Smart5Grid

Smart5Grid roadshow

13 Junio 2023, 14.00-15.00

Evento Virtual

Smart5Grid roadshow

Agenda

- Project Overview (Enel Grids)
- 5G Technology, public and private infrastructure overview (i2Cat)
- MEC Server, NAC and Orchestration (Nearby computing)
- OSR, V&V and **Network Application** concept (Atos)
- Spanish pilot, use case (E-Distribución)
- Opportunities for SMEs and experiences from implementers (Nosia)
- Open Debate

Daniele Porcu

Smart5Grid Project Coordinator

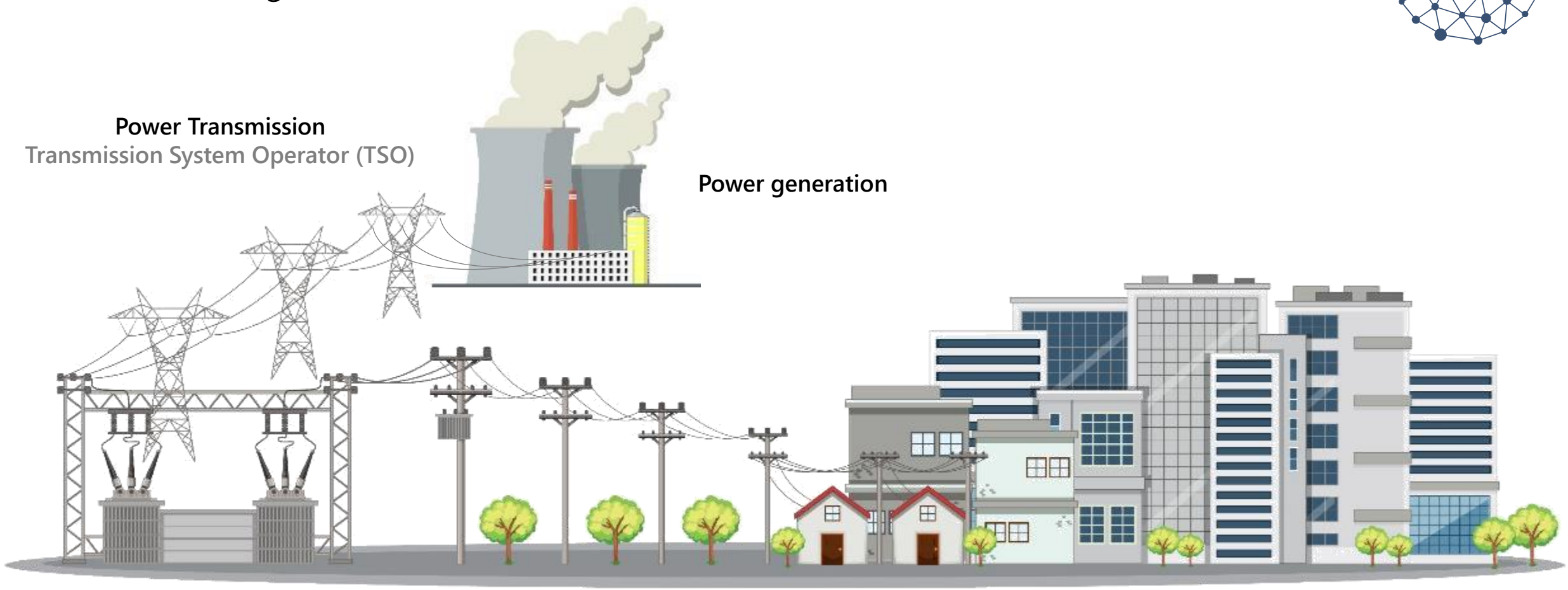
daniele.porcu@enel.com

Energy Vertical

Traditional grid

Power Transmission
Transmission System Operator (TSO)

Power generation

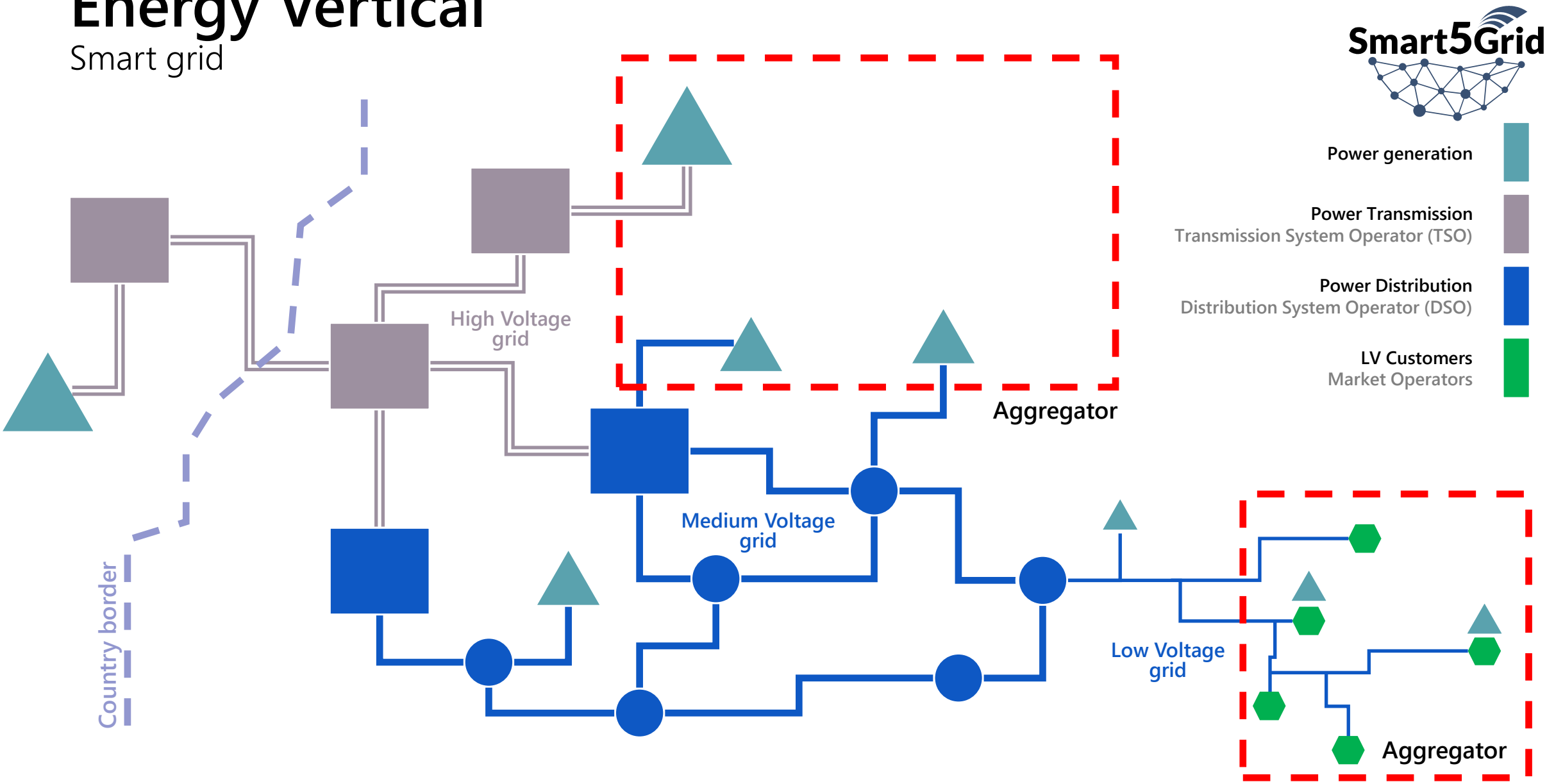


Power Distribution
Distribution System Operator (DSO)

Customers
Market Operators

Energy Vertical

Smart grid



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

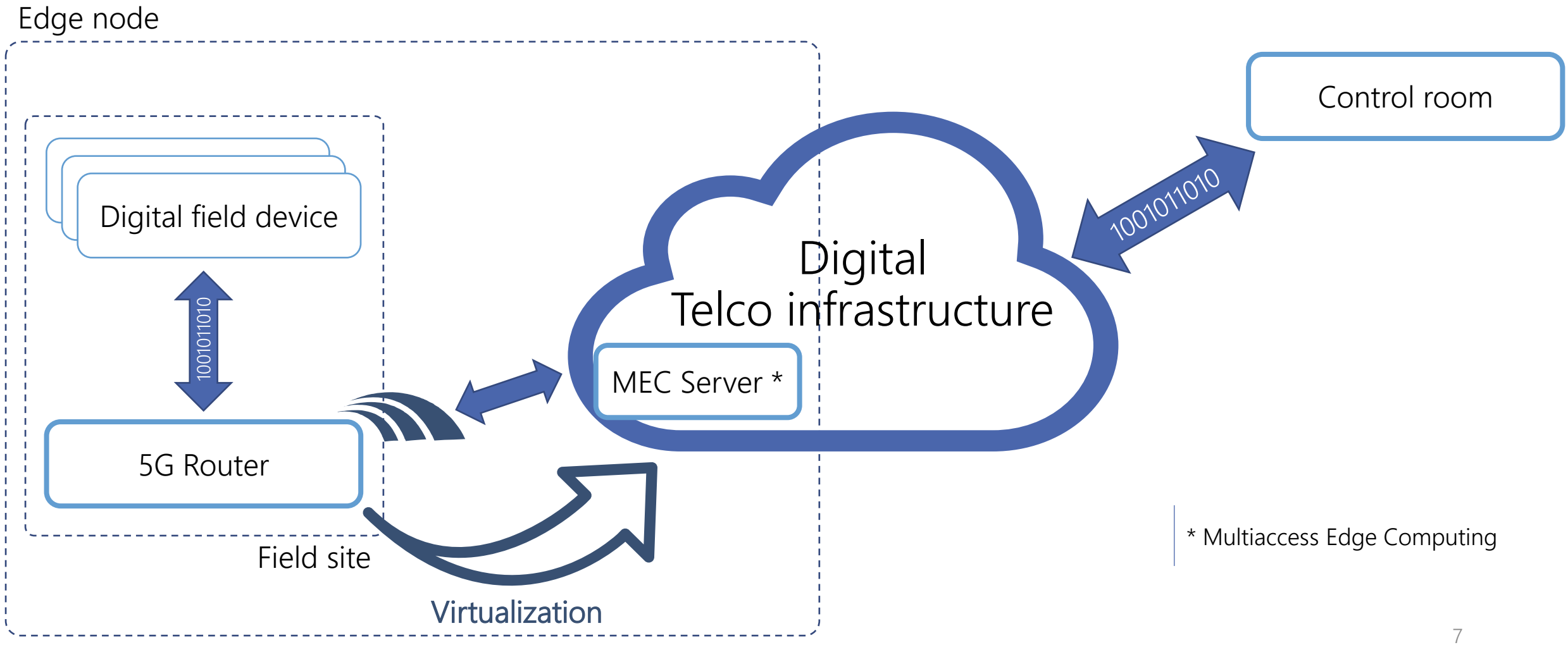
Safety for field operators

New solutions from 3rd parties

Need for digitalization

Security and reliability

5G-based cloud edge computing



* Multiaccess Edge Computing

Smart5Grid

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

The **Smart5Grid** project aims to investigate the potential of 5G-based Edge-Cloud Computation in the Energy industry, by introducing the concept of Network App for simplifying the 5G Complexity. The project testbeds are now available for third-parties' experimenters, fostering the creation of a new market-segment for Network Apps.

GENERAL INFORMATION

THE CONSORTIUM

24 EUROPEAN PARTNERS

(50% SMEs)

COVERING 7 EU STATES

DURATION

3 YEARS

TOTAL BUDGET

8M€

Italian Demo | Olbia

IP monitoring tool for Smart Grids supporting Automatic Fault Detection

Spanish Demo | Barcelona

Real-time power plant operators' safety monitoring

Bulgarian Demo | (Southern region)

DER management and predictive maintenance

Greek-Bulgarian Demo | (Cross-border)

Real-time cross-Country frequency monitoring

the Smart5Grid Consortium

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

DSOs

*e-distribuzione

*e-distribución

TSOs

ECO ЕАД

ադμηε

SMEs

EIGHTBELLS

INFOLYSIS

SC

NEARBY COMPUTING

ubiwhere
SUITING THE FUTURE

athonet

axon logic

SETECHCO

SIDROCO

ENTRA ENERGY

UBITECH
digitizing energy

nosia
- SEÑALIZACIÓN INDUSTRIAL
- EQUIPAMIENTO PARA LA INDUSTRIA

STAM
MASTERING EXCELLENCE

*Linked third-parties of Enel Grids

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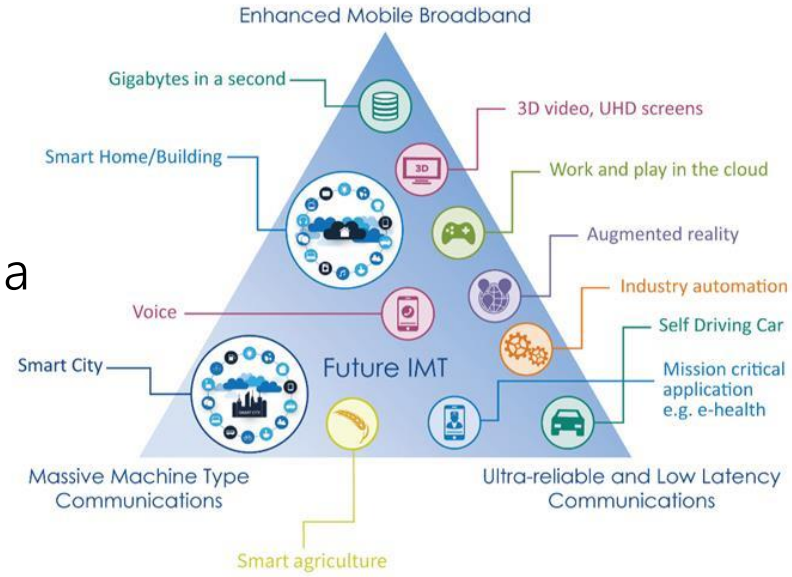
5G technology, public and private infrastructure overview

August Betzler

5G Technology



- 5G features new paradigms that enable novel use cases and support for a variety of verticals
  - Support for EMBB, URLLC and mMTC traffic types
  - Network slices for isolation of resources and traffic
  - Very high reliability and availability, low latency, high troughput

- Private 5G networks, compared to public ones, allow for isolation and full control of the resources
  - Dedicated edge computing resources (vs. Cloud) for applications using UPFs for minimal latency and local management
  - NFV MANO: Orchestration + Application management

Open Source MANO

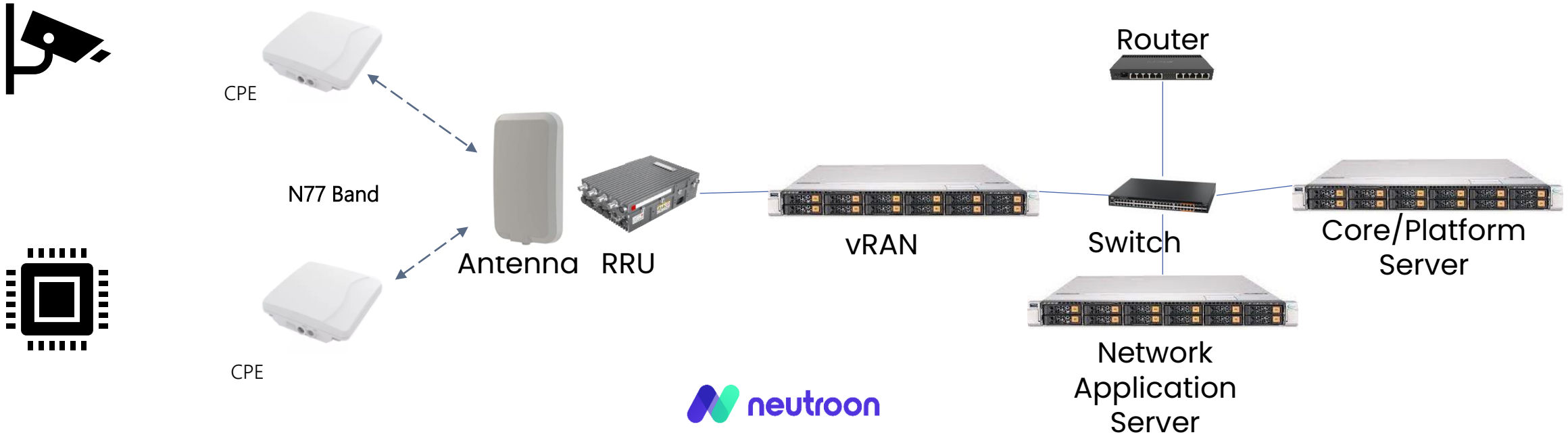
kubernetes

i2cat

Typical 5G network infrastructure

Example: 5G in the ECOGARRAF electrical substation

- A private 5G SA network is being deployed with the following characteristics:
  - 3 servers: vRAN server, Network Application server, Core/Platform server
  - 1 RRU: Outdoor RRU to provide coverage in the substation
  - Core is based on Open5GS, Release 16
  - Supports creation of slices (computation, (wired/logical) network, 5G NR)



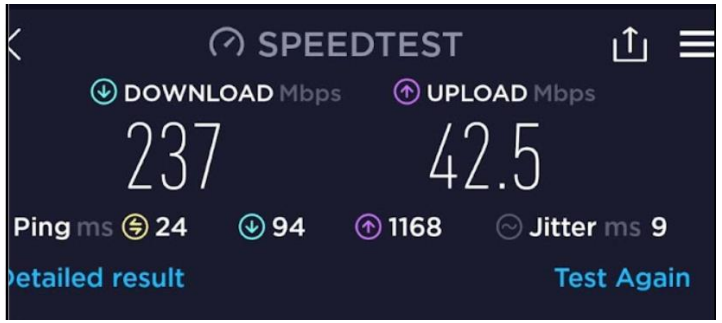
Example of 5G RAN Characteristics

KPIs:

- Low Latency
- High dedicated throughput

Static CPEs allow for devices to be connected to the 5G network

Pilot radio configuration: 40 MHz in band n77



These values may vary (depending on weather conditions and final setup)

Latency: 13.43 ms average (Device to core)

Fulfilling the needs of targeted applications (Project internal + third party experiments)

Network Application Server Characteristics

Smart5Grid

Hardware Capabilities:

- 12 vCPUs: Available ~10 vCPUs 
- RAM 32 GB: 16 GB Available 
- SSD: 1.7 TB 

Software Capabilities:

- Openstack as Virtual Infrastructure Manager (VIM)
- Kubernetes Cluster deployed as a VMs over Openstack (dynamic resources according apps needs)
- Helm Tool as a Kubernetes applications manager enabled into the Kubernetes cluster

Open Source MANO kubernetes HELM

Limitations:

- Does not include GPU resources

Cloud-oriented Telco Environment

Smart5Grid Layer:

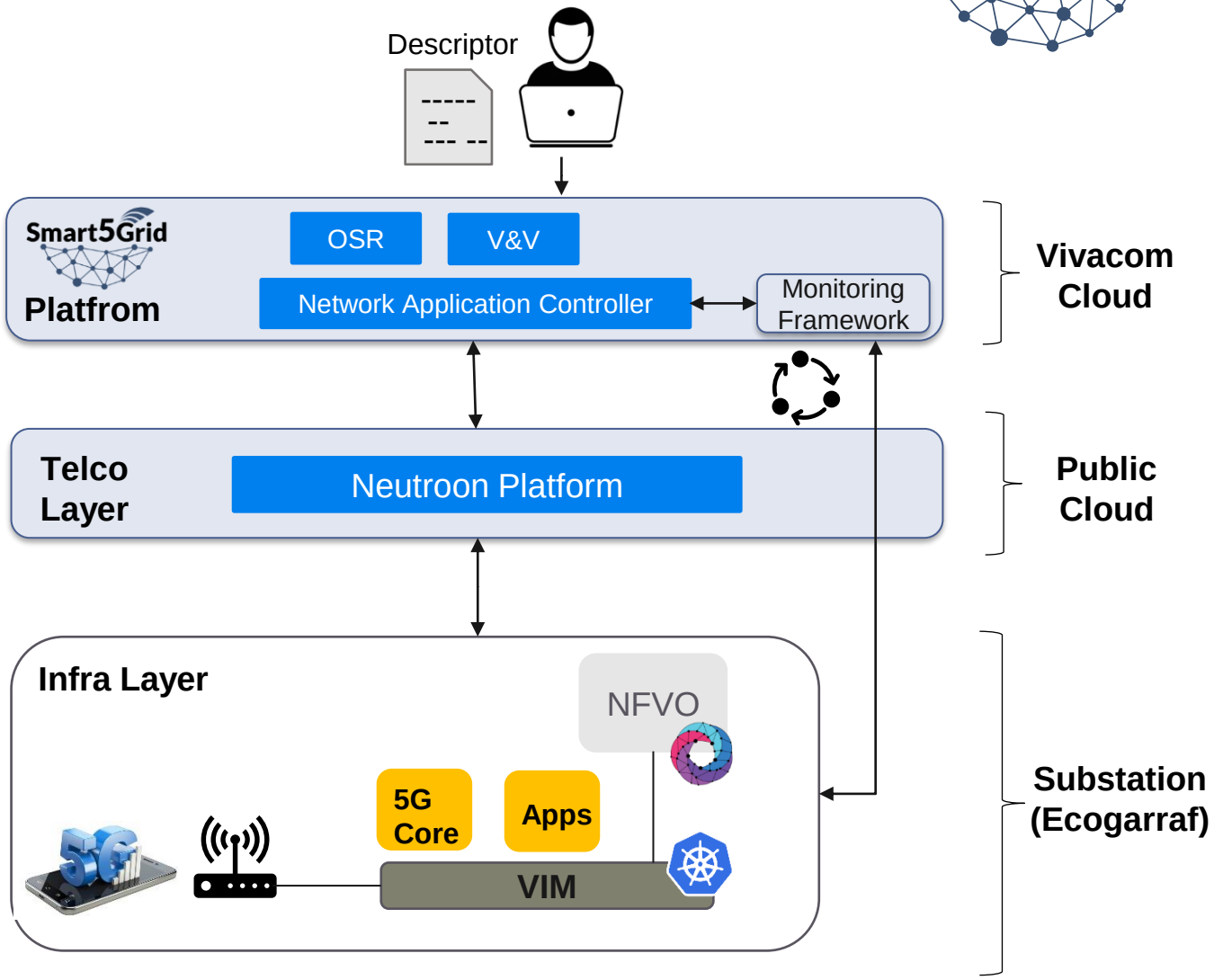
- First point of contact to deploy the Network Applications
- Application Lifecycle Management

Telco Layer:

- Infrastructure lifecycle management
- Management of NFV platform (e.g., OSM, k8s)

Infra Layer:

- Infrastructure lifecycle management (e.g., RAN, servers, VIMs)
- E2E Connectivity



Thank you

Wishing all the best for our common success!

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MEC Server, NAC and Orchestration

Nicola Cadenelli

Smart5Grid

NEARBY COMPUTING

Smart5Grid Network App Controller

June 2023

Network App Controller Definition and Main Features

*"Following a **cloud native approach** in which applications are architected as a set of services that run in Docker containers, Smart5Grid will develop the **Network App Controller** in the system management level, which will house the **MEC offloading** and **Elastic VNF sizing and chaining functions**."*

- Cloud-native and portable.
- Offer NBI for Network App onboarding (used by V&V Framework and ISVs).
- Manage the lifecycle of Network Apps.
- Edge and cloud infrastructure in the orchestration – either provision new nodes or onboarding existing infrastructure.
- Manage users (RBAC), organizations, and more settings.

Smart5Grid Use Cases

BENEFITS

❑MONITOR AND SECURE SUBSTATIONS

High-resolution 3D sensors combined with AI will support workers during maintenance, avoiding reaching live parts of the power grid.

❑ AUTOMATIC POWER GRID FAULT DETECTION

Monitor the power grid remotely and detect failure locations along lines reducing operation costs.

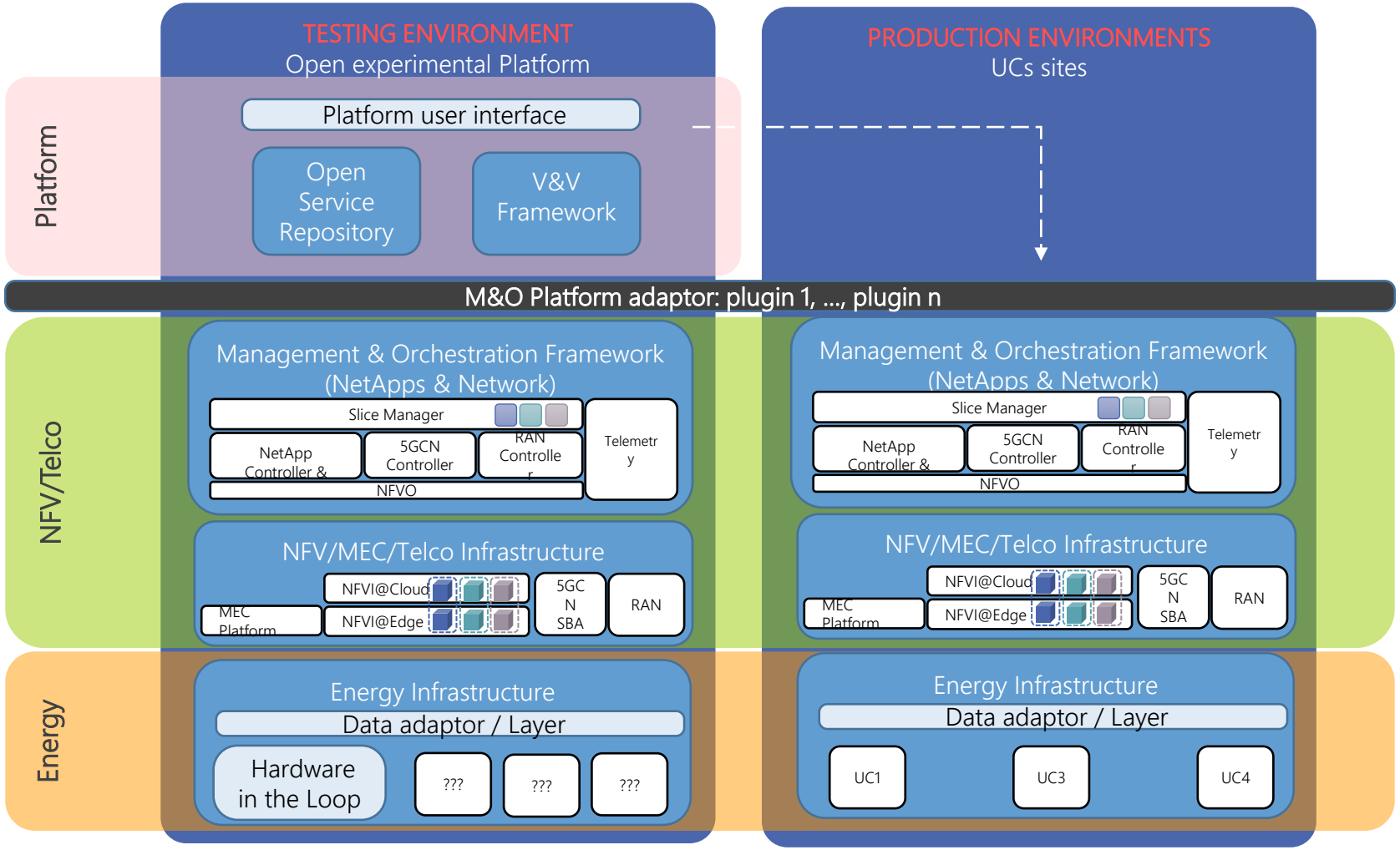
❑REAL-TIME WIDE AREA MONITORING

Aggregate and control data of 1000s of Medium and High Voltage decentralized Renewable Energy Sources and their inverters.

❑REAL-TIME WIDE AREA MONITORING

From Distributed Energy Resources at Medium Voltage levels operated by DSOs to High Voltage levels operated by TSOs, as well as inter-TSO cross-border Regional Security Coordination.

Smart5Grid Architecture



Smart5Grid

NEARBY COMPUTING

Nearby One as Smart5Grid Network App Controller

June 2023

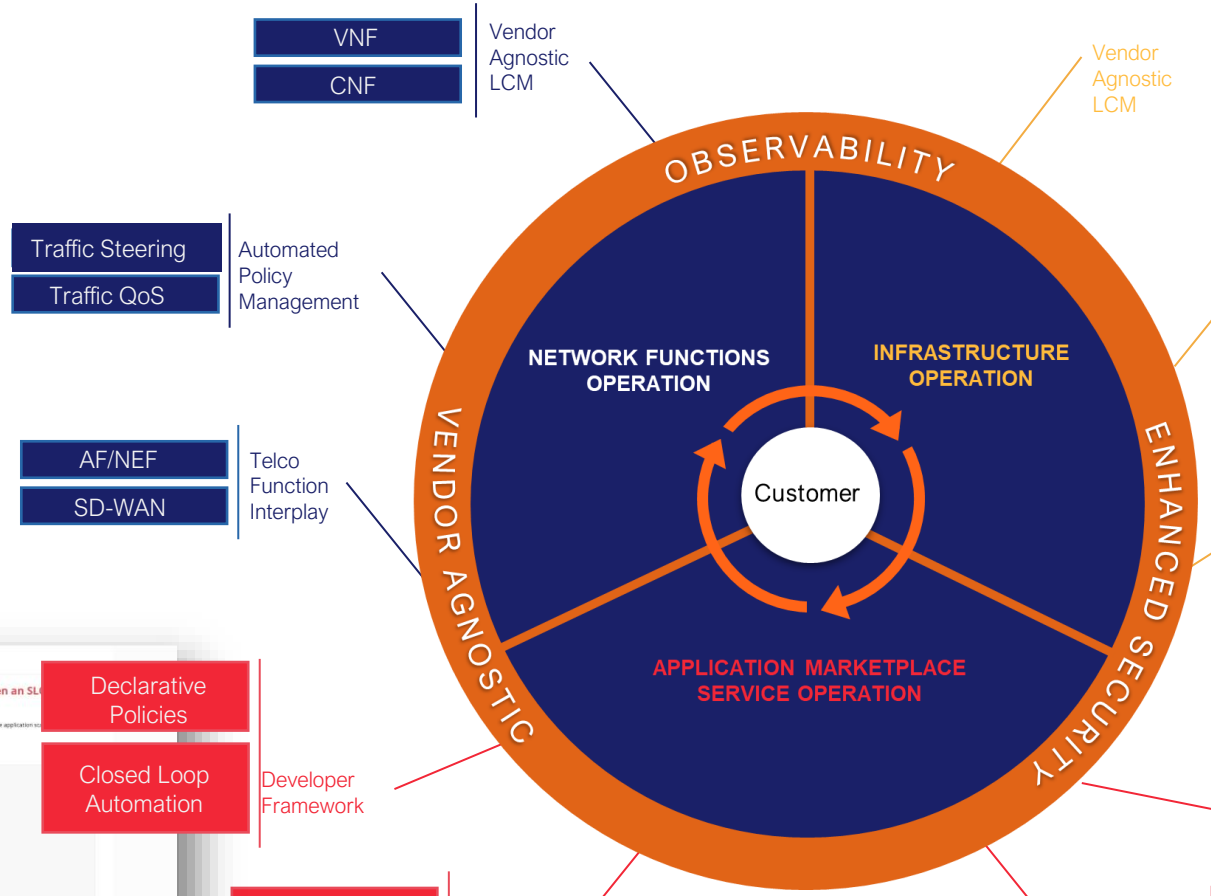
About NEARBY COMPUTING

Smart5Grid

- Founded in 2018 by leading experts from the Barcelona Supercomputing Center.
- A Global leader in Edge Orchestration, headquartered in Barcelona.
- Sales teams in EMEA and APAC.
- Servicing customers globally through strategic partnerships with Global Systems Integrators and Technology Partners.
- Backed by strategic investors.

Lenovo | RED ELÉCTRICA DE ESPAÑA | cellnex

Nearby One's Feature Set in One Slide



VNF
CNF
Vendor Agnostic LCM

Traffic Steering
Traffic QoS
Automated Policy Management

AF/NEF
SD-WAN
Telco Function Interplay

Declarative Policies
Closed Loop Automation
Developer Framework

SR-IOV
Accellerators
Platform Awareness

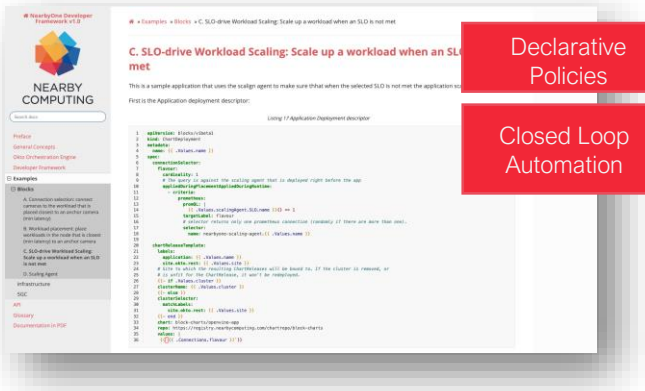
Vendor Agnostic LCM
nZTP
Cloudlets

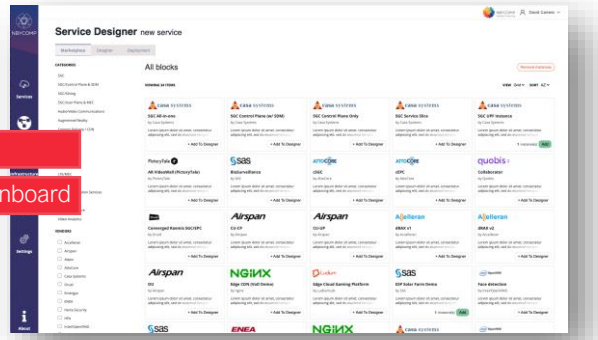
Multi-site Management
(Multi) On-prem
(Multi) Cloud

Resource Manager Agnostic
Virtual
Physical (x86 / IoT)

Marketplace
Extensible
Open to Onboard

Smart Placement Advisor
Resource-driven
Location-driven





Vendor agnostic by design

Smart5Grid

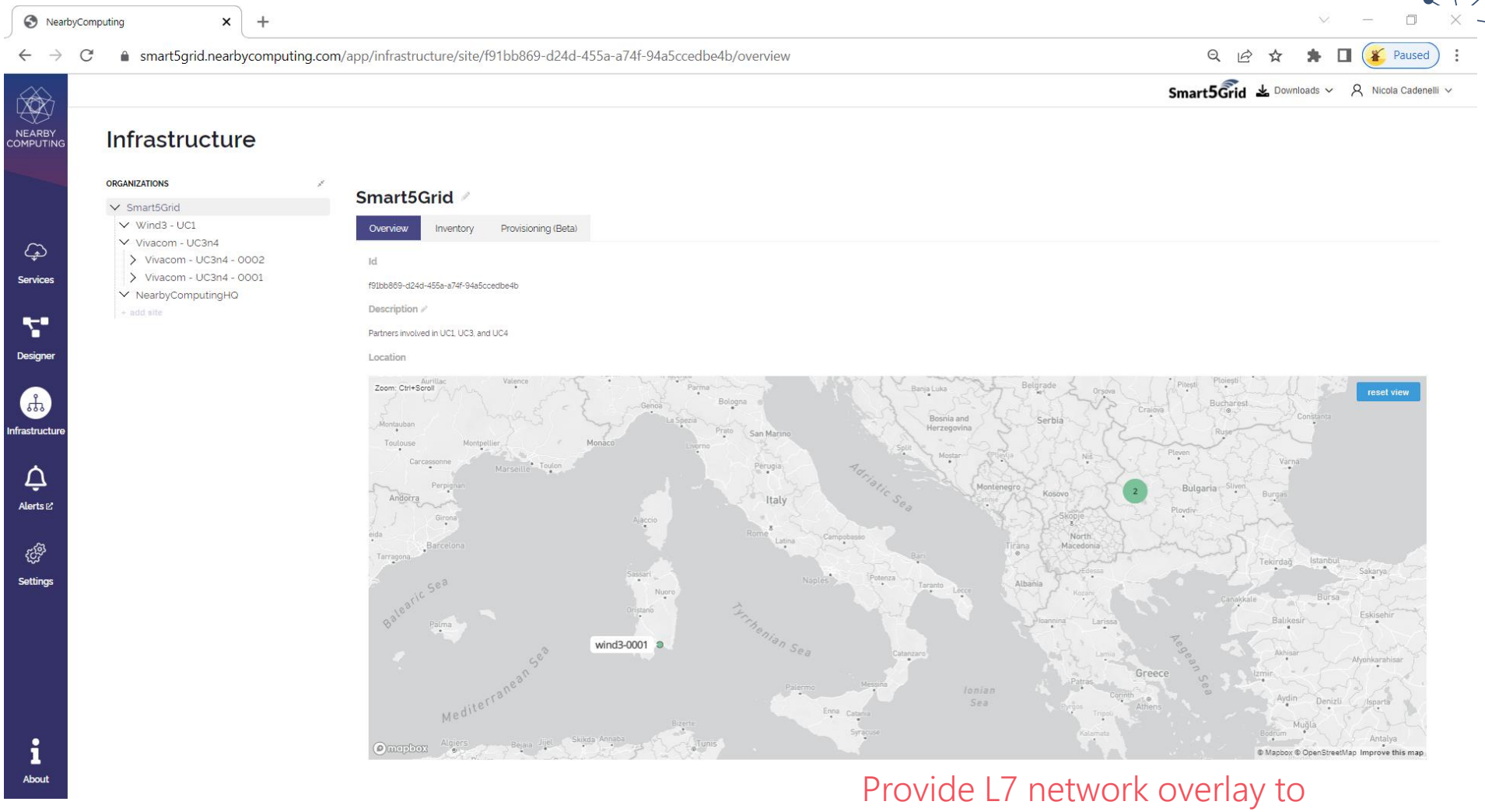
Lenovo
intel
Hewlett Packard Enterprise
CISCO
NVIDIA
DELL
AMD
ADVANTECH
Microsoft Azure
aws
DETASAD
RED HAT OPENSHIFT
WINDRVR
RANCHER

herta
NEARBYSENSOR
ALBORA
Qwilt
Ludium
Pictorytale
Omniscient
sprinx
verbio
sas
transparent edge services
quobis
EMERGYA

Quick Demo

Nearby One as Smart5Grid NAC: Infrastructure

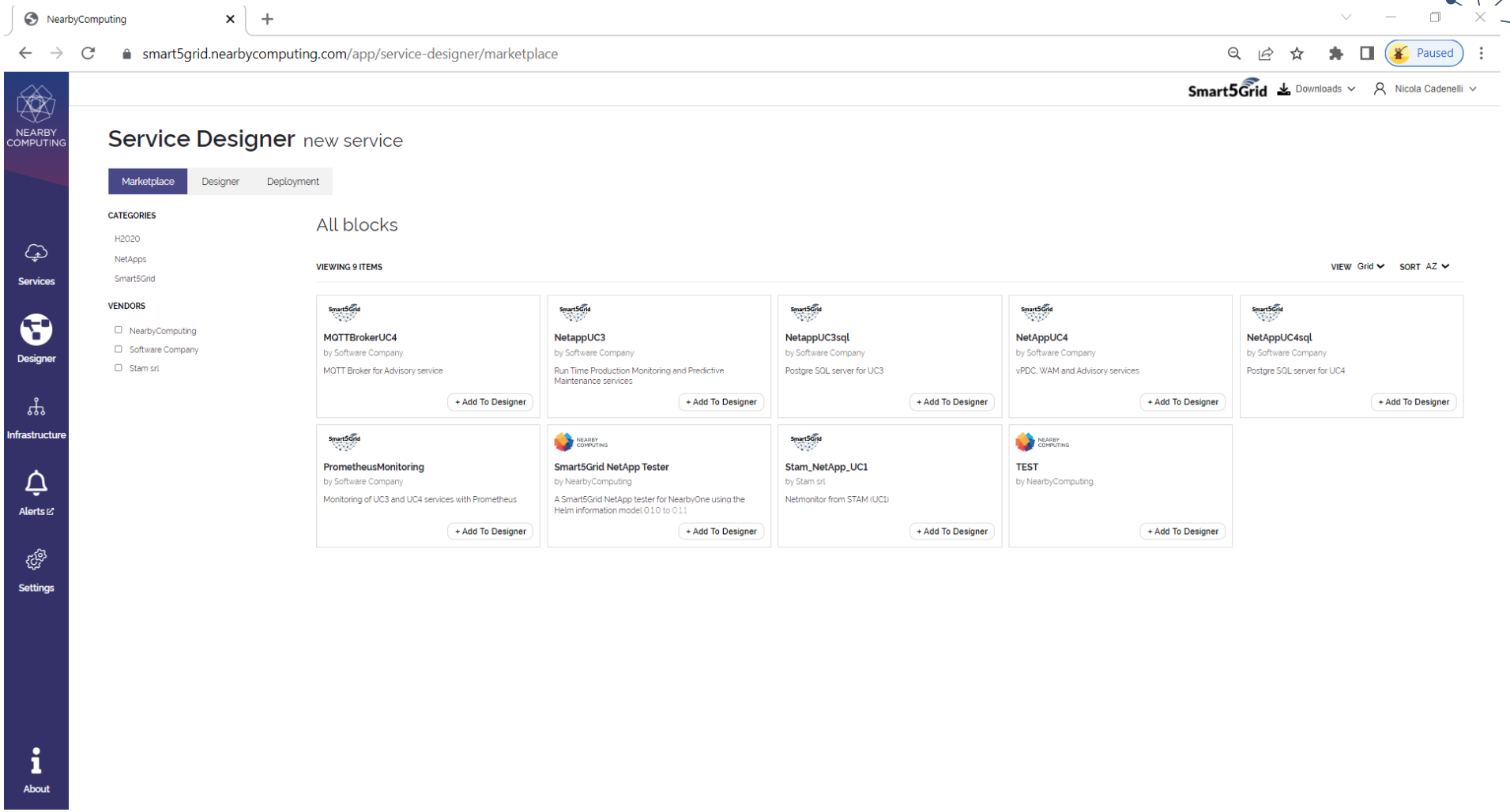
One public Network App Controller for **n sites** (UCs, edge sites, private or public cloud)



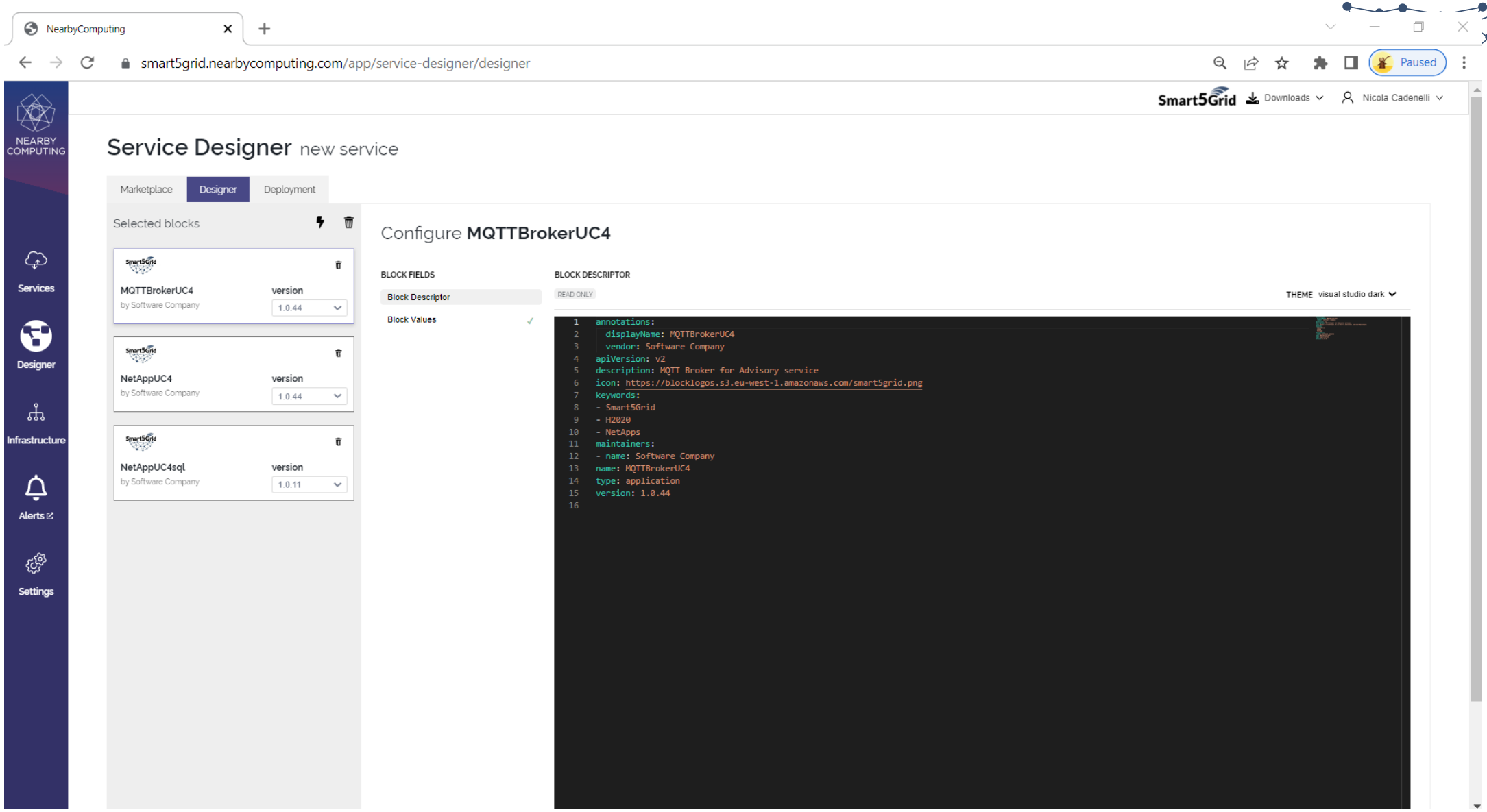
Provide L7 network overlay to manage sites behind firewalls and NATs

Nearby One as Smart5Grid NAC: Net.App Marketplace

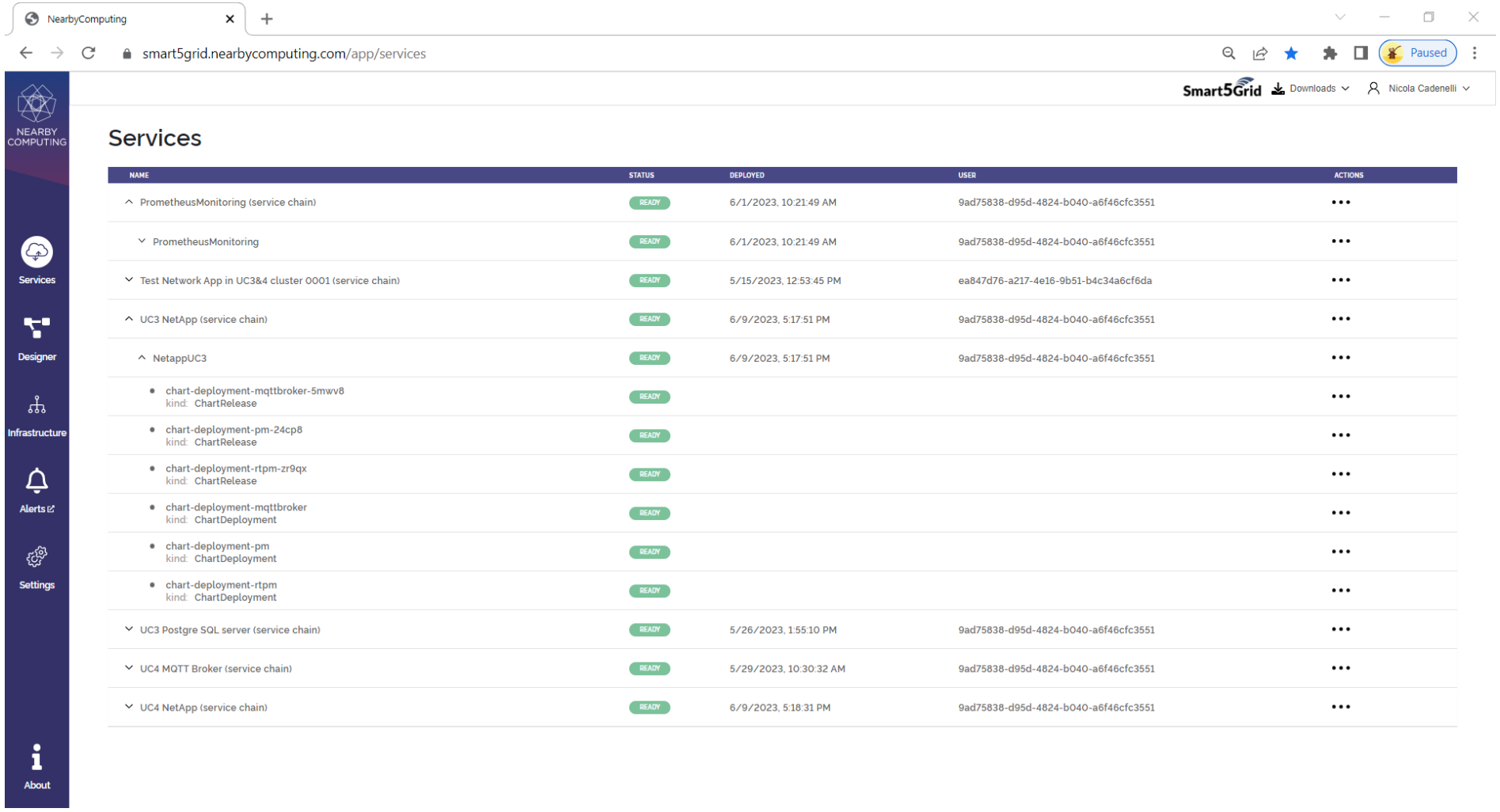
Onboarded Network App are available for deployment from a central marketplace



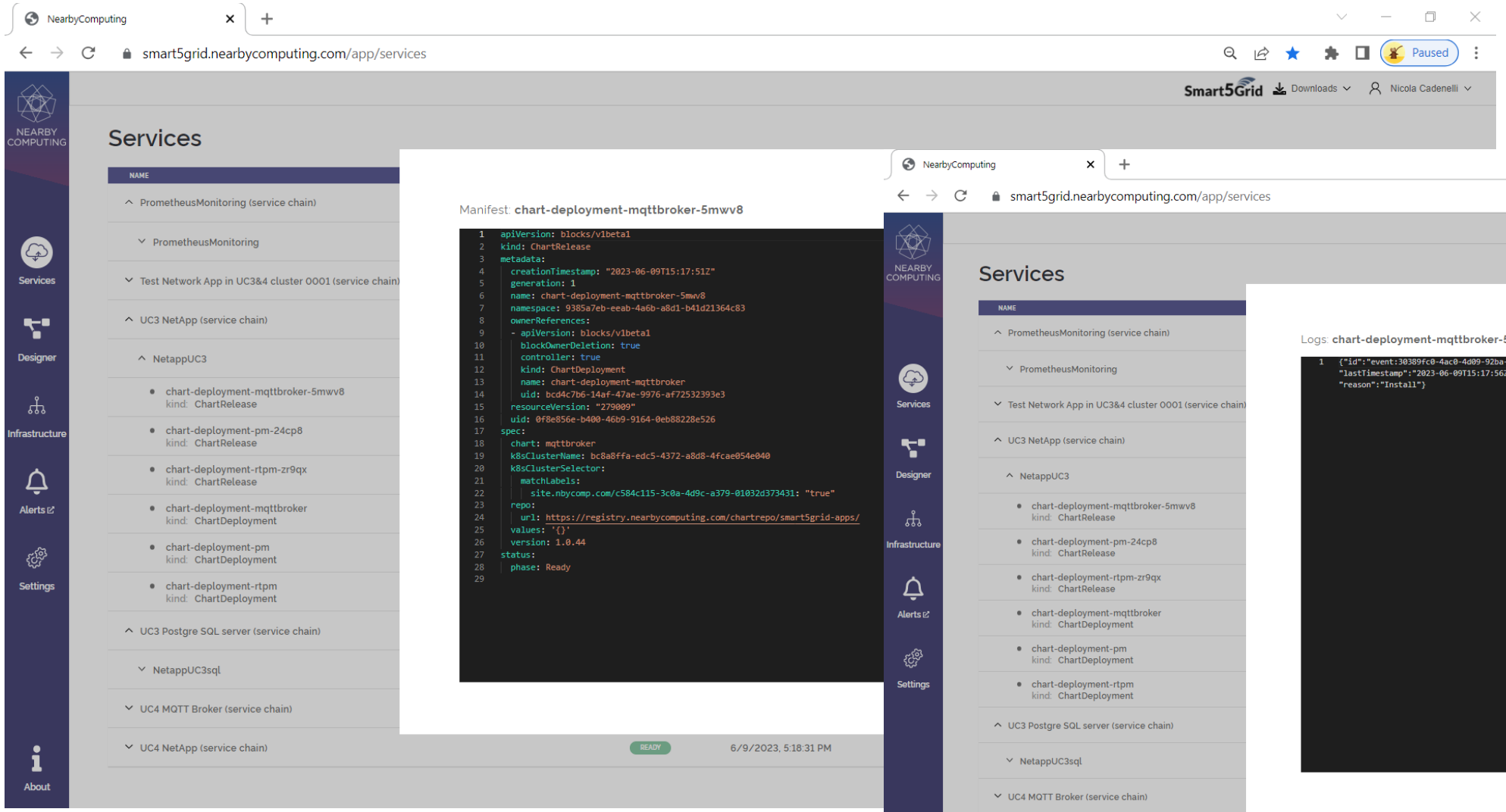
Nearby One as Smart5Grid NAC: Net.App Chaining



Nearby One as Smart5Grid NAC: Net. App Status



Nearby One as Smart5Grid NAC: Net. App Definition and Logs

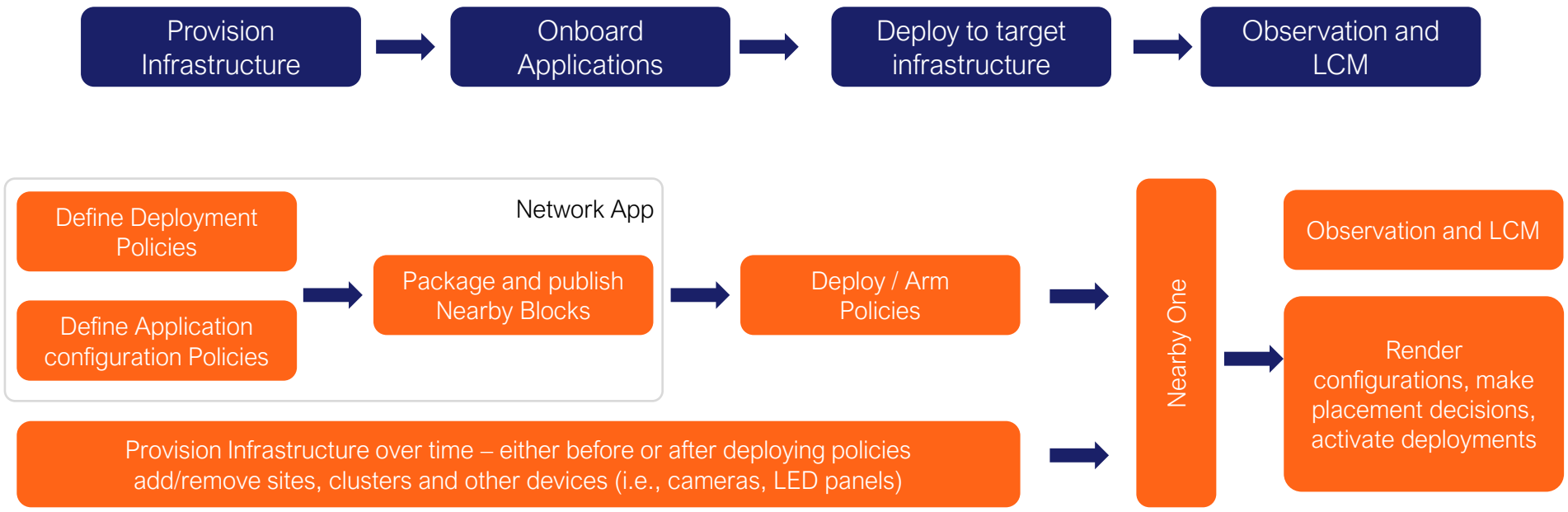


Deployment by policy

Paradigm shift: decoupling deployment/configuration from infrastructure

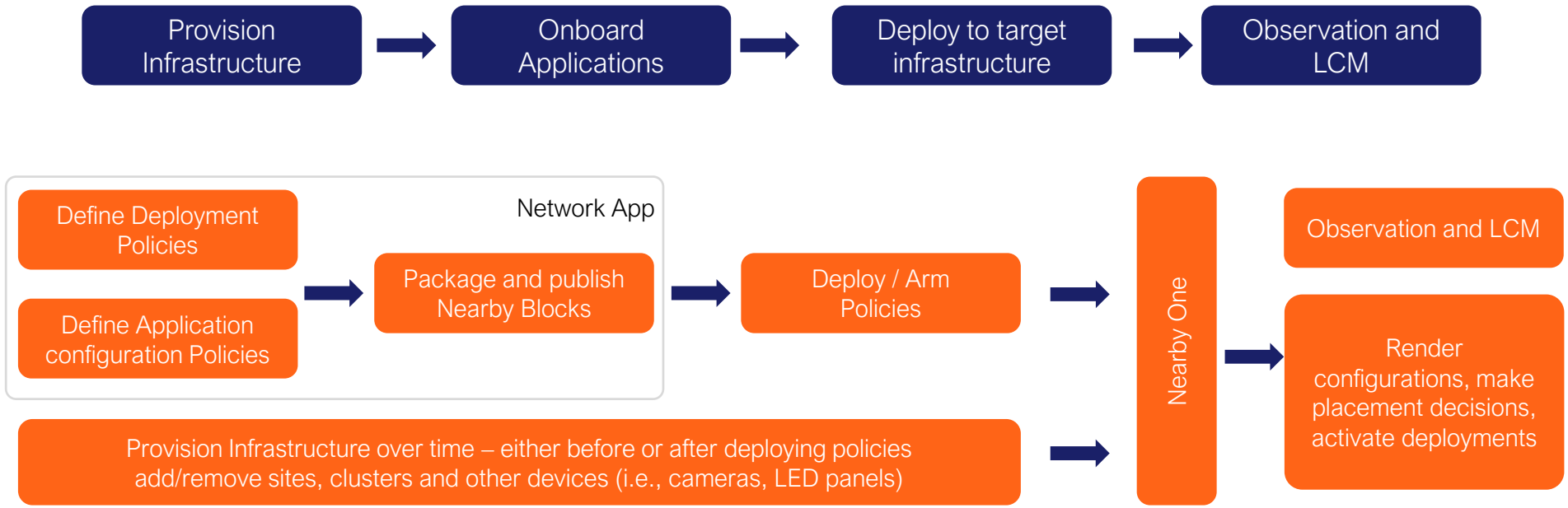
Deployment by policy

Paradigm shift: decoupling deployment/configuration from infrastructure



Deployment by policy

Paradigm shift: decoupling deployment/configuration from infrastructure



Example of use

Deploy a service policy (even before any cluster or site is registered) to make sure there is one video analytics instance up and running for each camera located in any of my customer sites (i.e., substations, telco edge site), and ensure each instance will run in the closest cluster to the associated camera.

Smart5Grid Use Cases

BENEFITS

❑MONITOR AND SECURE SUBSTATIONS

High-resolution 3D sensors combined with AI will support workers during maintenance, avoiding reaching live parts of the power grid.

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Monitor the power grid remotely and detect failure locations along lines reducing operation costs.

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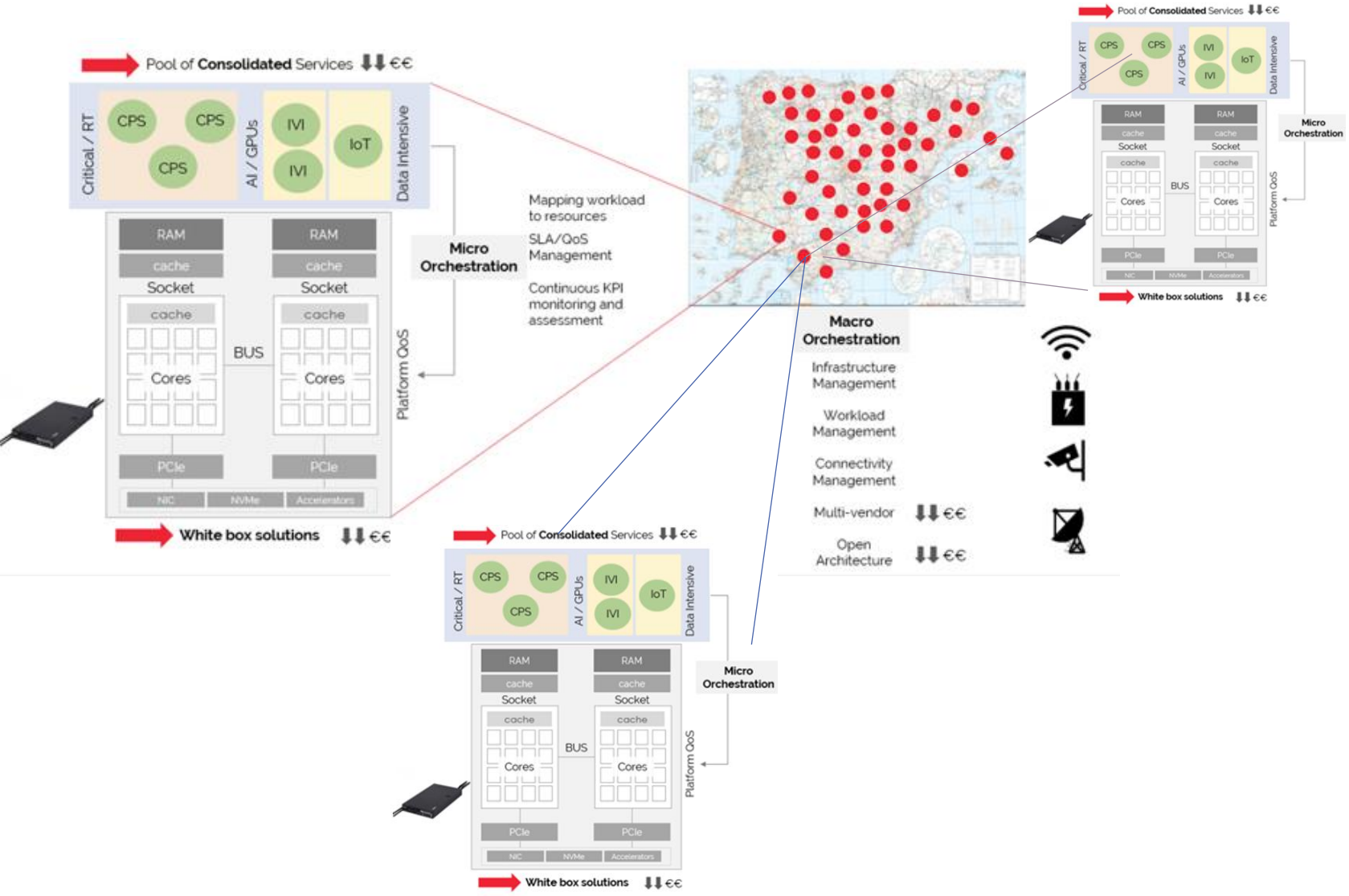
Markets- Utilities-Virtualized Substations

GRUPO RED ELÉCTRICA | redeia

Smart5Grid



BENEFITS

❑CRITICAL LOW-LATENCY (2 ms) PROTECTION AND SCADA SERVICES

Provide guaranteed performance and reproducible QoS to critical protection services thanks to the offered micro-orchestration and custom provisioning profile to set BIOS settings (Hyperthreading, CPU frequencies, caches, etc) and more.

❑COLLOCATION WITH ANCILLARY SERVICES

Other services can be deployed without impacting the performance of critical services.

❑MICRO&MACRO ORCHESTRATION FROM A SINGLE-PANE OF GLASS

Monitor and manage multiple sites from one remote dashboard. Plan upgrades rollout using blue/green or canary deployments

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Thank you

Barcelona – nearbycomputing.com –info@nearbycomputing.com

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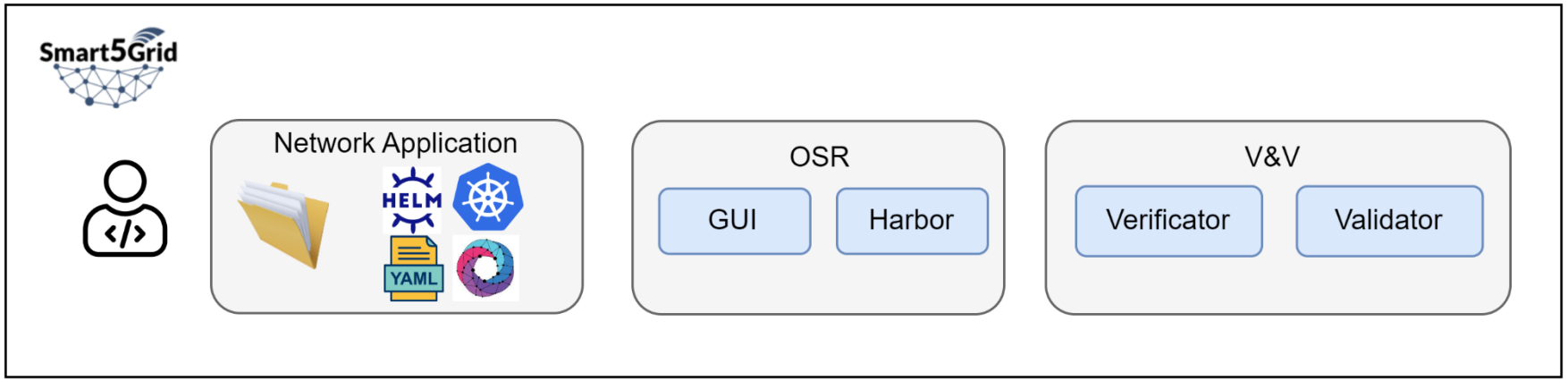
OSR, V&V and Network Application concept

Guillermo Gomez

Content

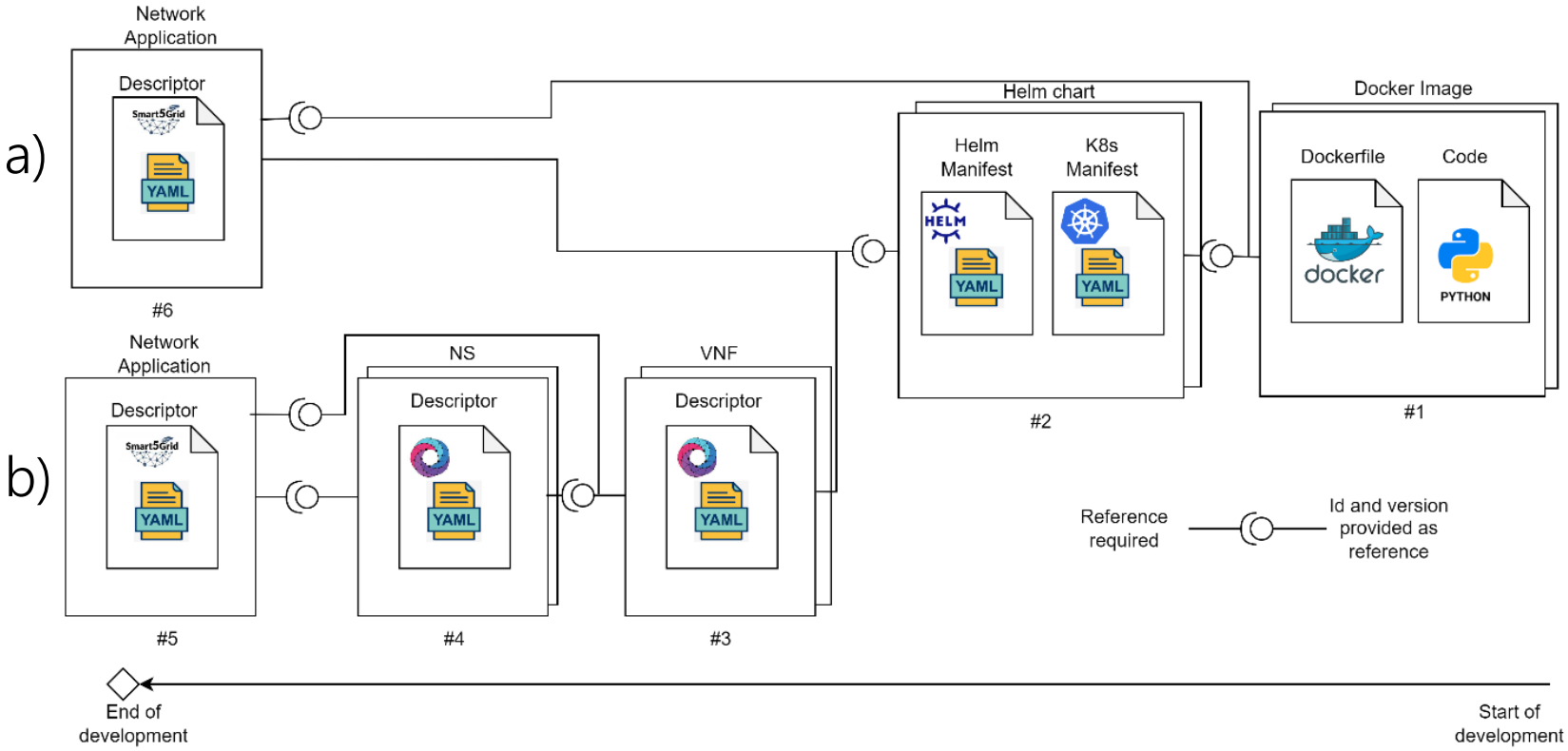
- Concepts & Relationships
- Network Application Technologies
- Network Application Information Model
- Network Application Development
- Network Application Example

Concepts & Relationships



- Network Application
  - Cloud-Native vertical applications
  - ETSI NFV support
    - ETSI OS MANO (OSM)
  - Abstraction from the network
  - Ease of use
- Open-Source Repository
  - Entry point to the Platform.
  - Commercial-grade CN Registry
  - Storage and Reusability
  - Trust, Quality and Control
  - Gitlab integration for devs
- Verification and Validation
  - Static Code Analysis.
    - Syntax
    - Integrity
    - Topology
  - Dynamic Code Analysis.
    - Onboarding
    - Deployment
    - Decommission

Network Application Technlogies



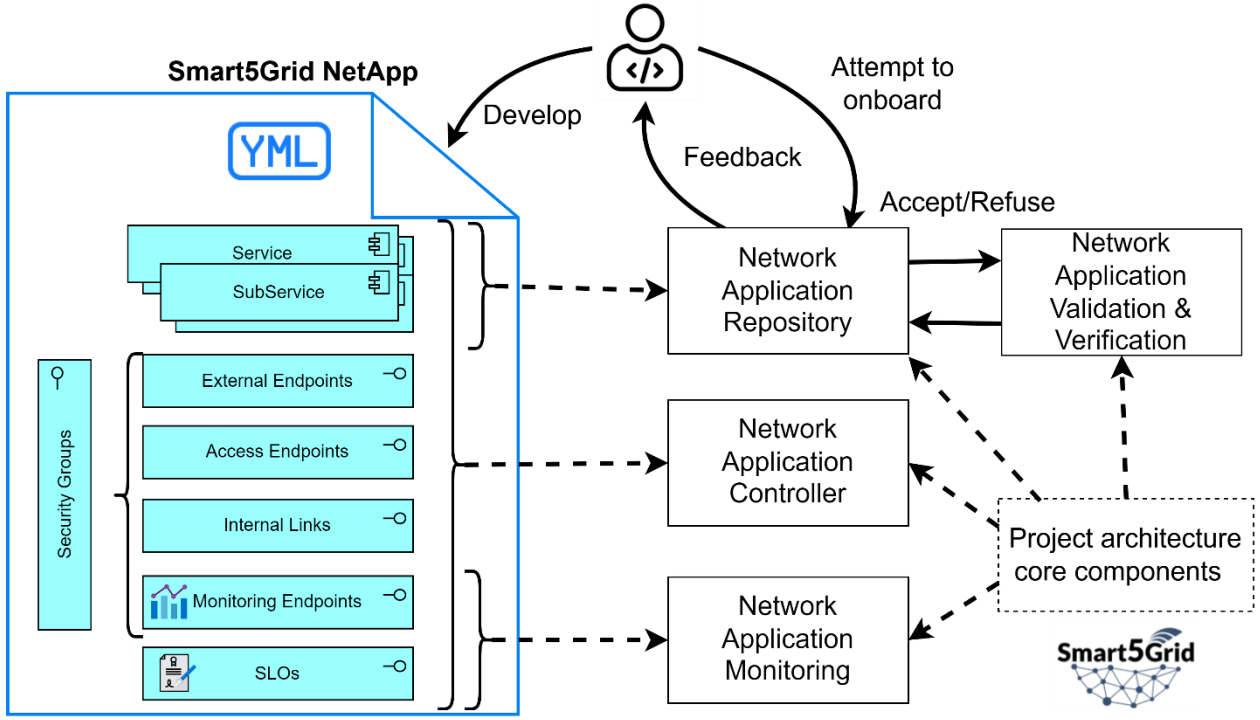
Artefacts involved in the delivery of a Network Application

- Cloud Native (CN) app + Network Application Information Model (IM) -> Docker, K8s, Helm, Yaml, OSM
- Orchestration tools:
  a) Commercial CN Solution for all Verticals:
     - NearbyOne
  b) ETSI OpenSource MANO for Telco
     - OSM + NAC

Network Application Information Model

Description and capabilities

- Declarative model (YAML)
- NetApp organized as collection of service + subservice.
  - Allows chain of services
  - Reusability of services and subservices by-design
- Abstracts the complexities of the network.
- Exploited by the V&V, NAC and Monitoring framework



Network application IM to Smart5Grid Platform components mapping

Network Application Development

Summary of steps

- #1. Standard CN development:
  - Application logic in any programming language and environment. [1].
  - Docker container. [2].
    - No additional requirements to work as a Network Application
  - Helm chart. Example. [3]
    - No additional requirements to work as a Network Application

- #2.* Create an OSM package:
  - VNF (CNF/KNF): The Information Model (IM) of the VNF descriptor is based on the specification SOL001 adapted to the YANG models as part of SOL006.
  - NS: The IM is defined in the SOL007 specification adapted to the YANG models as part of SOL006.

* Only for Telco Network Applications

- #3. Create and package the Network Application descriptor. [D4.1]
  - OSR provides a GitLab template folder [D3.3]
  - NearbyOne includes a plugin that translate to its internal requirements

Network Application Example (Telco)


```
netapp:
  im-version: 0.1.0
  name: $TELCO_NETAPP_NAME
  description: Telco NetApp example
  provider: ATOS
  version: $TELCO_NETAPP_VERSION
  service-format: osm
  services:
    - name: $APPLICATION_NS_ID
      package: $APPLICATION_NS_ID-$APPLICATION_NS_VERSION.tar.gz
      subservices:
        - name: $APPLICATION_VNF_ID
          package: $APPLICATION_VNF_ID-$APPLICATION_VNF_VERSION.tar.gz
      values: |
        foo: bar
      sap:
        - name: mgmtnet

  monitoring-endpoint:
    service-ref:  $APPLICATION_NS_ID
    sap-ref:  mgmtnet
    url: $MONITORING_URL

  external-endpoints:
    - name: external-endpoint1
      service-ref: $APPLICATION_NS_ID
      sap-ref: mgmtnet
      security-group-rules:
        - id-ref: http
```

```
access-endpoints:
  - name: access-endpoint1
    service-ref: $APPLICATION_NS_ID
    sap-ref: mgmnet
    security-group-rules:
      - id-ref: ssh
    policies:
      - key: latency
        value: '6'

SLOs:
  - name: number of connected PMUs
    expression:  rate(PMUs_number[5m])
    metric: PMUs_number
    threshold: '10'
    threshold-type: GT
    action:
      target-ref:
        target-service-ref: $APPLICATION_NS_ID
        target-subservice-ref: $APPLICATION_VNF_ID
      action-step: trigger-scale-up
    granularity: '3'
    cycles: '4'

security-group-rules:
  - id: http
    description: http rule
    direction: ingress
    ether-type: ipv4
    protocol: tcp
    port-range-min: 80
    port-range-max: 80
```

```
$TELCO_NETAPP
|_descriptor.yaml
|_vnf-packages
|__$APPLICATION_VNF_ID-$APPLICATION_VNF_VERSION.tar.gz
|_ns-packages
|__$APPLICATION_NS_ID-$APPLICATION_NS_VERSION.tar.gz
|_helm-charts
|__APPLICATION_CHART-CHART_VERSION.tgz
```

Telco Network Application content 2

tar -czvf $TELCO_NETAPP_NAME-$TELCO_NETAPP_VERSION.tar.gz

Thank you

Wishing all the best for our common success!

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Spanish pilot, use case

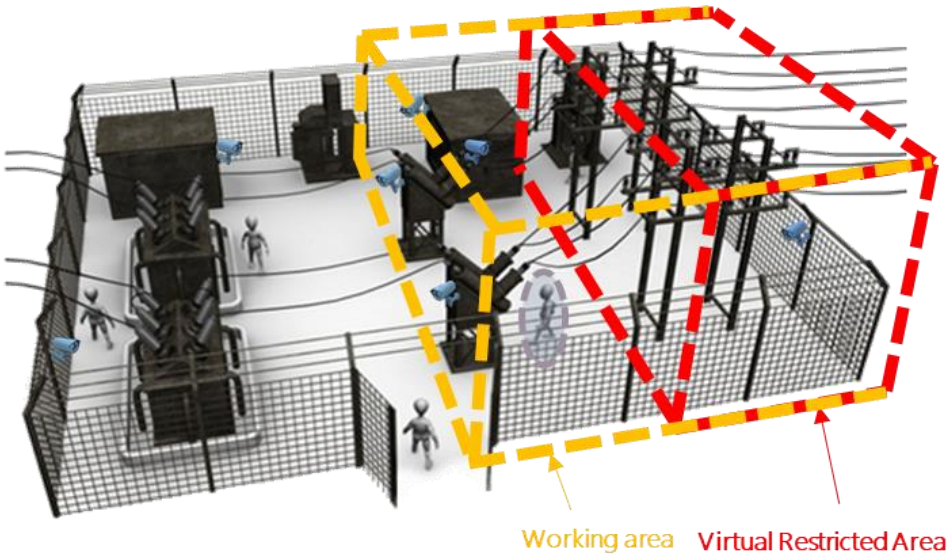
e-distribución

Ana Romero

UC2 Spanish Demo

Remote Inspection of Automatically Delimited Working Areas at Distribution Level

EcoGarraf, Barcelona Primary Substation (66 kV)



Business Goals

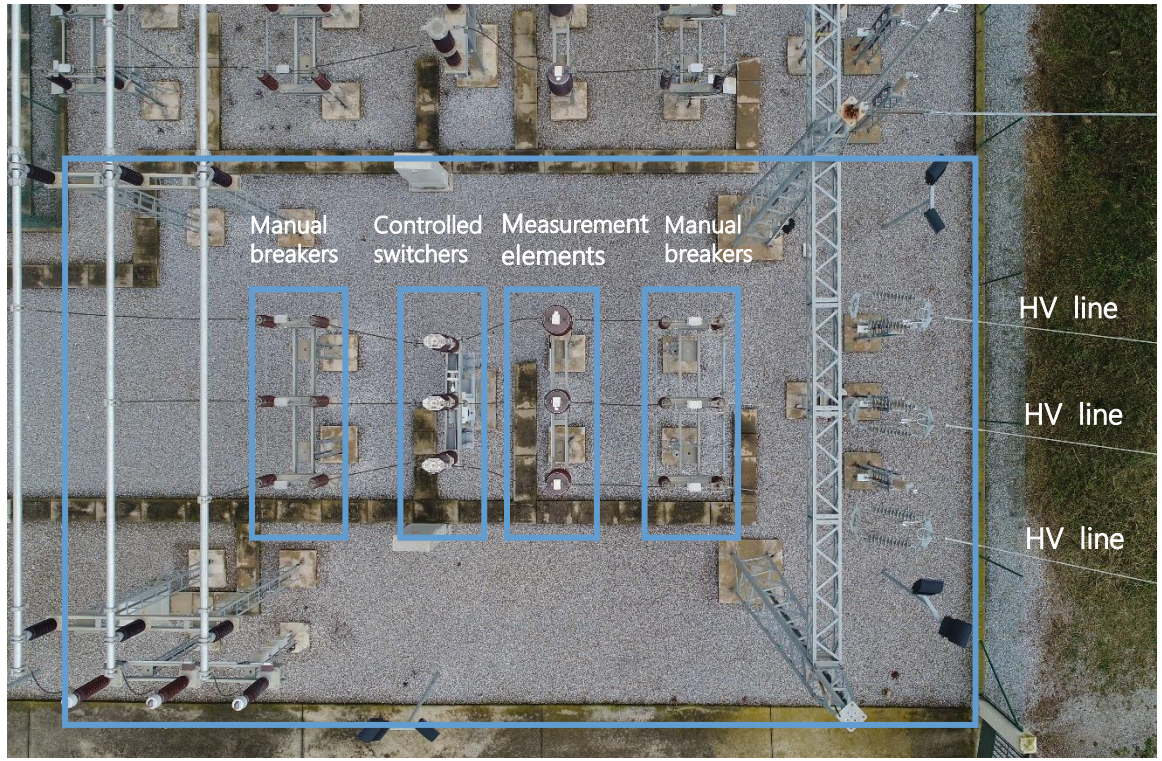
Safety improvement

Bordering a safety zone in a volumetric way, **Supporting field technicians**

Using **Real time tracking system** (sensors and cameras)

Communicated through **5G private network** (ultra reliable low latency communications)

Edge computing capabilities, enhanced **mobile broadband** and **AI** processing



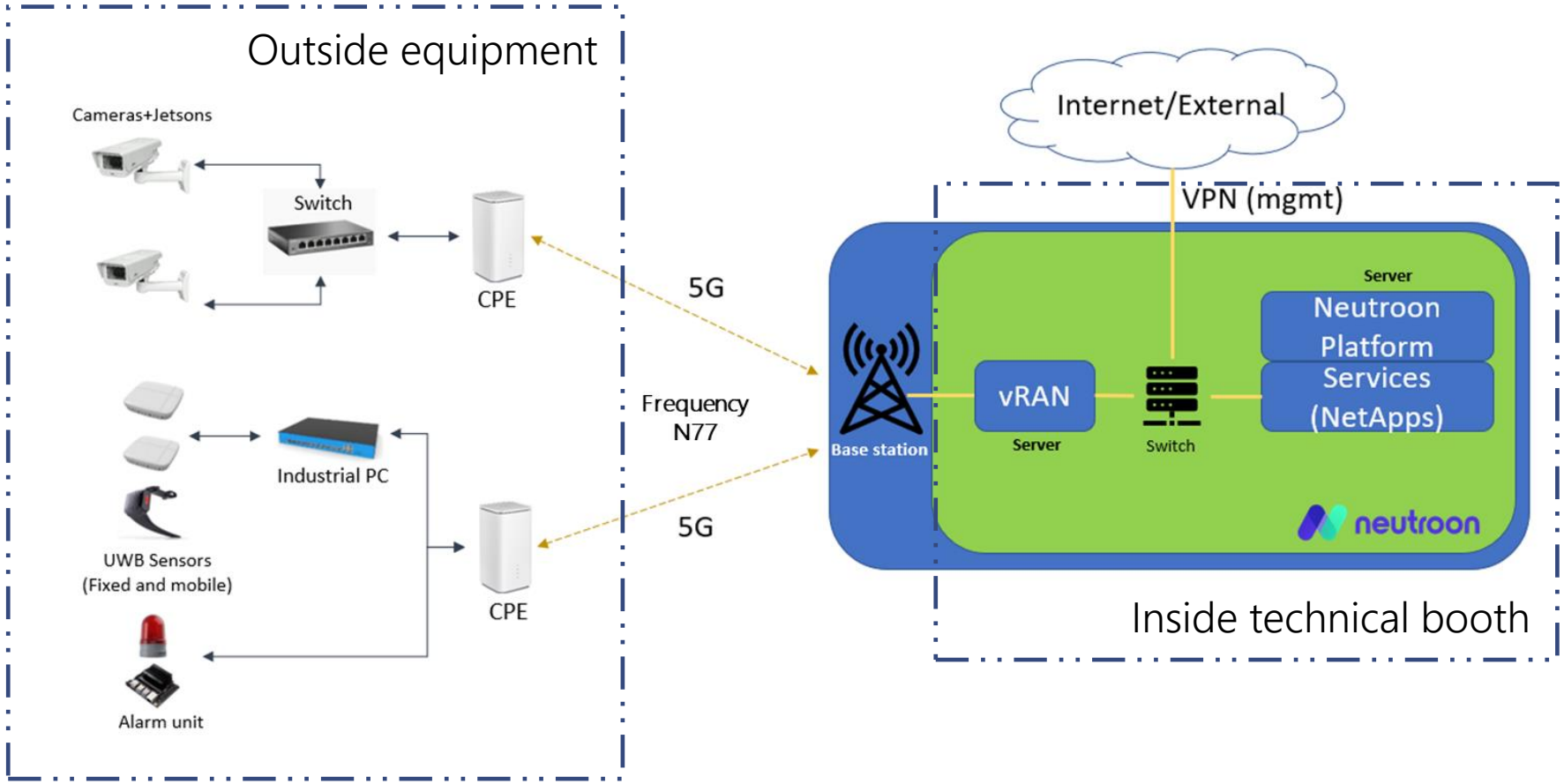
Advantages vs Legacy solutions

Remote Inspection of Automatically Delimited Working Areas at Distribution Level

Real time tracking system	• Reinforcement of current safety procedures by using sensors (UWB) and cameras.
5G NR network	• Transmission of the information fast and reliable.
Network App and Edge Computing	• Minimum end-to-end delay.
Performance improvement	• Fast image & AI processing. • Delimitation is performed in real-time. • Safety improvements. Cost reduction.

Field platform implemented

Architecture peculiarities



Network components:

- RRU R15 band N77
- Directional antenna
- vRAN R15 connection via CPRI
- 5G Core
- MEC server
- 5G CPEs outdoor
- Router and Switch

Network App

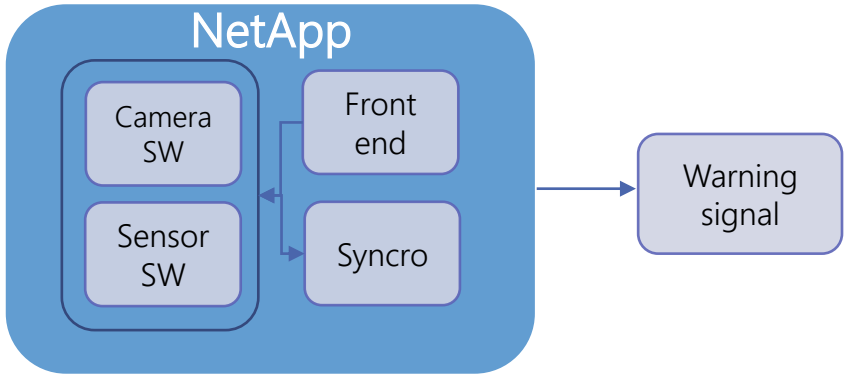
Remote Inspection of Automatically Delimited Working Areas at Distribution Level

Objectives

- Tracking function and AI recognition system.
- Triggering an alarm and notifying the worker in case of any security breaches.

Capabilities

- Continuously process inputs from UWB sensors and cameras deployed in substation.
- Detecting whether a worker has accessed a forbidden area.
- Final work report including KPIs.



Target market & opportunities

Remote Inspection of Automatically Delimited Working Areas at Distribution Level

Target market

Any company interested in raising security level by delimiting zones (DSOs, power generation plants, industrial facilities, etc).

Opportunities

- Safety improvement is our first goal.
- Reducing failures in the network and cuts in power supply (Government's penalties).
- It will also help to improve the company's social image.
- We are open to collaborate with other SMEs.

Thank you

Wishing all the best for our common success!

Smart5Grid

Smart5Grid roadshow

13 Junio 2023, 14.00-15.00

Evento Virtual

Opportunities for SMEs and experiences from implementers

Sergio Cadenas

nosia INDUSTRY SOLUTIONS

5G PPP
The 5G Infrastructure Public Private Partnership

Smart5Grid
Demonstration of **5G** solutions for
SMART energy **GRID**s of the future

This project has received funding from the European Union's *Horizon 2020 research and innovation programme* under grant agreement n° 101016912

Who we are?

SME Company manufacturer and rep of safety & labelling industrial products.

- ALIS TECH develops Real Time anticollision solutions for forklifts, safety led warning systems for the industry and safety taylor solutions like 3D detecting systems for cranes.

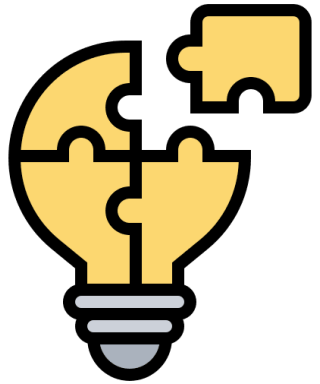
- During Corona ‘shutdown’ standard product range sales went to 0 and we developed our FDS Fever Detection System (non existing industrial solution at that time), finding components on the market and matching them and programing them in a short time. In 3 months we’re ready to serve the first units. Logically we had to readjust the systems as we had no realistic time to essay the protos.
- This action saved the company.

Smart5Grid

The project, a gate for success but a challenge

- Integration with other partners is the big challenge. And stepping out of the standard range of products development is something this kind of SME's can handle but normally according to their own calendar.

- Why? SME company like NOSIA – ALIS developing calendar is strongly exposed to internal issues. If any of this occurs, running projects has to be stop due to lack of resources and not enough 'lung',
- Employes fluctuation
- Cash flow (unpayments from customers i.e.)



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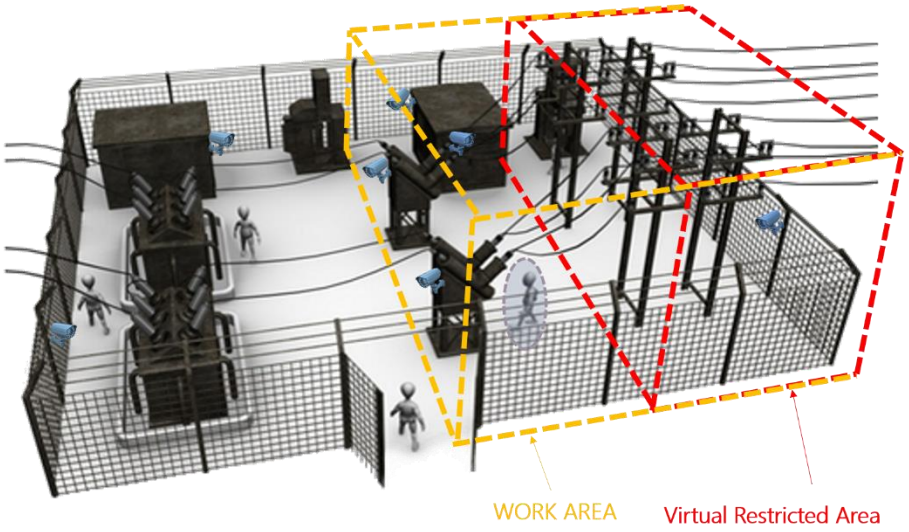
Use case 2 personal SME experience

PROS

- Technology development
- Market exploring
- Partnership network

CONS

- For a SME company being in a teamwork of structural different size creates a neckboottle on communication flow.



Thank you

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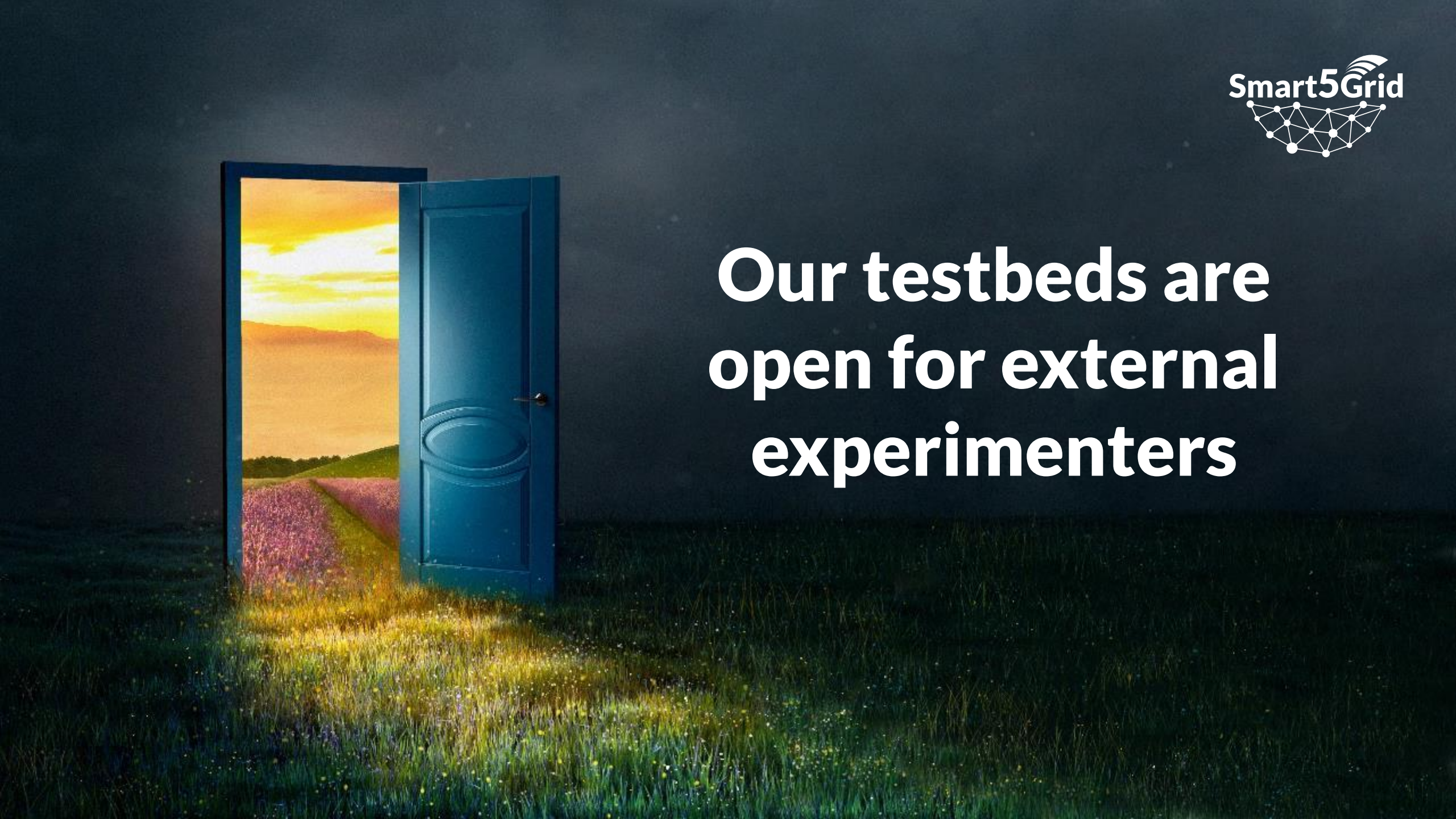
Demonstration of **5G** solutions for
SMART energy **GRID**s of the future


Smart5Grid
Our testbeds are open for external experimenters

build and test your own Network App

Third-parties experimentation

Available tools

OSR
Open Service Repository

V&V Framework
Validation and Verification

Contact desk
Remote support for developers

Foster flexibility and scalability

Network Application

one approach for multiple uses

5G PPP
The 5G Infrastructure Public Private Partnership

5G PPP Phase 3, Part 6: 5G innovations for verticals with third party services & Smart Connectivity beyond 5G

Dissemination

All the experimenters will be listed in our channels,

we will showcase all Network Apps to our stakeholders,

you will meet the European Commission to present your successful story!

Join us!
Follow us!
Like us!

[smart5grid.eu]

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Open discussion

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