



## 5GIA-TSDSI Webinar on “5G Trials and Pilots”

22 September 2021 1100-1300 CET / 1430-1630 IST



# 5GIA-TSDSI Webinar on “5G Trials and Pilots”

## Session: Smart Grids

### From NRG-5 Trials to Smart5Grid

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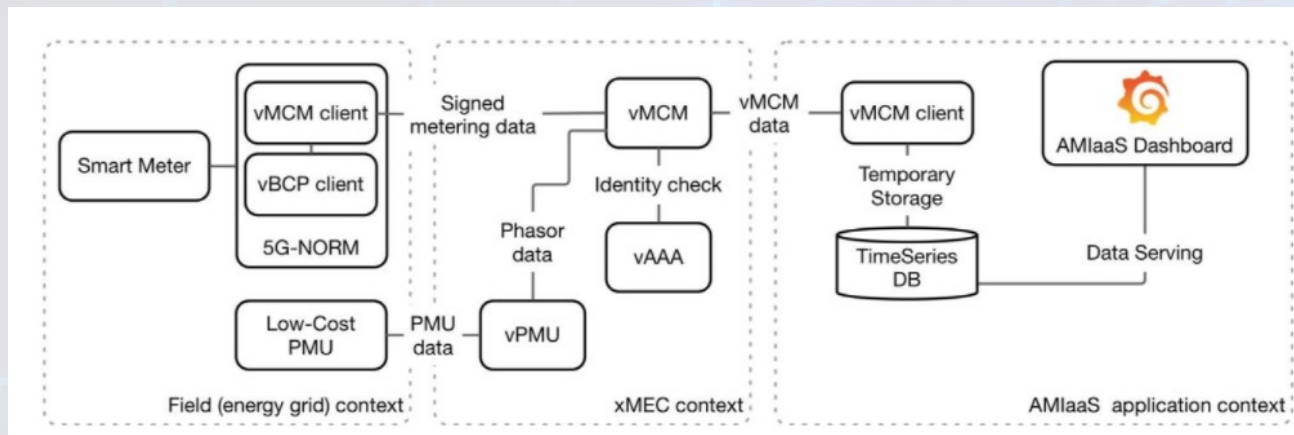
UCY-KIOS CoE

# Outline

- Lessons learned from NRG-5 Project - vPMU trial
- From vPMU in NRG-5 to 5G-enabled smart grid services in Smart5Grid - Trials description
- NetApps & Smart5Grid Architecture
- Pre-piloting for the vPDC trial
- Conclusions and future steps

# Main objectives of the vPMU demo

## NRG-5 Architecture



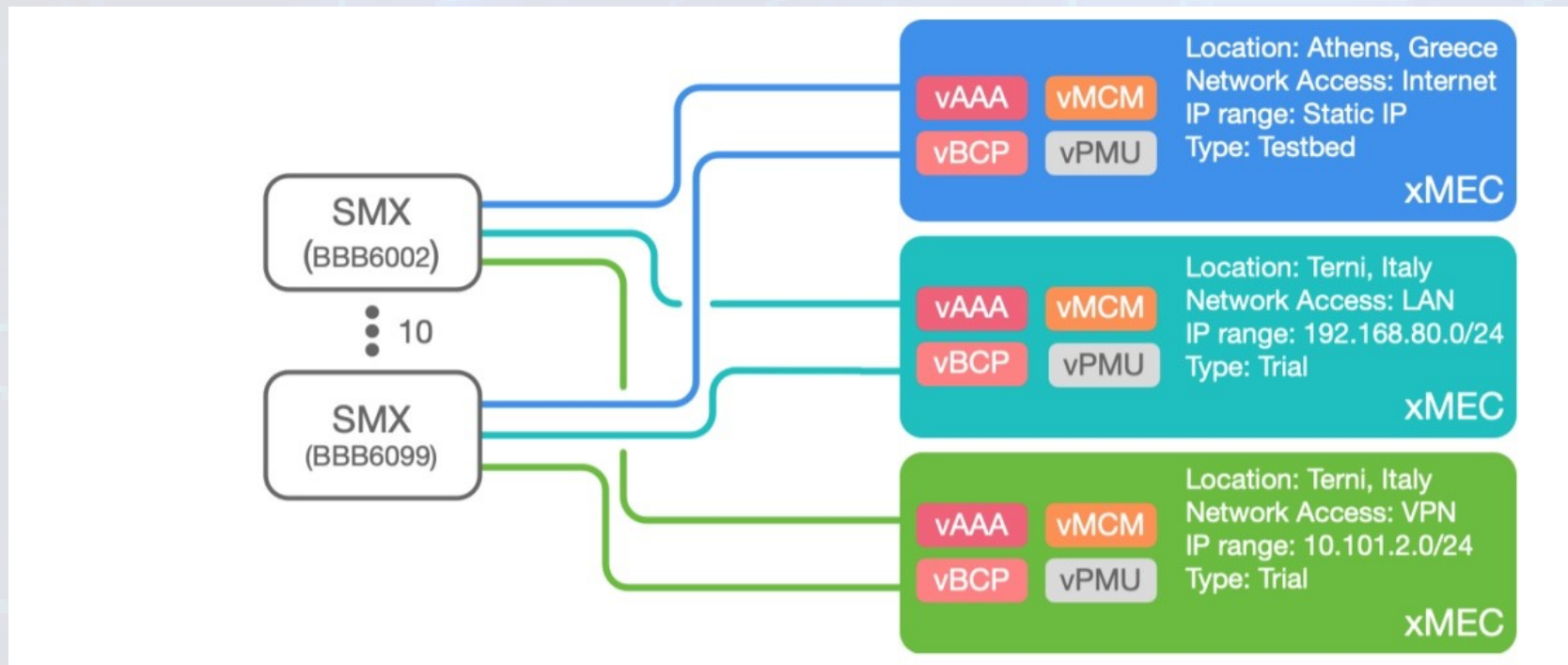
NRG-5 considers the deployment of

- i) sub-minute updates for smart meters (at the level of second) and
- ii) the mass deployment of low-cost PMUs reporting at least 20 samples per second, without calculating the phasors locally but on the edge assisted by vPMU.

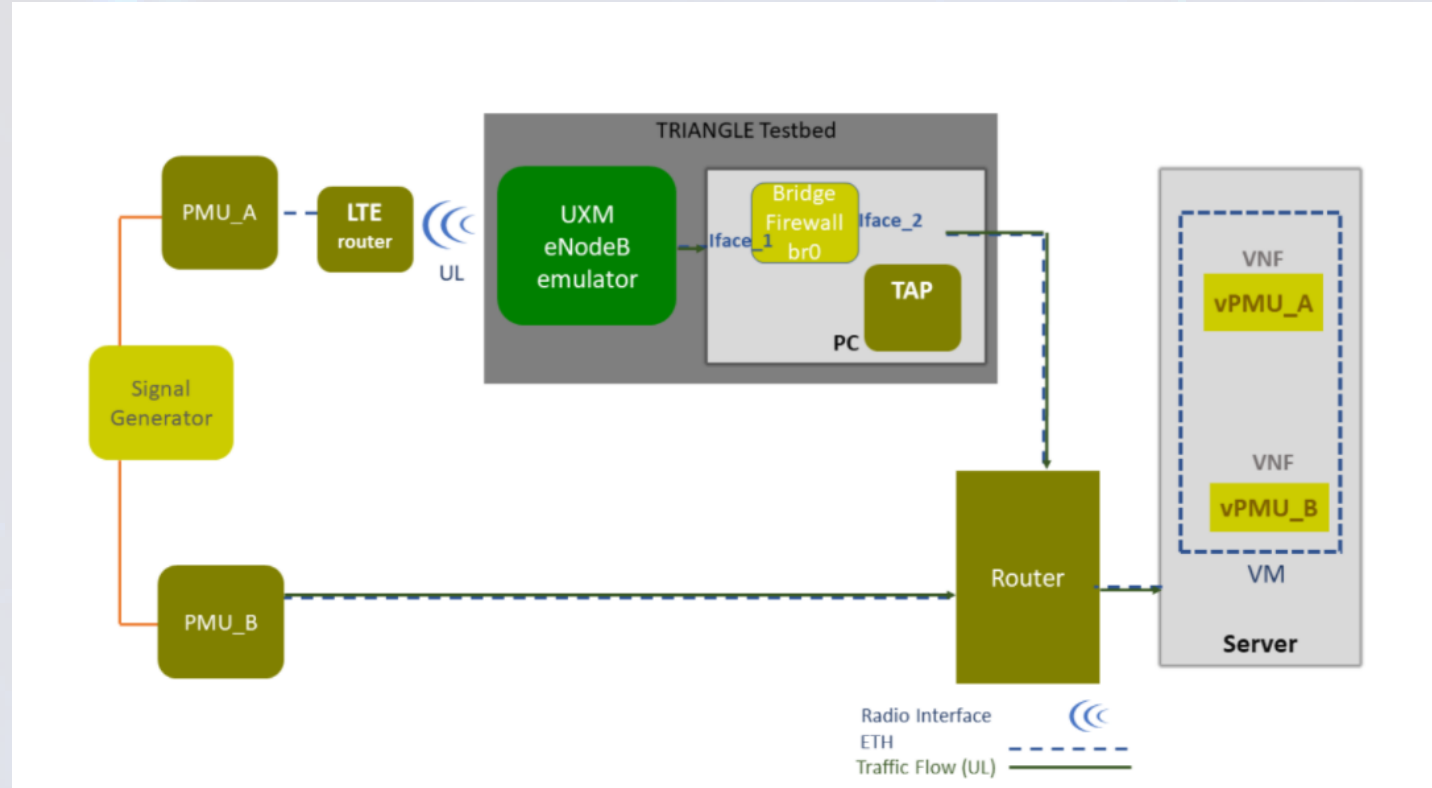
# vPMU Conceptual approach in NRG-5

In NRG-5 traditional PMU is divided into:

- a data acquisition unit responsible for sampling the electricity grid and
- a virtual network function (VNF) responsible for calculating the corresponding phasors. This VNF sits on the edge cloud



# NRG-5 TestBed



TRIANGLE testbed is an End-2-End (E2E) testbed which allows flexibility and reconfiguration for realistic testing scenarios:

- extensive testing of services against different scenarios.
- configurations in realistic controllable environment for testing and validation purposes.

# Result

Min.diversion	Voltage [v]		Phase [rad]		Freq. [Hz]		Latency [ms]		Reordered pcks	
	4G_div	5G_div	4G_div	5G_div	4G_div	5G_div	4G_div	5G_div	4G_div	5G_div
	0,12	0,12	5,58	5,41	1,53	0,30	0,006	0,000	0,00	4,00
<b>Avg. Diversion</b>	0,19	0,04	0,19	0,35	5,21	1,39	0,165	0,010	1602	541
<b>Max.diversion</b>	1,28	1,18	5,86	5,93	10,52	5,12	0,184	0,030	3040	899

The diversion of the main measurements between 4G and 5G-like mobile networks with respect to the reference case (Ethernet connection) are summarized in the table

# FROM vPMU in NRG-5 to vPDC in Smart5Grid

- Project and all demos overview
- Smart5Grid Open experimentation facility - architecture
- vPDC definition and concept under Smart5Grid
- Pre-piloting testing and validation environment





**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  
22 September 2021

**Bulgarian-Greek Demo | (Cross-border)**  
Real-time Wide Area Monitoring



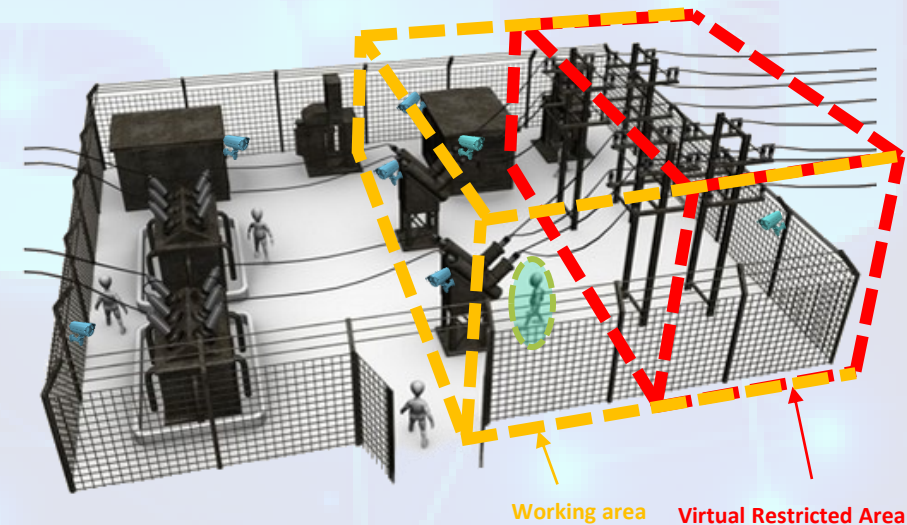
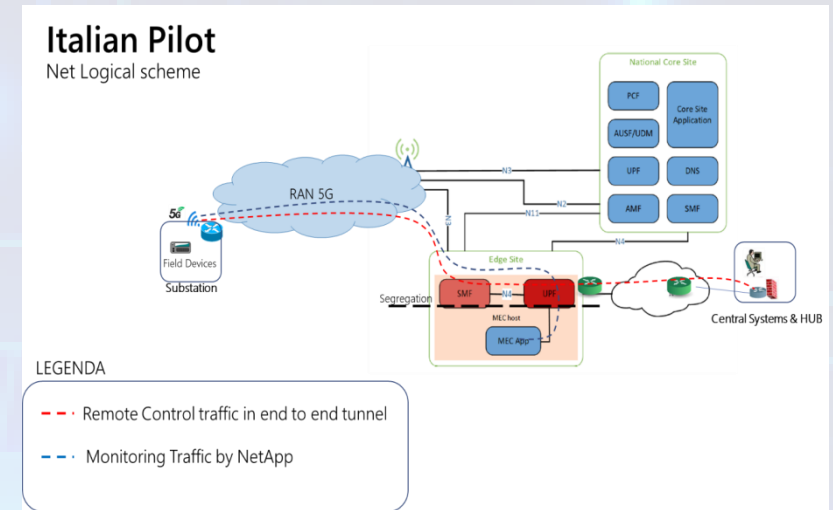
# Italian and Spanish demos

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 demo 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.



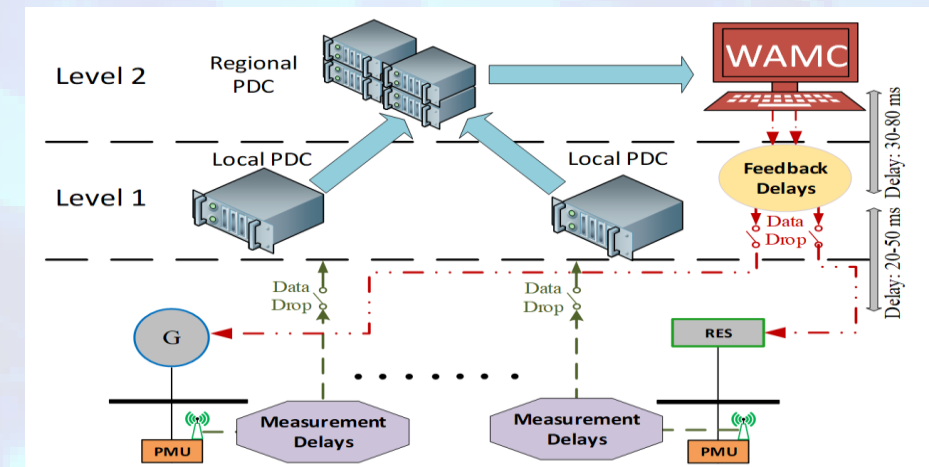
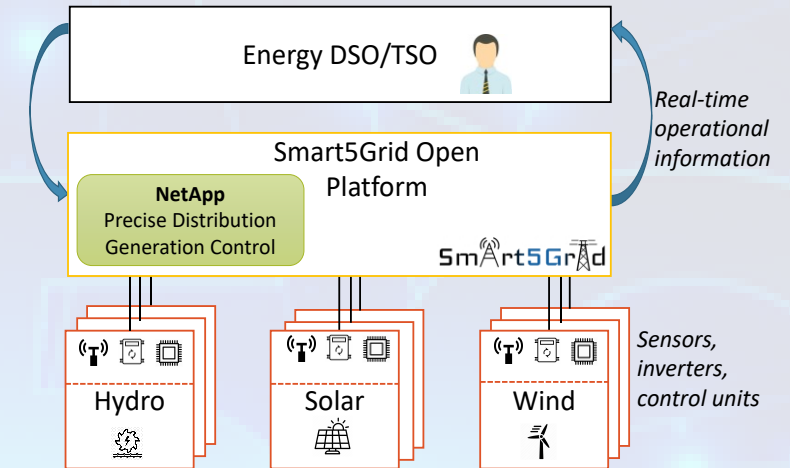
# Bulgarian and Greek demos

UC3 (Aggregator) Millisecond Level Precise Distribution Generation Control

Smart5Grid will enable the connection of thousands of Medium Voltage (MV) and High Voltage (HV) level decentralised RESs units and their inverters, to a platform with installed 5G communication protocols, which will allow their aggregation and control in millisecond rates

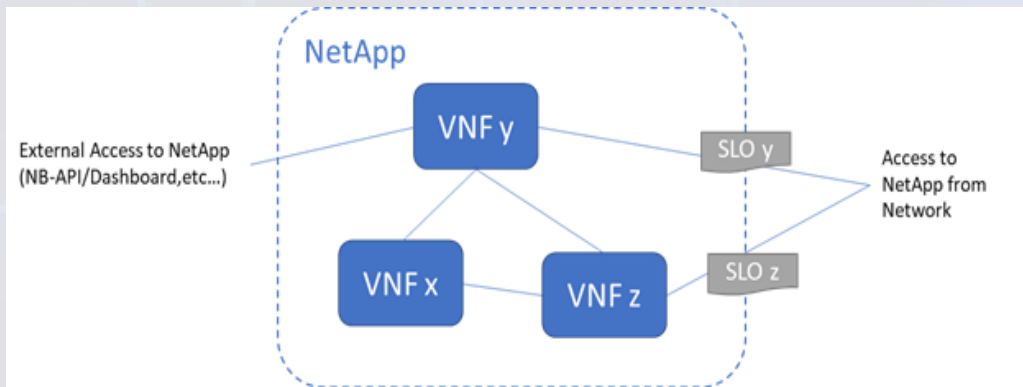
UC4 (TSO-TSO) Real-time Wide Area Monitoring

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 (RSC).

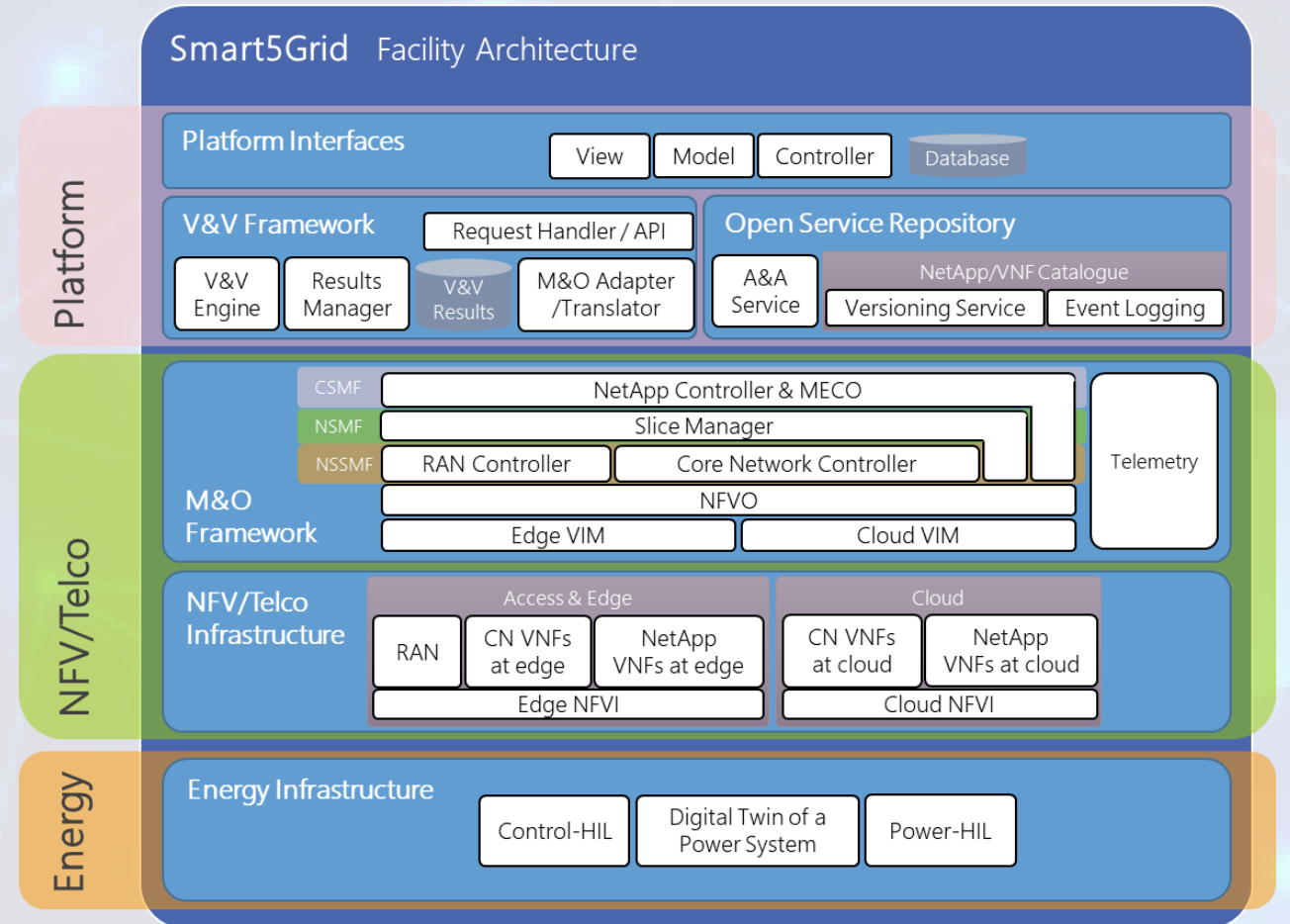


# Smart5Grid Facility Architecture

- NetApps in Smart5Grid
- Automated V&V Framework
- Open Service Repository
- 3rd party experimentation



Generic NetApp representation



# vPDC for WIDE AREA MONITORING

## Smart5Grids - Greece-Bulgaria Demo #4

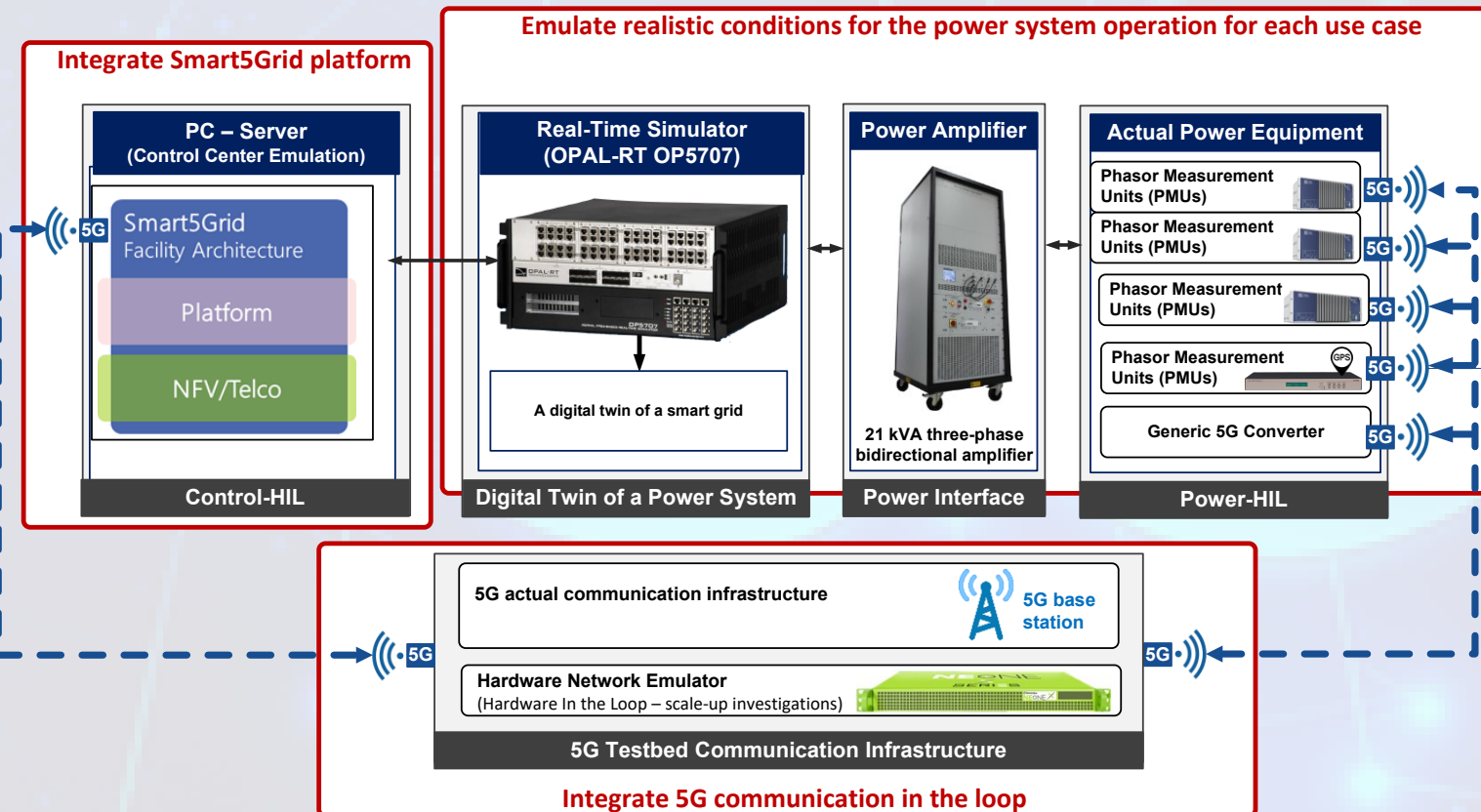
- **Application:** wide area monitoring of cross border power flow in large transmission power networks (TSO-TSO-RSC)
  - Role of the 5G technology
  - Business value

- **Implementation:**

- vPDC NetApp to be onboarded on the Smart5Grid Platform

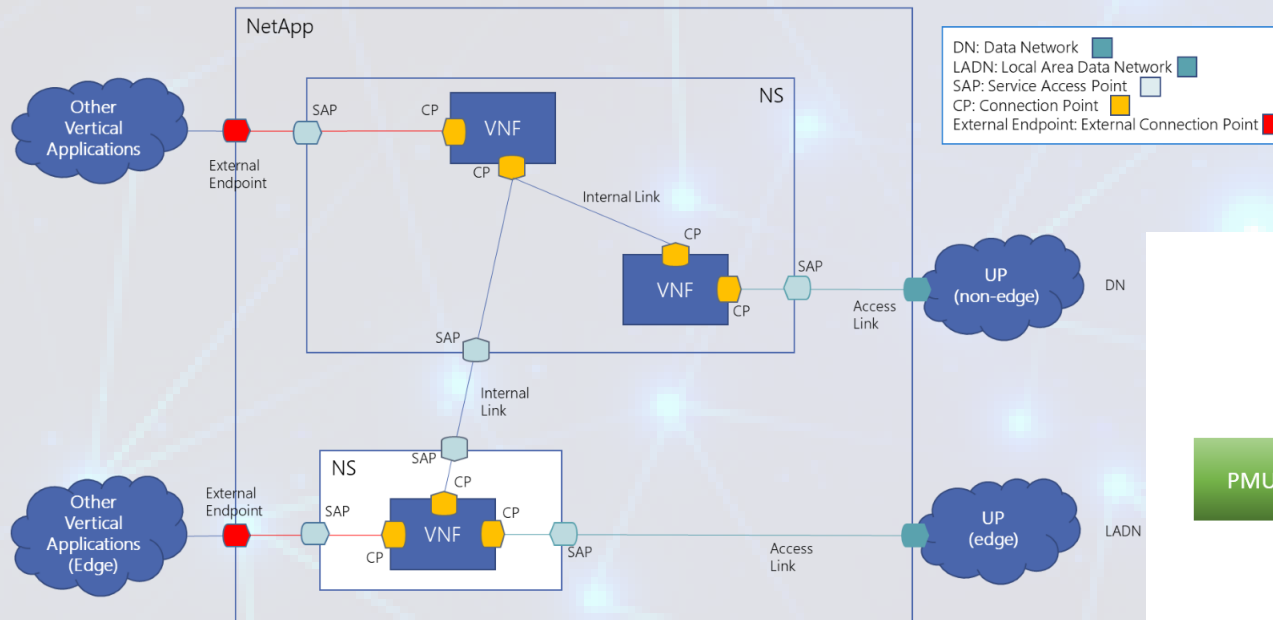
- **Pre-piloting testing environment**

- Digital twin of the pilot using OPAL-RT-HIL and 5GNetwork emulator
- Architecture of the trial



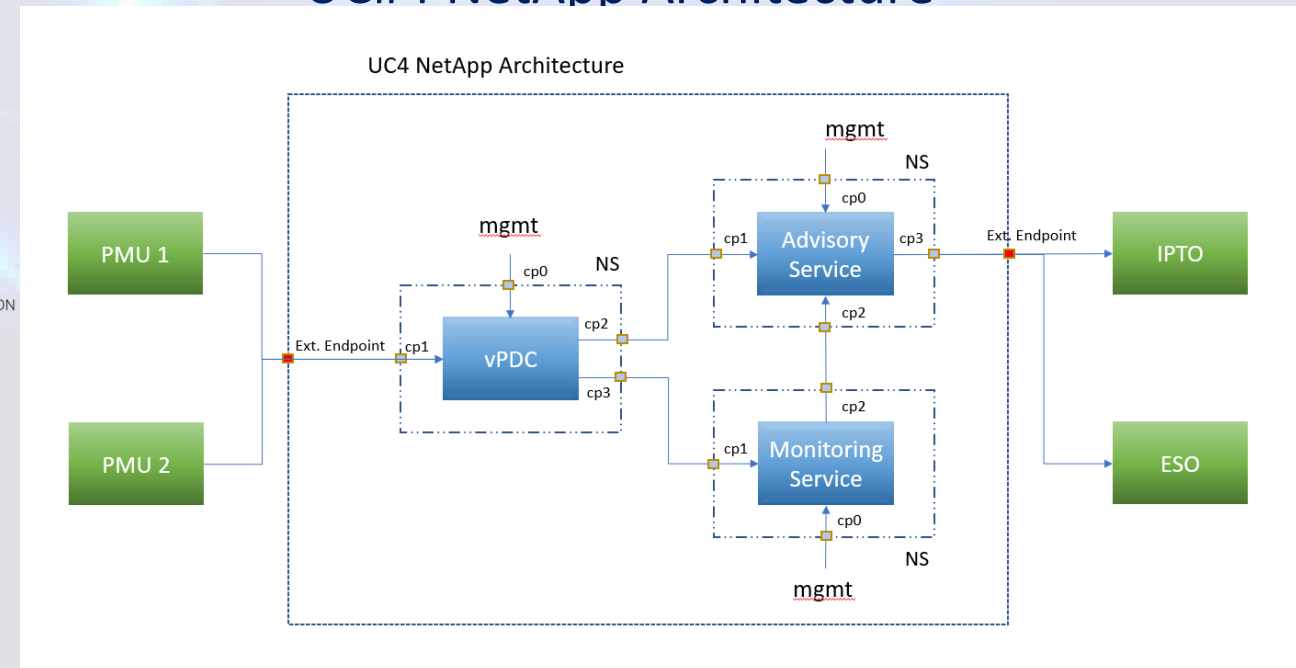
# NetApp for vPDC (UC#4 Smart5Grids)

- Generic Smart5Grid NetApp descriptor



- Services:
  - vPDC service
  - WAM service
  - Advisory service

## UC#4 NetApp Architecture





# Smart5Grid Project

## Main outcomes and general overview



Open NetApp  
repository



NFV automatic  
Verification  
and Validation  
framework



Four advanced  
5G real-life  
demonstrators



Roadmap for  
third party  
experimentation



Liaison and Interaction  
with 5G-PPP Program



Impact creation  
and exploitation

## GENERAL INFORMATION

THE CONSORTIUM

24 EU PARTNERS

7 EU STATES

DURATION

3 YEARS

TOTAL BUDGET

8M€

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# Thank You

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