Millisecond level precise distributed generation monitoring for optimized renewable energy resources (RES) operation and maintenance

Vertical Use Case

Ralitsa Rumenova (ENTRA ENERGY)

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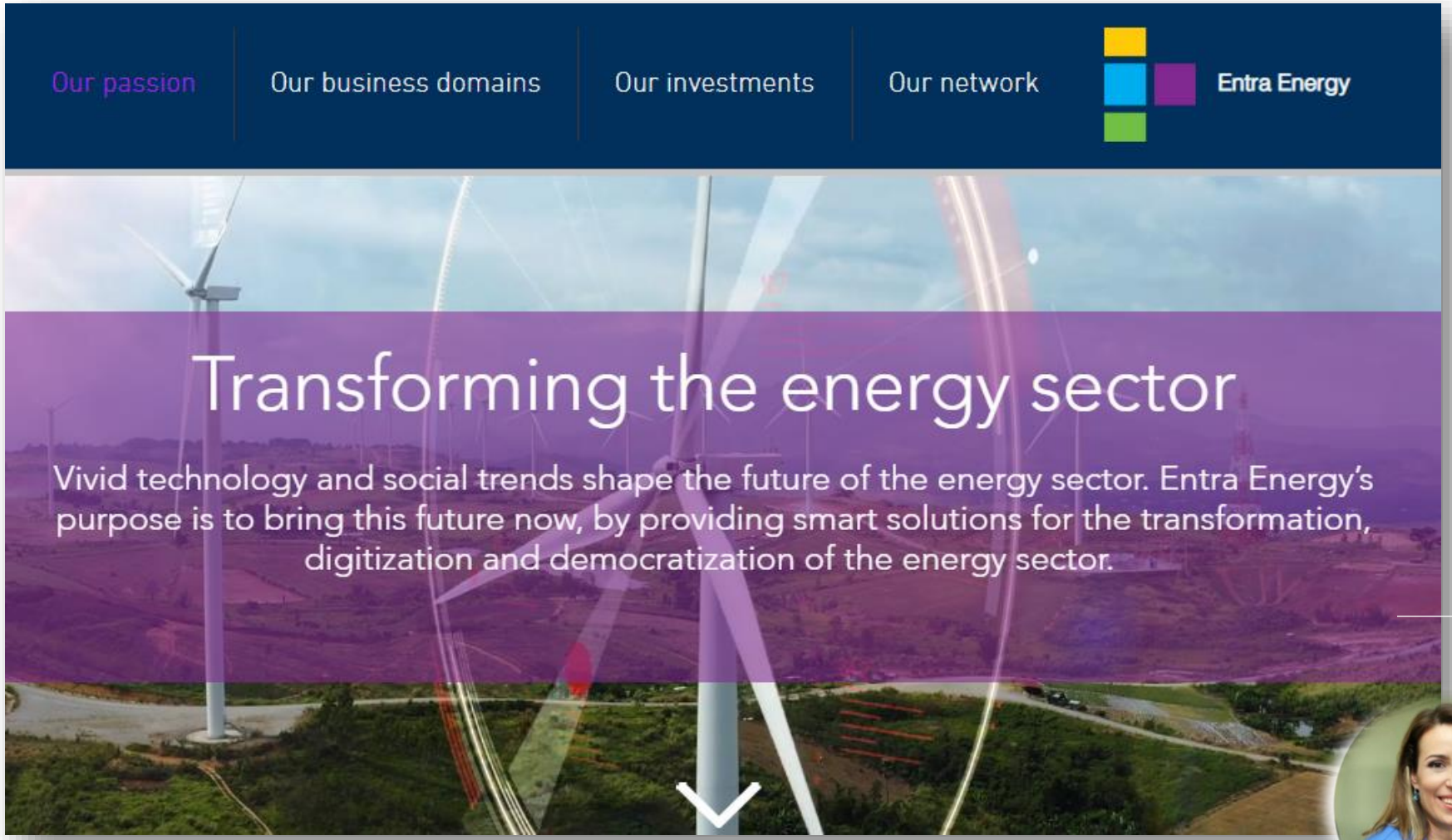
Smart5Grid

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

SUMMARY

Vertical Use Case MLPDGM

- About our company Entra Energy
- Background | Energy Sector Transformation
- Vertical Use Case Objectives
- Vertical Use Case NetApp VNFs
- Vertical Use Case Design
- Data flow diagrams
- Conclusion and next steps



RALITSA RUMENOVA
Driving innovation & implementation

+ 359 888 676 820
www.entra.energy
ralitsa.rumenova@entra.energy

Background | Energy Sector Transformation

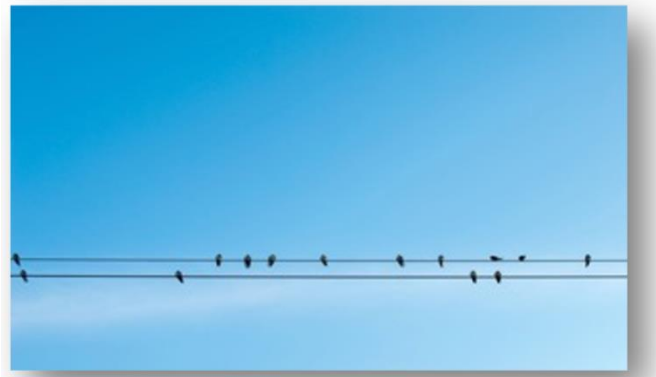
Problem statement | Challenges | Society

- Climate change & Energy independence (vs dependence on Gas and imported resources),
- Energy price (LCOE) drives an increase in RES production share
- Significant shift in energy production and consumption
  - Production: geographically distributed RES, variable in nature, many in number, small in size owned by non-professionals
  - Consumption: many industries go digital (e-transportation, industry 4.0, etc.); consumer to prosumer shift

Background | Energy Sector Transformation

Problem statement | Challenges | Grid | Infrastructure

- Change and Challenges
  - capacity
  - visibility
  - predictability
  - balancing
  - congestion management
- 5G Addresses:
  - connection density
  - Cost



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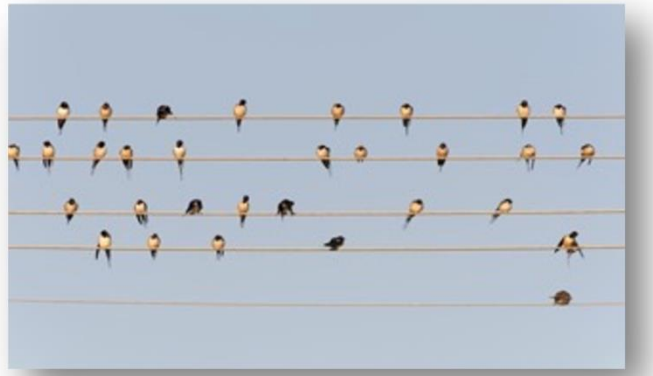
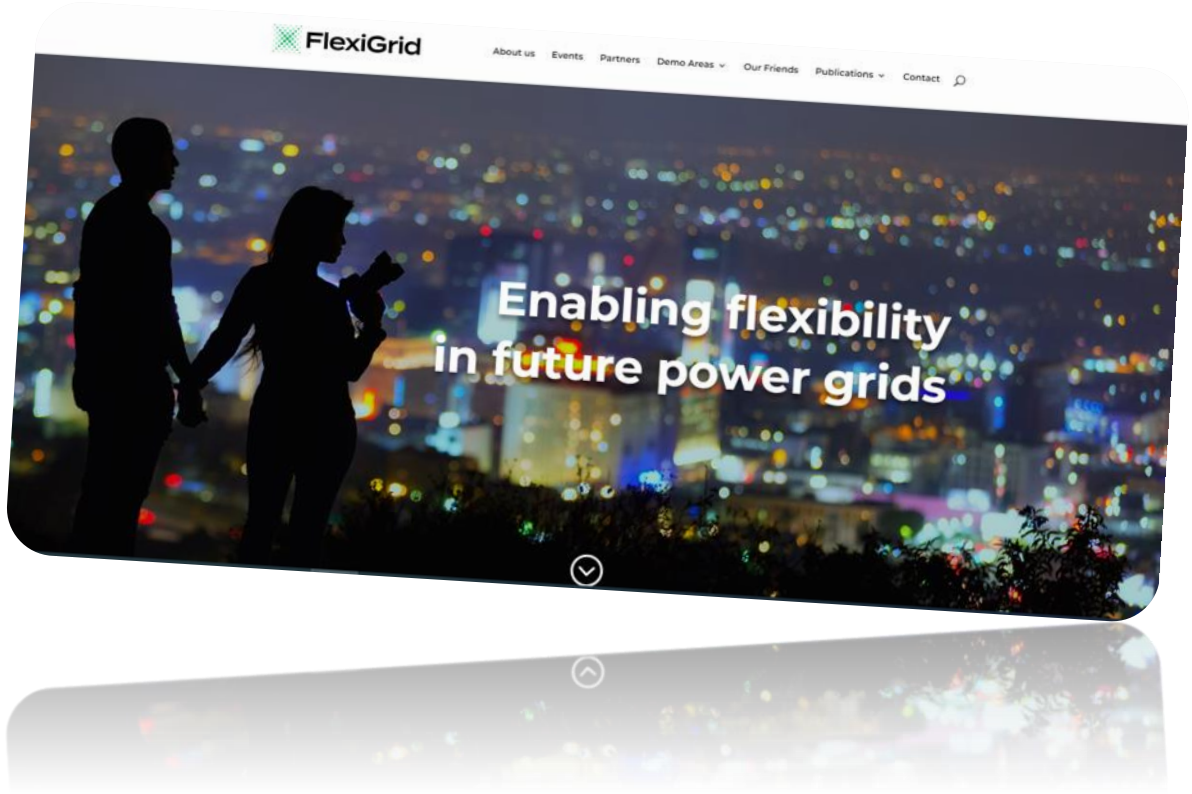


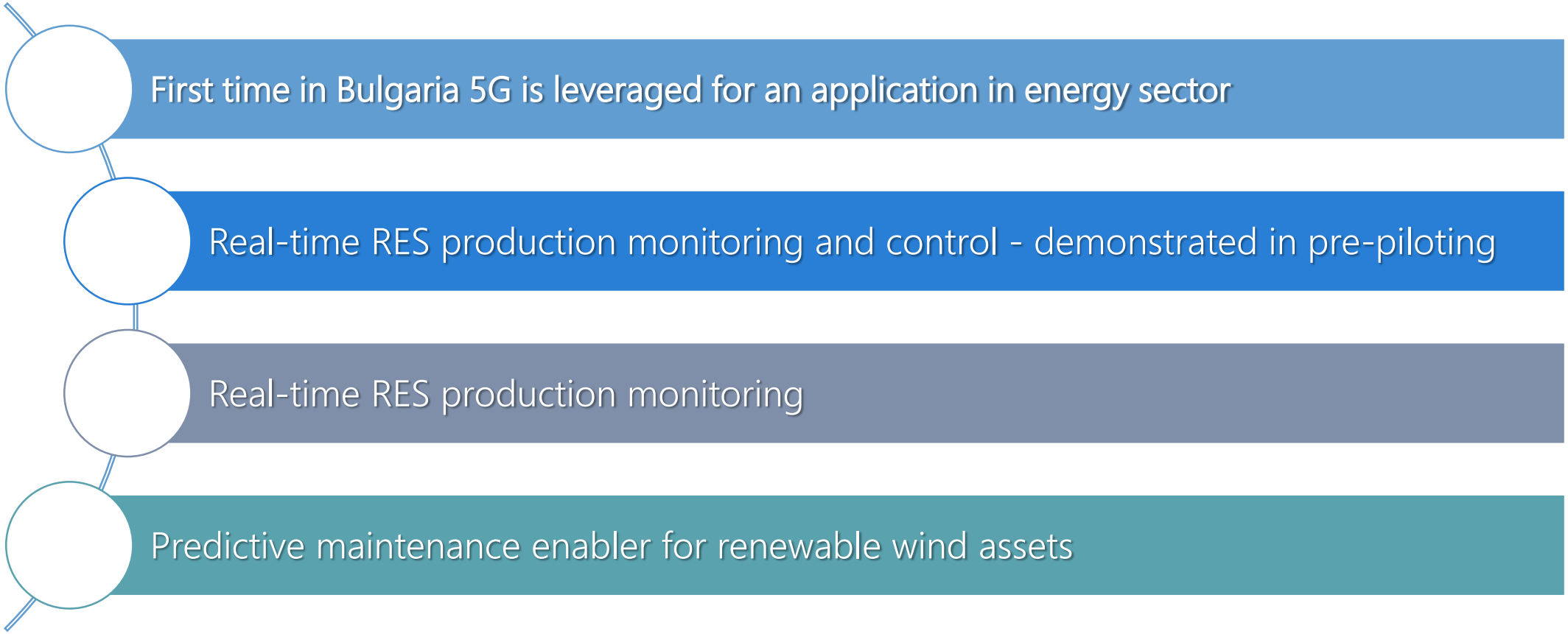
Background | Energy Sector Transformation

Problem statement | Challenges | End user

- Energy Management
  - Increased visibility
  - Improved availability
  - more accurate forecasting
  - Enabled energy flexibility exchange
- Technology advancements
  - Telecommunication
  - IoT
  - blockchain



Vertical Use Case Objectives



Vertical Use Case NetApp VNF

NetApp#1

Predictive Maintenance Enabler

- This NetApp *enables predictive maintenance capabilities* to the wind farm owner, by gathering measurements from SCADA system and sensors of different energy, environmental and technical parameters such as wind speed, active and reactive power, rotational speed, alarm status 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 key parameters – organized in 3 groups: energy, technical and environmental*. The data collection process follows similar approach as the previous described NetApp. It will also provide a bidirectional communication (and control function, demonstrated in HIL demo T3.4), 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.

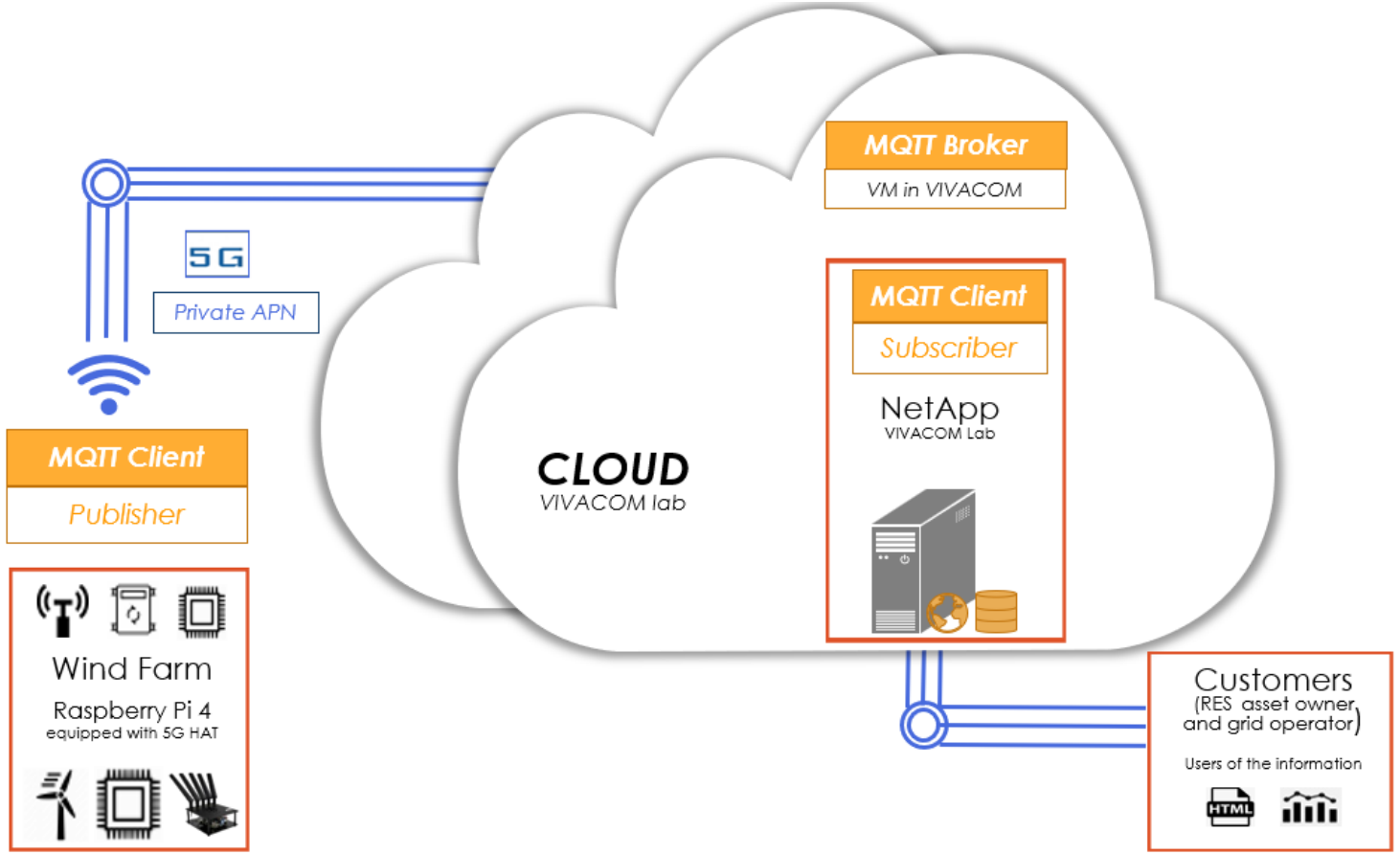
Additional control applications to investigate potential impact
(in pre-piloting demonstration)

- **Control Application#1:** Coordinated fast frequency support by DERs through 5G
- **Control Application#2:** Ramping rate compensation by DERs through 5G

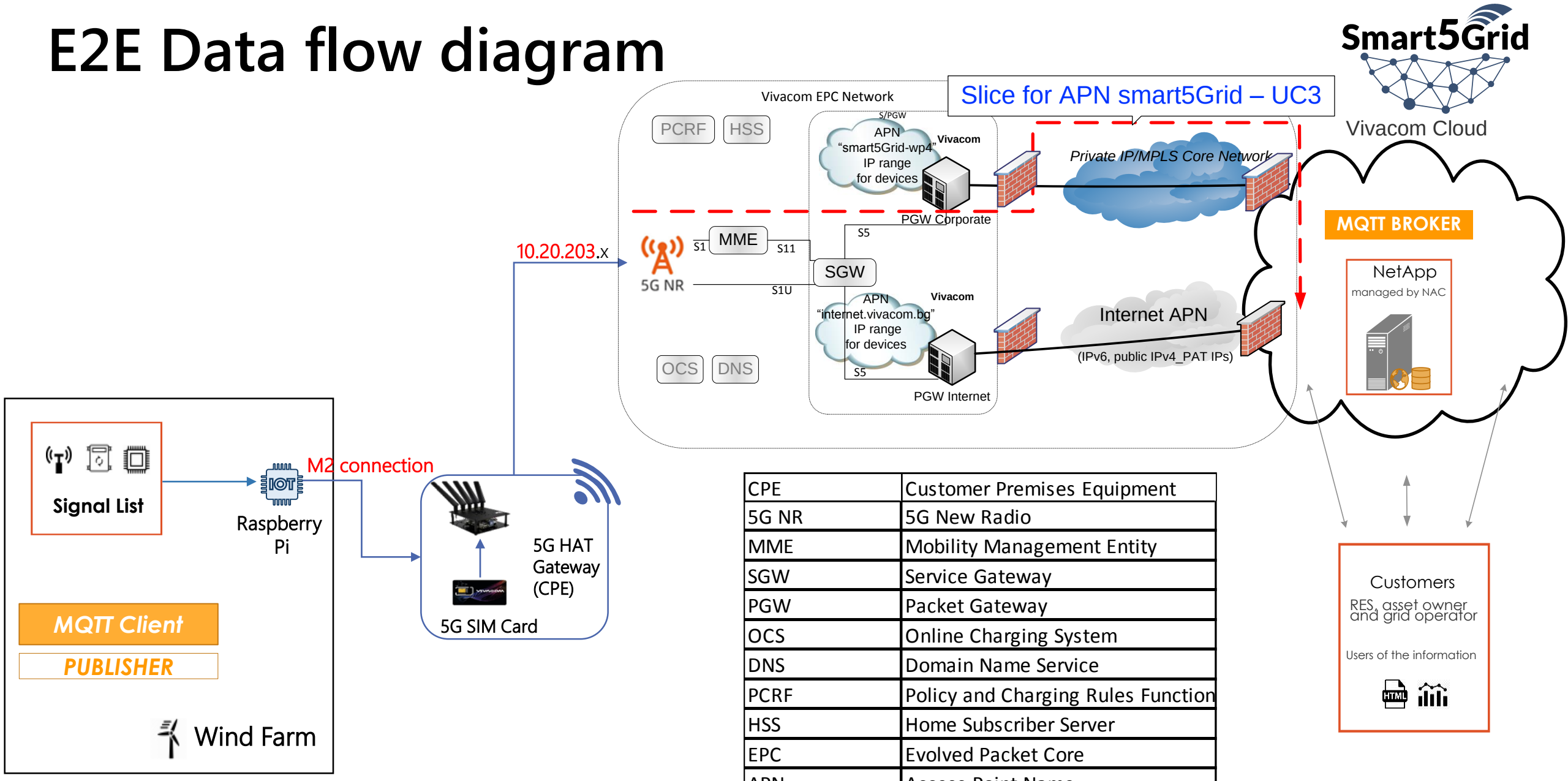
Vertical Use Case Design

How we address the challenges in Smart5Grid Vertical Use Case

- 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 IoT data exchange between the Raspberry Pi4 equipped with 5G HAT module and the server hosting the NetApps, which is in the VIVACOM cloud
- MQTT Broker, UC3 NetApp all installed on virtual machines in Vivacom cloud and NAC will be connected via Internet

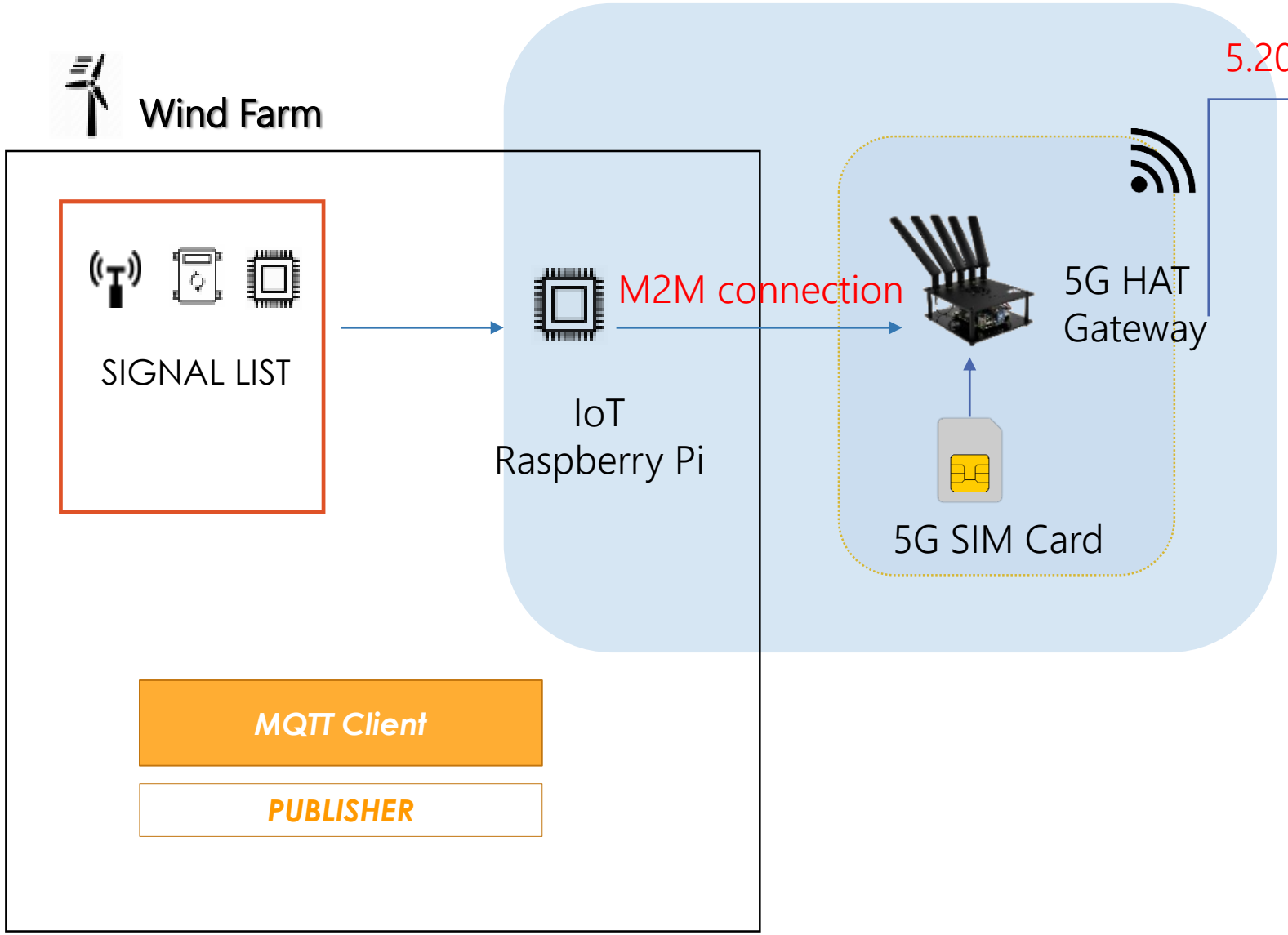


E2E Data flow diagram



CPE	Customer Premises Equipment
5G NR	5G New Radio
MME	Mobility Management Entity
SGW	Service Gateway
PGW	Packet Gateway
OCS	Online Charging System
DNS	Domain Name Service
PCRF	Policy and Charging Rules Function
HSS	Home Subscriber Server
EPC	Evolved Packet Core
APN	Access Point Name

Data flow SIMPLIFIED I Wind farm perspective

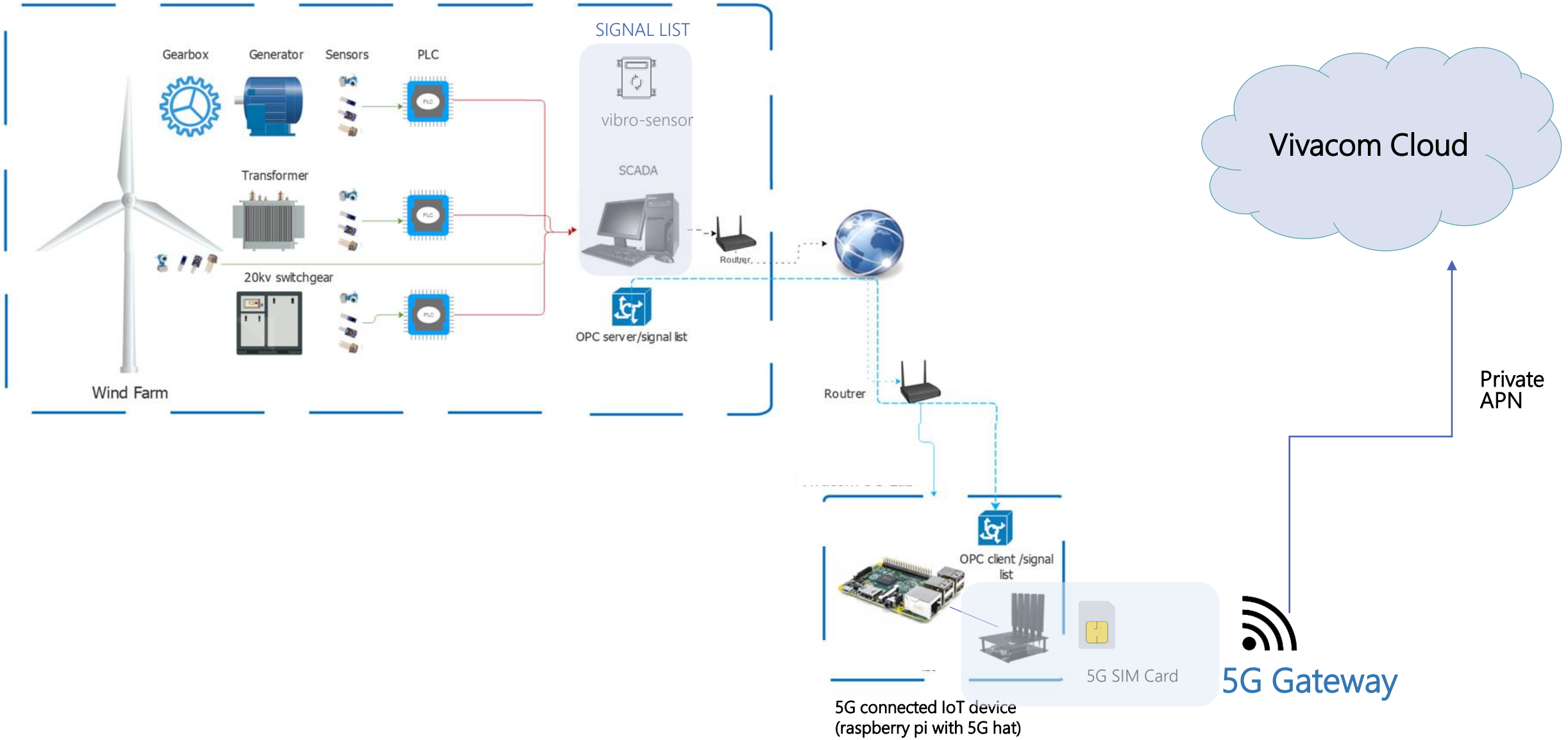


IoT device reads the signal list form SCADA and sensors by OPC client-server protocol

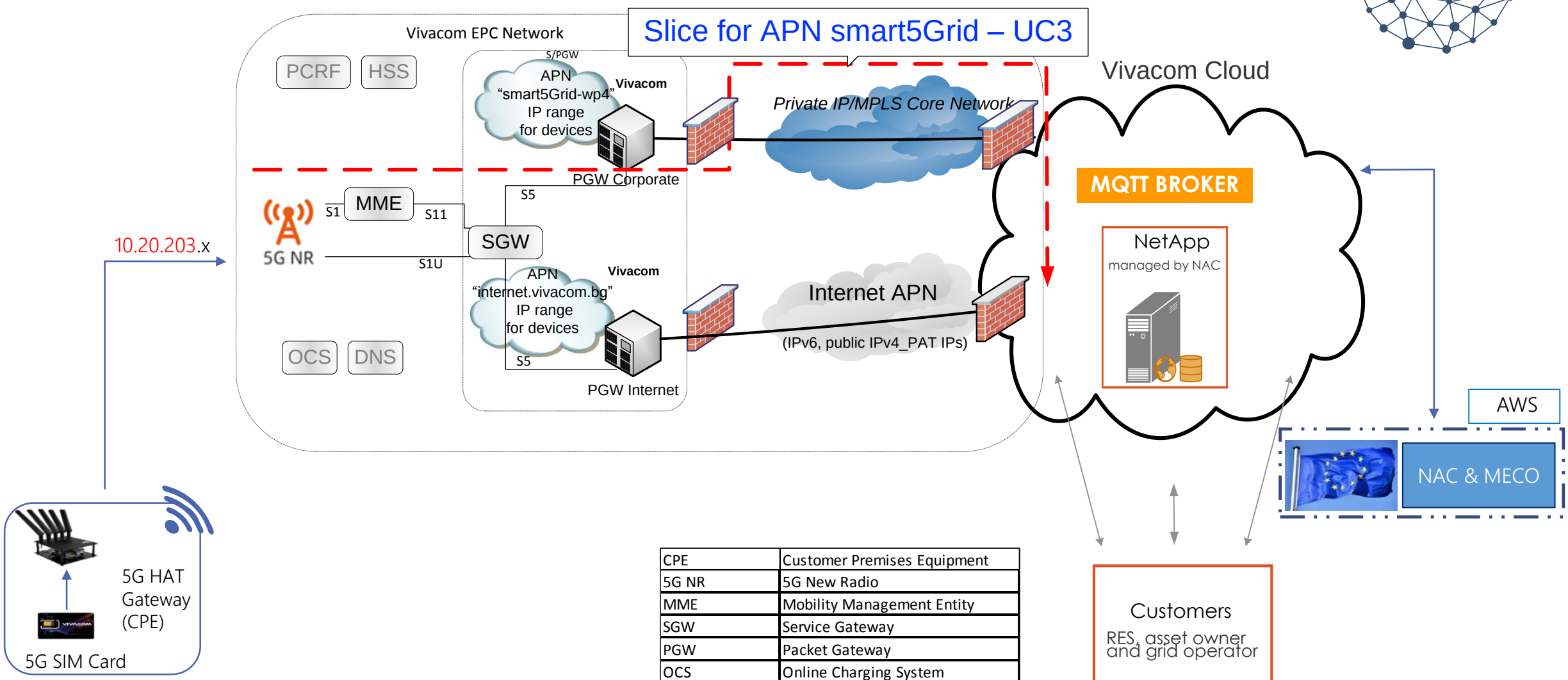
IoT is equipped with 5G HAT installed with 5G SIM that acts as a 5G gateway

MQTT Client – Publisher sends information to MQTT Broker in Vivacom Cloud

Data flow DETAILED I Wind farm perspective



Data flow network topology I Telco perspective



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Happy to answer any questions you may have!

Thank you

Wishing all a very interesting and fruitful conference!