5G INDUCE

Open cooperative 5G experimentation platforms for the industrial sector NetApps

www.5G-innduce.eu

5GPPP webinar on ICT-41 projects

05 February 2021

5G-INDUCE: Project Overview

Dimitrios Klonidis

UBITECH

5G-INDUCE in a nutshell

- 5G-INDUCE
  - Open cooperative 5G experimentation platforms for the industrial sector NetApps
- GA No: 101016941
- Duration:
  - 1st Jan. 2021 – 31st Dec. 2023
- Call:
  - ICT-41-2020: 5G PPP – 5G innovations for verticals with third party services
- Budget:
  - ~6M€ (~8M€ total cost)
- Effort:
  - 1013 PM
- Main concept:
  - To provide an end-to-end orchestration platform over enabling experimentation infrastructures for advanced 5G NetApps applicable in the broader Industry 4.0 sector.
  - To validate the 5G-readiness of both telecom operators and applications providers, through a 5G system platform that enables the smooth porting of NetApps in Industry 4.0 ecosystems.

Consortium

Concept

Background and main concept

Definitions

High level architecture

Background

- Industry 4.0
  - Originally rely on locally installed smart IoT monitoring and automated control technologies **but**…
  - Smartly interconnected and collaborating infrastructures offer even more advanced capabilities in
    - Manufacturing process optimization
    - Supply chain optimization
    - Offering of added value services (maintenance, surveillance, security, safety, …)

- 5G systems as the enabler
  - 5G meets the unique Industry 4.0 requirements and KPIs
    - Latency, Bandwidth, Modularity,…
  - 5G provides the overall framework platform for the porting and deployment of advance applications
    - Apps move beyond the strict limits of an industry
    - Can be tailored made or specially adapted apps

Main idea

➡ Deploy a complete 5G system platform that includes the mechanisms of:

- Service deployment,
- Network management and
- Network resource orchestration

➡ Interconnect the 5G system platform with the industrial sector

- Creating 5G Experimentation Facilities able to attract and evaluate Network Applications

➡ Demonstrate use cases that highlight

- The 5G system capabilities and functionalities
- The deployed NetApp capabilities and offered services
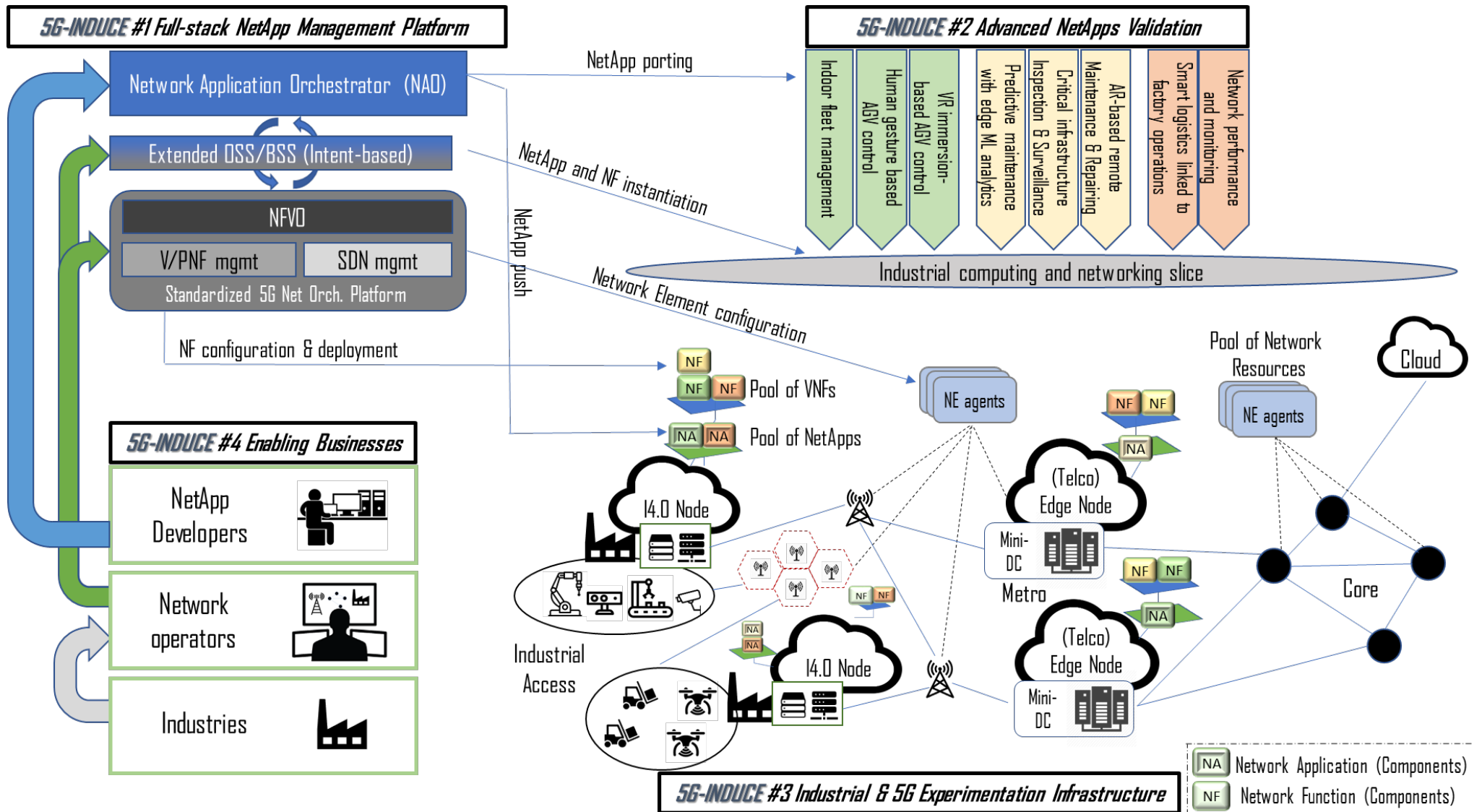- The benefits offered to the industry sector
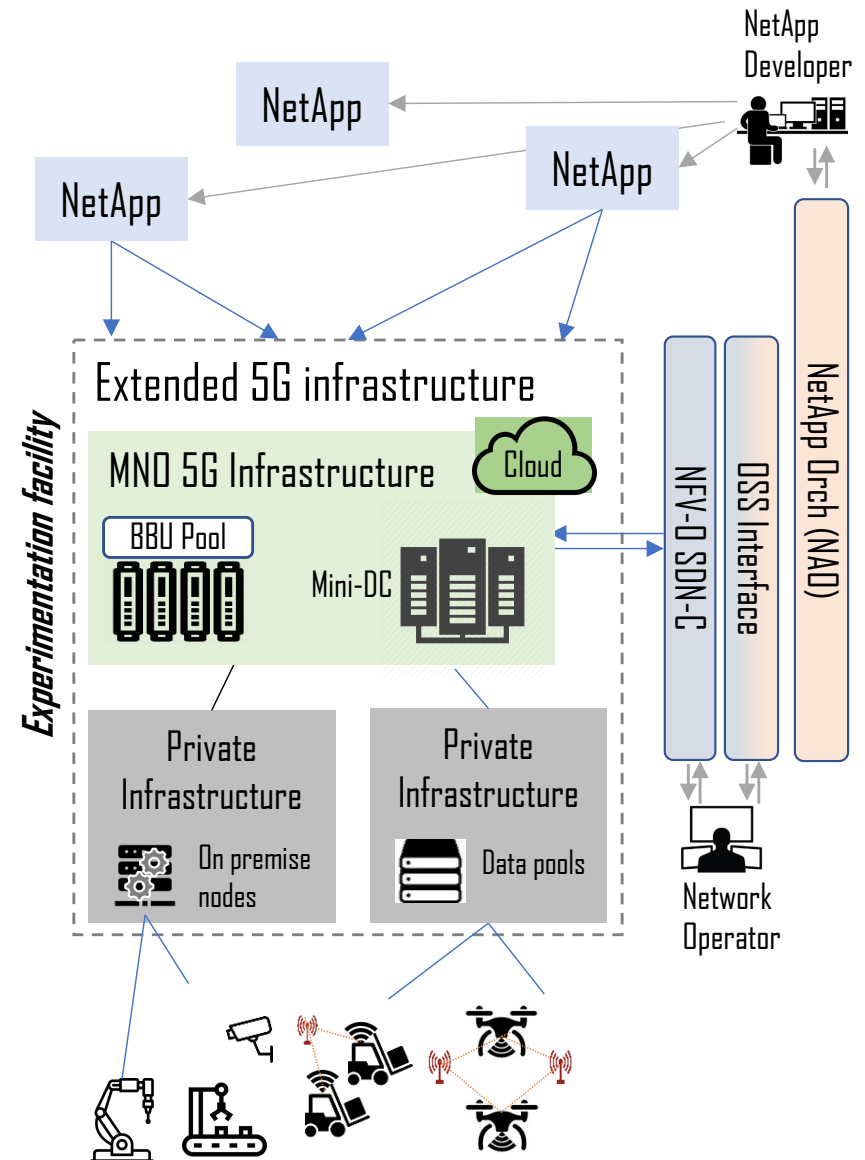
Definitions: NetApps and VNFs

- **NFs and NetApps**

  - **Network functions**: A virtualizable component in the network required to set-up the end-to end connectivity
    - No focus on NFs. Follow standard approaches
    - Operator driven process to optimize the infrastructure use.
      - Though we need to check compatibility with proposed 5G system platform

  - **Network Applications (or Service Functions)**: A set of networked services' components commonly deployed in a network to provide one complete end-to-end process (application).
    - Support the App developer or end customer (i.e.I4.0) approach
    - Highlight the benefit of NAO (NetApp Orchestrator)
      - Positioning on NAO in the value chain w.r.t. business aspects

The 5G-INDUCE architecture

5G-INDUCE #1 Full-stack NetApp Management Platform

Network Application Orchestrator (NAO)

Extended OSS/BSS (Intent-based)

NFVO

V/PNF mgmt   SDN mgmt

Standardized 5G Net Orch. Platform

5G-INDUCE #4 Enabling Businesses

NetApp Developers

Network operators

Industries

NetApp porting

NetApp and NF instantiation

NetApp push

Network Element configuration

NF configuration & deployment

5G-INDUCE #2 Advanced NetApps Validation

Indoor fleet management

Human gesture based AGV control

VR immersion-based AGV control

Predictive maintenance with edge ML analytics

Critical infrastructure Inspection & Surveillance

AR-based remote Maintenance & Repairing

Smart logistics linked to factory operations

Network performance and monitoring

Industrial computing and networking slice

Pool of VNFs

Pool of NetApps

NE agents

Pool of Network Resources

NE agents

Cloud

I4.0 Node

Industrial Access

I4.0 Node

(Telco) Edge Node

Mini-DC

Metro

(Telco) Edge Node

Mini-DC

Core

5G-INDUCE #3 Industrial & 5G Experimentation Infrastructure

NA Network Application (Components)

NF Network Function (Components)

Implementation

Study axes

The 5G-INDUCE platform

Experimentation Facilities

Use cases

Development and study axes

Axis #1 Full-stack NetApp Management Platform

- Based on MATILDA orchestrator.
- Includes an integrated full-stack 5G NetApp management platform.
- Integrates state-of-the-art control and data plane developments (industrial IoT, 5G radio access nodes, state-of-the-art OSS and scalable microservices-based cloud orchestration platform)

Axis #2 - Advanced Industry 4.0 NetApps

- A variety of innovative Industry 4.0 market verticals through the demonstration of advanced use cases, meeting demanding KPIs

Axis #3 – Industrial & 5G Experimentation Infrastructure

- Heterogeneous real-world industrial fields at scale.
- Address key industrial sectors, such as automotive, energy, and home appliances.
- Combination of Advance industrial infrastructures and 5G mobile network operator infrastructures
- Use of additional state-of-the-art 5G platform integrator and NetApp DevOps testbed for pre-deployment testing and validation.

Axis #4 – Enabling Businesses

- Impact creation for targeted market stakeholders through business model that generates mutual benefits for (i) industrial players, (ii) network operators, and (iii) a large pool of heterogeneous SMEs/start-ups acting as NetApp developers

5G Network platform
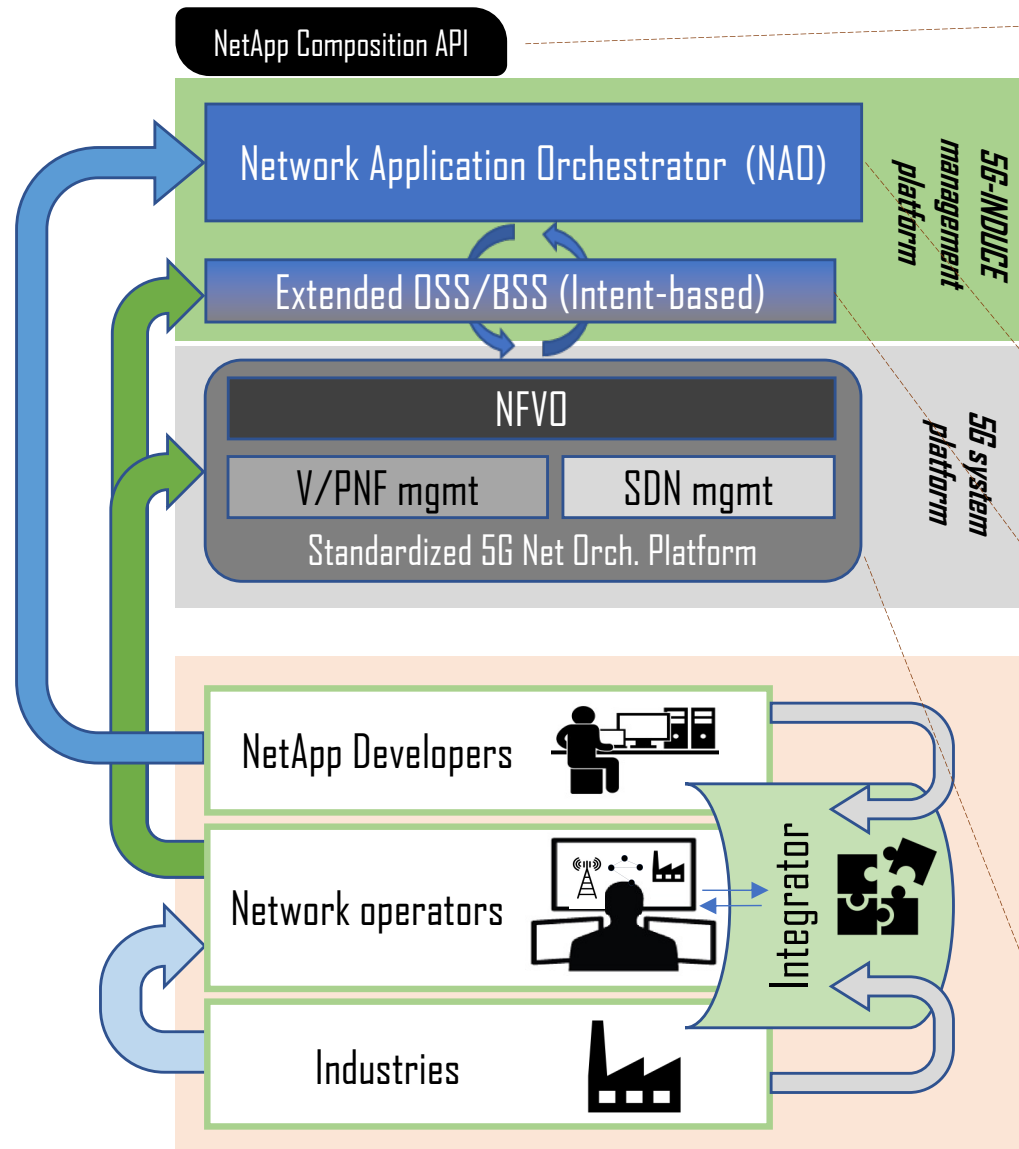
- NetApp preparation
  - Break NetApp into cloud native components
  - Create and upload a docker image per component
  - Build or Generate the interconnection of NetApp components
  - Add requirements, per component or NetApp or both
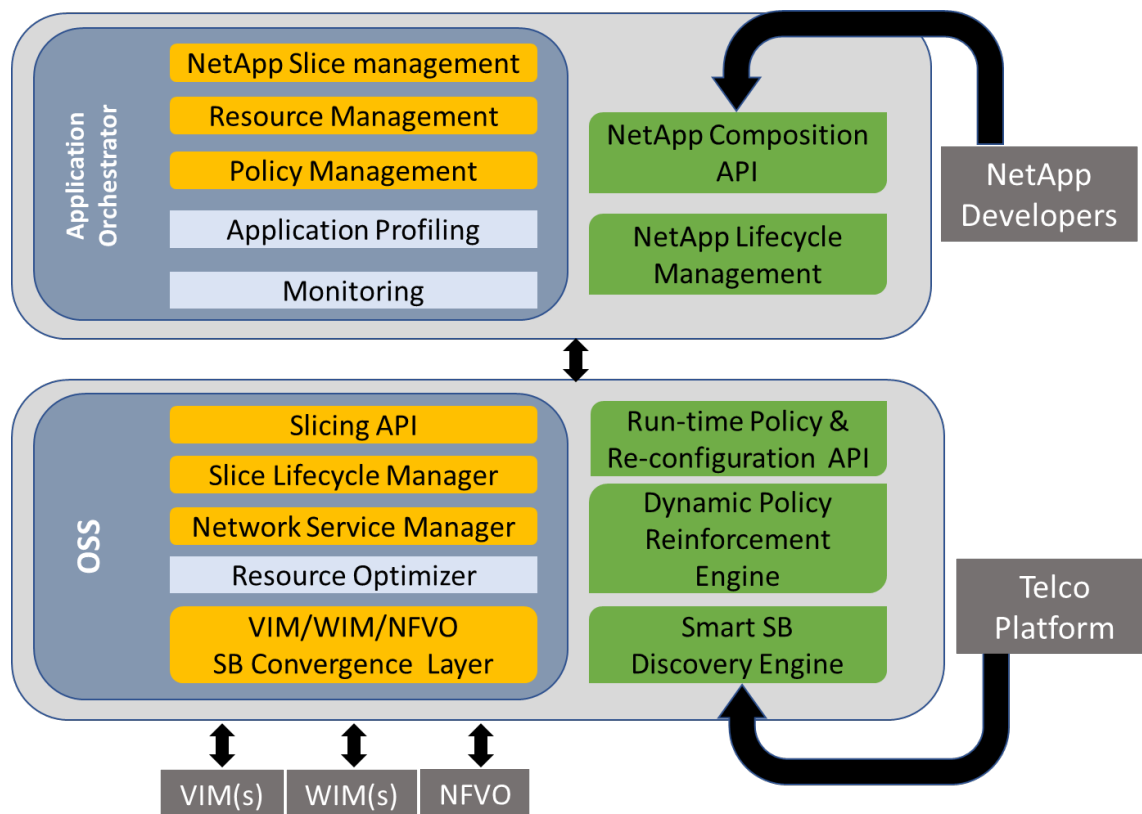
- NetApp porting
  - Slice Intent generation
  - NetApp life-cycle management during run time
  - Polices and Analytics

- NetApp and NF instantiation
  - Fulfil NetApp service deployment requests
    - Identify resources for NetApp components
  - Identify NF and connectivity needs + resource availability
  - Process monitoring
  - Resource optimization
  - Interfacing with VIM/WIM/NFVO
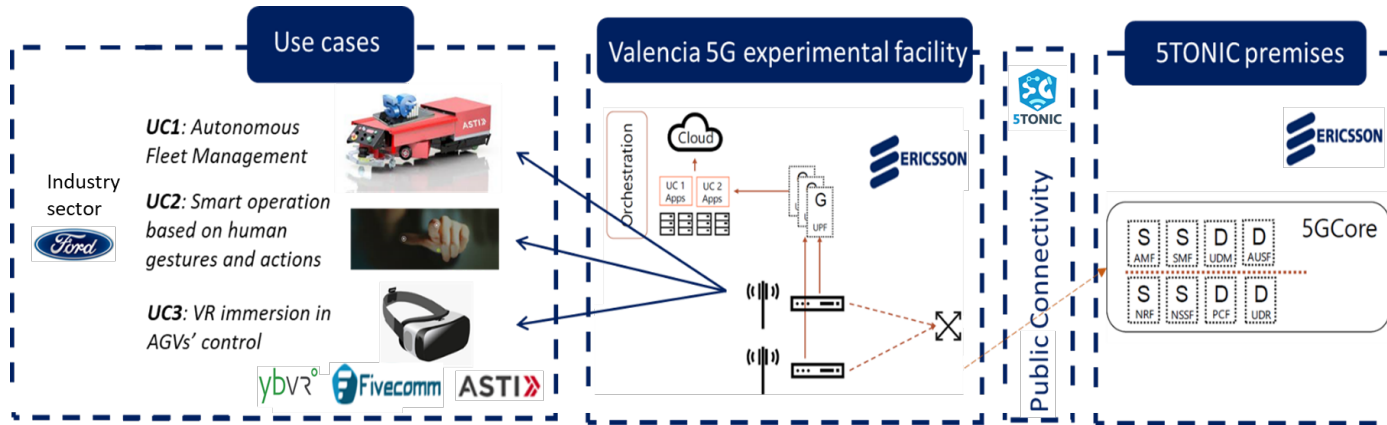
- NF configuration & deployment

- Network Infrastructure configuration

Diagram labels:
NetApp Composition API; Network Application Orchestrator (NAO); Extended OSS/BSS (Intent-based); 5G-INDUCE management platform; NFVO; V/PNF mgmt; SDN mgmt; Standardized 5G Net Orch. Platform; 5G system platform; NetApp Developers; Network operators; Industries; Integrator

5G Network platform

- **Starting point:**
  - The MATILDA VAO-OSS

- **Extensions in (orange)**
  - Dynamic NetApp slice management
  - Access to resource management at app level
  - Enhanced policy and security aspects

  - Dynamic slice life-cycle management
  - New OSS NB API permitting on-the-fly modification of a network slice's resources
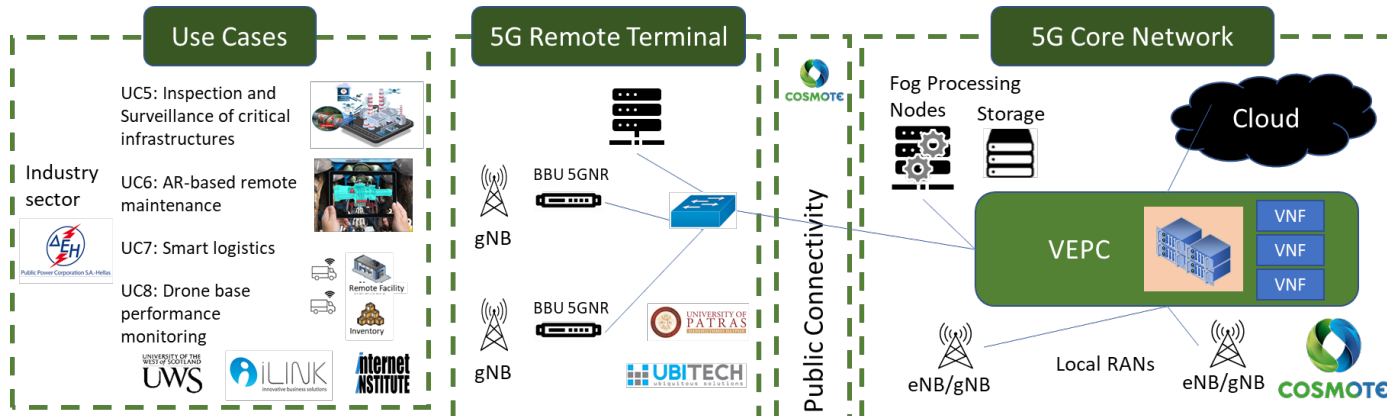 - Redesigned SB convergence layer with OSM (ETSI), OpenStack VIM for NFVO and edge computing, and WIM interfacing.

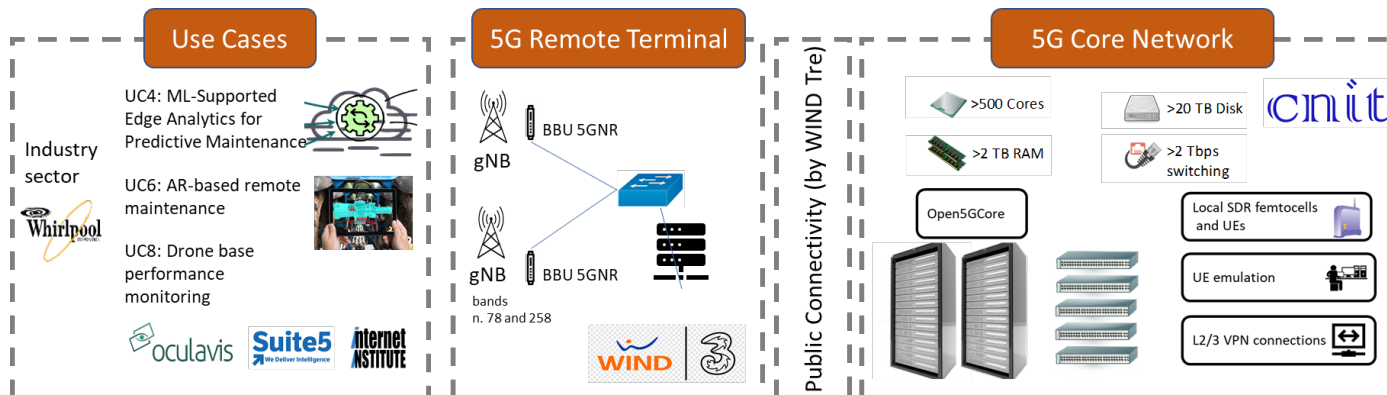# Experimentation Facilities

ExFa – Spain

Use cases
- **UC1:** Autonomous Fleet Management
- **UC2:** Smart operation based on human gestures and actions
- **UC3:** VR immersion in AGVs' control

Industry sector: Ford

Valencia 5G experimental facility

5TONIC premises

- Industry: FORD, Valencia
- 5G connectivity Ericsson remote node 5TONIC, 5G-EVE

ExFa – Greece

Use Cases
- UC5: Inspection and Surveillance of critical infrastructures
- UC6: AR-based remote maintenance
- UC7: Smart logistics
- UC8: Drone base performance monitoring

Industry sector

5G Remote Terminal

5G Core Network

- Industry: PPC, Lavrio Athens
- 5G connectivity COSMOTE 5G core and RAN enviroment Remote node

ExFa – Italy

Use Cases
- UC4: ML-Supported Edge Analytics for Predictive Maintenance
- UC6: AR-based remote maintenance
- UC8: Drone base performance monitoring

Industry sector

5G Remote Terminal

5G Core Network

- Industry: Whirlpool,
- 5G connectivity Wind3, CNIT DevOps test bed (core + RAN)

12

Industry 4.0 Use Cases

Autonomous indoor fleet management	Use case 1



Indoor/outdoor coordination of AGVs
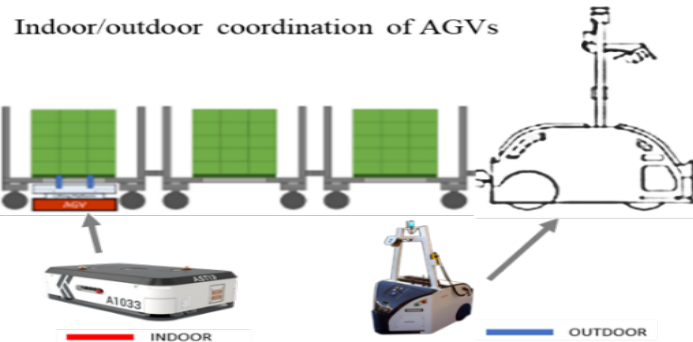
INDOOR — OUTDOOR

To manage a small fleet of automated guided vehicles (AGV) with simultaneous localization and mapping (SLAM) navigation, both outdoors and indoors, through 5G connectivity and edge computing capabilities.

Use case 2	Smart operation based on human gesture recognition

To control industrial operations of AGVs through human geticulations without using any type of special equipment, such as for instance haptic gloves or augmented reality (AR) glasses.
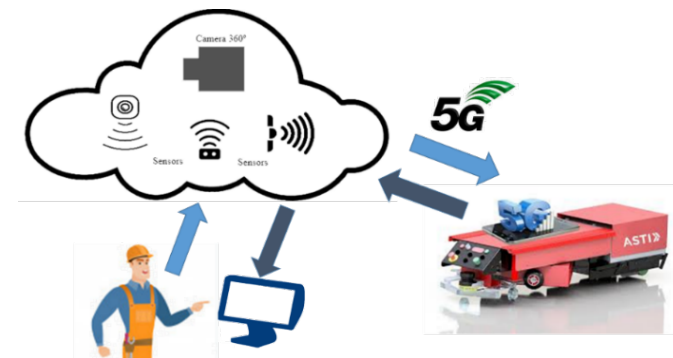
Industry 4.0 Use Cases

| VR immersion and AGV control	Use case 3
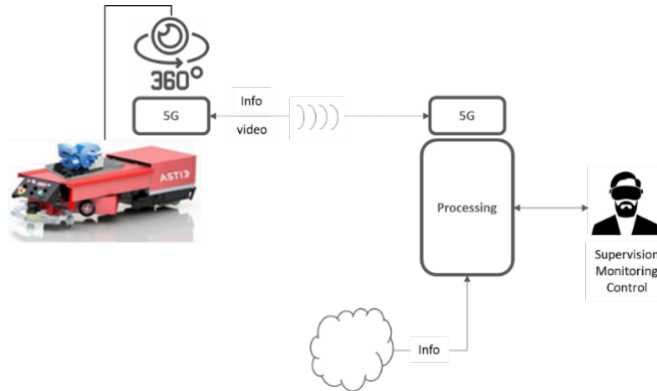
To explore VR and 5G capabilities to provide an immersive live 360 view from the AGV to a remote viewer.

Added features: secure connection, obstacle detection

Use case 4	ML-Supported Edge Analytics for Predictive Maintenance

To demonstrate ML-powered predictive maintenance using edge analytics in industrial settings, using federated learning to allow the propagation of system-wide models to distinct production lines to improve accuracy at near real-time, taking also into consideration the overall production targets and schedule of the whole industry.
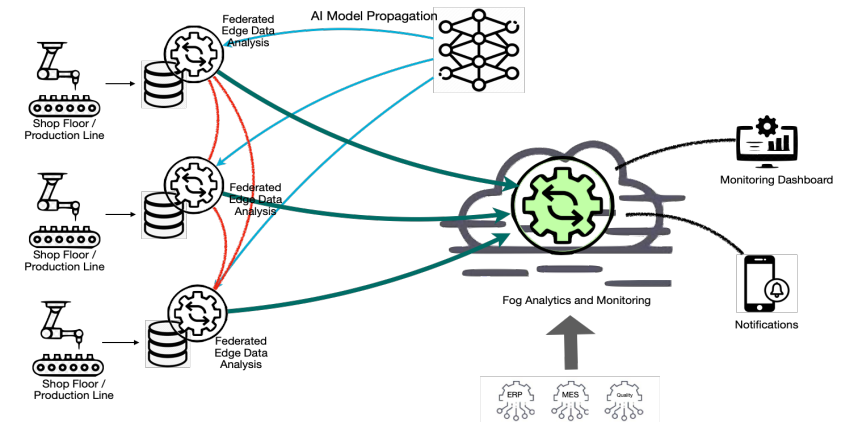
Industry 4.0 Use Cases

Inspection and surveillance services for critical infrastructures | Use case 5

To perform automatic UAV-based tank and pipeline inspection and area surveillance monitoring, based on advance AI-assisted object status and human identification algorithms, and linked to efficient warning mechanisms.

## Use case 6 | AR-based remote maintenance, repairing and upgrade

To deliver new and advanced safety and security features for Remote Assistance in maintenance applications. Minimum latency and high bandwidth allow to run demanding audio or image processing algorithms on HD/UHD video/audio streams, e.g. to anonymize confidential areas or faces and provide live speech translation services..

Industry 4.0 Use Cases

Smart logistics over supply chain linked with factory operations | Use case 7
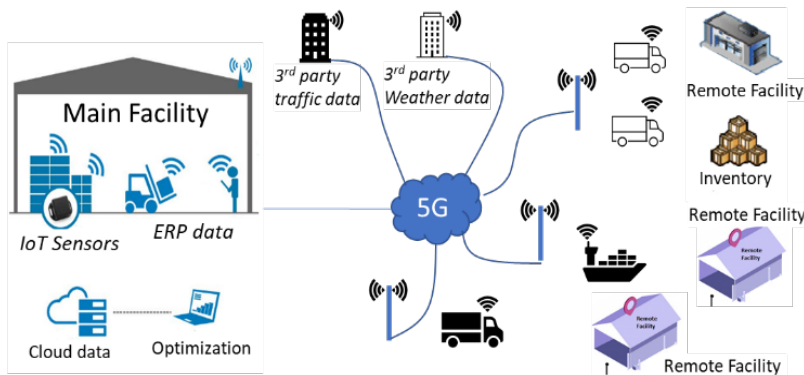

To optimise the Supply Chain Processes utilising the minimum number of vehicles-travels in order to satisfy all resource requirements, while also implementing critical levels continuous monitoring, allowing immediate actions when critical levels are exceeded, and external interaction is required.

Use case 8 | Drone assisted network performance and coverage monitoring

To provide industrial grade end-to-end network performance and coverage monitoring of the critical communications infrastructure in 5G smart factory environments using continuous and on-demand operational mode with drone-assisted metrics collection to enable visual mapping of 5G radio, network and service metrics and industrial SLA KPIs
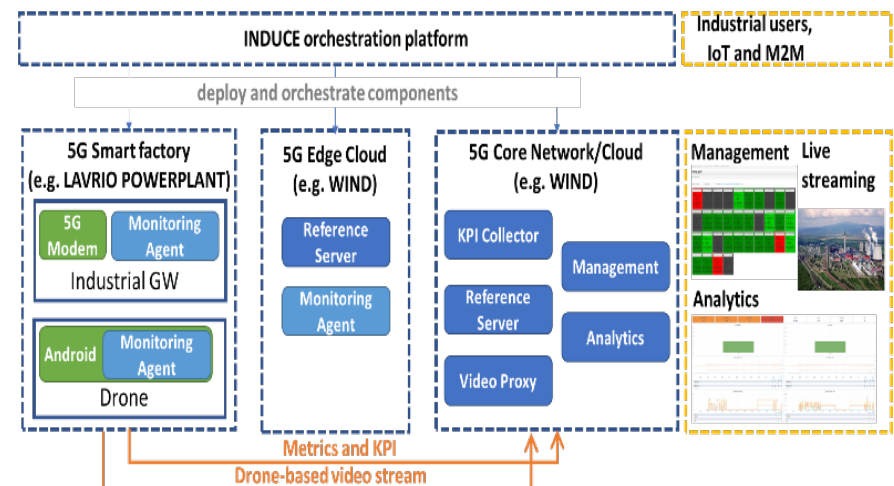
Expected benefits

- Create the full stack 5G platform for the porting of NetApps
  - Focus on Industry 4.0 needs for exploitation purposes
  - Clear view on specific stakeholder needs:
    - NetApp developers – Innovative and tailored services to vertical end users
    - Service Integrator – User friendly porting mechanism and logical separation from infrastructure owner
    - Operator – Management of own infrastructure including monitoring and statistics.
    - Industry (vertical) – Broad options for network service deployment through public infrastructure of private infrastructure interconnection

- Showcase the NetApp deployment chain
  - From NetApp porting to end user functional examples in industry environment (real 5G demos!)
  - Attract new NetApps (adaptability and ease of use)
  - User friendly interfacing

5G INDUCE

THANK YOU!

Dimitris Klonidis

UBITECH