Demonstration of 5G solutions for SMART energy GRIDs of the future – Smart5Grid

WS2. NetApps into Beyond 5G and 6G Networks

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Smart5Grid

Demonstration of **5G** solutions for **SMART** energy **GRID**s of the future

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GENERAL INFORMATION

THE CONSORTIUM

24 EUROPEAN PARTNERS COVERING 7 EU STATES

DURATION

3 YEARS

TOTAL BUDGET

8M€

Consortium Composition

24 partners, 4 Linked Third-parties, 13 SMEs

Smart5Grid

Coordinator

enel

TELCOs

WINDTRE

OTE GROUP OF COMPANIES

VIVACOM

Tech Companies

ENGINEERING

Atos

gridspertise
accelerating your electric future

Universities/Research institutions

i2cat

HELLENIC REPUBLIC
National and Kapodistrian University of Athens
EST. 1837

University of Cyprus
KOIOS
Research and Innovation Center of Excellence

DSOs

e-distribuzione
e-distribución

TSOs

ECO ЕАД

ադմηε

SMEs

EIGHTBELLS
Independent Research & Consultancy

INFOLYSIS

SC

NBYCOMP
NearbyComputing

axon logic

ubiwhere
SUITING THE FUTURE

athonet

SETECHCO

SIDROCO

ENTRA ENERGY

UBITECH
digitizing energy

nosia
- SEÑALIZACIÓN INDUSTRIAL
- EQUIPAMIENTO PARA LA INDUSTRIA

STAM
MASTERING EXCELLENCE

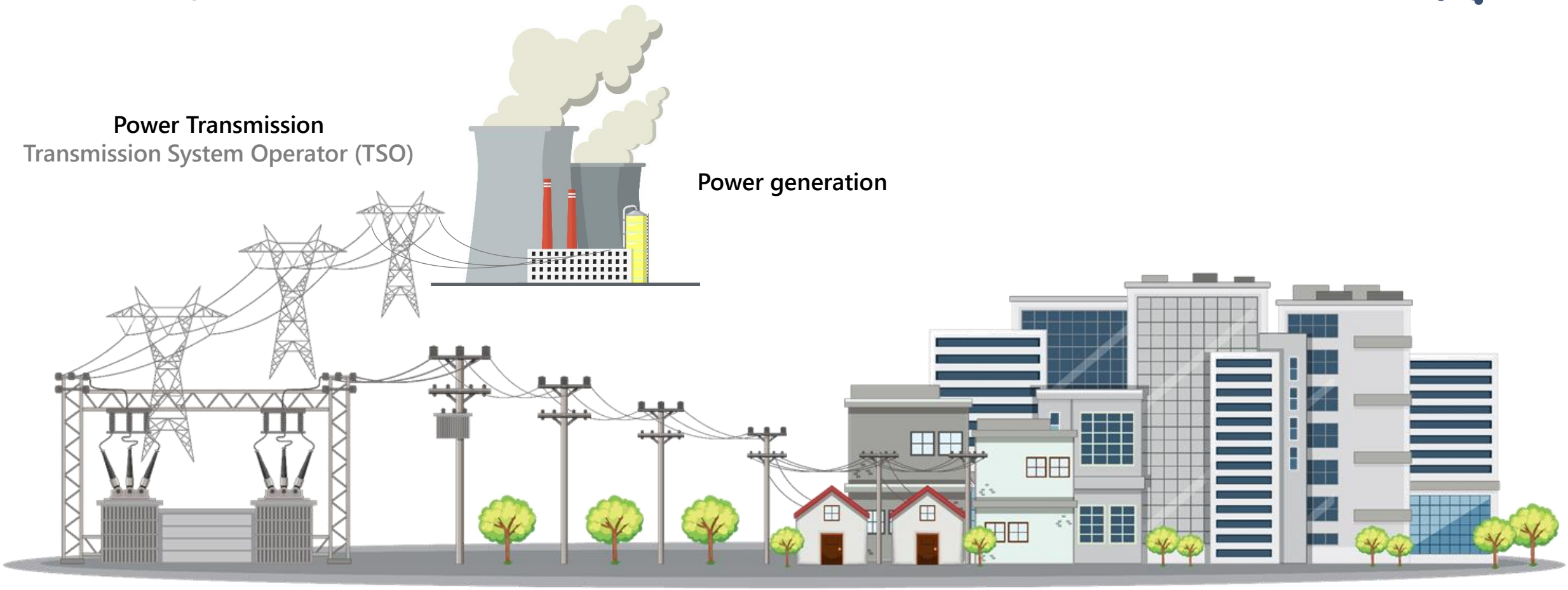
(Linked third-parties of Enel GI&N)

Energy Vertical

Traditional grid

Power Transmission
Transmission System Operator (TSO)

Power generation



Power Distribution
Distribution System Operator (DSO)

Customers
Market Operators

Scenario

Energy industry and need for more fast and reliable communications

High penetration of
Distributed Generation

New actors in the Energy Market

New generation of Smart Grids solutions

Stability issues

Safety for field operators

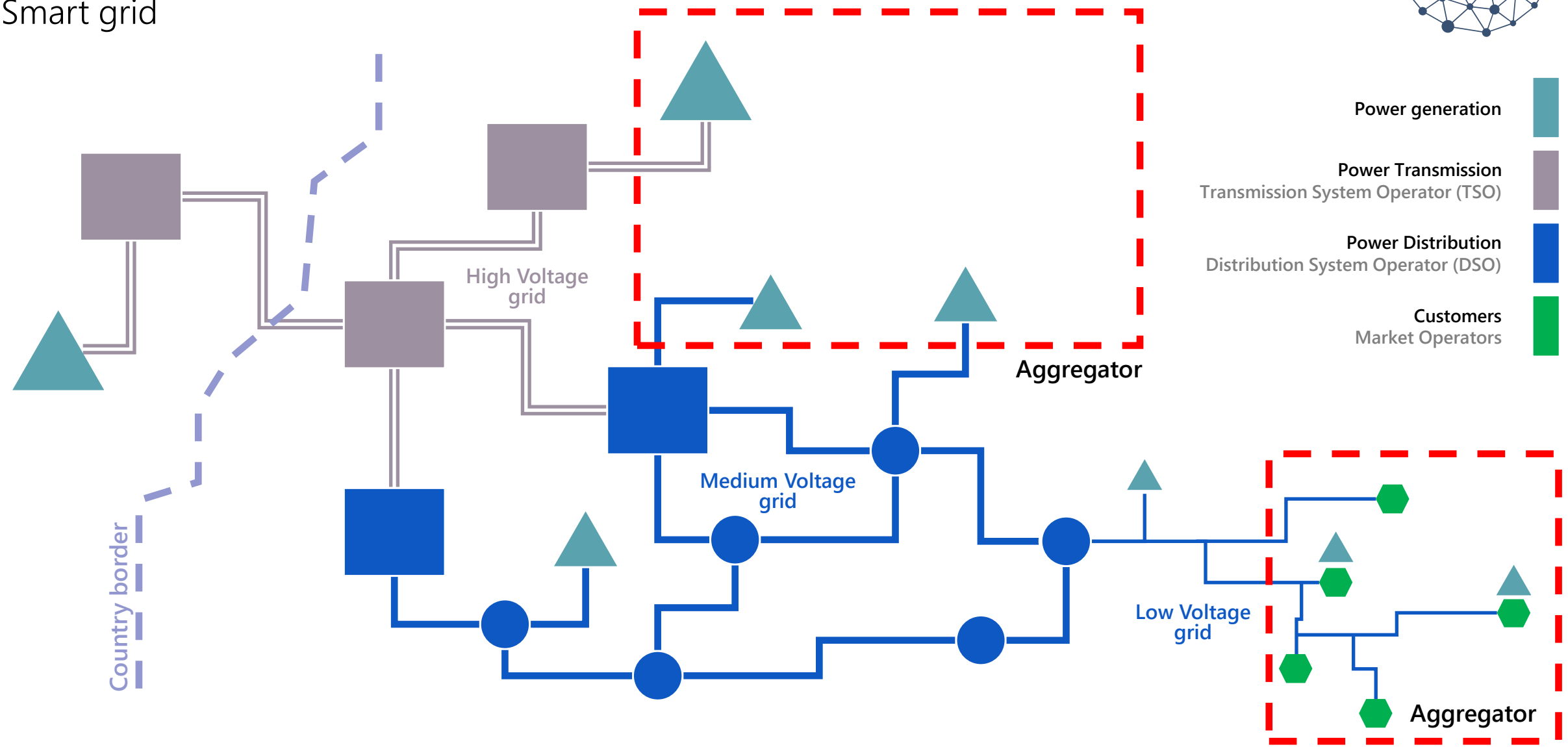
New solutions from 3rd parties

Need for digitalization

Security and reliability

Energy Vertical

Smart grid



Why 5G?

Advantages and opportunities

If compared to Optical Fiber

- Lower implementation costs
- Faster implementation
- Higher flexibility

If compared to 4G/LTE

- Lower latency (similar to Optical Fiber)
- Highest stability
- Virtually dedicated Network (Slicing)
- highest flexibility
- highest bandwidth

Major peculiarities

- Virtual Edge computing, strengthening the system resiliency

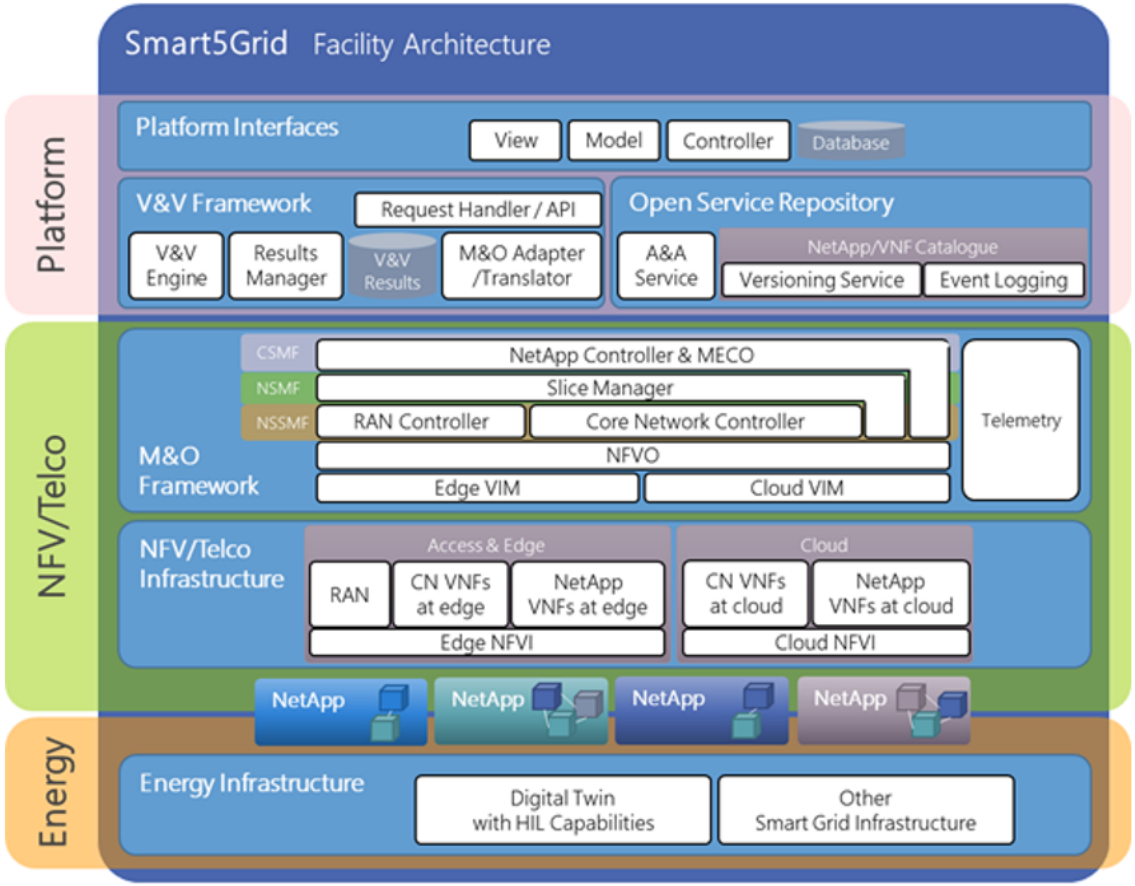
What we test in the project

- **NetApp**: an extension of the Network Virtualization Functionality that provides an **abstraction of the 5G complexity** to allow the development of data-network functionalities to a broader group of people. EC aims to create a market segment for NetApps, to support the penetration of 5G technology and foster the digitalization

Smart5Grid platform in a nutshell

5G market place of application for everyone: developers and customer

The Smart5Grid Architecture consists of three logically dived into three interdependent and interfaced layers:



Pleatform OS experimentation platform on top. The platform itself is composed of Open Service Repository (OSR), Verification and Validation (V&V) Framework, and various API's and UI's.

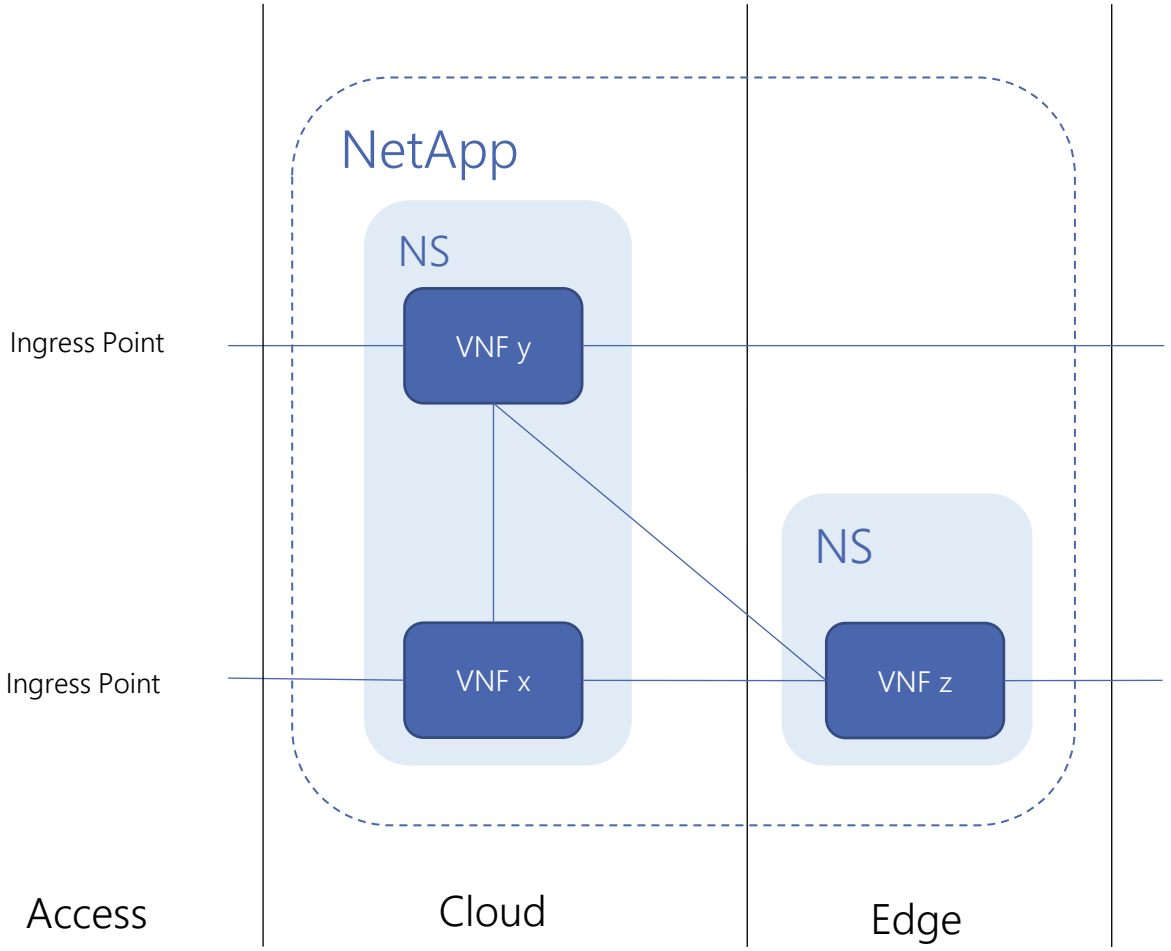
The OSR enables developers to register their NetApps and virtual network functions (VNFs), making them available for consumers to download and deploy over their infrastructures.

The **M&O framework** is responsible of managing the end-to-end lifecycle of a NetApp deployment. It also provides services to cover all aspects of the complete lifecycle, including onboarding, instantiation, monitoring, scaling, and termination.

NFV/Telco: computing and networking. This computing infrastructure can be centrally located or placed at the edge to benefit from reduced latency communications

Energy Infrastructure contains the grid components that connect to the NetApp services.

Smart5Grid NetApps



The Smart5Grid NetApp concept intends to:

- provide a solution for developers to define vertical applications
- While abstracting the complexities of the network.
- Reducing the level of networking expertise required

cloud-native application made up of VNFs based on containers technology.

By splitting the functionality of the NetApp into decoupled VNFs, the reutilization of software functions is encouraged, but also, whenever possible from an implementation point of view, the opportunity to take advantage of the cloud/edge infrastructure depending on the application needs.

NetApp Structure (with ETSI)

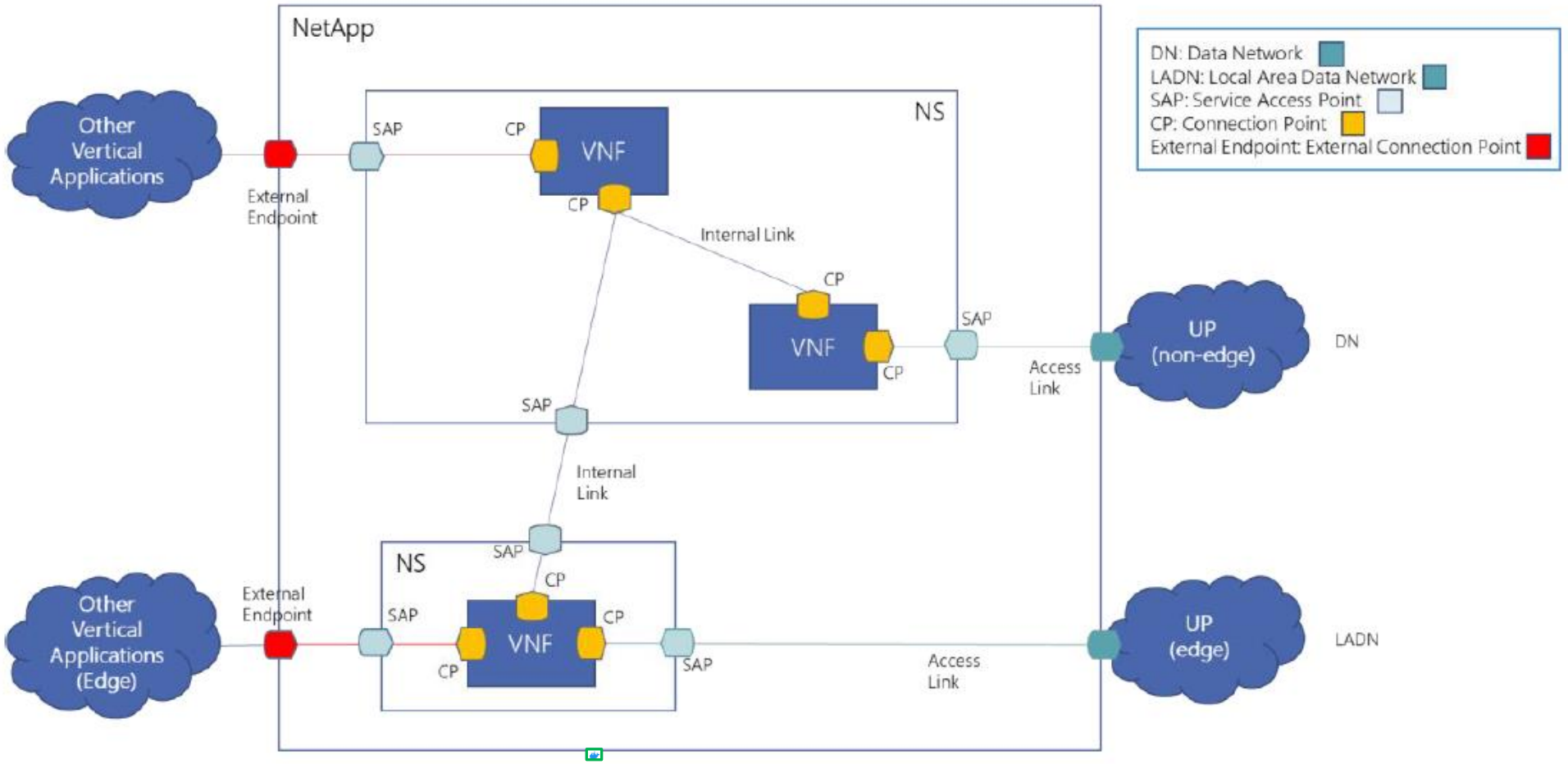


Figure 4-45 Example of a NetApp structure

NetApp Structure with Helm Charts

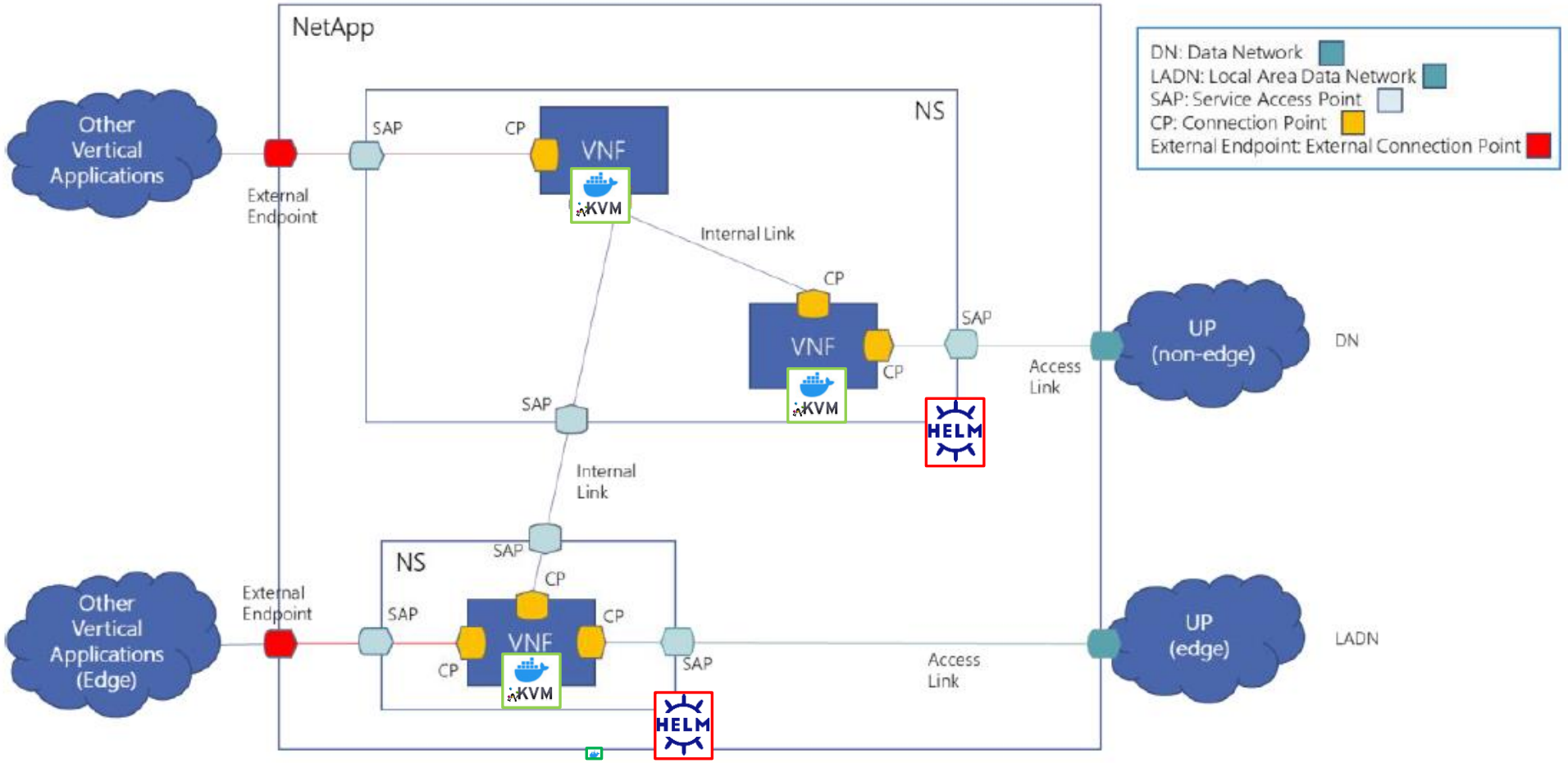
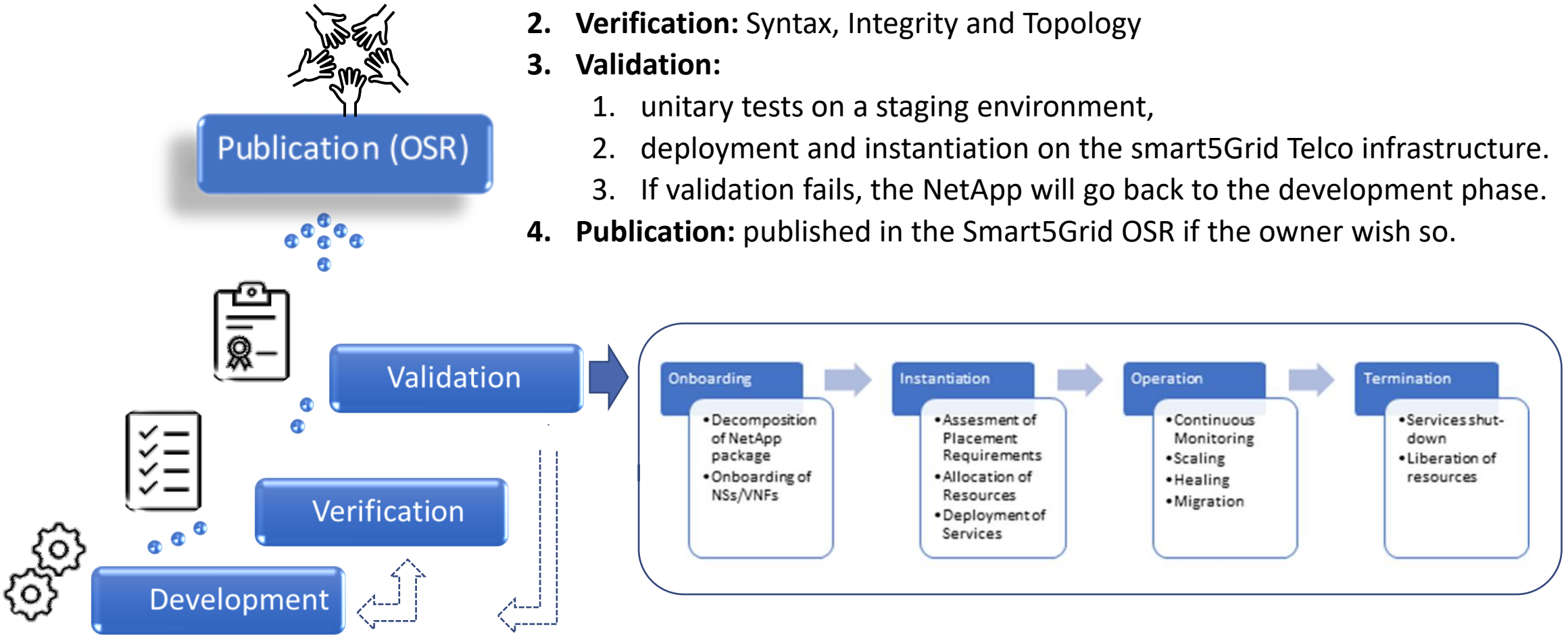


Figure 4-45 Example of a NetApp structure

Smart5Grid NetApps V&V

1. **Development:** according to Smart5Grid NetApp convention
2. **Verification:** Syntax, Integrity and Topology
3. **Validation:**
    1. unitary tests on a staging environment,
    2. deployment and instantiation on the smart5Grid Telco infrastructure.
    3. If validation fails, the NetApp will go back to the development phase.
4. **Publication:** published in the Smart5Grid OSR if the owner wish so.



Italian Demo | Olbia

Automatic Power Distribution Grid Fault Detection

Spanish Demo | Barcelona

Remote Inspection of Automatically Delimited Working Areas at Distribution Level

Bulgarian Demo | (Southern region)

Millisecond Level Precise Distribution Generation Control

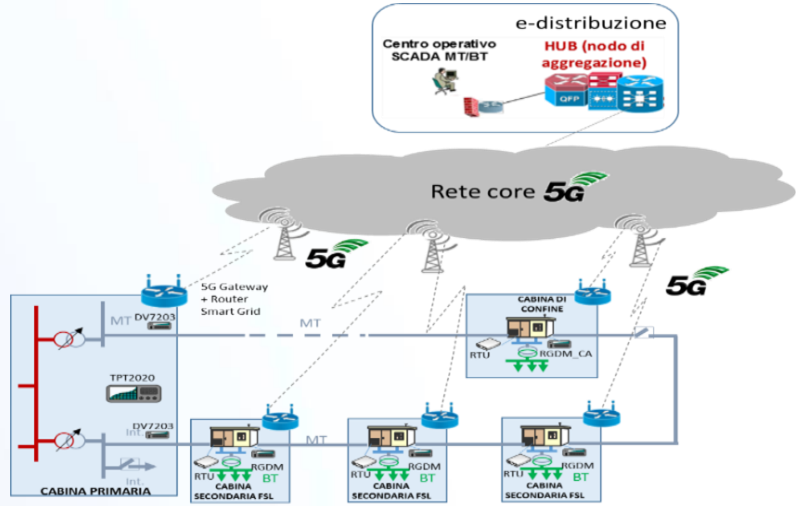
Bulgarian-Greek Demo | (Cross-border)

Real-time Wide Area Monitoring

Italian and Spanish demos

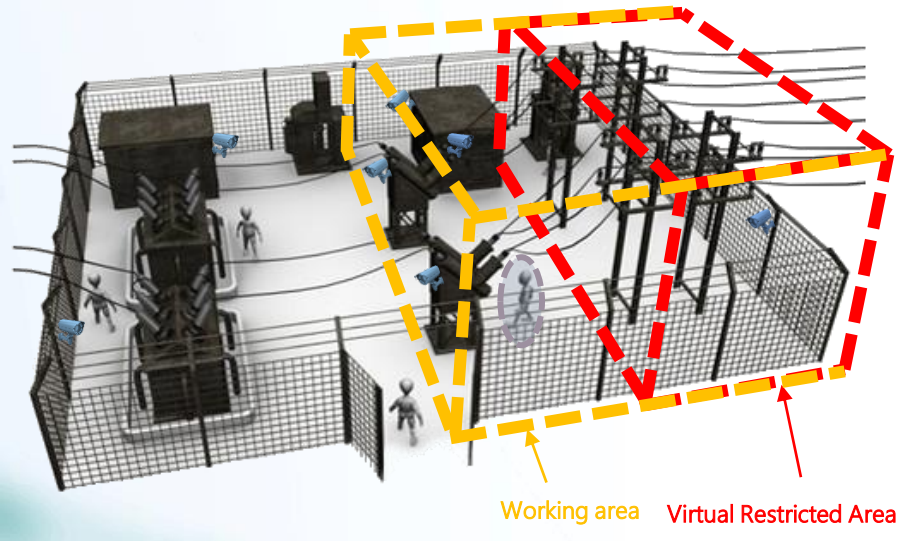
UC1 (DSO - Operations) Automatic Power Distribution Grid Fault Detection

E-Distribuzione developed the most advanced grid automation system, that is able to reconfigure the grid during an outage, minimizing the number of affected customers. This system will be tested using the 5G infrastructure in a real life environment.



UC2 (DSO - Safety) Remote Inspection of Automatically Delimited Working Areas at Distribution Level

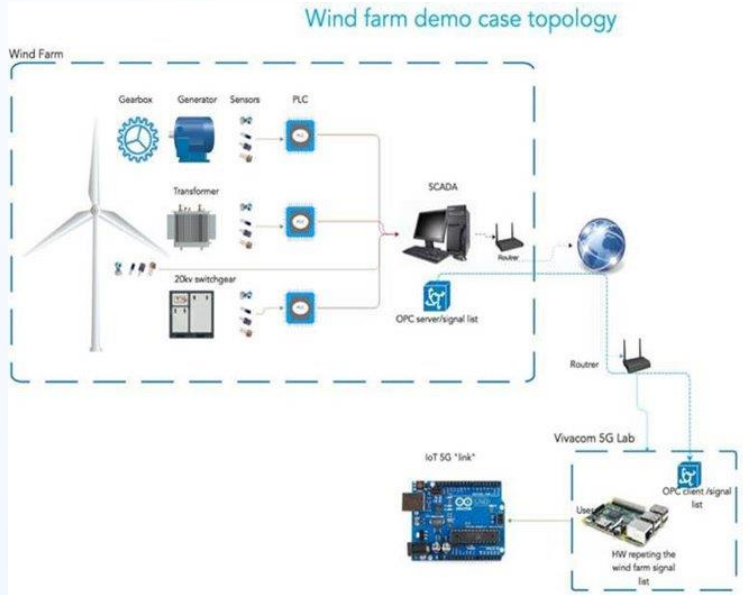
A system for monitoring the safety of people working in a power plant will be implemented using a private 5G facility. High resolution 3D sensors combined with AI will support workers during maintenance, avoiding to reach live parts of the power plant.



Bulgarian and Greek demos

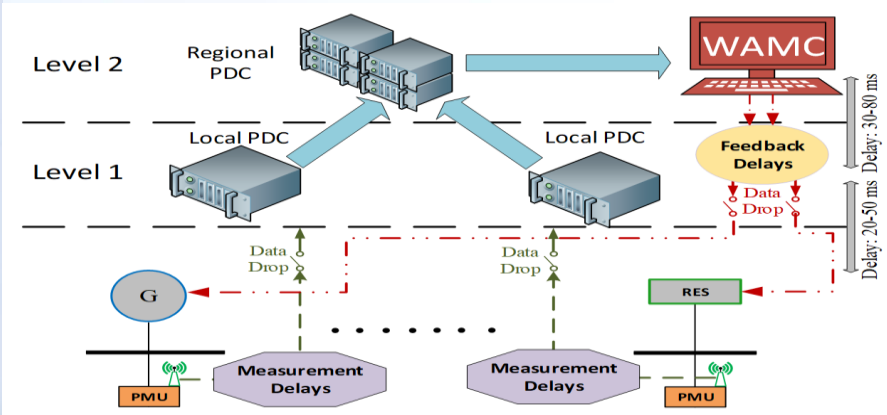
UC3 (RES Producer) Millisecond Level Precise Distribution Generation Monitoring

Smart5Grid will enable the connection of thousands of Medium Voltage (MV) and Low voltage (LV) level decentralised RESs units and their inverters, to a platform with installed 5G communication protocols, which will allow their-aggregated monitoring in millisecond rates



UC4 (TSO-TSO) Real-time Wide Area Monitoring

Smart5Grid aims to demonstrate the 5G virtual PDC capabilities for serving the Wide Area Monitoring of end-to-end electricity networks: from Distributed Energy Resources at Medium Voltage level operated by DSOs, to High Voltage level operated by TSOs, as well as inter-TSO cross border Regional Security Coordination.



UC3

Millisecond Level Precise Distribution Generation Monitoring?

- Use Case (UC) 3 of the Smart5Grid project demonstrates precise monitoring of RDER at millisecond level, which addresses the field of operation and maintenance of distributed power generation with a particular emphasis on renewable sources.
- More specifically, real-time (RT) monitoring of a wind farm, situated in southeast Bulgaria (Sliven area) and owned by Entra Energy, will be carried out using emerging capabilities of 5G telecom networks.
- Main functionalities needed by RES owner

(i) the RES owner, being aware of the real-time status of its power asset

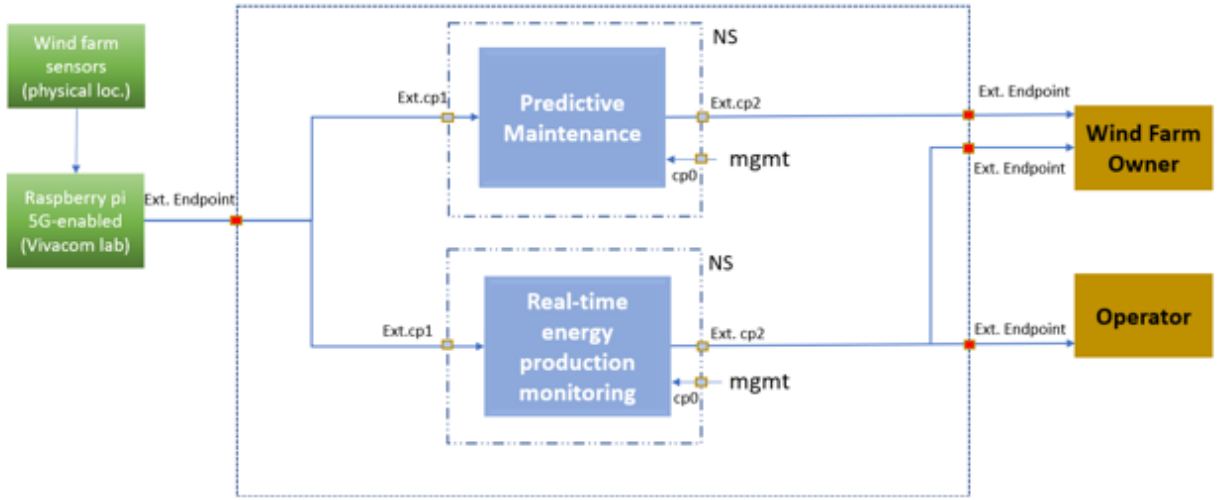
(ii) RES owners acting simultaneously as BRP (Balancing Responsible Party) and BSP (Balancing Service Provider) are responsible for potential imbalances and for providing real-time balancing services to the market.

- Main functionalities needed by Grid Operator
  - Real time visibility on RES production in their grid

NetApp developed for the Use Case

- **NetApps supporting the UC3 objectives**
- There are two services intrinsic to UC3 and supported by one tailored NetApp whose architecture is illustrated in Figure 2: Predictive Maintenance Enabler (UC3 NetApp1 based on massive Machine-Type Communication, mMTC) and
- Real-Time Energy Production Monitoring (UC3 NetApp2 based on Ultra Reliable Low Latency Communication, URLLC).
- Each of these two components is implemented as a different VNF (Virtual Network Function) that is linked and interacts with the inputs and provides the outputs as needed to support the performance specification of this particular UC.

- Netpp Architcture



Future advancement 6G and Energy services

- Faster data processing in RES
- P2P energy trade market
- AI based forecast for weather
- Energy Management System
- MIMO in 6G----> more dense volume so exploitation of not only RES but DER


Smart5Grid
• Open NetApp Repository
• Test and validation facility

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