EUCloudEdgeIoT.eu

WORKSHOP 2 OUTCOMES
CATALOGUE OF USE CASES

Task Force 5: Markets and Sectors

February 2023

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AGRICULTURE

aerOS: HPC Platform for Connected & Cooperative Mobile Machinery

NEMO: Precision Bio-spraying

FluiDOS: Smart viticulture

ICOS: Agriculture Operational Robotic Platform (AORP)

AEROS
HIGH PERFORMANCE COMPUTING PLATFORM FOR CONNECTED & COOPERATIVE AGRICULTURAL MOBILE MACHINERY

Sector: Agriculture and Mobility

Partners: John Deere, JD, TTC

Location: John Deere European Technology Innovation Center in Kaiserslautern (Germany)

Pilot duration:

Overview

- Precision farming as a solution to maximise yields and harvest quality while minimizing inputs
- Integrate, test and validate High-Performance Computing Platform for connected and cooperative agricultural mobile machinery
- Provide M2M connectivity for large-scale agricultural production system with limitations in connectivity of rural areas
- Edge computing to enable real-time performance with low latency networking; federated frugal AI capabilities to improve performance in the edge and data management

Objectives and expected benefits

- Contribute to enabling sustainable farming solutions
- Energy optimisation
- Noise reduction

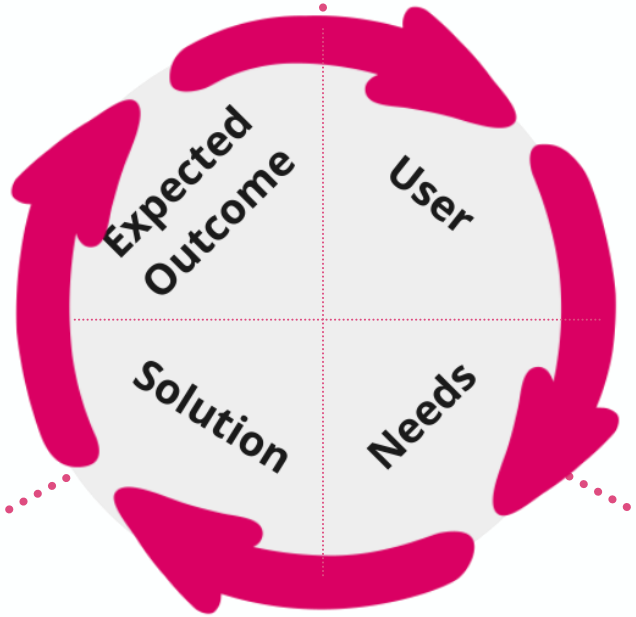
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- End user: John Deere European Technology Innovation Center in Kaiserslautern Germany
- Tech provider: TTControl in Vienna
- Agriculture
- Forestry
- Construction

Location of the use case, physical or virtual

- Testbed in John Deere ETIC premises

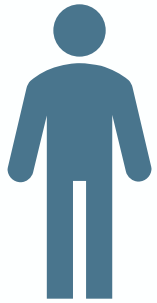


Constrains, challenges & risks

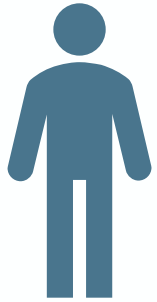
- Compatibility and integration of the provided HW from Tech provider
- Synchronizing machine work
- Time-critical machinery tasks

USER CENTERED IMPACT

The user specific needs addressed by the use case



Mobile Machinery Manager that needs a timely and synchronised machine work through HPC data analytics that will lead to optimise machine work.



Mobile Machinery Manager needs to be able to establish a M2M through enhanced capabilities and data analytics that which will lead to optimise machine performance.

TECH COMPONENTS

Workloads

- Applications & Services
- Enterprise Systems / Apps
- Data Systems / Storage

Data Governance

Infrastructure

- Cloud
- Container as a Service
- Communications
  - Cellular LTE / 5G
  - Ethernet
  - CAN
  - WIFI

Data & Analytics

- Grafana

Devices

- ECU Platform
- GNSS Receiver
- Cellular modem
- Sensors TBD
- Stereo camera

Edge

if possible, please specify the type of edge

- Location / positioning data
- Video / images
- Machine status
- Network status

2 What **data sources** are needed to develop your solution?

- Timely data analysis
- (semi) Real-time data transfer

3 What are the **key components** that are not available today?

4 Are there any relevant **standards** that need to be considered?

NEMO
SMART FARMING-
PRECISION BIO SPRAYING

Sector: Agriculture

Partners: Synelixis, Agia Sofia Estate, OTE

Location: Peloponnese, Greece

Pilot duration: _____

Overview

- Precision farming solution combining multiple types of ground micro-climate/soil/leaf information stations, agri-drones, semi-autonomous mobile robots and wearable devices.
- Pilot done in organic olive plantations in Greece and NEMO will support technologies already implemented, e.g. Anti-frost system, irrigation system, etc.

Objectives and expected benefits

- Reduce crop spraying and support organic olives harvesting while validating NEMO OS on heterogenous and fast-moving scenario.
- Make intelligent decisions through real-time positioning and CF-DRL functions hosted on the IoT or at the edge.
- Create extensive Data Sets to be shared as FAIR data via the European Open Science Cloud (EOSC)
- Validate NEMO user acceptance from a farmer viewpoint evaluating bio-spraying efficiency, simplicity and cost

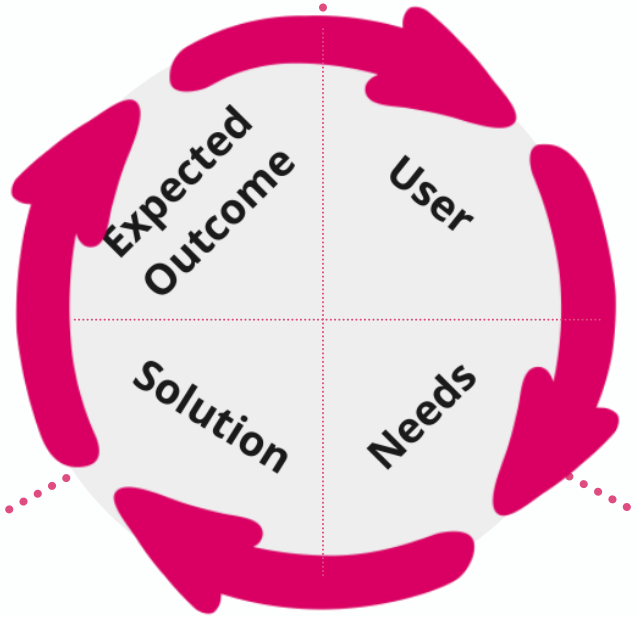
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- European Commission
- IoT device manufacturers
- Farmers
- IoT/edge/Cloud solution provider
- Citizens
- Business in olive oil value chain

Location of the use case, physical or virtual

- Ground robots
- Mobile Apps
- Cloud server
- Drones
- Synfield nodes
- Edge server
- Agia Sophia estate Peloponnese

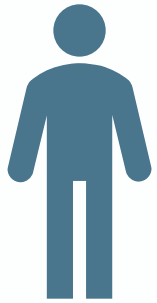


Constrains, challenges & risks

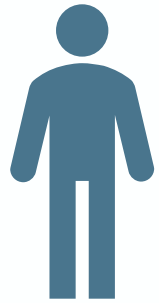
- Rural areas and limited availability of high-end infrastructure (5G nets)
- Weather conditions
- Plethora of diverge devices and architectures (legacy systems)
- Limited datasets
- Dataset security
- Security in M2M interactions
- Physical Security of Network and devices

USER CENTERED IMPACT

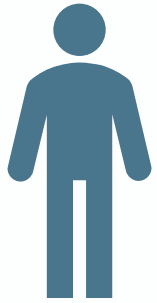
The user specific needs addressed by the use case



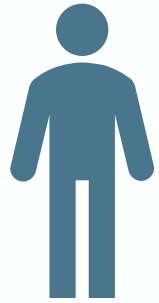
Smart Farmer who needs to optimise the use of resources, specifically organic pesticides using precision spraying to reduce operations costs.



Smart Farmer who needs to situational awareness of the farm through integrated IoT-edge-cloud solution which will result in optimised operations and greater harvest.



Smart Farmer who needs to grow healthy olive trees to increase harvest.



Smart Farmer requires a fast and robust smart farming tools through spraying precision (aerial & terrestrial) with advanced ML-based models which will preserve organic certifications and secure product supply.

TECH COMPONENTS

Workloads

- Applications & Services
- Enterprise Systems / Apps
- Data Systems / Storage

Data Governance

Infrastructure

- Cloud
- Container as a Service
- Communications

Data & Analytics

Devices

- Smart cameras
- Electric vehicles
- Charging stations
- Smart meters
- Power quality analysers
- PMU's

Edge

if possible, please specify the type of edge

2 What **data sources** are needed to develop your solution?

- Hyperspectral imaging

3 What are the **key components** that are not available today?

4 Are there any relevant **standards** that need to be considered?

FLUIDOS
SMART VITICULTURE

Sector: Agriculture

Partners: Terraview

Location:

Pilot duration: _____

Overview

The Smart Viticulture project enables smart farming for viticulturalist. This pilot uses Terraview's climate SaaS platform bringing data from multiple sources with proprietary AI/ML pipelines to help create intelligence for the practitioners on the ground, to make better decisions and make better wines in a climate-sustainable way.

Objectives and expected benefits

- Allow critical decisions on the ground using intelligence from various sources
- Automatised data and analytics with connected reports
- Automatic alert response system
- Increase efficiency of workforce
- Improve health of crops and reduce loss of vines
- Decrease use of chemicals

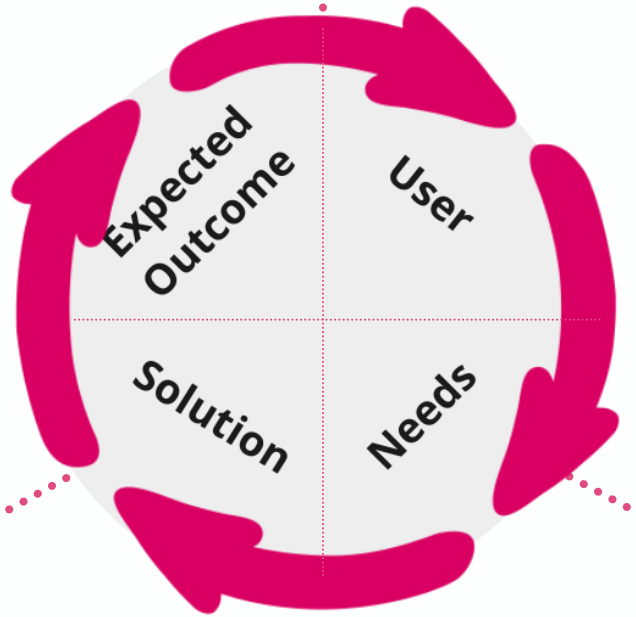
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- Vineyard operator/manager
- Viticulturalist
- Fruit distributor
- Fruit buyer (winery)
- Cooperative

Location of the use case, physical or virtual

- Vineyard
- Core Cloud
- Edge/on-prem
- Autonomous vehicle (aerial or ground)



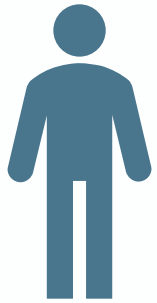
Constrains, challenges & risks

- Data privacy
- Connectivity availability
- Reliability and accuracy
- Resource constraints at the edge

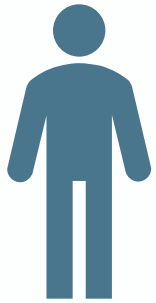
- Education on digitalisation to realise its value/potential
- Partial set of services at the edge, the rest in core

USER CENTERED IMPACT

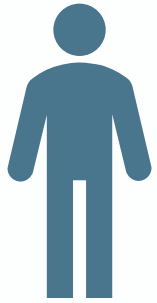
The user specific needs addressed by the use case



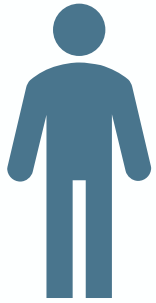
Vineyard manager needs actions and notifications of key events and management of workforce through reliable disconnected operations for instant access to information for optimised operations and reduced costs.



Viticulturalist needs in depth metrics and indicators on managed crop through reliable operations to create actionable crop reports and predictions and minimise crop loss.



Vineyard manager needs reports and information on the progress of their crop across multiple plots/blocks with focused context aware UI to achieve frictionless digitisation of processes.



Cooperative needs to meet multiple SDG sustainability goals which can be monitored through data and computation sharing and consequently report the SDG goals and results.

TECH COMPONENTS

Workloads

Applications & Services
- DSS
- Image Processing
- AI/ML

Enterprise Systems / Apps
- CRM integration

Data Systems / Storage
- File
- Object

Data Governance
- Secure computation (TEE)
- Encryption at rest, in transit

Infrastructure

Cloud
- IaaS

Container as a Service
- using Swarm--> k8s

Communications
- WIFI
- Satellite
- 3/4/5G
- Lora

Data & Analytics
- Disease prediction
- Water utilisation efficiency
- Yield
- Vintage

Devices
- Desktop
- Mobile phone
- Drone
- Sensors
- Smart phone
- Robot
- Satellite

Edge
- On-premise computation device, head/worker configuration

if possible, please specify the type of edge

- Weather
- Satellite imagery -many types
- Ground sensor data

2 What **data sources** are needed to develop your solution?

- Optional: Hyperspectral imaging

3 What are the **key components** that are not available today?

4 Are there any relevant **standards** that need to be considered?

ICOS
AGRICULTURE OPERATIONAL ROBOTIC PLATFORM (AORP)

Sector: Agriculture

Partners:

- L-PIT (SIEC BADAWCZA LUKASIEWICZ – POZNANSKI INSTYTUT TECHNOLOGICZNY)
- PSNC (INSTYTUT CHEMII BIOORGANICZNEJ POLSKIEJ AKADEMII NAUK)

Location: Poland

Pilot duration: _____

Overview

- The Agriculture Operational Robotic Platform (AORP) use case optimizes farming with agro robots (Agbots)
- In order to achieve benefits, it is necessary to further develop digital and robotic systems based on data exchange ecosystems and services based on their semantic processing.
  - This will provide knowledge and tools that will increase efficiency, ensure safety, and confirm product quality in the supply chain, while reducing costs and providing valuable information to farmers

Objectives and expected benefits

- Reduction of operating costs as well as amount of used plant protection products
- Improvement of:
  - awareness of technology potential impact
  - digital competences
  - effective use of resources

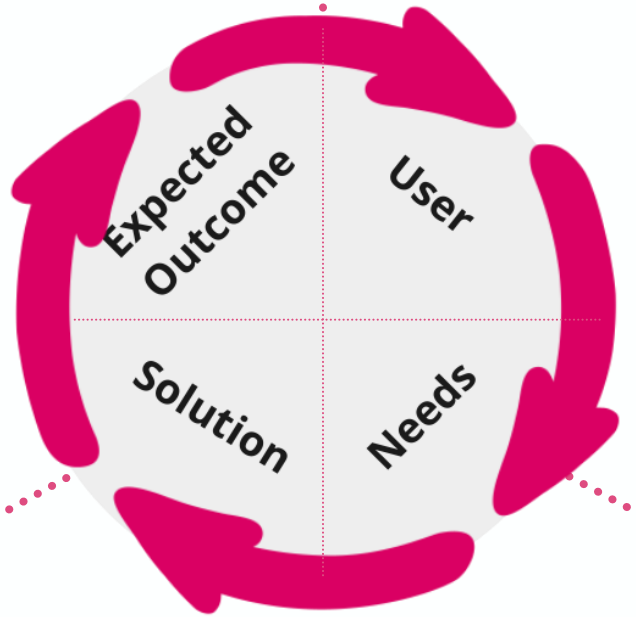
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- Farmers
- Robotic Solution Providers
- Service Providers

Location of the use case, physical or virtual

- Field (corn / beet)
- Farm

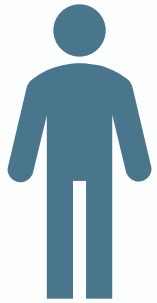


Constrains, challenges & risks

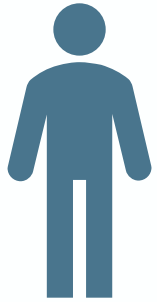
- Latency of Service
- Connectivity of Service
- Coexistence of real-time processing and coordination with cloud services

USER CENTERED IMPACT

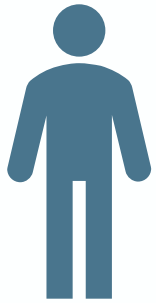
The user specific needs addressed by the use case



Farmers seek to use an **efficient and well-functioning device** that is easy to manage and exhibits **high accuracy** in its operations, while maintaining **low failure rates**. This is accomplished by incorporating various functionalities such as **monitoring**, weed detection, mapping and removal, as well as yield mapping. Additionally, the device allows for **fast data exchange with robot-external data sets and services**, without compromising the robot's speed. As a result, farmers can rely on a **dependable, precise, and efficient robotic platform** for their farm operations.



Robotic solution providers need to **gather information** about machinery performance to **enhance both the hardware and software of their robots**. This information is obtained through **device logs and accuracy data of models**, enabling them to make necessary improvements to the models. As a result of these enhancements, the robotic platform becomes more **effective**, and **optimal mission planning** is achieved.



Service providers aim to **monitor real-time information** regarding machinery performance. They accomplish this by utilizing **device logs** and implementing **predictive maintenance techniques**. Through these measures, they can **optimize the robotic platform** to **cater to the specific needs** of different clients effectively.

TECH COMPONENTS

Workloads

Applications & Services

- Crop management analytics:
  - Weed recognition, monitoring, weed detection, weed mapping, weed removal, yield mapping
- Decision support system

Enterprise Systems / Apps

- Administration / steering dashboard
- Maintenance dashboard

Data Systems / Storage

- Cloud storage Databases, Edge devices
  - up to 100 GB per day

Data Governance

- Security and authentication procedures
- Authorisation for different types of users

Infrastructure

Cloud

- Cloud infrastructure for data management, models training dashboards, maintenance system

Container as a Service

- Several applications, and several containers per application / service

Communications

- Available networks: Cellular, Wifi, LoRaWAN

Data & Analytics

- Prediction module
- Maintenance module
- Training module for model improvements
- Crop analytics system

Devices

- Agriculture Operational Robotic Platform with control and driving modules
- Attached to AORP: seeder and a sprayer, RTK GPS, camera on the front of the robot and ultrasonic sensors

Edge

- ICOS EDGE Node on AORP Transport platform, acting also as EDGE
- ICOS EDGE Node on AORP

if possible, please specify the type of edge

- Camera, lidar, sensors on AORP
- Robotic platform information: speed, ...
- Mission maps

2 What **data sources** are needed to develop your solution?

- Intelligent Cloud-Edge Orchestration
- Use of ML and AI to obtain satisfactory solutions at edge

3 What are the **key components** that are not available today?

- Data security
- ROS

4 Are there any relevant **standards** that need to be considered?

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ENVIRONMENT

Nephele: Disaster/Emergency Recovery

Nebulous: International Disaster Response

NEPHELE DISASTER/EMERGENCY RECOVERY

Sector: Environment

Partners:

Location:

Dates

Overview

- When a natural or human disaster occurs, the first 72 hours are particularly critical to locate and rescue people.
- Rescuers are assisted by different robots equipped with different sensors and wireless communication means. Victims are usually equipped with wearable sensors (mobile phones) that could send useful complementary data.

Main Objectives

1. Locate and identify victims.
2. Assess the victims' injuries
3. Assess the disaster damages and understand remaining risks to prioritize the rescue operations.

Challenges:

- Challenges rely on the diversity of devices and time strong constraints. Nephele aims to orchestrate all devices and deploy edge computing
- A pilot will be set using lab HW such as Turtlebots Niryo arms, Summit XLS with a UR5 arm with several depth cameras, lidars and sensors.

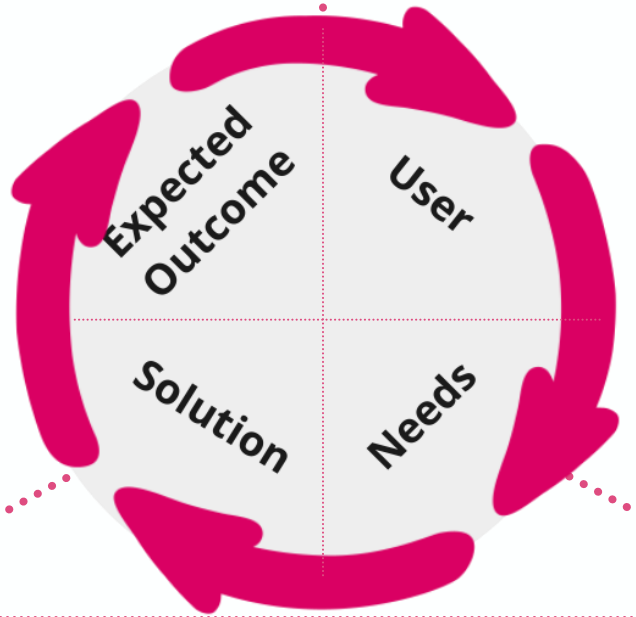
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- First responders
- Government
- Insurers
- Citizens
- Victims

Location of the use case, physical or virtual

- First responders
- Government
- Insurers
- Citizens
- Victims



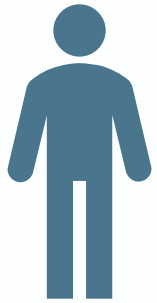
Constrains, challenges & risks

- High computational needs
- Regulatory restrictions
- Fast response
- No network infrastructure
- Reaching dangerous areas

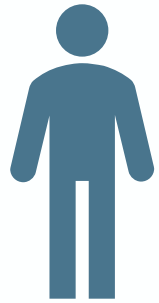
- Monitoring situation
- Economic risks
- Heterogeneous devices
- Reliability of the network
- Physical security of humans reaching dangerous areas

USER CENTERED IMPACT

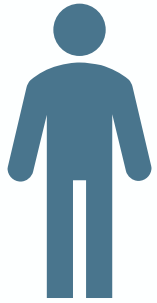
The user specific needs addressed by the use case



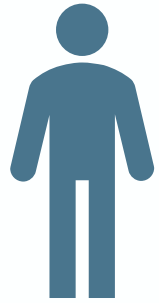
First responder needs to give a prompt response to a disaster which can be accelerated by mapping and sensing to accurately locate and rescue victims.



Victims need to be quickly found, rescued and offered life support in disaster scenarios, which can be achieved using motion detection and a fleet of drones and robots.



First responder needs situational awareness with a fleet management of drones and robots to minimise human risk and have greater mission control while optimising the use of devices.



The rescue services need to perform safe operations and to create safe zones from real time monitoring, and data analysis and AI to minimise human risk, both victims and rescue teams.

TECH COMPONENTS

Workloads

Applications & Services
- Mission optimisation
- Mapping & risk/ victim detection

Enterprise Systems / Apps
- Mission control

Data Systems / Storage
- Cloud
- Edge

Data Governance
- Fusion
- Filtering
- Compression
- Context awareness

Infrastructure

Cloud
- MLaaS
- Orchestration

Container as a Service
- k8s/ k3s

Communications
- CoAP
- MQTT
- 5G
- WIFI
- Bluetooth

Data & Analytics
- Sensor data analysis for monitoring & forecast
- ML for victims detection and localisation

Devices
- Robots
- Drones
- Sensors
- Servers
- Gateways

Edge
- M2M communication
- ML/DL Processing
- Fleet management
- Storage

if possible, please specify the type of edge

- Robots, drones and cameras
- Sensors data

2 What **data sources** are needed to develop your solution?

- Heterogenous IoT devices communication
- Cloud-to-Edge-to-IoT orchestration

3 What are the **key components** that are not available today?

- ROS
- 3GPP
- IEEE working groups on IoT

4 Are there any relevant **standards** that need to be considered?

NEBULOUS INTERNATIONAL DISASTER RESPONSE

Sector: Agriculture

Partners: Bibo, @Fire

Location:

Pilot duration: _____

Overview

- One of the most difficult challenges in dealing with large-scale disasters is coordinating response crews, materials, and equipment from various stakeholders. Obtaining a clear picture of the situation in the affected area is critical for operational management, allowing for the efficient and safe deployment of available resources.

Main Objectives

- To enable widespread communication and computing in crisis scenarios by delivering a flexible fog computing platform that can adapt to the situation at hand.
- By combining the NebulOuS platform with modern LPWAN technologies, not only a situational map can be developed but also AI algorithms can be deployed on multiple levels of the edge-cloud-continuum.

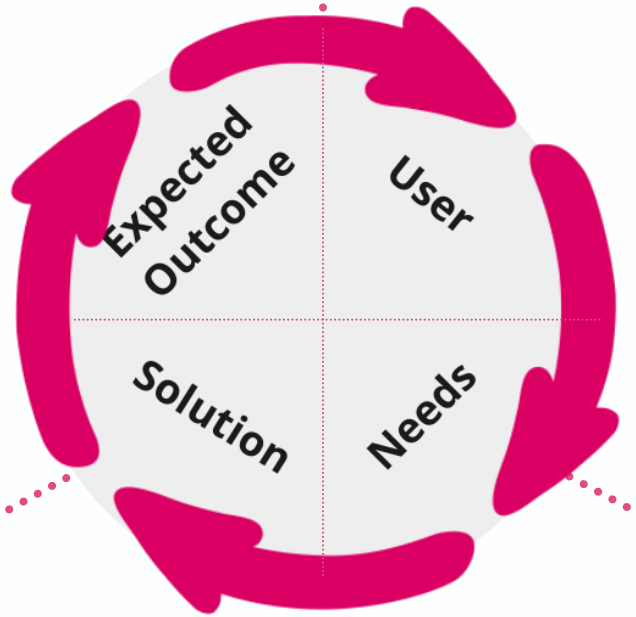
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- System Operator (@fire)
- Affected Public
- Application Developer
- Other Emergency Services
- First Responder
- General Public
- Gov. Authorities

Location of the use case, physical or virtual

- Anywhere!
- Off the grid
- Local Server
- On Edge Point/IoT
- Smartphones / Mobile App

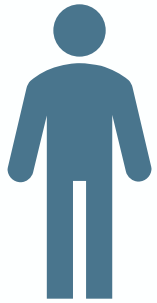


Constrains, challenges & risks

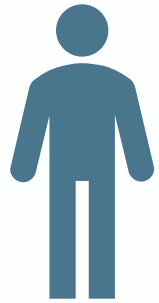
- Different Cloud provider
- Internet connectivity
- Communication Possibilities
- Connectivity between Nodes/Edge to Cloud
- On field data processing
- Data acquisition
- Orchestration of between edge point and designated cloud

USER CENTERED IMPACT

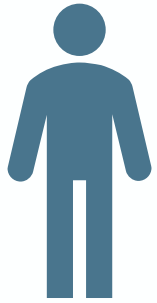
The user specific needs addressed by the use case



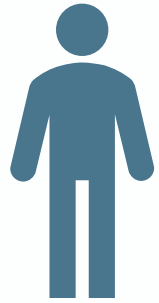
Disaster Response Management Cell needs to have data management on field using mobile computational capacity which will consequently increase total information processed digitally in disaster management.



Responders need to be able to communicate digitally even in remote areas with low coverage while having reliable communication and instant access to information.



Governmental Authorities need better coordination between different teams and efforts to deliver post-process information and to have access to better and faster information.



Citizens need to have faster updates and information on the status of a disaster response with information filtering and post process which will be publicly available and visualised.

TECH COMPONENTS

Workloads

Applications & Services
- Digital data transfer
- Digital comms

Enterprise Systems / Apps

Data Systems / Storage

Data Governance
- Secure Back-up
- On Edge

Infrastructure

Cloud
- Data Bank
- Computation capacity

Container as a Service

Communications
- Low Band or offline network

Data & Analytics

Devices
- Camera
- Smart Devices
- PC/Laptop

Edge

if possible, please specify the type of edge

- Sensor data
- Image / Video

2 What **data sources** are needed to develop your solution?

3 What are the **key components** that are not available today?

4 Are there any relevant **standards** that need to be considered?

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ENERGY AND UTILITIES

NEMO: Smart Grid Flexibility, Smart Mobility

aerOS: Containerised Edge Computing Near Renewable Energy Sources

Fluidos: Energy grid resilience

ICOS: Energy Management and Decision Support system (EMDS)

NEMO
SMART GRID FLEXIBILITY, SMART MOBILITY

Sector: Energy

Partners:EMOT, Novoville, Thales, ENG and TSG, ASM

Location: Terni, Italy

Pilot duration: _____

Overview

- This use case will combine multiple smart meters, RES and photovoltaic cell controllers, energy customers (i.e. Buildings and offices), Medium/Low Voltage (MV/LV) substations, Electric Vehicles (EV) and EV chargers.

Objectives and expected benefits

- Deal with TSN and several thousand of nodes using the CMDT concept
- Validate Twin Green Clouds infrastructure for micro-services migration in Italy and in Germany
- Advanced CF-DRL analytics to create models and provide alarms, along with traffic and parking prediction.
- Validate NEMO user acceptance from a citizen viewpoint by utilizing the NOVO smart city platform in Terni

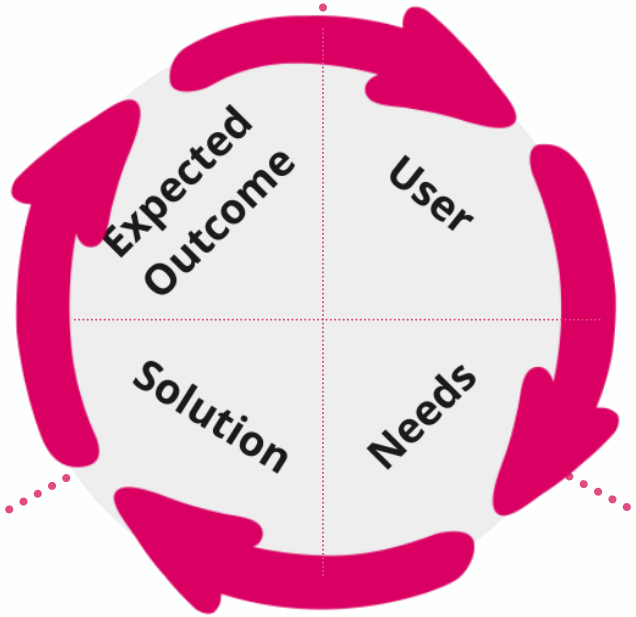
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- End users with solar panels (Prosumers)
- The Terni municipality
- The European Commission
- EV Fleet operation manager
- Citizens
- EMaaS Provider
- EV Owners
- Local DSO

Location of the use case, physical or virtual

- The Terni Municipality
- RES Infrastructure
- ASM servers
- Terni Electricity distribution grid
- NEMO Platform
- Location of charging stations

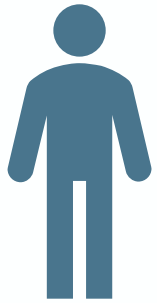


Constrains, challenges & risks

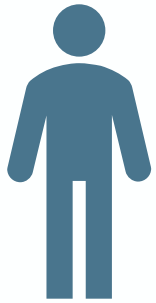
- Old electrical infrastructure
- Regularity constraints
- Increase the integration of RES in the grid
- Physical security of the network
- Security in M2M interactions
- Cybersecurity of IoT Devices
- Improvement of grid observability
- IoT device interoperability
- Reliability of the networks

USER CENTERED IMPACT

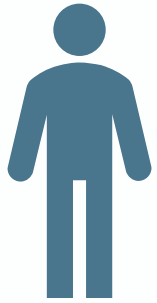
The user specific needs addressed by the use case



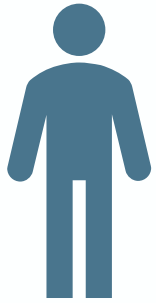
The Terni Distribution System Operator (DSO) needs to have a monitoring system with accurate information on the infrastructure using real-time data collection and ML trained models which will reduce the impact of voltage variations on the grid and improve the power quality.



The Terni Municipality needs to balance the supply and demand of renewable energy achieved using data analytics and ML models resulting in improved renewable energy resources load balanced with EV charging.



The Charging Point Operator needs to attract more EV users to its charging stations which can be done by provisioning the service through a blockchain-based marketplace, reducing the operating costs and attracting new users, thus directly increasing revenues.



Electric Vehicle users need to charge their EVs at their convenience using the emobility platform which will provide instant payments while being ecologically friendly.

TECH COMPONENTS

Workloads

Applications & Services
On board diagnostics module
Workforce planning manggement

Enterprise Systems / Apps
DLT used for Micro-payments, smart contracts and the interaction between CPO & DSO

Data Systems / Storage
- Cloud

Data Governance
- DLT
- Data layering

Infrastructure

Cloud
- DR module
- MLaaS

Container as a Service

Communications
- 5G

Data & Analytics
- ML forecasting system
- ML libraries

Devices
- Electric vehicles
- Smart charging stations
- Smart meters

Edge
- ML/DL processing

if possible, please specify the type of edge

- Energy demand
- Infrastructure map

2 What **data sources** are needed to develop your solution?

- Sensors within the energy grid
- Digitalisation across the energy infrastructure

3 What are the **key components** that are not available today?

- IEEE working groups on IoT
- ETSI SDN-NFV
- 3G PPP

4 Are there any relevant **standards** that need to be considered?

AEROS
CONTAINERISED EDGE COMPUTING NEAR RENEWABLE ENERGY SOURCES

Sector: Agriculture

Partners: CF, ELECT

Location: Poland

Pilot duration: _____

Overview

- To allow containerised edge data centres management located directly at energy sources, connected to the smart infrastructure and providing cloud continuity.

Objectives and expected benefits

- Use case will proof applicability of aerOS for managing small, edge nodes located directly at energy producing locations, gathering information and events from the deployed smart devices.
- aerOS will distribute, monitor and relay tasks of stateless processing among a pool of near and far-edge nodes located at ELECT renewable energy premises
- Will use of heterogeneous information in the orchestration and scheduling model boosting the energy and resource optimisation
- Will reduce equity investment of the system

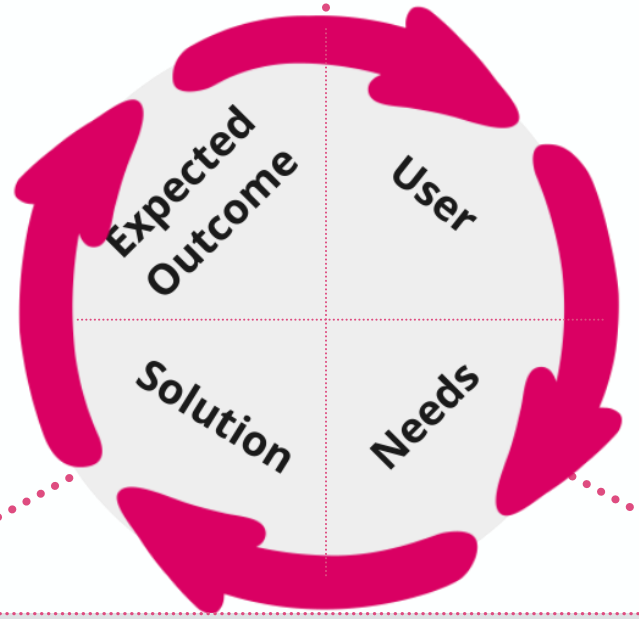
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- Edge provider - CF
- Energy premises manager - ELECTR
- Energy consumers
- IT provider

Location of the use case, physical or virtual

- Cloud
- Containerised edge data centers - CF
- Edge
- Renewable energy centres ELECT
- Far Edge Existing CF cloud-edge infrastructure WAW 2-1

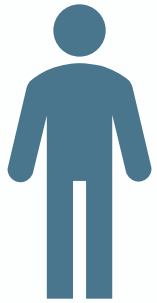


Constrains, challenges & risks

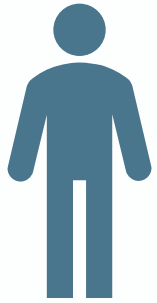
- Privacy restrictions for data sharing
- Trustworthy intelligence in a critical sector
- Possible rapid changes in task distribution due to available energy, network throughput etc.
- Heterogeneous sources of information for orchestrating and scheduling optimisation
- Connection challenges
- Difficulties in monitoring the grid at large scale
- Decentralised and distributed configuration of Renewable Energy structure in the local area
- Usage of AI for intelligent forecasting
- Considering far edge

USER CENTERED IMPACT

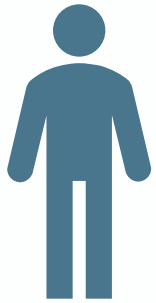
The user specific needs addressed by the use case



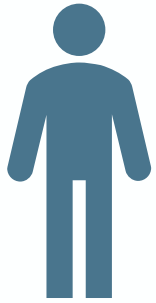
The infrastructure provider needs to be able to make effective decisions including monitoring and distributing tasks for definition and implementation of energy and network conscious management leading to accelerated decision making.



The infrastructure provider needs to automate system management and decrease the capital intensity and system redundancy with failover mechanisms for tasks execution to gain quicker response time, lower transmission latency and flexibility and scalability of the infrastructure.



The infrastructure consumer needs private and trustable continuum which will use fabric computing with intelligent orchestration to reduce energy consumption.



The infrastructure consumer needs to run FaaS like activities/jobs using frugal AI and explainable AI support to reduce energy consumption due to transfer of AI and real-time analytics to edge nodes.

TECH COMPONENTS

Workloads

Applications & Services
SELF-* e.g. scalability, automation
Dynamic continuum management

Enterprise Systems / Apps
Data repositories
Monitoring and administration tools
Dashboards for processing disposition
Everything Monitoring and Control System software

Data Systems / Storage
- Shared long term storage
- Local storage

Data Governance
- Privacy
- Trust
- Provenance

Infrastructure

Cloud
- CF infrastructure

Container as a Service
- Docker
- Kubernetes

Communications
- Fiber optics
- WIFI

Data & Analytics
- Predictive maintenance
- AI/ML for decision support
- Frugality

Devices

Edge
- Sensors, actuators
- IoT devices
- Smart devices

if possible, please specify the type of edge

2 What **data sources** are needed to develop your solution?

- Advanced intelligence decision support
- Infrastructure's autonomy in terms of management

3 What are the **key components** that are not available today?

- European Green Deal
- Fit for 55 package

4 Are there any relevant **standards** that need to be considered?

FLUIDOS
ENERGY GRID RESILIENCE

Sector: Energy

Partners: RSE Italia

Location: Milan, Italy

Pilot duration: _____

Overview

The pilot looks at monitoring of the grid state- on both transmission and distribution grid. It takes place in a testbed in RSE Milan and aims to integrate non-programmable, renewable energy sources which require a strong digitalisation of power network operations.

The current challenges of smart grid are:

- Increasing complexity due to increasing number of RES plants, local energy communities, etc.
- Increasing flexibility due to non-programmable power production
- New services and operators

Objectives and expected benefits

- Resilient ICT infrastructure
- Demand/supply energy balance
- Monitoring and control of transmission and distribution of energy

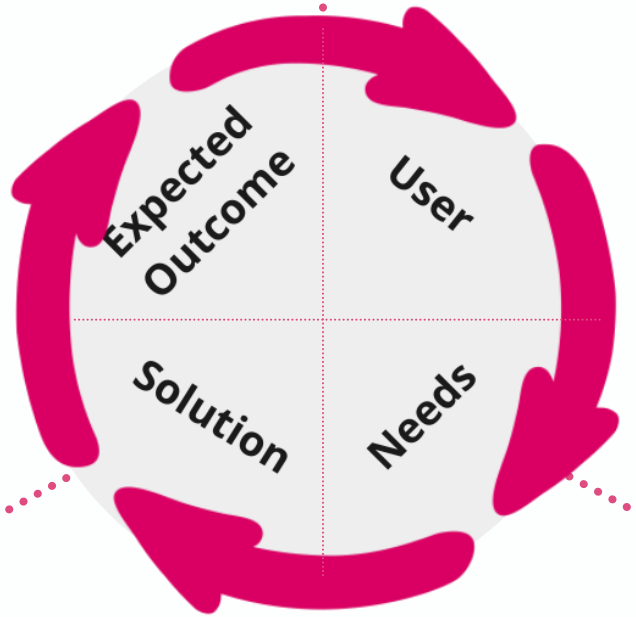
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- Transmission System Operator (TSO)
- Power Utilities
- Phasor Measurement
- Units (PMUs)
- Distribution System Operator (DSO)
- Power Protection entities
- Resilient ICT infrastructure
- RSE

Location of the use case, physical or virtual

- Transmission grid
- Secondary substation
- Distribution grid
- Primary substations
- Energy production sites and lines



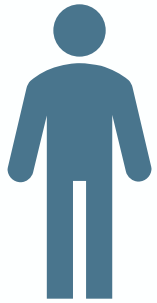
Constrains, challenges & risks

- Latency
- Time synchronization
- Resilience
- Reliability
- Scalability

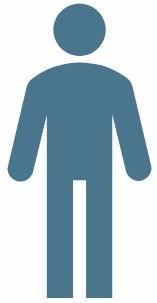
- High sampling rate
- Cybersecurity
- Data Congestions
- Low cost infrastructure

USER CENTERED IMPACT

The user specific needs addressed by the use case



The Transmission System Operator (TSO) needs to monitor transmission grid for control purposes which can be achieved using Phasor measurement and concentration, and resilient ICT infrastructure resulting in grid state estimation and supply-demand energy balance.



The Distribution System Operator (DSO) needs to monitor transmission grid for control purposes using orchestration of systems and devices to reduce costs.

TECH COMPONENTS

Workloads

- Applications & Services
- Enterprise Systems / Apps
  - Grid State Estimator Algorithm
- Data Systems / Storage
  - Cloud
  - Fog-Edge

Data Governance

- Secure Transport
- Time Synchronization
- Reliable Data

Infrastructure

- Cloud
  - Grid State Estimator Algorithm
  - PDC
- Container as a Service
  - PDC
- Communications
  - 4G
  - 5G
  - Ethernet
  - Optical Fibers

Data & Analytics

- Grid State Estimation Algorithm
- Synchrophasor measurements

Devices

- PMU
- PDC

Edge

- High sampling rate
- Low latency
- Cybersecurity

if possible, please specify the type of edge

- Real time monitoring of ICT Infrastructure
- Power grid and ICT topology
- TSO & DSO Requirements

2 What **data sources** are needed to develop your solution?

- Low cost PMU
- Microservices Architecture

3 What are the **key components** that are not available today?

- IEEE C37.118
- IEC 61850-90-5

4 Are there any relevant **standards** that need to be considered?

ICOS
ENERGY MANAGEMENT AND DECISION SUPPORT SYSTEM (EMDS)

Sector: Energy

Partners:

- SSEA (SSE AIRTRICITY LTD)
- CeADAR (UNIVERSITY COLLEGE DUBLIN, NATIONAL UNIVERSITY OF IRELAND, DUBLIN)

Location: Ireland

Pilot duration: _____

Overview

- The Energy Management and Decision Support system (EMDS) use case focuses on the energy consumption in smart homes. Already consumers are investing in smart devices and energy storage to better manage their electricity consumption. Green energy is enabling the transition to smart homes through active participation in, and support of, ESBN's SMART meter programme and the installation of solar PV, solar thermal, smart heating controllers and EV chargers through Airtricity Energy Services.

Objectives and expected benefits

- Support of the distribution network
- Foster uptake in smart, controllable domestic devices
  - Can leverage payments for flexible energy usage

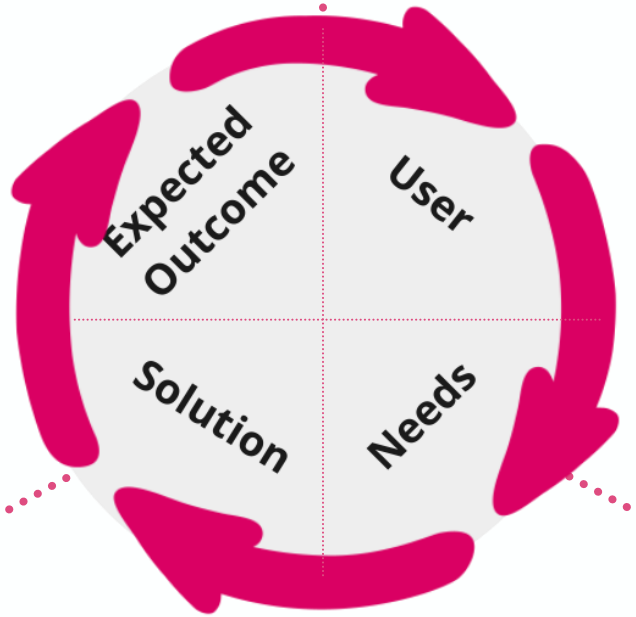
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- Energy Utility customers
- Academic partner (CeADAR)
- Energy Utility company
- ICOS consortium
- DSO and TSO

Location of the use case, physical or virtual

- IoT sensors in the house (Ireland)
- Edge devices gateways in the house (Ireland)
- ICOS Cloud (TBC)
- Cloud service in Azure (SSE provider)
- ICOS edge node (Ireland)

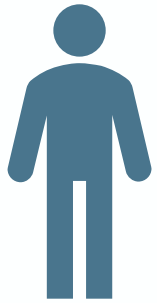


Constrains, challenges & risks

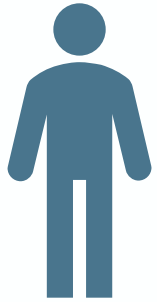
- Flatten demand/ supply curve
- Complete data flow for different phases of the validation process in ICOS
- Data security and data privacy
- Connectivity of service (especially in rural areas)
- scalability (from 5 to 5000 to 500000 customers)

USER CENTERED IMPACT

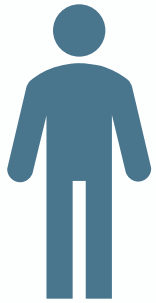
The user specific needs addressed by the use case



Energy utility customers have various goals they wish to accomplish by utilizing AI and the ICOS system. The system aids in achieving **net-zero emissions** by providing features like dashboarding with a clear visual of **cost and consumption**. The benefits of using this technology include a **rise in green energy usage, optimizing energy consumption, reducing costs, enhancing energy literacy, and promoting digital empowerment.**



Energy utility companies strive to attain **net zero emissions** and **scalability** while simultaneously **maximizing customer retention and satisfaction**. They achieve it by implementing **ML models with home-to-home sharing of learnings**, which in turn **flattens the demand and supply curve, improves frequency stability, data privacy and security**.



Distribution System Operators (DSOs) and Transmission System Operators (TSOs) have the objective of achieving **net zero emissions** and ensuring **grid stability**. This effort leads to **reduced wind curtailment and increased energy usage**, resulting in a **flattened demand and supply curve**. Furthermore, it brings about **improved frequency stability** and enhances the **flexibility of services for dispatchable demand.**

TECH COMPONENTS

Workloads

- Applications & Services
- Enterprise Systems / Apps
  - Dashboarding for usage and associate costs
- Data Systems / Storage
  - Cloud, DB, Edge devices

Data Governance

- Time stamps and versioning required
- Security and authentication procedures
- Data archiving

Infrastructure

- Cloud
  - SSE proprietary Cloud infrastructure for data management /storage/processing depending on the ICOS phase
  - ICOS cloud capabilities
- Container as a Service
- Communications
  - Wireless communication for data transmission on the cloud

Data & Analytics

- Anomalies detection
- Energy Forecasting models
- Results visualization / dashboarding for customers use

Devices

- Energy clamps for energy data exportation (attached to the solar panel)
- Energy clamps for energy data consumption
- Energy clamps for EV energy data (attached to the EV charger)

Edge

- Edge device (jetson or raspberry pie)

if possible, please specify the type of edge

- Consumption data
- BER
- Power export data
- Power storage data
- Sensor occupancy data
- EV charging data
- Market price data

2 What **data sources** are needed to develop your solution?

- IoT, Cloud, Edge orchestration
- Scalability
- Use of ML and AI to obtain solutions at edge level to share knowledge from home to home

3 What are the **key components** that are not available today?

- Data security and Data privacy
- GDPR standards and policies

4 Are there any relevant **standards** that need to be considered?

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SMART CITY & BUILDINGS

Nephele: Energy management in smart buildings/cities

NebulOus: Computer Vision for City Maintenance

aerOS: Energy Efficient, Health Safe and Sustainable Smart Buildings

NEPHELE ENERGY MANAGEMENT IN SMART BUILDINGS/CITIES

Sector: Energy/Smart City

Partners:

Location:

Pilot duration: _____

Overview

- Smart applications and services can help to manage control actions of building equipment..
- This is implemented by deploying an automation scheme that gathers real-time information from a variety of IoT devices together with Edge nodes that will instantiate VOs.

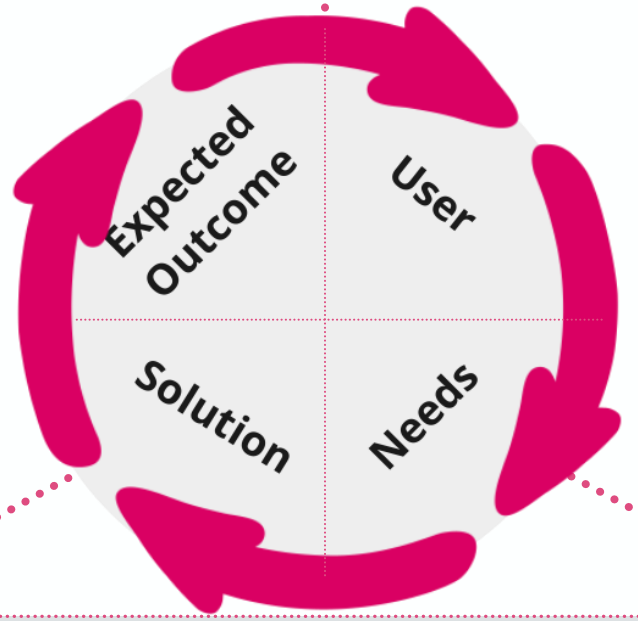
Objectives and expected benefits

- High-performance level of benefits in terms of:
  - Latency.
  - Energy consumption.
  - Reliability of the offered services.
- Energy Efficiency Management security, which is of paramount importance for smart building applications

OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- Energy communities
- Network operators
- Architects & builders
- Energy providers
- Ministry of Economy, Transport & Industry
- Citizens
- City government
- Businesses and companies
- IoT device manufactures
- HVAC manufacturers & installers
- Appliance manufacturers



Location of the use case, physical or virtual

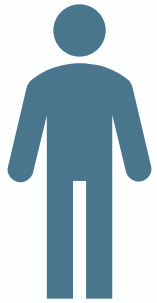
- Gateways
- Sensors
- Buildings
- Cameras
- Cloud
- Edge
- Appliances
- Urban furniture
- Network infrastructure

Constrains, challenges & risks

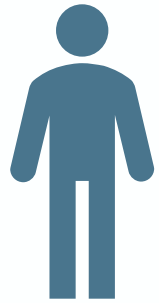
- Economic risks
- Heterogeneous devices
- No network infrastructure
- Reliability of the network
- Physical security of humans
- User data security
- Regulatory limitations
- Real-time execution
- Trust
- Constrained IoT devices
- Privacy risk

USER CENTERED IMPACT

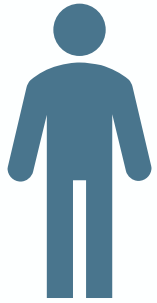
The user specific needs addressed by the use case



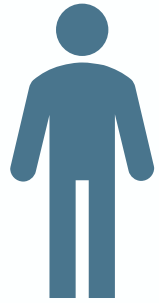
Citizens want energy efficient and secure homes using secure group communications, real time monitoring and execution resulting in a dashboard with authentication & authorisation features and reduced energy costs.



Building managers want to reduce resource usage while improving services offered with data security and analytics achieving smart energy management.



The local government wants to reduce resource usage while improving services offered using data analysis and IA-driven decision based on distribution of smart energy management applications.



Security services need to ensure citizens' security while respecting privacy using distributed AI and real-time monitoring resulting in improved object detection and better security.

TECH COMPONENTS

Workloads

- Applications & Services
- Enterprise Systems / Apps
- Data Systems / Storage

Data Governance

- Fusion
- Filtering
- Compression
- Context awareness

Infrastructure

Cloud
- MLaaS
- Meta-orchestration framework

Container as a Service
- K8s

Communications
- CP-ABE

Data & Analytics

- Real-time resources allocation
- Continuous monitoring and failure alerting of devices in the field

Devices

- IoT GW
- sensors
- UHD cameras

Edge

if possible, please specify the type of edge

- Various IoT sensors
- Video cameras

2 What **data sources** are needed to develop your solution?

- VO Stack (heterogenous IoT devices communication)
- Cloud-to-Edge-to-IoT orchestration framework
- Decentralized ML techniques

3 What are the **key components** that are not available today?

- ETSI
- W3C

4 Are there any relevant **standards** that need to be considered?

NEBULOUS COMPUTER VISION FOR CITY MAINTENANCE

Sector: Smart City

Partners: Ubiwhere

Location: Aveiro, Portugal

Pilot duration: _____

Overview

- Cities use the IoT to collect real-time data to better understand how demand patterns are changing and respond with faster and less expensive solutions.
- With a 5G connection, cities will be able to gain knowledge at every social iteration and protect their data lakes from external access. From sensors, street furniture, and user equipment, cities are constantly producing data which requires connecting the sources and storing their data.
- As more knowledge is gained and more data is collected, there is an increasing need to process and secure data analysis mechanisms and exchange between geographically distributed places.

Objectives and expected benefits

- The NebulOuS goal is to give connectivity, edge analytics, and interoperability to these cities, giving them the capacity to evolve by processing the available data to verify the information and identify possible damages to improve maintenance actions.
- Pilot case will validate the 5G technology for efficient smart-city maintenance, combining IoT data collection sensors integration and edge processing and will develop Computer Vision software to detect different damages in public buildings and other public infrastructures.

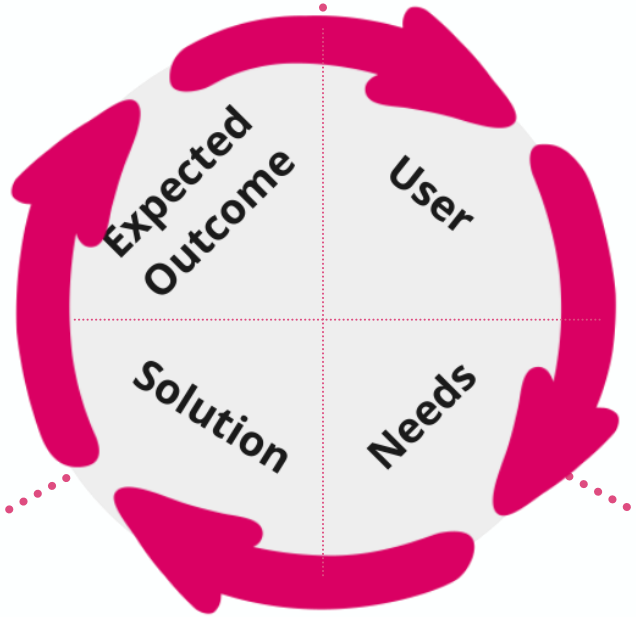
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- Ubiwhere
- Third Parties
- Smart City Managers

Location of the use case, physical or virtual

- City of Aveiro, Portugal
- Smart City Platform
- Edge Nodes
- UNICLE

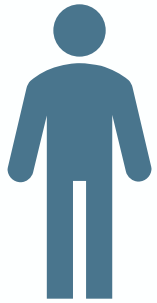


Constrains, challenges & risks

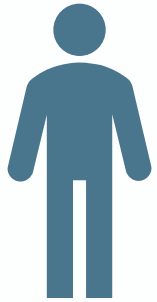
- Latency issues on critical messages from cloud to edge
- Automatic scaling of workloads throughout the edge and cloud continuum
- Orchestration between fully edge / partially edge + cloud / fully cloud
- Privacy/security aspects on data between edge nodes and cloud

USER CENTERED IMPACT

The user specific needs addressed by the use case



Government Authorities want to be warned about damage to public infrastructure using cameras and computer Vision algorithms detecting issues in buildings and infrastructures which will instantly detect issues in public property and allow timely resolution.



City managers want to visualise trends and statistics on public infrastructure status using computing statistics which will allow deeper understanding of trends and more accurate planning.

TECH COMPONENTS

Workloads

Applications & Services
- Computer Vision Algorithms

Enterprise Systems / Apps
- Ubiwhere Urban Platform

Data Systems / Storage
- Object Storage (e.g. S3)
- Broker?

Data Governance
- Data owners: Ubiwhere, City
- Data stewards: Ubiwhere
- Data custodians: Ubiwhere
- Data rules and definitions: Schema in JSON

Infrastructure

Cloud
- Ubiwhere Cloud Platform
- NEBULOUS Cloud Platform

Container as a Service
- K8s

Communications
- 5G

Data & Analytics
- CNNs (e.g. [1])
- Object Detection

Devices
- CCTV Cameras
- Wireless Gateways

Edge
- Thick Edge (Jetson)
- IoT Edge (cameras)

if possible, please specify the type of edge

- Video camera streams
- Other sensors telemetry if needed

2 What **data sources** are needed to develop your solution?

- Orchestration edge / cloud
- Auto scaling edge / cloud
- Privacy in edge <-> cloud

3 What are the **key components** that are not available today?

- GDPR

4 Are there any relevant **standards** that need to be considered?

AEROS
ENERGY EFFICIENT, HEALTH SAFE AND SUSTAINABLE SMART BUILDINGS

Sector: Smart City

Partners: COSMOTE, Demokritos, FOGUS and UPV

Location: Athens, Greece

Pilot duration: _____

Overview

- Demonstrate aerOS architecture in an edge deployment for energy efficient, sustainable, flexible and health-safe smart buildings
- Real-time processing of data and decision making related to events, are supported through aerOS capabilities, offering autonomous solution for safe and sustainable workplaces

Objectives and expected benefits

- Expected benefits will be derived from aerOS nodes intelligence, addressing distinctive infrastructure characteristics of buildings, through autonomous and decentralised decision-making at the edge.
- Moreover, the aerOS approach will offer an adaptable solution that can bridge heterogeneity (data and platforms), so that sensors, systems, and analytics could be orchestrated in the IoT edge-cloud continuum, and new IE or federating with new elements added.
- COSMOTE, a telecom operator owning a large number of buildings geographically dispersed, is interested in autonomous, intelligent, smart buildings so that to appropriately locate employees in the flexible workspace conditions in order to minimise energy consumption and operational costs and maximise health safety.

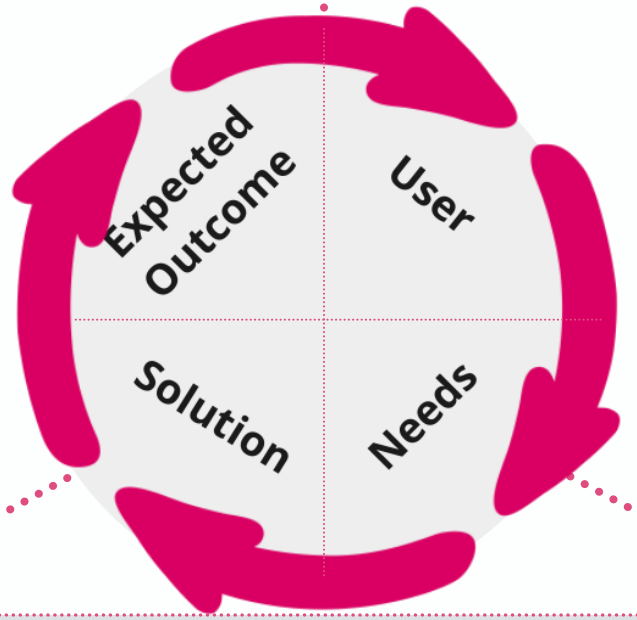
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- NCSRD (National Centre for Scientific Research "Demokritos")
- COSMOTE
- INFOLYSiS
- Police
- Maintenance desk
- Habitants
- Building employees
- FOGUS
- Owner of buildings

Location of the use case, physical or virtual

- Cloud (Digital Twin)
- Portable LoRa GW
- Mobile or web app
- COSM building in Athens, GR (physical)

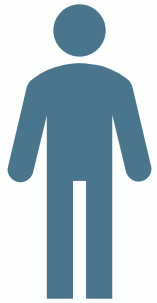


Constrains, challenges & risks

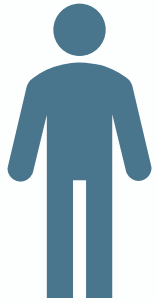
- Various IoT protocols
- The employee is seated in the most health safe Station, and according to his/her preferences
- Transform existing buildings to smart buildings with minimum investment.
- The appropriate placement of the employee should be instantly decided upon his/her entering the building
- Each building has its own characteristics and employees placement conditions (open space etc)
- Heterogeneous devices, technologies

USER CENTERED IMPACT

The user specific needs addressed by the use case



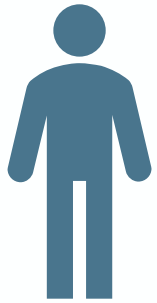
The company employee wants an appropriate desk at the company premises based on a decision system with AI capabilities using historical data, IoT measurements and employees preference to propose the most suitable placement allowing the employee to sit at the most health safe station accounting for personal preferences.



The owner of the building wants a cost-effective technical solution that can be flexibly replicated to many buildings, allowing for local decision making with loose central control as far-edge technologies decreasing operational costs and maintaining health safe working environment.

USER CENTERED IMPACT

The user specific needs addressed by the use case



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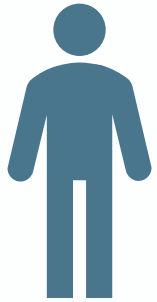

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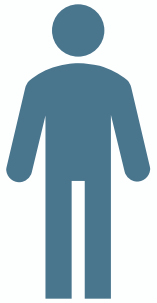

It is essential for the Maintenance Team to be always aware of the performance of the system, and minimise time-to-detect and time-to-recover which will be possible using federated resources orchestration to automate the infrastructure reconfiguration as necessary, automation for 1st level incident handling and and deep-dive monitoring capabilities managing a cluster of buildings/federated domain resulting in instant and exact overview of the status of each smart building while lowering operational costs by minimising human intervention.

TECH COMPONENTS

Workloads

- Applications & Services
- Enterprise Systems / Apps
- Data Systems / Storage

Data Governance

Infrastructure

Cloud
- RH Openstack (on prem)

Container as a Service
- Docker
- Kubernetes
- (K8S)

Communications
- VPN
- MQTT
- Rest APIs

Data & Analytics
- Grafana
- InfluxDB
- ThingSpeak (Mathworks)
- Kapacitor (TICK stack)
- ML Desk Recommendation System

Devices
- IoT GW
- IoT sensors
- LoRa GW
- LoRa COTS devices

Edge
- K8s
- K3s

if possible, please specify the type of edge

- Building Data
- Employees Data
- Sensors Data
- Company Policies/ Maintenance Plan
- Gateway Data Location Data

2 What **data sources** are needed to develop your solution?

- AI-based health-safe/energy efficient prediction and recommendation engine
- Mobile or
- Web App

3 What are the **key components** that are not available today?

- IT protocols
- Edge-Cloud Best practices (Open-source projects)

4 Are there any relevant **standards** that need to be considered?

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LOGISTICS & MOBILITY

aerOS: Port Continuum

Nephele: AI-assisted Logistics Operations in the Port of Koper

ICOS: Railway Structural Alert Monitoring system (RSAM)

AEROS
SMART EDGE SERVICES FOR THE PORT CONTINUUM

Sector: Logistics

Partners: EUROGATE,

Location: Port of Limassol, Cyprus

Pilot duration: _____

Overview

- With the constant increase in international commerce, existing ports are currently at capacity with physical expansions of terminals being difficult. The best solution is to increase the efficiency and productivity of existing ports through digitalisation and use of new technologies.
- aerOS will allow to orchestrate smart services in the edge, allowing maritime companies to react faster without the need of a high-performance processing in the cloud

Objectives and expected benefits

- Ensure that the data generated in the sources of the information are manipulated at the edge
- Enough computing performance in the edge elements in compliance with the smart orchestration approach of aerOS
- New AI and abstraction cloud methodologies application that will allow sophisticated cognitive services validation

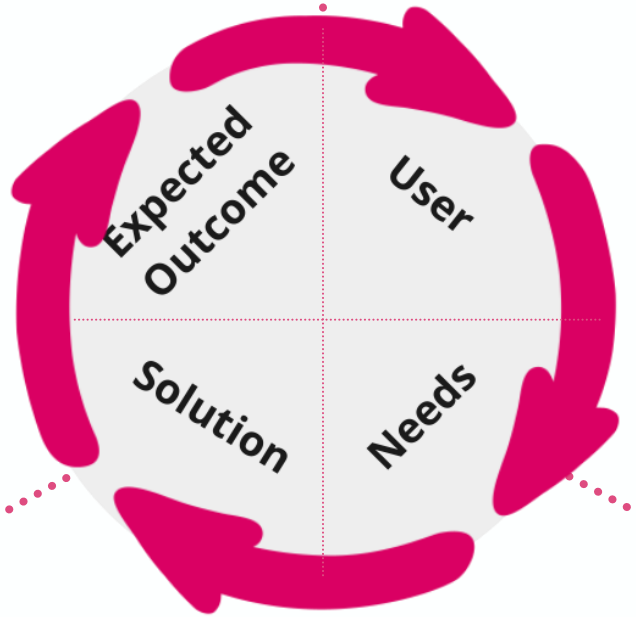
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- Container terminal board
- Maintenance team
- Shipping company
- AI-based service provider
- Crane manufacturer
- Freight forwarder
- IoT Technology provider
- Crane driver

Location of the use case, physical or virtual

- EUROGATE Limassol
- STS Crane
- Straddle Carrier
- Edge
- Cloud
- AV cameras
- Video recorder / processor
- Containers
- Computer vision software
- CMMS



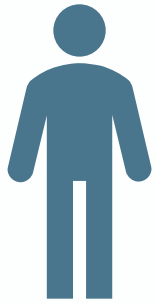
Constrains, challenges & risks

- Proprietary maintenance solutions
- Cargo handling quality check
- Workers safety
- Preventive maintenance solutions
- Reactive -> Not proactive

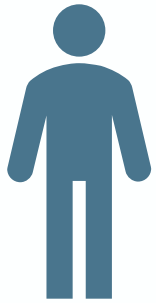
- Security risks sending to cloud
- Old infrastructure
- Costly (money-wise) OCR solutions
- Computational demanding CV solutions
- Heterogeneous manufacturers

USER CENTERED IMPACT

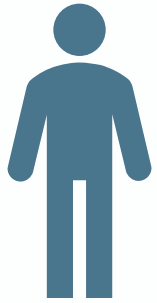
The user specific needs addressed by the use case



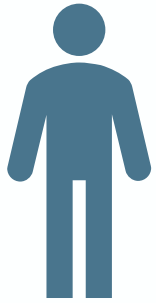
Container terminal board needs to optimise crane operations to provide safe working environment, quality assurance and increased efficiency thought an IoT platform that can be connected to various sensors and monitor operations resulting in optimised operations of the port.



IoT technology provider wants to provide a secure and affordable IoT platform for asset monitoring using storage and processing infrastructure which will be based on IoT platform running over a aerOS supported in any infrastructure environment.



Container terminal maintenance team needs to extend the lifespan of cranes to decrease costs and optimize operations using terminal operating system connected to crane monitoring management system based on AI-based IoT service proactively alerting potential damages on cranes.



AI-based service provider needs a service proactively alerting potential damages on cranes to optimise operations using computer vision which will result in AI/ML services at good value and increased security in the working environment.

TECH COMPONENTS

Workloads

Applications & Services

ML for container sealing, predictive maintenance & containers damage recognition

Enterprise Systems / Apps

- CMMS
- TOS

Data Systems / Storage

- Long-term storage on cloud
- Short-term storage on edge

Data Governance

Infrastructure

Cloud

Container as a Service

Communications

- Fiber optics
- WIFI
- MQTT / HTTP broker

Data & Analytics

- Computer vision tools (OpenCV/Tensorflow)
- Predictive maintenance AI/ML-based functionalities (Jupyter/Keras)

Devices

- Cameras
- Additional sensors (accelerometer, gyroscope, ...)
- TPMS
- PLCs

Edge

- MQTT / HTTP broker
- IoT Gateways
- Edge AV server

if possible, please specify the type of edge

- Tyre pressure
- TOS data
- Cranes telemetry from PLCs
- Video streams
- Fuel/Oil Levels
- CMMS data

2 What **data sources** are needed to develop your solution?

- AI-based services
- Digitalization across the terminal with IoT

3 What are the **key components** that are not available today?

- TIC 4.0

4 Are there any relevant **standards** that need to be considered?

NEPHELE AI-ASSISTED LOGISTICS OPERATIONS IN THE PORT OF KOPER

Sector: Logistics

Partners: Luka Koper Port And Logistic System

Location: Port of Koper

Pilot duration: _____

Overview

- As many other ports, Port of Koper is equipped with state-of-the-art trans-shipment and warehousing equipment, It also has excellent connections to road and railway network.
- Continuous monitoring and optimization of the traffic within the port poses a daily challenge.

Objectives and expected benefits

- NEPHELE will optimize the routing of containers from the terminal yard to different Container Freight Stations (CFS), where the cargo is stuffed/stripped, and viceversa. This will:
  1. Reduce routing times.
  2. Lower CO2 emissions.
  3. Get higher truck/forklift utilization and service level agreements.
  4. Allow to exchange and aggregate data among the physical components involved in the use case through VOStack layers.
  5. Comply with security and low latency requirements due to the application of decentralized machine learning techniques at a VO level.
  6. Allow the orchestration of the deployed microservices between the cloud and edge computing orchestration platforms.

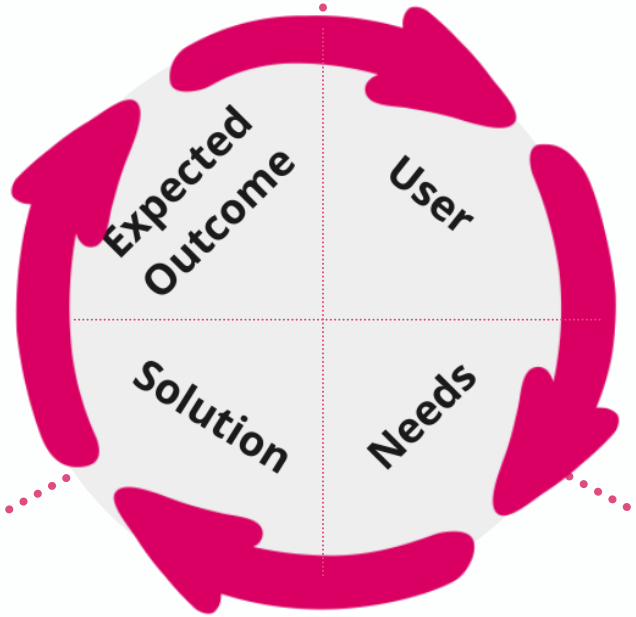
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- Port operator
- Port work force
- Network providers
- Rail operator
- Freight forwarders
- Ship operators
- Port authority
- City and State government
- Port owner
- Logistics/AI SW services providers
- Local citizens
- Truck operators

Location of the use case, physical or virtual

- Sensors
- UEs
- UHD cameras
- Cloud
- 5G NPN
- AI computational infrastructure
- Port area - terminal yard, CFS, roads
- Forklifts, terminal trucks
- IoT GW

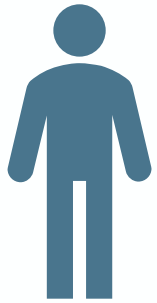


Constrains, challenges & risks

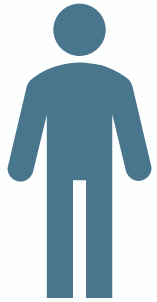
- Forklifts (trucks) availability and location
- Route (roads) status update
- Container localization accuracy
- Devices status update
- Real-time resources allocation
- Policies and KPIs definition
- Human safety risks
- Cyber security risks
- Economic risk

USER CENTERED IMPACT

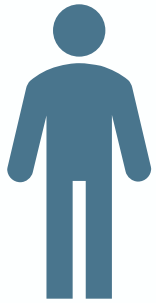
The user specific needs addressed by the use case



The **port operator** needs to **optimise work processes and resource usage while improving services** using **sensing and surveillance, AI algorithms and 5G NPN infrastructure** resulting in **improved machine and workforce utilisation and optimised port traffic flows.**



The **freight forwarder** needs to **optimise costs while improving service** using an array of applications from **collecting demands, forecasting delivery times to reporting delivery status** consequently **improving delivery times and reducing delivery errors.**



The **local government** wants do **reduce both CO2 and noise pollution in the area without hindering the prosperity of the local economy** using **AI algorithms for port traffic flows optimization** resulting in optimised port services and routes with less noise and less CO2.

TECH COMPONENTS

Workloads

Applications & Services
- Container route optimization

Enterprise Systems / Apps
- Port information system

Data Systems / Storage
- Cloud
- Edge
- Far-Edge

Data Governance

Infrastructure

Cloud
- MLaaS
- Meta-orchestration framework

Container as a Service
- K8s

Communications
- Fiber optics network
- VPN over internet
- 5G NPN

Data & Analytics
- Containers localization
- Real-time resources allocation
- Continuous monitoring and failure alerting of devices in the field
- KPIs/SLAs required

Devices
- IoT GW
- Sensors
- UHD cameras
- Body-worn cameras

Edge
- Decentralized MLaaS
- Port information system
- 5GS (NPN)

if possible, please specify the type of edge

- Port information system
- Various IoT sensors
- Video cameras

2 What **data sources** are needed to develop your solution?

- VO Stack (heterogenous IoT devices communication)
- Cloud-to-Edge-to-IoT orchestration framework
- Decentralized ML techniques

3 What are the **key components** that are not available today?

- 3GPP
- ETSI

4 Are there any relevant **standards** that need to be considered?

ICOS RAILWAY STRUCTURAL ALERT MONITORING SYSTEM (RSAM)

Sector: Logistics

Partners:

- WS (Worldsensing)
- FGC (Ferrocarrils de la Generalitat de Catalunya)

Location: Spain

Pilot duration: _____

Overview

- The Railway Structural Alert Monitoring system (RSAM) improves the railway monitoring process. Today the monitoring process is done by a special train, which can measure several key parameters of the railway system. However, this measurement is only taken every few months; in the remaining months, nobody knows what happens.
- ICOS will enable a proactive maintenance approach and improve decision making by providing more in-depth and frequent data, therefore providing railway authorities with valuable insights.

Objectives and expected benefits

- **Continuous Real-time Monitoring:** RSAM gathers data on various aspects, including rail track levelling, tensions and slope, surrounding area settlements, falling elements, catenaries maintenance, and cyber processes monitoring.
- **Cost Optimization:** By leveraging digital technology and real-time monitoring, RSAM reduces monitoring and maintenance expenses. Up-to-date information on railway infrastructure status allows for efficient planning and execution of maintenance activities, reducing the need for frequent manual inspections.
- **Enhanced Safety:** RSAM plays a crucial role in improving railway safety by promptly identifying issues or anomalies. By continuously monitoring diverse parameters, railway authorities can take appropriate actions to mitigate risks, ensuring safer operations.

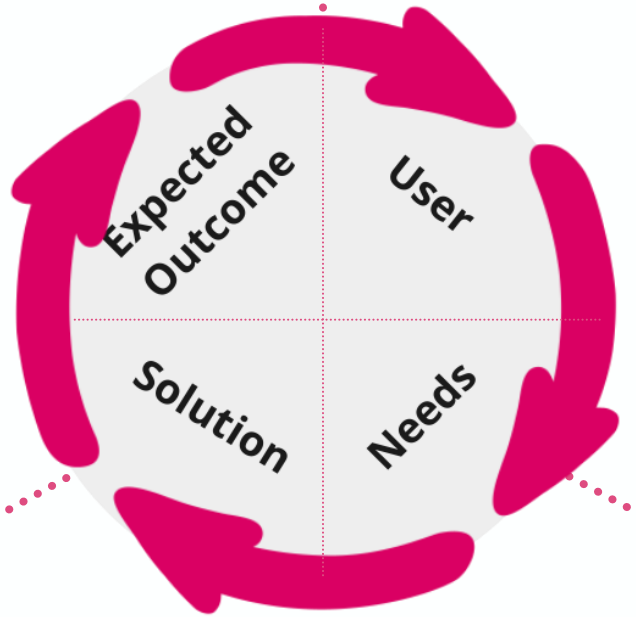
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- Railway Operators
- Monitoring Technology Providers
- Citizens who utilize railway services

Location of the use case, physical or virtual

- Lleida-La Pobla railtrack, Catalunya, Spain
- Low power IoT Edge sensors and Gateway
- Cloud

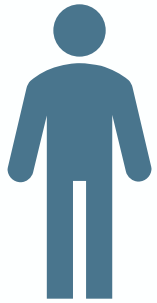


Constrains, challenges & risks

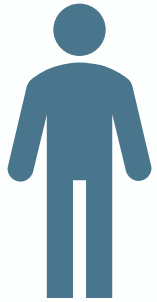
- Coexistence of real-time processing and coordination with Cloud Services
- Edge to Cloud Orchestration of several applications according to complexity, processing, or time requirements
- Interruptions of Wireless or Internet Connection

USER CENTERED IMPACT

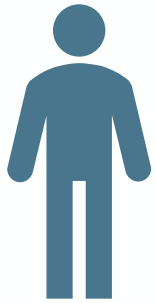
The user specific needs addressed by the use case



Railway operators need to **exploit** all the **available resources** for the monitoring process of **critical infrastructure** in order to **optimise the decision-making process**. They do it by using **maintenance and rail track geometry applications** as well as **real time alarm detection modules** in order to **plan maintenance activities** and **mitigate failure risks**.



Monitoring technology providers need to **ensure data integrity and synchronization** between Edge devices and the cloud by **implementing cloud-edge orchestration and failure recovery management** to **guarantee full offline operational capability of safety applications**.



Citizens who **utilize railway services** expect **safe travel** and **punctual train service**, which would be further guaranteed through **RSAM application** which **decreases the possibility of delay** due to track maintenance and accidents.

TECH COMPONENTS

Workloads

Applications & Services

Rail track geometry: application, Real time alarm detection module, Maintenance application

Enterprise Systems / Apps

Data Systems / Storage

Connectivity Management Tool (CMT) application receiving data from sensors placed on the rail track

Data Governance

Appropriate devices (edge or cloud). No privacy constraints, no performance requirements

Infrastructure

Cloud

- Connectivity Management Tool (CMT)

Container as a Service

- Several applications and containers per application, using the same database

Communications

- extremely limited bandwidth LoRA
- wireless networking protocols

Data & Analytics

- Anomalies detection
- Prediction module
- Advanced time series visualisation

Devices

- Low powered IoT sensors
- IoT Gateway

Edge

- Low powered IoT sensors
- IoT Gateway

if possible, please specify the type of edge

- Under-track crossings
- Track subsidence
- Landslips
- Embankment failures
- Viaducts
- Rail track geometry

2 What **data sources** are needed to develop your solution?

- Cloud-edge orchestration
- Failure recovery management when losing the connectivity

3 What are the **key components** that are not available today?

- Railway operator safety standards

4 Are there any relevant **standards** that need to be considered?

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MANUFACTURING

NEMO: Smart Manufacturing & Industry 4.0

aerOS: Data-driven Cognitive Production Lines

Fluidos: Robotic Logistics

NEMO
SMART MANUFACTURING & INDUSTRY 4.0

Sector: Manufacturing

Partners: Continental, Simavi, Telefonica, Cumucore

Location: Ingolstadt, Germany

Pilot duration: _____

Overview

- Robotics in general and particularly Cobots have a strong impact within highly automated production facilities. As market demands transformation and demographic change induce new challenges on mass production, Continental investigates Cobots and AGVs with respect to the strict requirements of electronic production.
- This pilot takes place in one of the Continental plant which will test some of NEMO capabilities in Innovative manufacturing processes.

Objectives and expected benefits

- Combine 3D Vision, heterogeneous networks, edge (remote) and semi-autonomous (on-device) CF-DRL/ Transfer Learning, enabling fully automated SMD-Components recognition and transfer to production site
- AGVs-AGVs and AGVs-humans collision prediction, detection and avoidance through real-time cm-level High Accuracy Indoor Positioning (HAIP) and CF-DRL functions hosted locally on the IoT nodes and in 5G edge.
- Digital powertrain optimization (production, process, asset and energy) in brown field factories
- Validate NEMO user acceptance from an industry employee viewpoint by validating efficiency and productivity

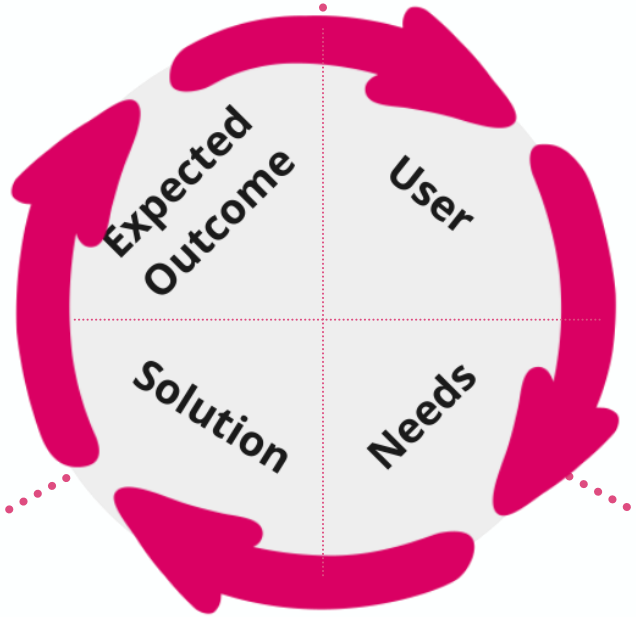
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- Operator at production line
- Operator in logistics
- Persons/employees in the transport routes

Location of the use case, physical or virtual

- Continental plant Ingolstadt: logistics and production area
  - First Step: ground floor
  - Addition: second and third floor

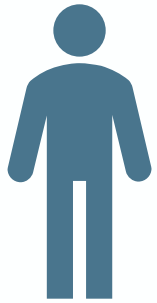


Constrains, challenges & risks

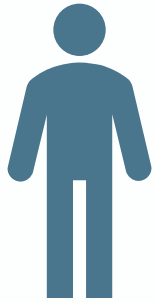
- Automized transfer to AGV
- Collision-free driving of AGV
- Automized component recognition
- Automized picking process

USER CENTERED IMPACT

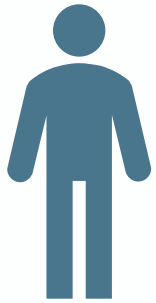
The user specific needs addressed by the use case



An **operator in logistics** needs **automatised component recognition and picking process** using **error free bin picking and trouble-free coworking with operator** for an **automatic and timely removal of materials and transfer to AGV** which will **increase the efficiency of processes.**



An **operator at the product line** needs an **automatised transfer of components to AGV** without an **interference in the work area** which will speed up the process with an **automatic and timely delivery of materials to the production line.**



Employees on the transportation route would greatly benefit from **collision-free driving of AGV** due to no impairment of walkways which would **decrease errors and repair costs while increasing productivity.**

AEROS
DATA-DRIVEN COGNITIVE PRODUCTION LINES

Sector: Manufacturing

Partners: MADE, Innovalia, SSF, Siemens, POLIMI, Nasertic, SIPBB

Locations:

- Bilbao, Spain
- Milan, Italy
- Biel, Switzerland
- Nuremberg, Germany

Pilot duration: _____

Overview

- Evolution of existing modular manufacturing systems needs strategies towards mass customisation for processing a wide range of products.
- The fast use and processing of data is of paramount importance to make intelligent automated human-centred augmented and assisted decisions.
- aerOSwill introduce the enablers to raise production autonomy as its distributed edge-powered modular approach will facilitate IoT edge-cloud continuity,

Objectives and expected benefits

- First worldwide autonomous production line (Level 4) introducing an open modular edge orchestration approach/OS building on IoT, Big Data & ROS2 communities.
- Quality, circularity, zero footprint and AI testing and validation.
- Effective data distribution and sharing closer to the source ensuring data integrity and security.
- Safe human/machine collaboration.
- Dynamic intralogistics adaptation and autonomous production scheduling

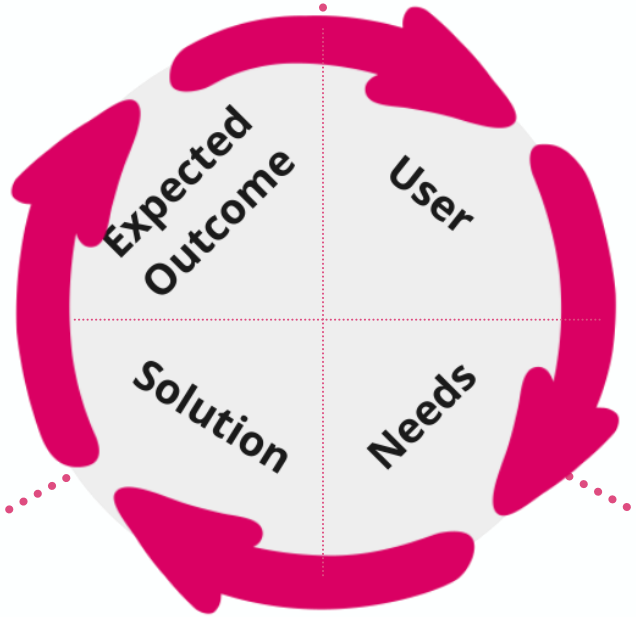
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- INNOVALIA
- SIEMENS
- MADE
- Nasertic
- Switzerland Innovation Park Biel
- POLIMI

Location of the use case, physical or virtual

- Siemens Innovation Factory
- Manufacturing facilities
- Didactic factory at AIC
- Cloud infrastructure at NASERTIC
- Made Competence Center
- Polimi Industry 4.0 Lab Facilities
- SSF Open Factory Lab at SIPBB

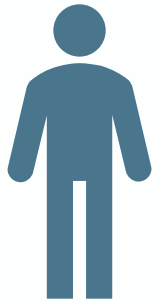


Constrains, challenges & risks

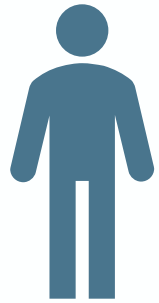
- High latency response
- Big data volumes to process
- Mass customization needs
- Cloud's computing resources
- Complexity and variety of production processes
- Data sources variety
- Adaptation to all production lines
- Send information securely to the cloud
- Obsolete machinery
- Obsolete IT infrastructures

USER CENTERED IMPACT

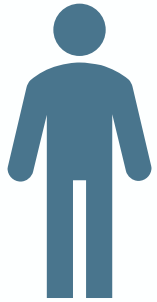
The user specific needs addressed by the use case



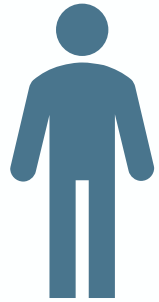
Production lines Intelligence and analytics service providers/users need an efficient yet secure data management and processing using AI. Smart devices and Containerised services which will contribute towards continuous improvement of production processes and optimised production.



Real-time logistics/ AGV providers need various functionalities including real-time, low latency autonomous operations and processes thorough manufacturing execution systems, PLCs and AGVs leading to zero-breakdown logistics and optimised processes.



Quality control/ dimensional monitoring providers/users want real-time operation warnings with self-diagnostics and recovery capabilities achieved using AI, databases and dimensional instrumentation devices which will together increase the efficiency and safety, avoid defects in production and allow zero-touch service management



Industrial equipment and IT infrastructure providers/users needs high yield production lines and decrease costs not only due to data intelligence and predictive capabilities but also data sharing and integration.

TECH COMPONENTS

Workloads

Applications & Services

- AI for Quality Control Process & Predictive Analytics
- Production line reconfiguration process
- Data intelligence

Enterprise Systems / Apps

- ERP
- MES
- MRP

Data Systems / Storage

Edge databases
Shared databases long term

Data Governance

Infrastructure

Cloud

- NASERTIC's
- HPC cluster

Container as a Service

- Docker
- Kubernetes

Communications

- WIFI
- Fiber optics
- 5G
- TSN

Data & Analytics

Devices

- CMMs
- Controllers
- PLCs
- Dimensional instrumentation devices
- AGVs

Edge

- IoT devices
- Smart devices
- Sensors, actuators

if possible, please specify the type of edge

- Process parameters (e.g: temperature, speed, pressure)
- Positioning data
- Dimensional data
- Product data
- Quality requirements data

2 What **data sources** are needed to develop your solution?

- Fully automated quality control
- Self diagnosis and recovery
- CO2 footprint prediction

3 What are the **key components** that are not available today?

4 Are there any relevant **standards** that need to be considered?

FLUIDOS ROBOTIC LOGISTICS

Sector: Manufacturing

Partners: Robotnik

Location: Poland

Pilot duration: _____

Overview

Optimize movement processes to improve battery life of factory robots and achieve energy saving and connectivity

Objectives and expected benefits

- Facilitate autonomous resource discovery across a cloud-edge continuum without disruptions
- Extend the lifecycle of batteries of AMR robots through reduction of energy consumption
- Effective data distribution and sharing closer to the source ensuring data integrity and security.
- Improved robot functionality and real-time AI-based decision making

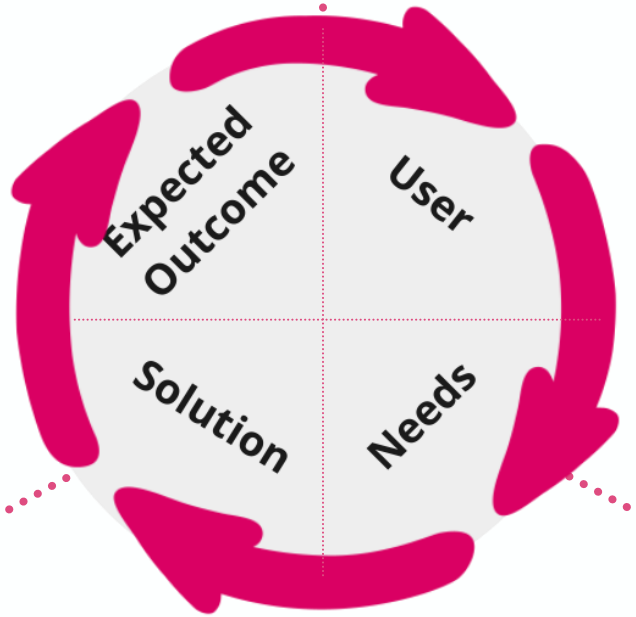
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- Warehouse owners
- Robotic companies
- Robotic fleet owner
- Robotic developers

Location of the use case, physical or virtual

- Robot
- Cloud
- Edges



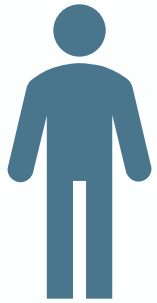
Constrains, challenges & risks

- Seamless switch among robot/edge/cloud
- Security of the data
- Limited robot resources
- Network interruptions

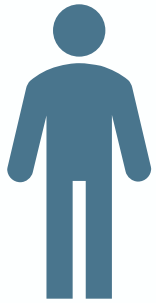
- ROS architecture
- Network delays
- Scalability

USER CENTERED IMPACT

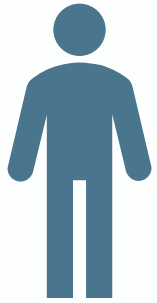
The user specific needs addressed by the use case



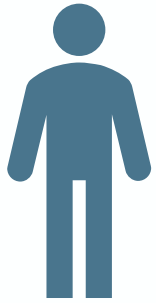
A **robotic company** needs to **decrease the cost of robots** while **increasing their productivity** with **advanced robot functionalities** which will **optimise computational requirements** consequently **optimising tasks and productivity.**



Robotic Developers want **faster development and delegated infrastructure** through **precise location** and **advanced robot functionalities** resulting in **shifted focus to robotic software and easy-to-deploy framework.**



Warehouse owners want to **reduce global transportation time and increase productivity** with **advanced robot functionalities** resulting in **Intuitive interface to manage the fleet** and **energy cost saving.**



Robotic fleet owner wants to have **intuitive interface with easy infrastructure management and fast deployment** resulting in **adaptable intuitive interface and** will allow for **faster scalability.**

TECH COMPONENTS

Workloads

Applications & Services

Environment recognition
Autonomous indoor transport
Autonomous inventory

Enterprise Systems / Apps

- Ros topics

Data Systems / Storage

- Edge devices
- Cloud
- Robot

Data Governance

- Secure transport
- Reliable data

Infrastructure

Cloud

- Map processing

Container as a Service

Communications

- 4G
- Wi-Fi
- 5G

Data & Analytics

- ML Multi robot path planning
- ML Multi robot energy optimization
- Object identification

Devices

- Robot
- Local edges

Edge

- High processing requirements
- Low latency processing

if possible, please specify the type of edge

- Warehouse maps
- Energy requirements

2 What **data sources** are needed to develop your solution?

- Robotic Kubernetes deployments
- Robotic task
- Offloading

3 What are the **key components** that are not available today?

- ROS network infrastructure

4 Are there any relevant **standards** that need to be considered?

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ENTERTAINMENT

NEMO: Smart Media

ICOS: In-car Advanced Infotainment and Multimedia Management system (IAIMM)

NEMO
SMART MEDIA/ CITY & XR USE CASES

Sector: Smart Media

Partners:

Location: Athens, Greece

Pilot duration: _____

Overview

- XR Time Machine:
  - We aim to push the boundaries of immersive experience by optimising multi-sensorial stimuli via effects such as wind, heat, vibration, in addition to audiovisual (AV) and tactile.
- Round of Athens Race:
  - During the race, media content is captured by many spectators along the running circuit. Incoming content is automatically processed (partially on the device using already trained AI/ML models and partially at the edge), and a selection is directly broadcasted

Objectives and expected benefits

- NEMO as Differentiator at Smart Media/Smart City and Smart Media/XR Living Lab
- Very fast/time sensitive services migration to the edge and extreme large media from thousands of users.
- Media processing and rendering at the IoT-to-Edge-to-Cloud continuum to support multiple users.
- Advanced FML analytics to calculate the accurate positions and orientation and create ML models and alarms.
- Validate NEMO user acceptance from a citizen viewpoint by utilizing the NOVO smart city platform in Athens

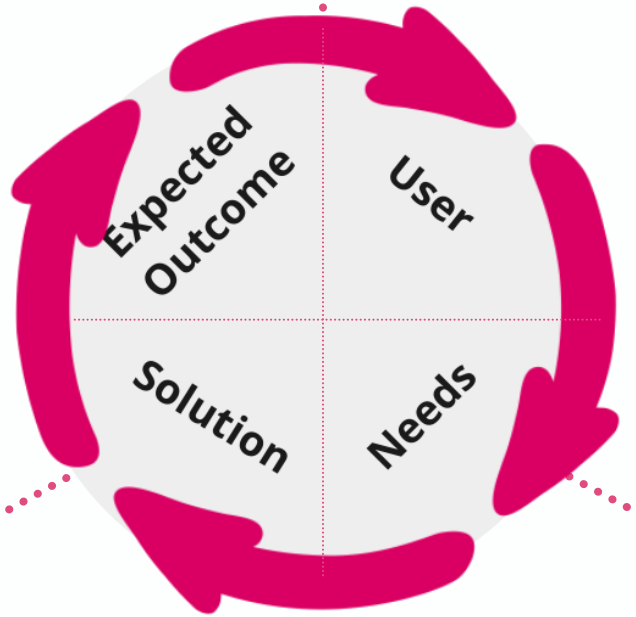
OVERVIEW OF USE CASE: SMART XR VALIDATION

Stakeholders all parties participating and affected

- XR/VR users
- Cultural venue educators
- Cultural venue visitors
- Cultural venue admin

Location of the use case, physical or virtual

- Sensors (cameras/wearables)
- NEMO Platform
- FHW Venue XR/VR headsets
- FHW Venue Dome "Tholos"
- Cloud Servers
- Edge Servers

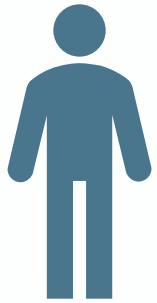


Constrains, challenges & risks

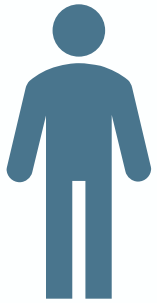
- Interoperability with existing infrastructure
- Heterogenous IoT devices
- Service migration
- Real time data analysis
- Network security

USER CENTERED IMPACT

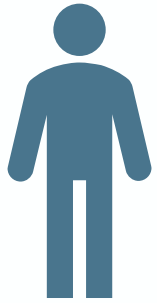
The user specific needs addressed by the use case



A race runner with GoPro wants to capture content from the race using geolocation and content annotation, processing and rendering to instantly share content and enhance race event experience.



A remote viewer wants to follow the race remotely in real-time using media broadcast selection to have instant access to content and remote enhanced race experience.



A race spectator wants to broadcast content from the race which is automatically processed and trained using AI/ML models on devices to enhance the race experience.

TECH COMPONENTS

Workloads

Applications & Services

Enterprise Systems / Apps
- Biodata analysis
- Gesture/Voice recognition

Data Systems / Storage
- Edge/Cloud

Data Governance
- Admin handled, secure
- Anonymized Data

Infrastructure

Cloud
- Bio data analysis
- Gesture and Voice recognition

Container as a Service
- Bio data analysis and emotional state classification
- Voice / Gesture recognition

Communications
- Between Server for Camera/Voice and Edge
- Between HMD and server Emotional recognition and Edge

Data & Analytics
- Bio data for accessing emotional state
- Camera and Video data for gesture/voice recognition

Devices
- Small devices for floor control and interfacing
- User Bio sensors
- Cameras, Microphone
- Server for HMD communication and control
- Server for Dome control of actions

Edge
- Gesture and Voice recognition
- Bio data analysis
- Emotional state classification

if possible, please specify the type of edge

- Camera Gesture recognition over the Edge/Cloud
- Audio voice recognition over the edge/cloud
- Biofeedback sensor analysis and emotional recognition over the edge/cloud

2 What **data sources** are needed to develop your solution?

- Gesture, Voice recognition as a service
- Biofeedback analysis as a service of HMD shows

3 What are the **key components** that are not available today?

- Adherence to Dome Show relevant protocols
- Adherence to HMD good practices regarding app response

4 Are there any relevant **standards** that need to be considered?

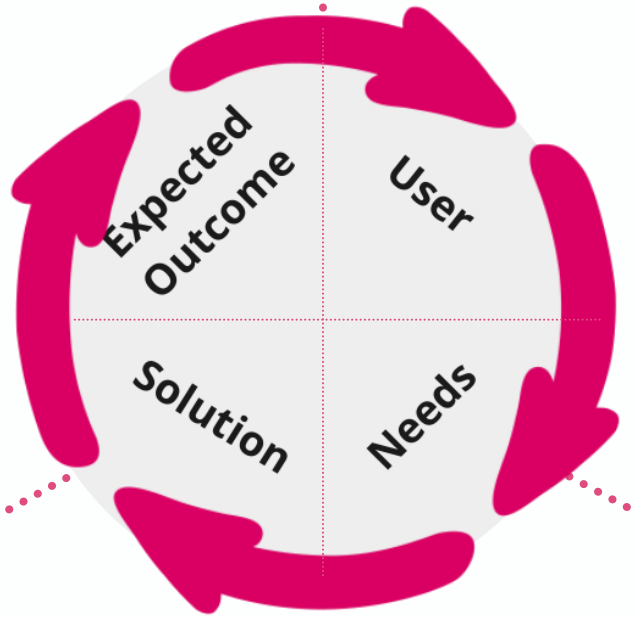
OVERVIEW OF USE CASE: AI DRIVEN DATA/XR

Stakeholders all parties participating and affected

- Race spectators with cameras
- Runners with cameras
- Runners
- Application end-users
- Race spectators
- Technical director
- Remote race viewers/followers

Location of the use case, physical or virtual

- Run of athens
- Smart phones
- Race incidents
- Change of situation of the run
- Professional TV cameras
- NEMO platform
- Drone cameras
- Edge servers
- Cloud servers

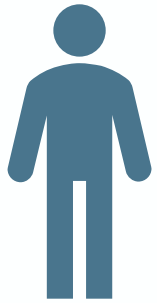


Constrains, challenges & risks

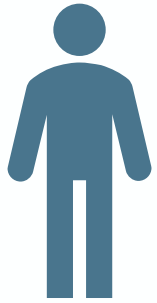
- Synchronisation of events with media content
- High computing resources
- Low video latency
- Low network latency
- QoE optimisation
- Right access to content with privacy preservation

USER CENTERED IMPACT

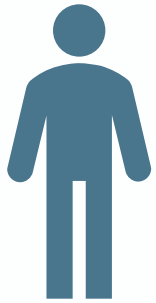
The user specific needs addressed by the use case



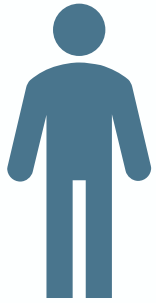
Cultural venue educators want to interact and help users engage with the VR/XR and Dome infrastructure using recognition tools; voice, emotional and gesture, in an adapted VR/XR infrastructure to enhance the cultural experience.



The cultural venue admin needs to have easier administration and management over the experience while being able to identify users who are in distress using recognition tools to optimise the experience and have optimal management of the VR/XR infrastructure.



The venue visitor wants optimal management of the VR/XR infrastructure using adaptation of VR experience to have unforgettable memories from a cultural visit.



Culture venue admin needs optimal service life-cycle management which is achieved using NEMO m-orchestrator leading to cost reduction, easier management of the infrastructure and energy efficiency.

ICOS IN-CAR ADVANCED INFOTAINMENT AND MULTIMEDIA MANAGEMENT SYSTEM (IAIMM)

Sector: Smart media

Partners:

- CRF (CENTRO RICERCHE FIAT SCPA)
- ATOS (ATOS SPAIN SA)

Location: Italy

Pilot duration: _____

Overview

- The In-car Advanced Infotainment and Multimedia Management system (IAIMM) optimizes the distribution of multimedia content, ensuring high-quality reception even in low-connectivity situations as well as enriched multimedia functionalities for trip planning, enjoyment, and exploring touristic sites.
- ICOS will base the system on a deployment architecture including edge nodes for rendering and pre-processing, along with more powerful cloud nodes.

Objectives and expected benefits

- Optimisation of multimedia content distribution through network support
- High-quality reception stabilisation irrespective of connectivity through localised processing
- Enrichment of all multimedia functionalities by preventing interruptions and latency and offering a personalised user experience

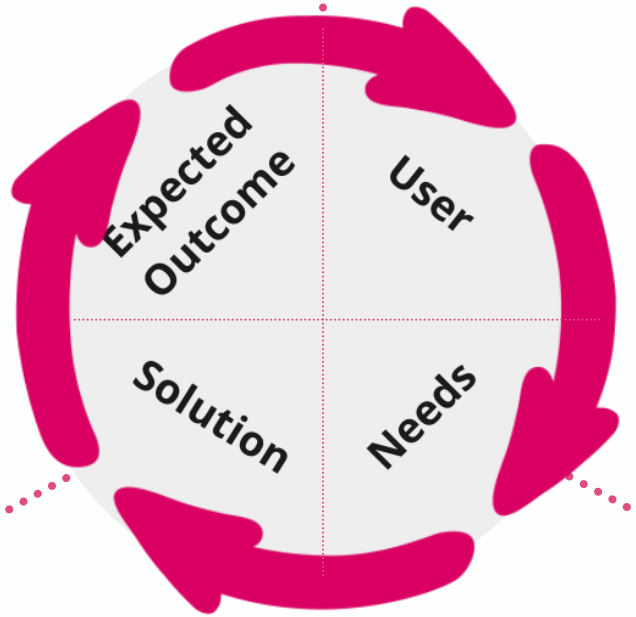
OVERVIEW OF USE CASE

Stakeholders all parties participating and affected

- Infrastructure providers
- Remote touristic guide
- Application providers
- Vehicle / shuttle occupants
- Fleet operators
- Content providers

Location of the use case, physical or virtual

- Stellantis vehicle as IoT in Torino
- Remote touristic guide device as IoT in Torino
- ICOS EdgeNode In Torino
- ICOS CloudNode In Barcelona

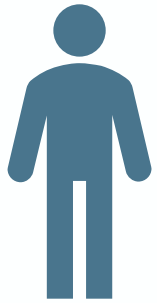


Constrains, challenges & risks

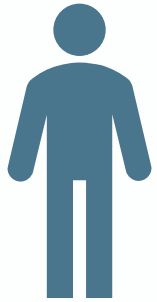
- Scalability issues in case of high request of the service
- Minimizing exchange of data
- Interruptions of Wireless or Internet Connection

USER CENTERED IMPACT

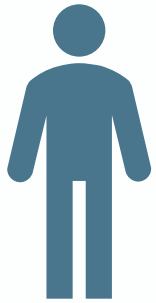
The user specific needs addressed by the use case



Vehicle occupants desire a **synchronized and real-time responsive user experience** to view and interact with media content aligned with their interests. This experience relies on **lobby handling**, while **personalized information of interest** is obtained through interactions with **point of interest models**.



Remote touristic guides want to give **explanations and travel inputs remotely**, therefore relying on **lobby handling** and the **synchronization** of their explanations with the respective content. This enables them to **communicate and interact** with the occupants inside the vehicle **from a remote location**.



Fleet providers strive to deliver their service in vehicles while **measuring and ensuring the quality of the service** and overall experience for vehicle occupants. Their primary goal is to **provide a seamless and uninterrupted experience** for the occupants throughout their journey.

TECH COMPONENTS

Workloads

Applications & Services
- Lobby management
- 3D render

Enterprise Systems / Apps

Data Systems / Storage

Data Governance

Appropriate devices (edge or cloud). No privacy constraints, no performance requirements

Infrastructure

Cloud
- ICOS EdgeNode In Torino
- ICOS CloudNode In Barcelona

Container as a Service
- Several applications and containers per application

Communications
- Scalability of the service
- Wireless networking protocols

Data & Analytics
- POI planning module
- Map matching
- Anomalies detection

Devices
- Stellantis vehicle as IoT in Torino
- Remote guide device as IoT in Torino

Edge
- ICOS EdgeNode in Torino

if possible, please specify the type of edge

- Vehicle information:
  - Speed
  - Position
  - ...
- 3D Models for POIs

2 What **data sources** are needed to develop your solution?

- Intelligent cloud-edge orchestration

3 What are the **key components** that are not available today?

- V2X ETSI standard
- Automotive safety and security standards
- GDPR
- Users' privacy

4 Are there any relevant **standards** that need to be considered?

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