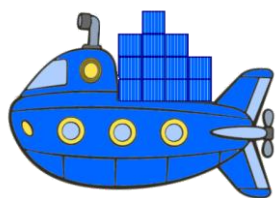


Next Generation Meta Operating System



NEMO

NEMO:Next Generation Meta Operating system Vertical Applications

Mrs. Maria Belesioti

(Hellenic Telecommunications Organization S.A. – OTE)

24th InfoCom World Conference

Fiber & 5G Highways: DigitAll Greece!

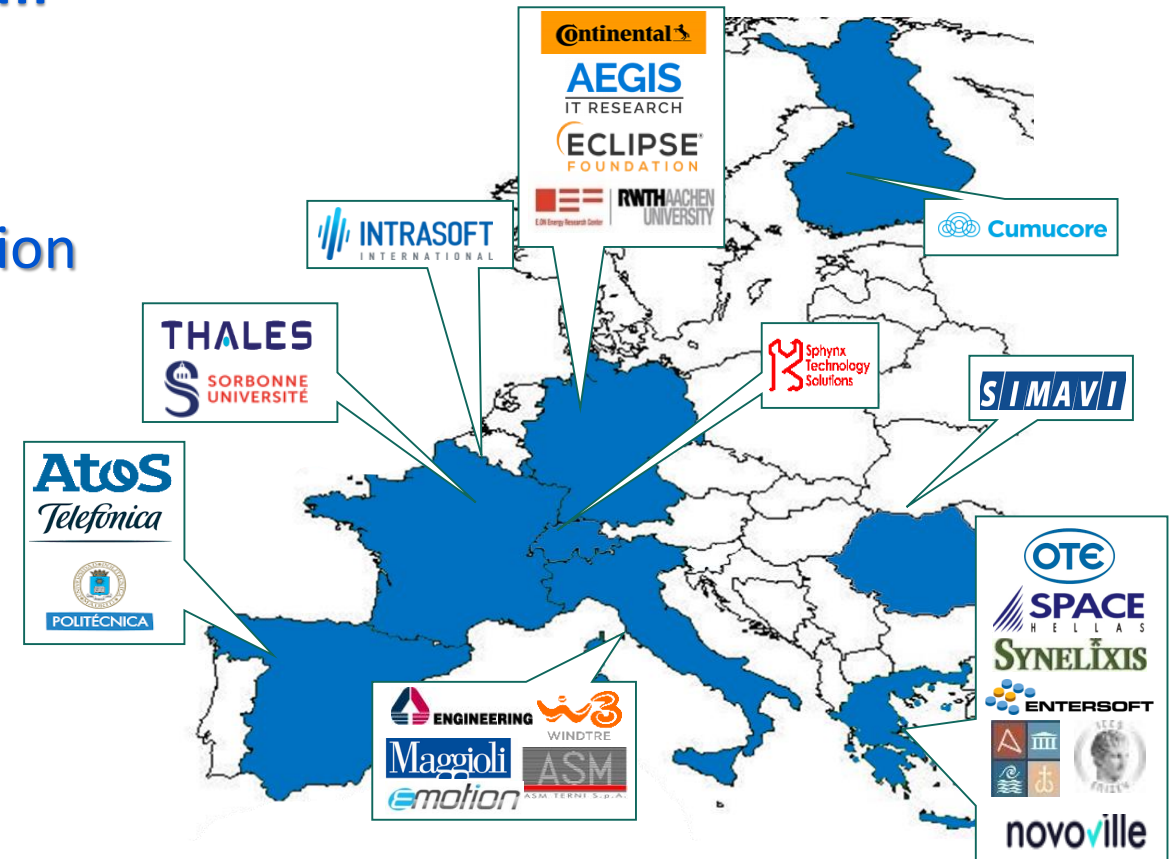


NEMO will receive funding from the EU Horizon Europe research and innovation Programme under Grant Agreement No. 101070118 (under preparation)



NEMO @ a Glance

- Title: **Next Generation Meta Operating System**
- Grant agreement ID: **101070118**
- H2020 Call: **Horizon-CL4-2021-DATA-01-05**
- Funding Instrument: **RIA (Research & Innovation Action)**
- Coordinator: **ATOS Spain**
- Duration: **36 months**
- Starting Date: **1st September 2022**
- EU Contribution: **10.5 MEuros**
- **26 Partners – 9 Countries**
- **8 Use Cases**



Motivation

- Internet of Things ecosystem growth
- A variety of applications that leverage data and metadata from connected things moving IoT to the AIoT (Artificial Intelligence of Things).
- AIoT difficulties
 - ❑ There is no sufficient, real-time, secure and trusted support from the edge cloud
 - ❑ The intelligence should be “closer” to data

Vision

- On-device Intelligence to enable AIoT (interacting as self-aware, (semi-)autonomous entities)
- Transparent IoT-to-Edge-to-Cloud continuum
- Intent based DevZeroOps tools and plugin mechanisms
- Open and modular meta-Operating System (mOS)
- Massive AIoT applications and high penetration



NEMO: Next Generation Meta Operating System

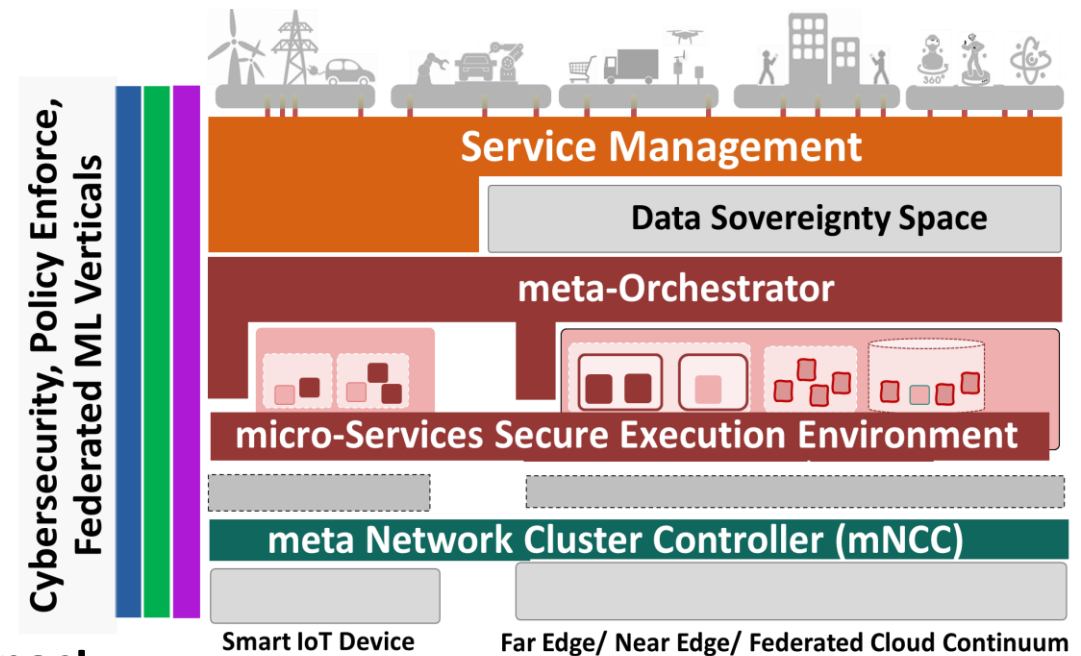
1) Technological Innovations

- ✓ Full stack, fully configurable, cloud-native, data aware meta-OS
- ✓ *Bring intelligence closer to data/make AI integral part of meta-OS*
 - Self-Organized/Healing Network Clusters/5G/6G Integration
 - Cybersecure micro-Service Secure Execution Environment (mSEE)
 - SLO/EE based self-optimized meta-Orchestrator
 - ZeroOps Plug-in mechanism
- ✓ Cybersecurity, Privacy Compliance & Federated ML verticals

2) Strengthening the EU competitiveness

3) Expected (Technical, Economical, Environmental, Social) Impact

- ✓ Novel components, tools, methods
- ✓ Dataspace & IoT-Edge continuum integration in reality
- ✓ New paradigms in Smart-X Apps delivery
- ✓ Push processing to cloud => directly reduce CO₂
- ✓ Smart Agriculture: reduce pesticides/spraying/soil erosion....
- ✓ Closing the digital gap by enabling Smart-X Edge processing
- ✓ Reinforcing competitiveness via open-source & Open Calls



Pilot 1: Smart Farming, Greece

- Aerial Precision Bio-Spraying
- Terrestrial Precision Bio-Spraying

Pilot 2: Smart Energy & Smart Mobility, Italy

- Smart Grid Flexibility
- Smart Mobility/City

Pilot 3: Smart Manufacturing & Industry 4.0, Germany

- Fully automated indoor logistics/supply chain
- Human-centered indoor factory environment safety

Pilot 4: Smart Media & XR, Greece

- Round of Athens Race
- XR Time Machine

Verticals

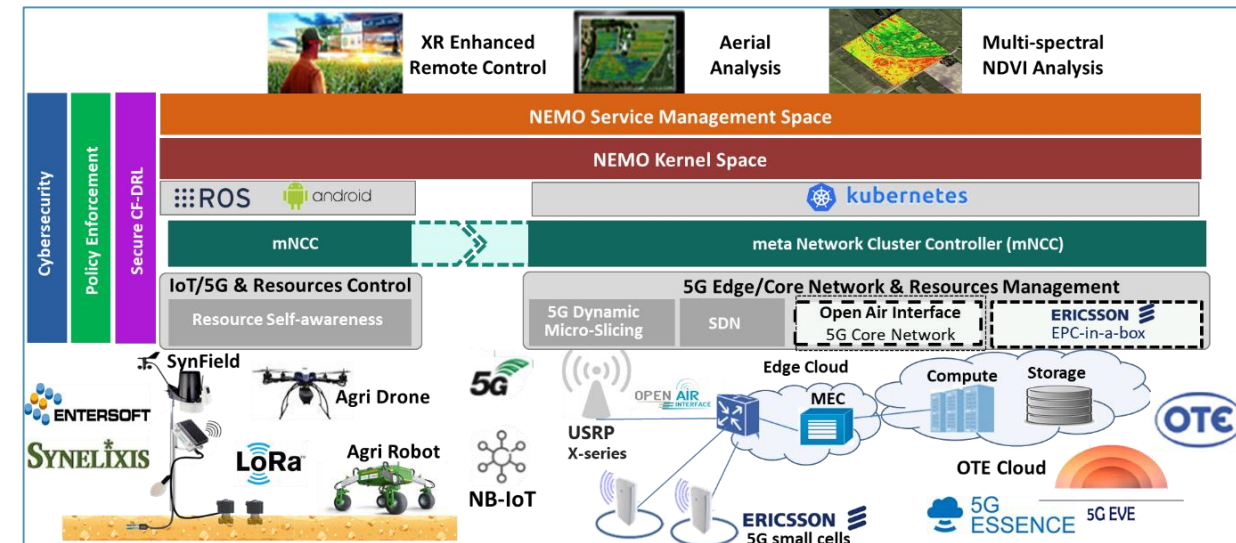
- ✓ Farming,
- ✓ Energy
- ✓ Mobility/transportation
- ✓ Industry 4.0
- ✓ Media/smart city & XR



Smart Farming Pilot: Aerial Precision Bio-Spraying

- Autonomous insecticide spraying.
- Olive tree spraying with **drones** equipped with multi-spectral cameras.
- Spraying procedure enhancement with **SynField** data.

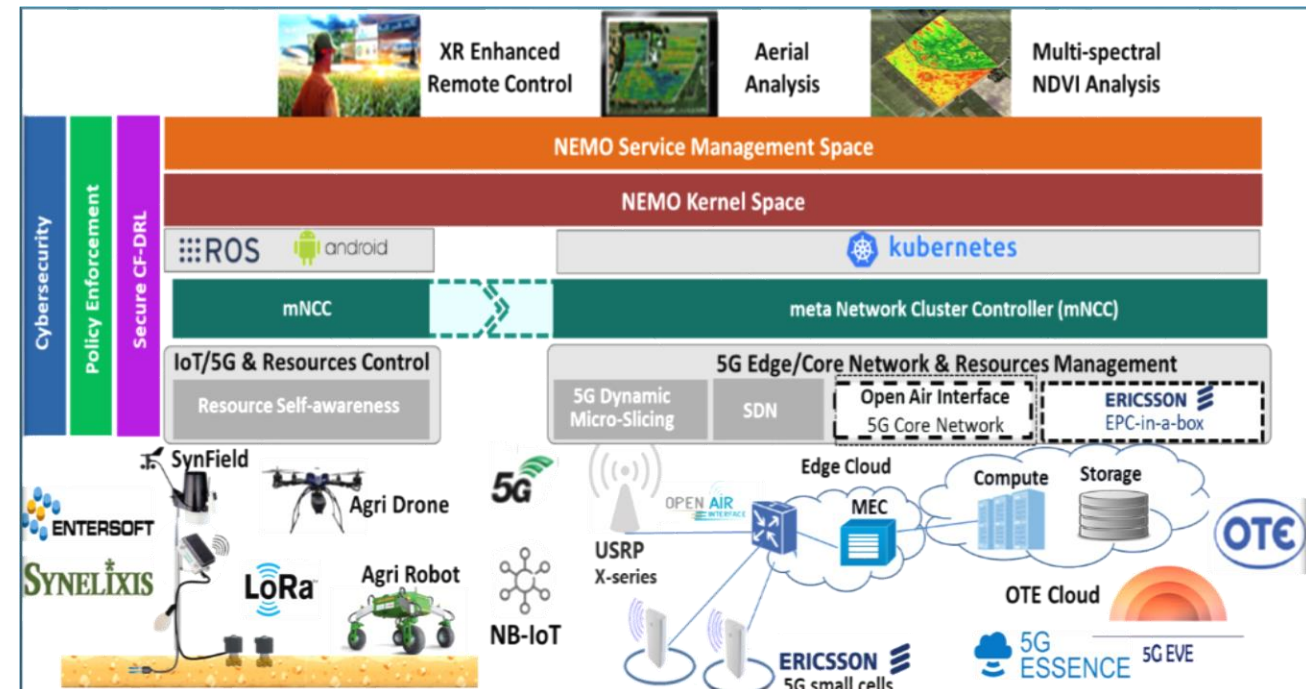
- ✓ Improved crop disease prediction based on both micro-clima measurements (SynField) drone images via FL models/transfer learning
- ✓ On-device intelligent decisions to trigger actuations
 - ☐ On the drone
 - ☐ ML-based disease prediction to trigger aerial spraying
- ✓ Cybersecure IoT and AI operation to increase yield safety & support food security



Smart Farming Pilot: Terrestrial Precision Bio-Spraying

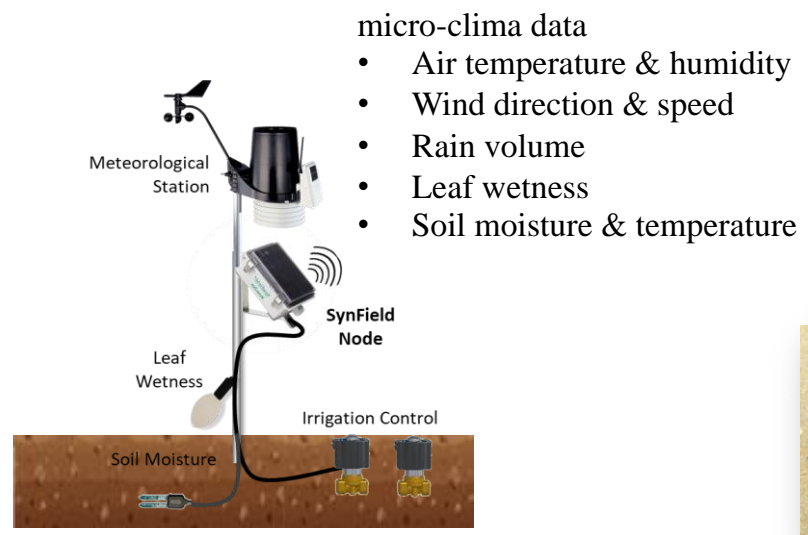
- **Autonomous** insecticide spraying
- Weeds spraying with **Agri robots** *avoiding workers and trees.*
- Spraying procedure enhancement with **SynField** data.

- ✓ Improved ML-based object detection based on both location/activity data (wearables) and stereo cameras (mobile robots) via FL models/transfer learning
- ✓ On-device intelligent decisions to trigger actuations
 - ☐ *On the mobile robot*
 - ☐ *ML-based disease prediction to trigger terrestrial spraying*
 - ☐ *Object detection to trigger trajectory updates*



Smart Farming Pilot : Involved Technologies

- Data acquisition
- Data communication



drone

Image/videos

- Multi-spectral camera
- On-device ML-based disease prediction

- Data acquisition
- Data communication
- Model update (FML/Transfer Learning)
- Inference (disease prediction)
- Actuation (aerial spraying, trajectory optimization)

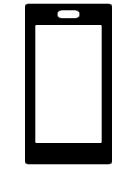


Mobile robot

Image/videos

- Stereo camera
- On-device ML-based disease

- Data acquisition
- Data communication
- Model update (FML/Transfer Learning)
- Inference (object detection, disease prediction)
- Actuation (trajectory change, terrestrial spraying)



Workers' smartphones

- Data acquisition
- Data communication

Location/activity data

Cloud

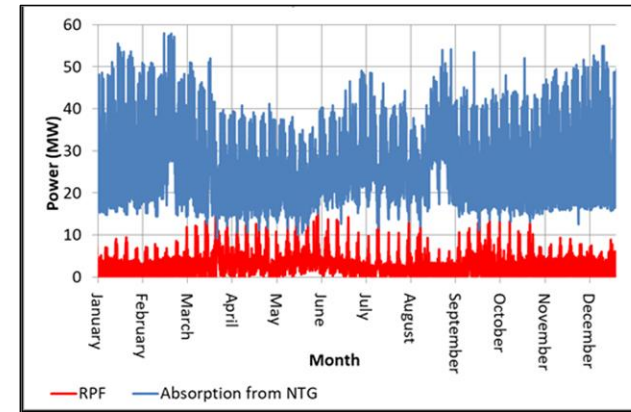
- Data persistence
- ML model aggregation (FML)
- Model sharing
- Data sharing

Edge

- Data persistence
- ML model training (FML)
- Inference

Application #1

- ✓ **Smart Grid Flexibility** – monitoring and analysing of Medium Voltage (MV) / Low Voltage (LV) electricity voltage quality, by using innovative power sensors able to protect MV/LV substation breakers and smart meters which measure electricity generation and consumption.



Application #2

- **Smart Mobility/City** – drivers-friendly scenarios based on traffic flow and parking prediction (Electric Vehicles (EV), Electric Vehicle Supply Equipment (EVSE), camera) dispatchable charging of EVs based on RES (Renewable Energy Sources) demand-response along with human-centred smart micro-contracts and micro-payments.



Motivation

- **Improve mass production and safety in factories with high levels of automation**, enabling Collaborative Robot (Cobots) systems, Automated Guided Vehicles (AGVs) and humans co-work.
- **High speed heterogeneous connectivity using 5G NR, TSN (Time-Sensitive Networking) and WiFi at various types of AGVs**
- **Analyze input from sensors, 3D cameras and RFID nodes and predict, identify and avoid collisions** between humans and AGVs and between different types of AGVs



✓ Fully automated indoor logistics/supply chain

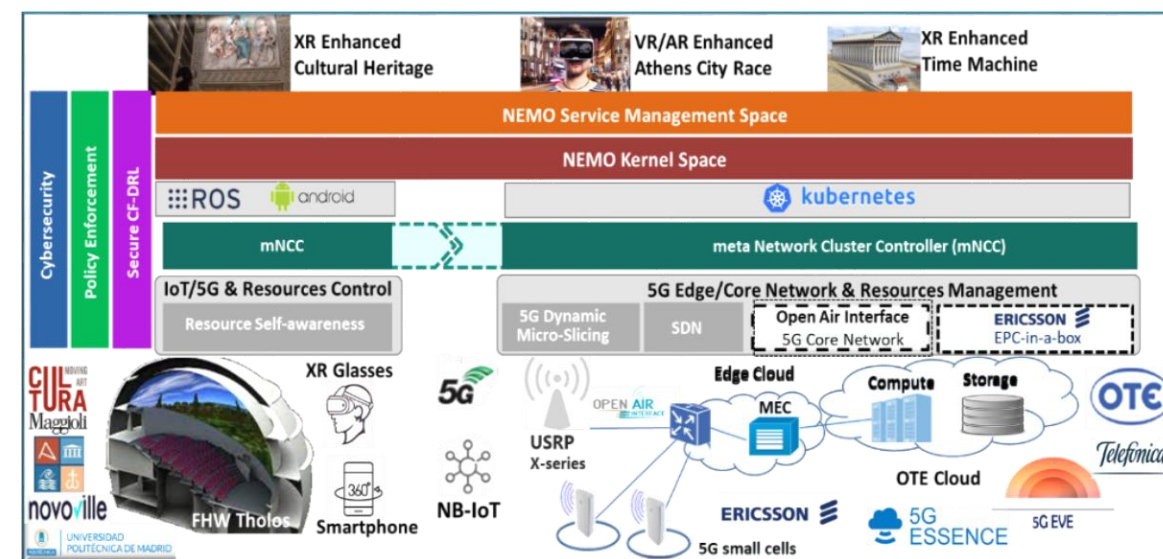
By utilizing a 3D-Vision-Camera for Bin Picking Application, integrated Barcode Scanner and collaboration between different robot systems (one cobot and several types of AGVs), we aim to fully automate controlled material picking from Auto Store and autonomous transfer to the production line.

✓ Human-centred indoor factory environment safety

- This use case will provide a high precision AGV localization layer merging real time localizations info obtained from cognitive sensors (safety cameras, radar and lidar).
- A high speed and ultra-low latency (TSN) private wireless network will support massive data uploads to the edge cloud facilities, where AI functions will detect the position of each body and build a "safety shell" around it to ensure human-centred safety.



- ✓ 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



- *Round of Athens Race*
- *XR Time Machine*



✓ Round of Athens Race

Emphasis will be put on the **Round or Athens Race** and challenges associated to real-time user generated content processing and rendering using FML hosted locally on the IoT nodes (smart phones), in the edge and at the cloud, and deal with thousands of nodes using the digital twin concept.

✓ XR Time Machine

The XR Time Machine Use case will be validated with

- heterogeneous IoT devices (i.e. AR/VR glasses and sensors),
- extreme bandwidth requirements (up to 12K resolutions for 360o video & geometry plus textures for 3D media) and
- the highest refresh rates (up to 240Hz for AR headsets)



- ✓ **Federation of SU OneLab with 4 NEMO Living Labs in:**
 - ☐ *Monemvasia*
 - ☐ *Terni*
 - ☐ *Ingolstadt*
 - ☐ *Athens*
- ✓ **Cross platform seamless access** to more than 30 types of heterogeneous sensors, drones, robots and smartphones
- ✓ **Micro-services migration between clouds in 4 countries** (Greece, Italy, Germany and Spain)
- ✓ **CyberSecure Federated Deep Reinforcement Learning (CF-DRL) and Transfer Learning of AI models** will be aggregated between different living labs
- ✓ **User Acceptance** for Next Generation AIoT



Thank you for your attention!!!

Maria Belesioti

Telecommunications Engineer

mbelesioti@oteresearch.gr

Fixed Network R&D Programs Section

R&D Department, Fixed & Mobile

Hellenic Telecommunications Organization S.A. (OTE)