/Core (4G and 5G NSA)
- Orchestration/SDN

Use cases software and hardware components:
- sensors, video cameras, analytics

Field trials experimental methodology and guidelines
Supported by French 5G-EVE cluster(Sofia Antipolis/Paris)

5G network infrastructure deployment
- 3GPP access(NSA 3x); NFVI
- NFV/VNFs MANO

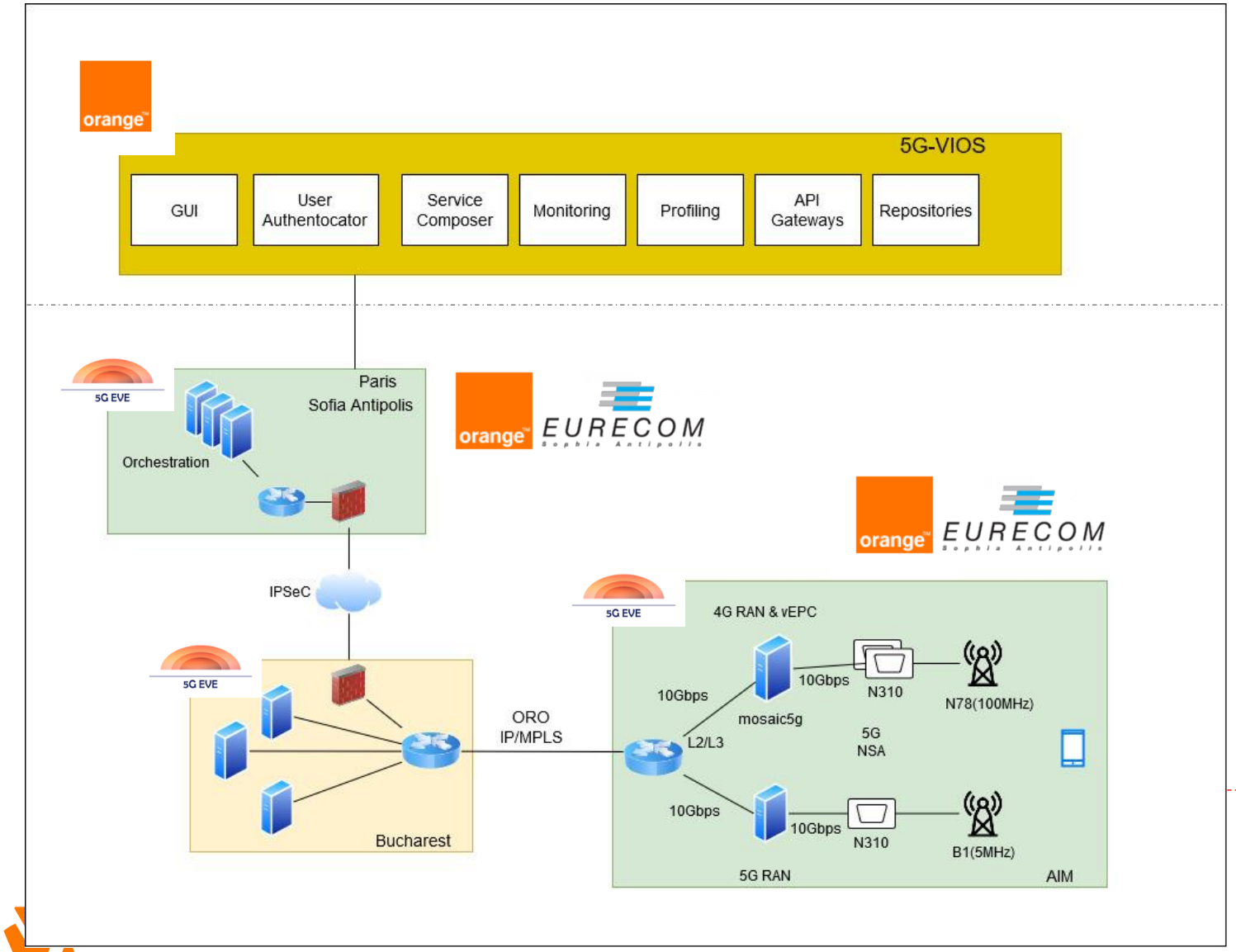
Orchestration deployment
- ONAP (helm charts)
- kube5g

Use cases and vertical's integration in the cluster
5G-EVE alignment and integration in 5G-VICTORI, 5G-VIOS, experimentation portal

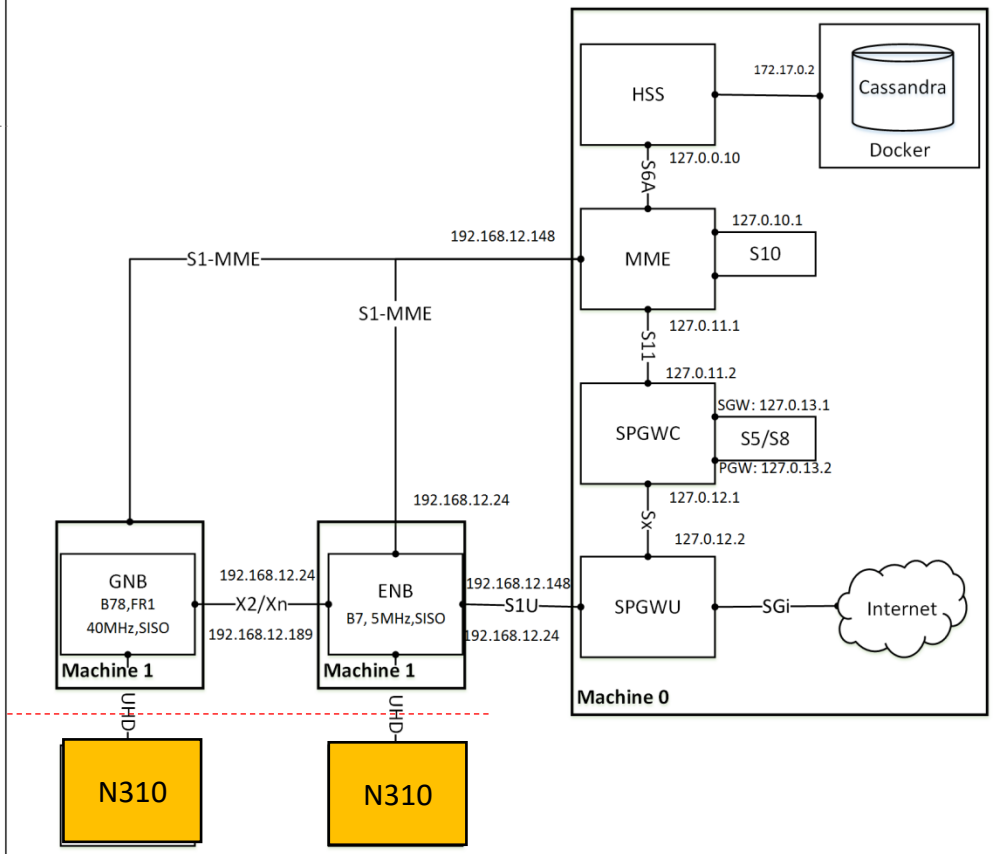
Integration framework 5G-EVE – 5G-VIOS portal
API and additional interfaces to be further defined and tested

Field trials and services implementation based on Mosaic5g

High level architecture view

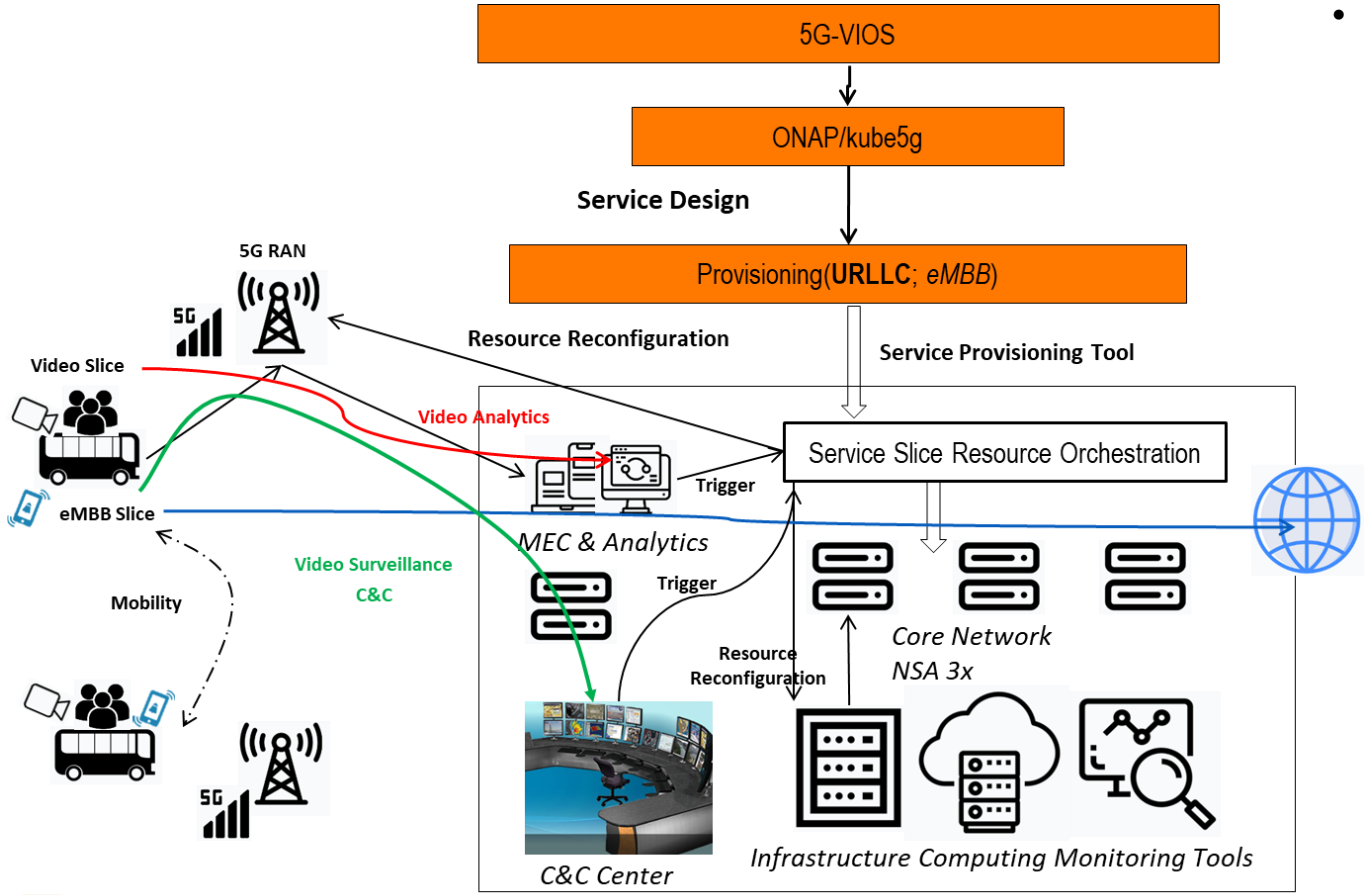


- Extension of ICT-17 5G-EVE
- 5G-NSA Opt 3x, deployed Mosaic5G repository
- 5G RAN NSA from M5G Snap

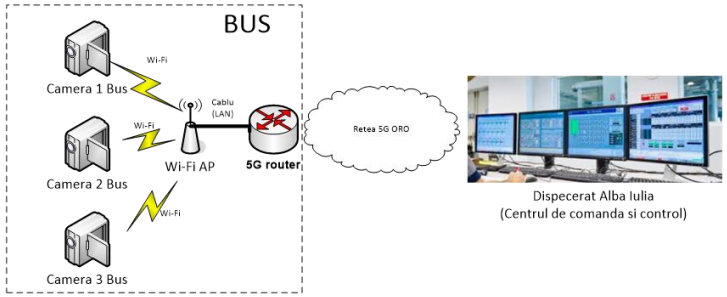


Trials details (I)

- UC# 1.2 Digital Mobility

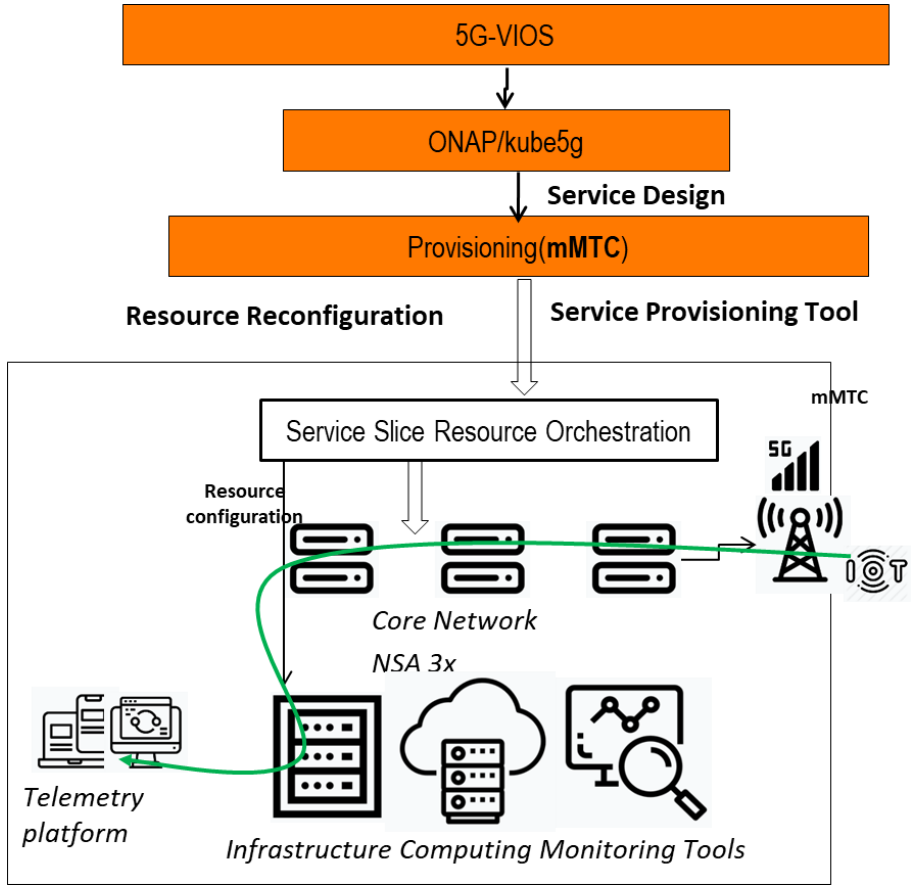


- **App1**: Real time infotainment/ video services in dense, static and mobile environment
- **App2**: AI recognition and identification of emergency situation
- **App3**: Prioritized communication to command and control center

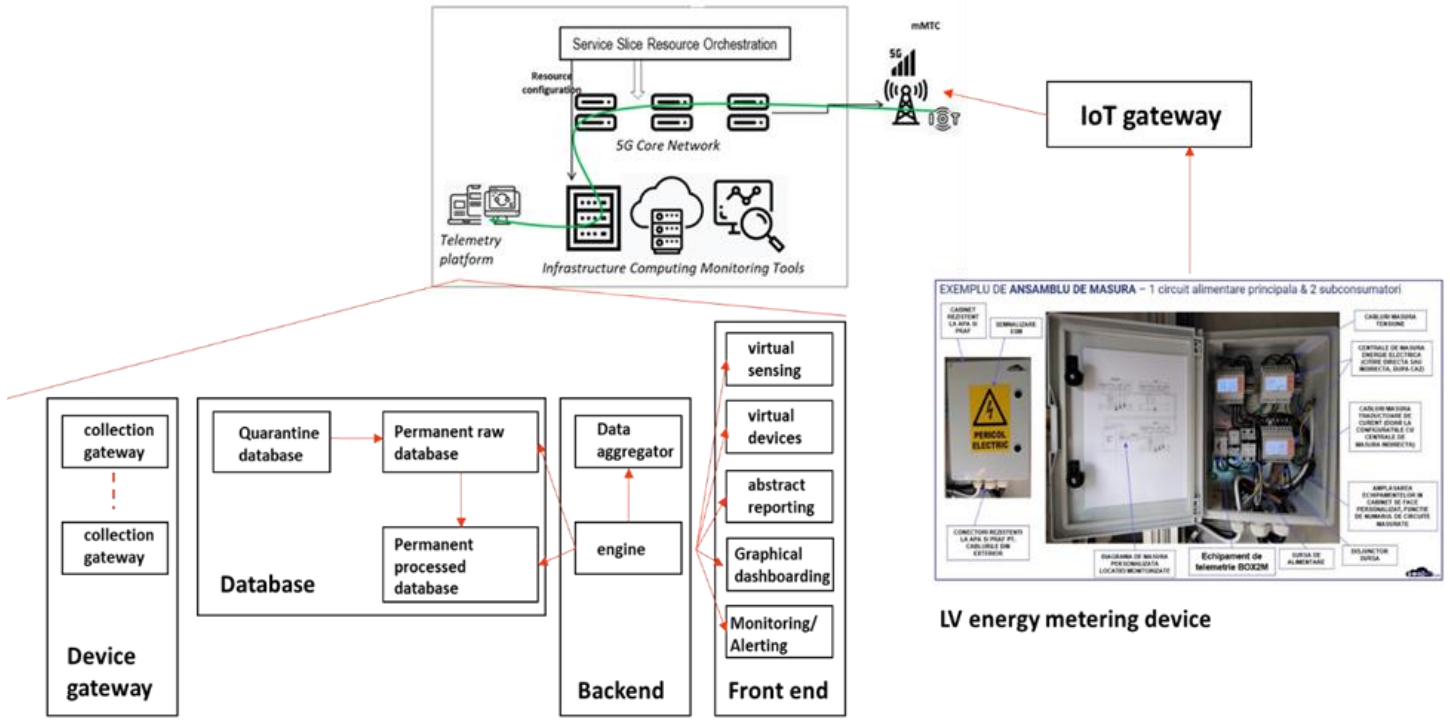


Trials details (II)

- UCs: #4.2 LV

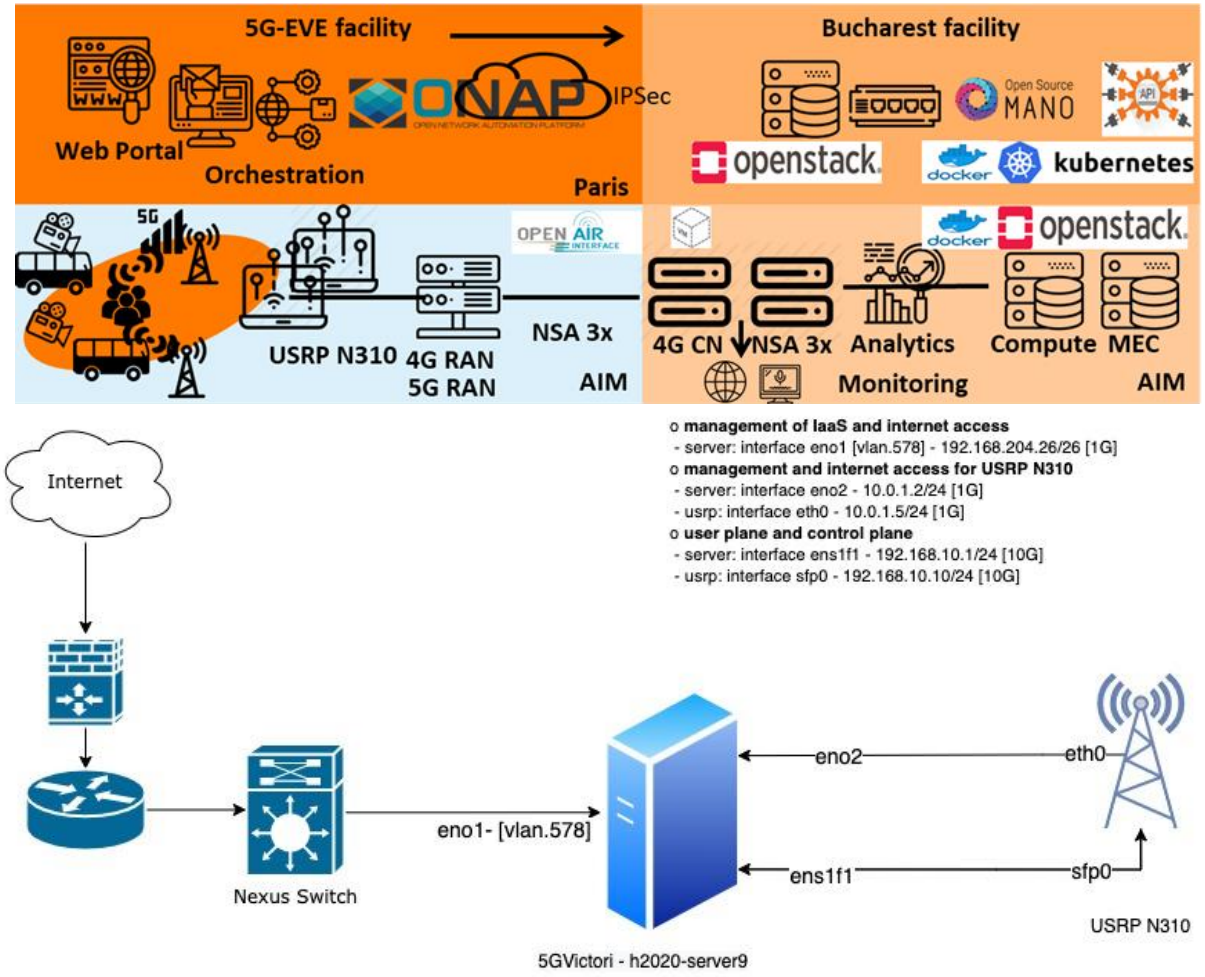


- **App1**: Real-time LV energy metering services for designated points of interest (schools, administrative buildings)
- **App2**: Energy Analytics for predictive and proactive maintenance for designated points of interest



Activities (I)

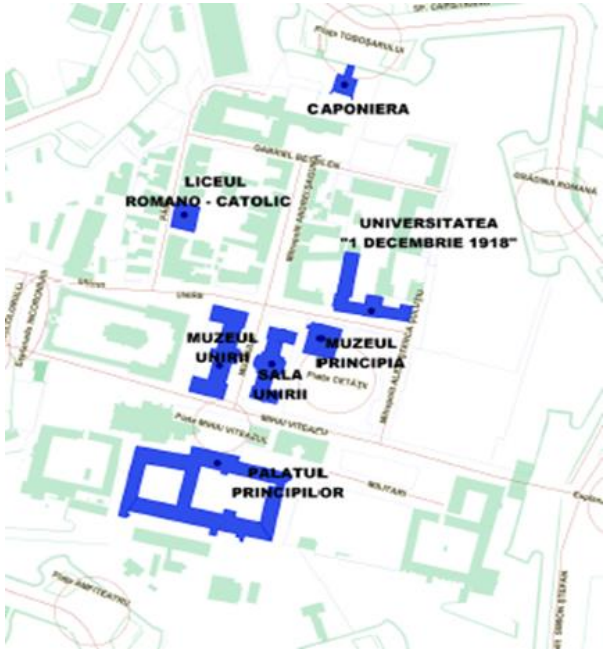
- Facility specific extension respecting ICT17 5G-EVE
  - Mobile network infrastructure(RAN and Core)
    - Software availability and NFVI requirements for network deployments
    - 5G NSA option 3x
  - Hardware validation for Romanian cluster extension
  - 5G-EVE WEB portal architecture description
    - experiment workflow, methodology and identification of testing procedures
  - 5G-EVE concepts and architecture adoption
  - Lab infrastructure deployment in Bucharest



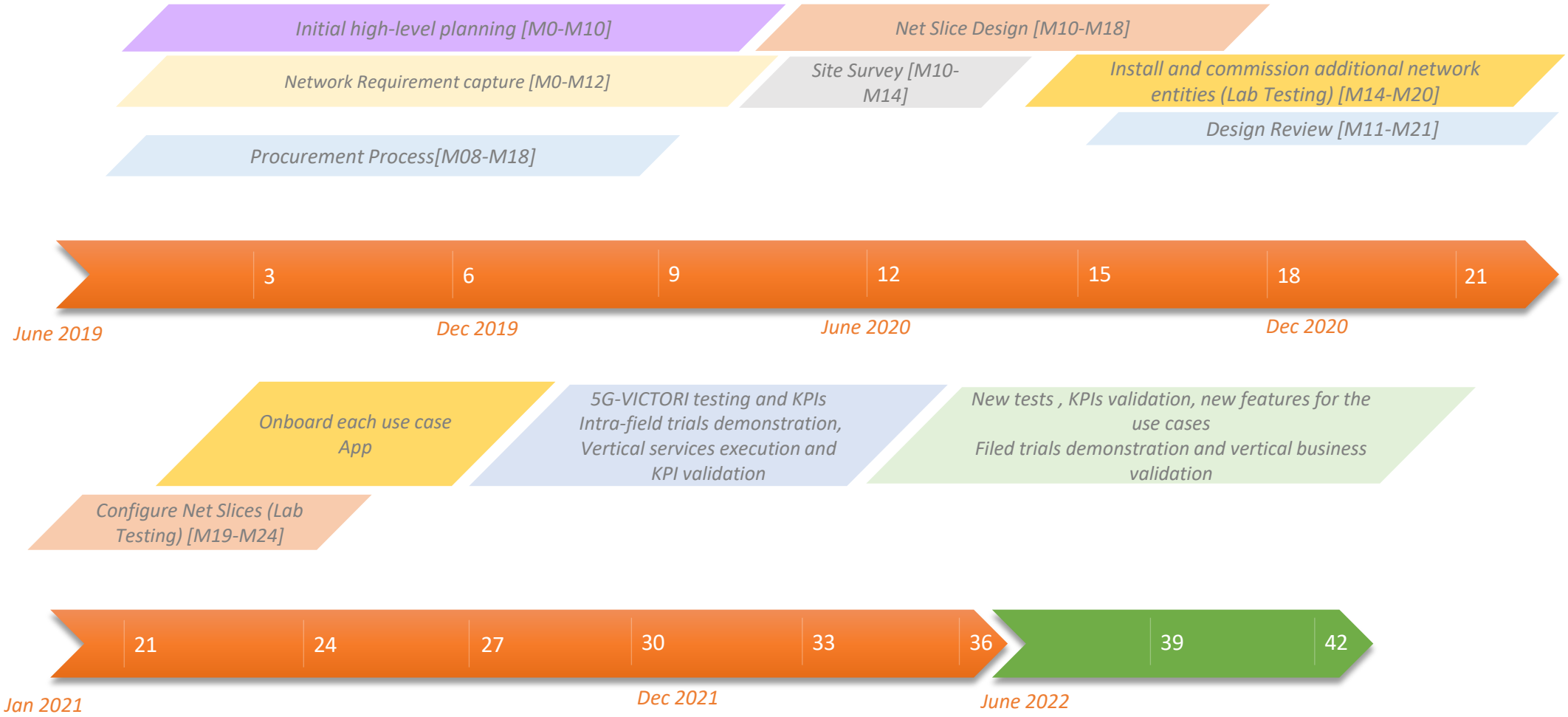
Supported by Orange H2020 LAB

Activities(II)

- Radio facility update and cluster analysis
  - Radio spectrum: ORO commercial spectrum in AIM for 4G and 5G
    - 4G: B3; B7 and B1, **5MHz spectrum in B1**
    - 5G: N78; up to **100MHz spectrum in N78**
- Infrastructure radio software and hardware components
  - Radio units 4G RAN and 5G RAN (option 3x); K8s implementation
  - ETTUS N310 and related computing nodes per RAN technology



FR/RO Cluster



5G-VICTORI Consortium

Thanks for your attention!

5G-VICTORI Project

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Technical Manager: Anna Tzanakaki (Anna.Tzanakaki@bristol.ac.uk)