Use Case 3

Millisecond level precise distributed generation monitoring

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

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Problem Statement

- Increased penetration of distributed RES and decarbonization of energy sector drives a challenging **Energy sector Transformation**,
- High stochasticity introduced by RES provokes issues in real-time operation, rendering necessary the **introduction of new flexibility services**,
- Most of the communication technologies used for the communication between the RES assets and the power grid are **still wire-bound**,
- The massive digitalization of energy sector aimed to facilitate energy systems transformation, requires a **stable, fast, agile and reliable communication infrastructure** and telco solutions.

Value Proposition

Real-time RES production monitoring

Predictive maintenance for renewable assets

Framework enabling participation in future flexibility services

Visualization of analytics about RES real-time production

5G need in UC3

- Previous generations of wireless technology *do not fulfil the criteria for low-latency and high reliability in millisecond basis* imposed by the use case's specifications.
- The participation of DERs in *fast frequency response requires orchestration* (optimization of assets setpoints) and assets activation in sub-second latency in order to meet the strict temporal requirements for service provision.
- Anticipating and foreseeing *the massive deployment of DERs* that will penetrate the power systems, there is a need for new technology that could assist the transformation that the grid will experience, as well as the issues that will arise from that. The envision that more and more IoT-enabled energy devices will be connected and controlled by aggregators or system operators, and thus rendering necessary the investigation of robust solutions that consider *the scalability aspect*.
- A *widespread IoT ecosystem* that includes millions or even billions of devices that operate on a range speed, *have different bandwidth* as well as a variety of quality of service (QoS) requirements. To achieve that, technologies before 5G cannot provide the needed coverage, latency, security, and cost optimization.

Advantages vs legacy solution

Real-time operation & maintenance	• Increase the real-time operation of the renewable assets and
5G network	• Transmission of the information fast and reliable, by also establishing the last mile connection.
NetApp and Edge Computing	• Deployment next to 5G radio access network: minimum end-to-end delay.
Performance improvement	• Regarding power system flexibility (reduce problems introduced by the stochasticity of the renewables), resilience and security of power supply

Impacted 5G-PPP and business KPIs

KPIs - Requirements	5G Use case category/ Slice Type
	URLLC
Reliability	99.999 %
Availability	99.999 %
E2E Latency	20ms-200ms
Multi-Domain Slicing	Yes
Private Slicing	Yes
Security	High

Business KPIs	Additional Explanation	Means of verification	Indicative quantitative values
Reduced wind farm down time	Due to malfunction	Comparison between historical annual statistics and down time during the demos	↓ 120%
Reduced maintenance costs	Predictive maintenance can prevent faults and therefore expensive repairs	Comparison between existing maintenance cost and costs due to the predictive maintenance NetApp	↓ 10%
Reduced financial loss	Reduction of wind farm down time leads to reduction in financial losses	Comparison between historical and actual data measured from the demos	↑ 10%
Decreased DER asset monitoring time	Due to low latency monitoring of power production	Measure the difference in time monitoring in the existing conditions and the time through the 5G environment in the lab	↓ 80%
Potential for asset owner to generate additional revenues from providing ancillary services	Real-time visibility on the asset generation will allow the asset owner to participate in the flexibility market and provide/trade flexibility services	1) Number of the actual flexibility transactions 2) Volume (MWh) of the actual flexibility transactions	Minimum 1 transaction per month

Target markets & opportunities

The proposed solution is directly targeted to **multiple energy sector stakeholders:** RES Producers, Balancing Service Providers, Aggregators, System operators, Original Equipment Manufacturers

3rd party developers and SMEs can **build upon and add new functionalities** (further enhance predictive maintenance tools, advanced forecasting tool, real-time control functionalities for fast flexibility services provided by RES).

Dedicated NetApp(s) for UC3

NetApp#1

Predictive Maintenance

- This NetApp enables *predictive maintenance capabilities* to the wind farm owner, by gathering measurements from sensors, such as rotational speed, vibration, wind speed, total energy production, moment power, temperature of the environment, etc. allows for capturing *the performance of key components* of the wind turbines, and thus offering the wind farm owner information regarding the asset performance, and the power system operator information about the operational availability of the asset.

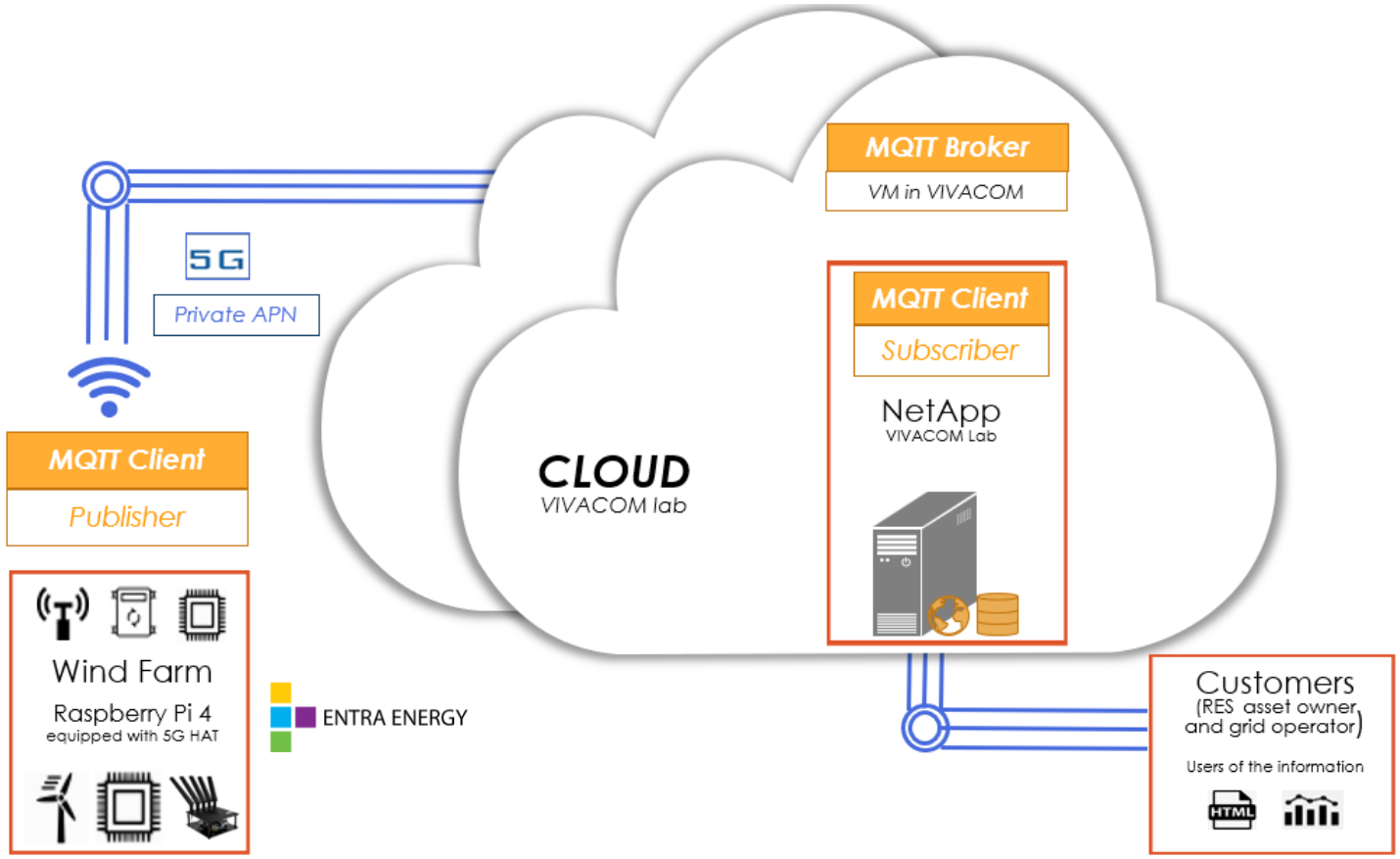
NetApp#2

Real-time production monitoring

- This NetApp provides real-time data monitoring with a millisecond latency of the wind farm production. The data collection process follows similar approach as the previous described NetApp. It will also provide a bidirectional communication, base for integrating the assets in future Flexibility Services market. This will foster the development of innovative observability models for power system operation, where TSOs gain insight in lower voltage levels of the grid.

Use Case's Architectural Setup

- First time in Bulgaria 5G is leveraged for an application in energy sector,
- Demonstration of an ultra-reliable and with low-latency 5G network in the energy domain in the laboratory environment, replicating the on-the-field implementation which is not yet in place,
- MQTT protocol will be used for the data exchange between the Raspberry Pi4 equipped with 5G HAT module and the server hosting the NetApps, which is in the VIVACOM lab
- An additional investigation will be performed to validate the applicability of 5G network to be used for enabling the coordination of DER portfolio to provide balancing services in a millisecond basis. This investigation will only be showcased during the pre-piloting phase, using the real-time hardware in the loop facilities of UCY.



Thank you for attending!

Any Questions