Alliance for IoT and Edge Computing Innovation

6G SNS IA

Webinar • 10 July 2024

Presentation of joint White Paper The role of 6G in agriculture

AIOTI

Opening and Welcome

Raffaele de Peppe, 6G IA Governing Board Vice-Chair

Damir Filipovic, AIOTI Secretary General

Agenda

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15.00 **Opening and Welcome (5 min)**

Raffaele de Peppe, 6G IA Governing Board Vice-Chair

Damir Filipovic, AIOTI Secretary General

15.10 **Presentation of the paper and recommendations (30 min)**

Alexandar Kaloxylos. 6G IA Executive Director

Luis Perez-Freire, AIOTI WG Agriculture Chairman (Gradiant)

15.40 **Presentation of the use cases (20 min)**

Srdjan Krco, COMMECT project

16.00 **Questions from the audience (10 min)**

Moderator: Luis Perez-Freire, AIOTI WG Agriculture Chairman (Gradiant)

16.10 **Wrap up and end of Webinar (5 min)**

Raffaele de Peppe, 6G IA Governing Board Vice-Chair

About 6G IA Vertical TF

The Vertical Task Force - Activities

EVENTS – Industry Influencing

- Selection of events with key vertical partners
- **Tracker** & **Planner** for vertical industries conferences

PARTNERSHIPS – Ecosystem Building

- **Memorandum of Understandings** (MoU) implementation
- Renewals of MoU portfolio and selection of new vertical partners (e.g. EIM)

CARTOGRAPHIES – Industry Orienting

- SNS JU Projects
- 5G Trials & Pilots Brochures
- **Vertical Tracker** (online tool) – 6G use cases

PAPERS –Orchestration &Dissemination

Vertical **Whitepapers**

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The Vertical Task Force - Achievements

INDUSTRY INFLUENCING – 50 events attended

- Key **vertical industry events** in European strategic sectors selected with MoU partners and attended with high-level **speakers**.
- Post event **reports**
- **Website and social accounts for promotion**

ECOSYSTEM BUILDING – 11 MoUs signed

- Key vertical sectors have been addressed establishing collaboration frameworks though **MoUs/LoIs**
- More sectors in the radar (eg Railways)

CARTOGRAPHY – 3 Vertical Projects Map + 3 Brochures

- A **cartography** of vertical related projects and platforms available– Phase 2 and 3 of 5GPPP projects have been produced
- **Vertical Tracker on 6G projects and use cases**
- **Brochures** on **Trials & Pilots** orchestrated and promoted

PAPERS – 10 Whitepapers

- Guidance provided to edit and disseminate vertical related **Whitepapers**

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The Vertical Task Force – Our partners

esa	EUROPEAN SPACE AGENCY Space	Member
PSCEurope	Public Safety Communications Europ Public Safety	Board Member
ECS	EUROPEAN CYBERSECURITY ORGANIZATION Cybersecurity	
5GAA	5G AUTOMOTIVE ASSOCIATION Automotive	
ERTICO	EUROPEAN INTELLIGENT TRANSPORTATION SYSTEMY AND SERVICES Transportation	Member
EBU	5G MAG Media	
nem	NEM Media	
5GACIA	5G ALLIANCE FOR CONNECTED INDUSTRY AND AUTOMATION Smart Manufacturing	
	6G Health Institute eHealth	Member
NGMN	New Generation Mobile Networks Alliance ICT/Telecom	
AIOTI	AIOTI Agriculture	

AIOTI

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About AIOTI WG Agriculture

AIOTI Working Group Agriculture

Leadership:

Chair
Luis Perez Freire, Gradiant

Co-Chair
Christopher Brewster, TNO

Vision: Unlock the full potential of IoT (technologies, solutions, services, ecosystem, and infrastructure) for supporting future-proof, sustainable agri-food and forestry value chains in the Green Deal era

Scope: EU policies and standards, collaborative research and innovation, key technological developments and gaps in agriculture, farming and aquaculture

Highlights:

65 member organisations

96 participants

Main achievements:

- White Paper Role of IoT and Edge Computing in addressing biodiversity and environmental monitoring
- White Paper the role of 6G in agriculture with 6G IA
- Update of the digital farming context in EU
- Facilitating the creation of consortia for collaborative research projects. First successful project in HE
- Organisation of workshop on the role of IoT in agroecology
- Co-organisation and participation in preparatory workshops for defining the Common EU Agricultural Data Space
- Two webinars presenting white papers
- Position agriculture as a relevant vertical for research in next-generation networks and services (SNS JU) and other EU funded projects and partnerships

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Presentation of the Paper and Recommendations

Alexandar Kaloxylos, 6G IA Executive Director

Luis Perez-Freire, AIOTI WG Agriculture Chairman (Gradiant)

The role of 6G in agriculture

The Voice of European Industry and Research for Next Generation Networks and Services

Alexandros Kaloxylos

Executive Director, 6G Smart Networks and Services Industry Association (6G-IA)

Using 6G for agriculture

Novel Farming Techniques

Precision Agriculture and Aquaculture

Environmental and biodiversity monitoring

Sustainability: energy consumption, carbon/pollution footprint

Challenges in agriculture and aquaculture relevant to 6G

Area	Challenges relevant to future 6G networks
Sensing and monitoring	▪ Ultra-low-power communications to gather data generated by miniaturised and autonomous sensors in a sustainable manner ▪ Adaptive bandwidth to meet low (sensing) and high (monitoring) data rate requirements ▪ Ubiquity of communications, esp. in remote areas ▪ Accurate geo-location to allow high-precision application of treatments ▪ High spatial density of sensing devices (scalability) ▪ Improved device security ▪ Zero-energy devices that use energy harvesting capabilities. ▪ Environmental impact
Farm management systems	▪ High throughput for managing high-definition remote sensing imaging ▪ Decentralized data analysis and decision making (in autonomous sensors and actuators) ▪ Low latency and real-time deterministic capabilities for distributed critical device control. ▪ Communications networks interoperable with brownfield agricultural systems and devices. ▪ Energy Efficiency for IoT Devices
Digital farm twins	▪ Synchronisation of the physical measurements and virtual representations in real time[4] ▪ Real-time management ▪ Low latency and real-time deterministic capabilities for distributed critical device control. ▪ Flexible orchestration of Digital Twin services and algorithms through the Cloud-Continuum.
Autonomous and cooperative machines	▪ Accurate geo-location ▪ Autonomous decision making ▪ Safe operation in collaborative environment with human workers ▪ Inter-machines connectivity to enable cooperation ▪ Cybersecurity ▪ High-quality image/video communications: both for safety reasons and for automating farm tasks like health analysis, harvesting, etc.

Novel Farming Techniques

Area	Challenges relevant to future 6G networks
Smart sensing	▪ High-throughput and scalable communications for massive (i.e. high-spatial-density) sensing of different parameters: o Crop/animal growth and health (ideally, at individual level) o Pest management o Environment conditions o Energy efficiency ▪ Integrating artificial intelligence (AI) and machine learning (ML) algorithms into smart sensing devices requires substantial computational power. ▪ Joint sensing, communications and lighting integrated into one single device.
Autonomous and cooperative machines	▪ Reliable communications for remote control of autonomous robots and actuators ▪ High-throughput communications for multispectral data ▪ Inter-machines connectivity to enable cooperation ▪ Accurate indoor geo-location ▪ Cybersecurity
Digital twin	▪ Continuous monitoring for synchronisation of the physical measurements and virtual representations ▪ Low latency and deterministic communications for precise control of CEF devices from Digital Twins ▪ Dynamic and flexible orchestration of services between 6G MEC, devices and Cloud.

Environmental and biodiversity monitoring

Area	Challenges relevant to future 6G networks
Monitoring	▪ Collection of ground-based monitoring data in remote areas in efficient, low cost and sustainable manner ▪ Extended coverage network, e.g. via non-terrestrial networks (satellite, unmanned systems) ▪ Geo-location ▪ Zero-energy/very-low power consumption devices that use energy harvesting capabilities. ▪ Zero-touch AI/ML-based surveillance
Surveillance	▪ Enabling of surveillance (including the capture of audio and video) in remote areas ▪ Extended coverage network, e.g. via non-terrestrial networks (satellite, unmanned systems) ▪ Real-time Processing and Analysis - Surveillance systems often require real-time processing and analysis of data to respond quickly to potential threats.

Sustainability: energy consumption, carbon/pollution footprint

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6G enablers for agriculture

- Global coverage
- Seamless spectrum access
- Throughput
- Ultra-massive Machine Type Communication (MTC)
- Edge computing
- AI as a service
- Security
- Integration with data spaces
- Energy consumption
- Joint communication and sensing

Main findings from use cases and on-going projects

Application of 5G to agriculture still in an early stage

Technology still being deployed mainly as proof of concept.

Demands on communication networks in digital farming are expected to grow exponentially: requirements beyond the capabilities of current 5G networks.

AI

AI as major driver

Future 6G networks should go beyond data transfer capabilities (high reliability and throughput, low latency) but also support the integration of artificial intelligence, machine learning, and advanced services

Autonomous vehicles/robots as a major driver

Communications with the edge for real-time decision-making

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Main findings from use cases and on-going projects

Mismatched reality-expectations

In EU innovative projects, network/connectivity services are assumed to be available and ready to use

Reality: serious limitations and challenges. Viability depends at a large extent on the proper delivery of the network

Connectivity challenges hamper development of AI and advanced services in agriculture

Agricultural and remote areas face a lack of proper wireless networks coverage.

Non-terrestrial networks are technically the only choices nowadays; however, this alternative is yet far from being fully deployed or even available.

Few digital farming innovation projects are already considering/using advanced 5G networks to implement and test their use cases.

The real performance/benefit of these networks for agriculture and aquaculture is not being yet assessed in a systematic manner.

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Proposed way forward

Systematic approach necessary to identify **use cases and needs** in EU agrifood activities related to advanced communication networks, to **proactively detect the opportunities**

Involve **end users of the agrifood value chain and ICT experts** working together to discuss end users' "pain" and (connectivity) "gains"

Example: COMMECT EU Project

Recently closed and on-going **innovation projects** (H2020, HEU, national…)

- Inquire to understand pains, challenges, needs… from hands-on experience
- **Refine prospective analysis** in this paper

Productive activity (not projects):

- Figures/statistics about utilisation of connectivity solutions/network services
- Understand current shortcomings
- Measure **penetration of 5G** in agrifood sector → **5G sectorial roll-out in EU?**

Presentation of the use cases

Srdjan Krco, COMMECT project

Use cases from the paper

- SPADE
- PLOUTOS
- QuantiFarm
- Data4Food2030 EU Project – Data Economy for Food Systems
- U-GARDEN
- NGI-UAV-AGRO
- AgriBIT EU Project – AI applied to precision farming
- I-SWARM-X project
- DEMETER
- AgrifoodTEF
- SARMENTI
- COMMECT

COMMECT

In a nutshell

Title: **Bridging the digital divide and addressing the need of Rural Communities with Cost-effective and Environmental-Friendly Connectivity Solutions**

Status: **Active**

Duration: **36M**

Start Date: **01.09.2022**

Funding Scheme: **Research and Innovation Action**

Funded under: **Horizon Europe**

Call ID: **HORIZON-CL6-2021-COMMUNITIES-01-03**

Call Title: **Smart XG, last-mile and edge solutions for remote farming, forestry and rural areas**

Budget: **5M**

https://www.horizoneurope-commect.eu/

5 Living Labs Multi-Sector | Multi-Actor

LUXEMBOURG
Digitalisation of Viticulture

NORWAY
Connected Forestry

DENMARK
Connected Livestock Transport

TÜRKIYE
Smart Olive Tree Farming

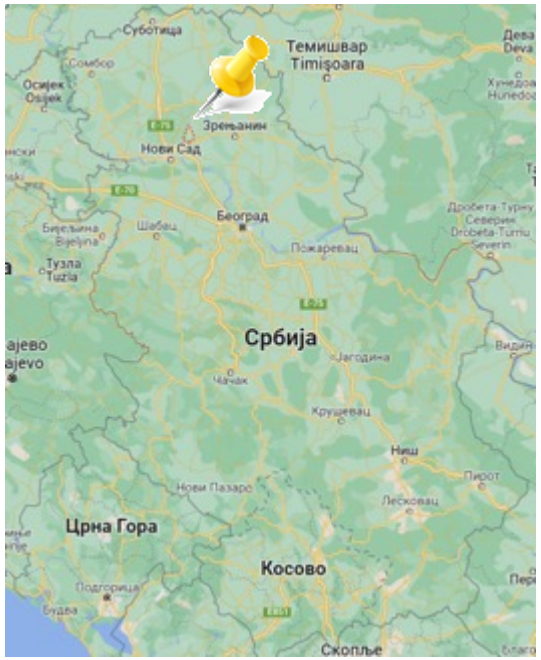
SERBIA
Sustainable Agriculture and Preservation of Natural Environment

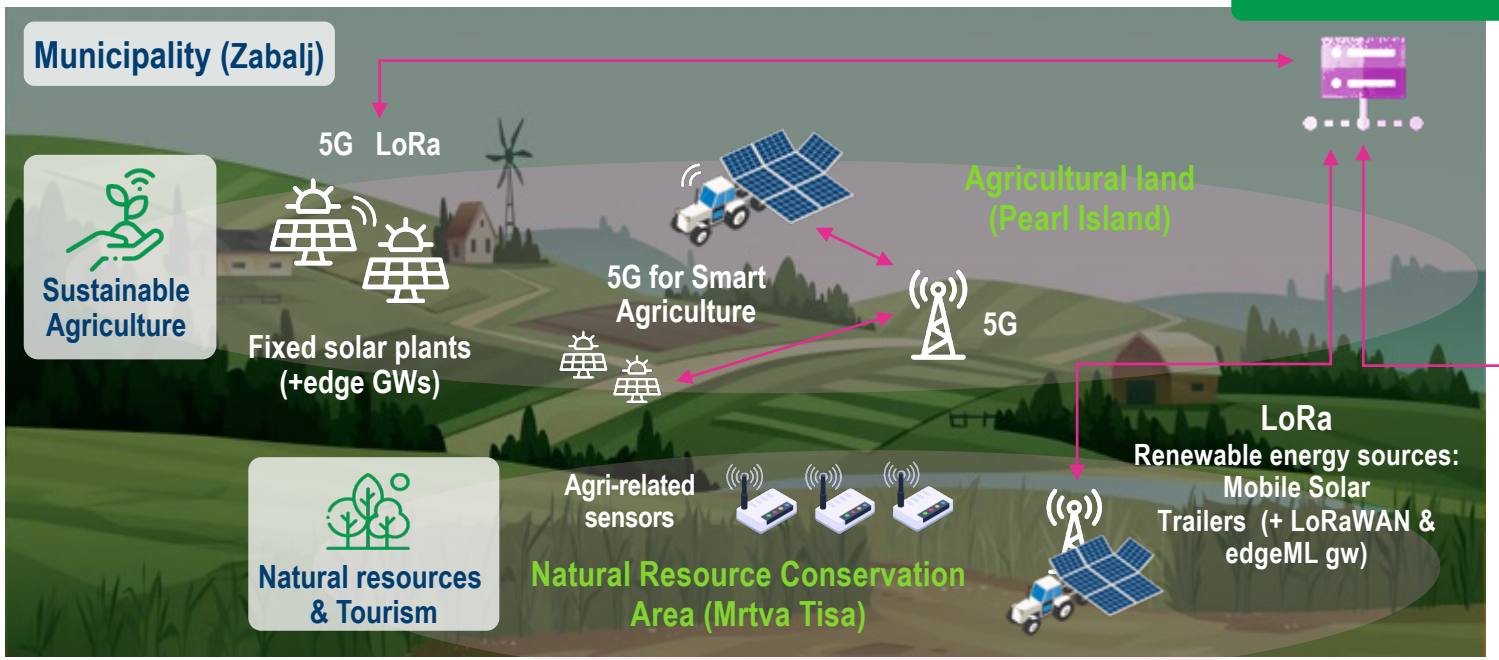
Smart XG, Last Mile and Edge Connectivity Solutions

Satellite | Cellular | UAV Networks | EDGE Networks | Non-Cellular

Living Lab Serbia: Sustainable agriculture and preservation of natural environment

Gospodjinci, Vojvodina province, Serbia





End-User Apps: Web and mobile apps for farmers and other stakeholders to visualize measurements and manage processes

Farmers

Sensor data, e.g., soil humidity, soil temperature

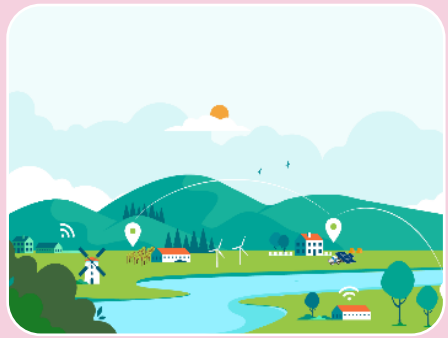
Sustainable Agriculture

End users Needs

Access to agricultural and environmental expertise

Improving efficiency of farming practices.

Understanding environmental conditions and their impact on the quality of life..



Network connectivity

Communication infrastructure is required, from mobile to communication suitable for monitoring and managing fields and farms.

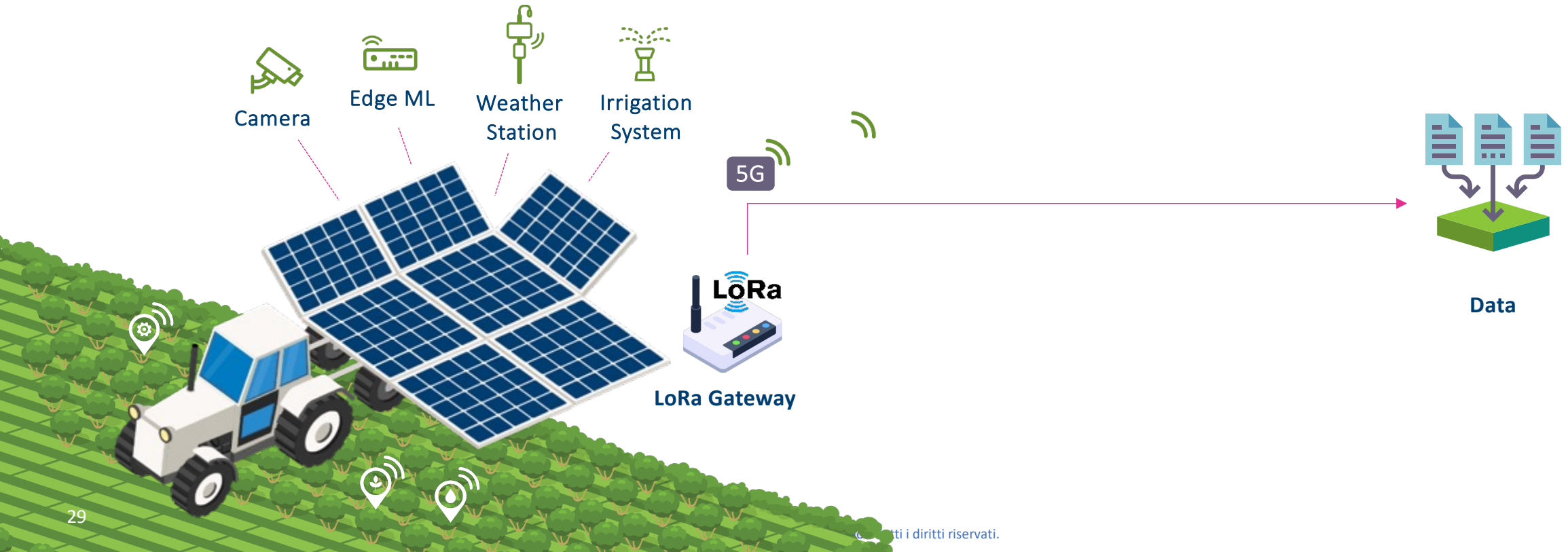
Energy

Continuous supply of energy required, including in the field (run irrigation systems, power communication network, etc.).

Sustainable Agriculture and rural development

Use Case #1: Creation of a shared rural infrastructure

Energy, computing, communication



29

30

COMMECT Living Lab #2 Connected Forestry

Kongsvinger, Norway

telenor

Klosser Innovasjon

Inland Norway University of Applied Sciences

CREDS
Center for Research on Digitalization and Sustainability

AI TI

Use case and deployment plans for connectivity solutions

Use case 2.1: Remote operational support from expert for forest machine operators

- Remote guidance and support for forest operators using high quality video transmissions from forest machinery over 5G networks
- Deployment of local private 5G networks specifically tailored for forestry areas
- A 5G private network will be used as access network to provide connectivity to the cameras mounted on the forest machinery

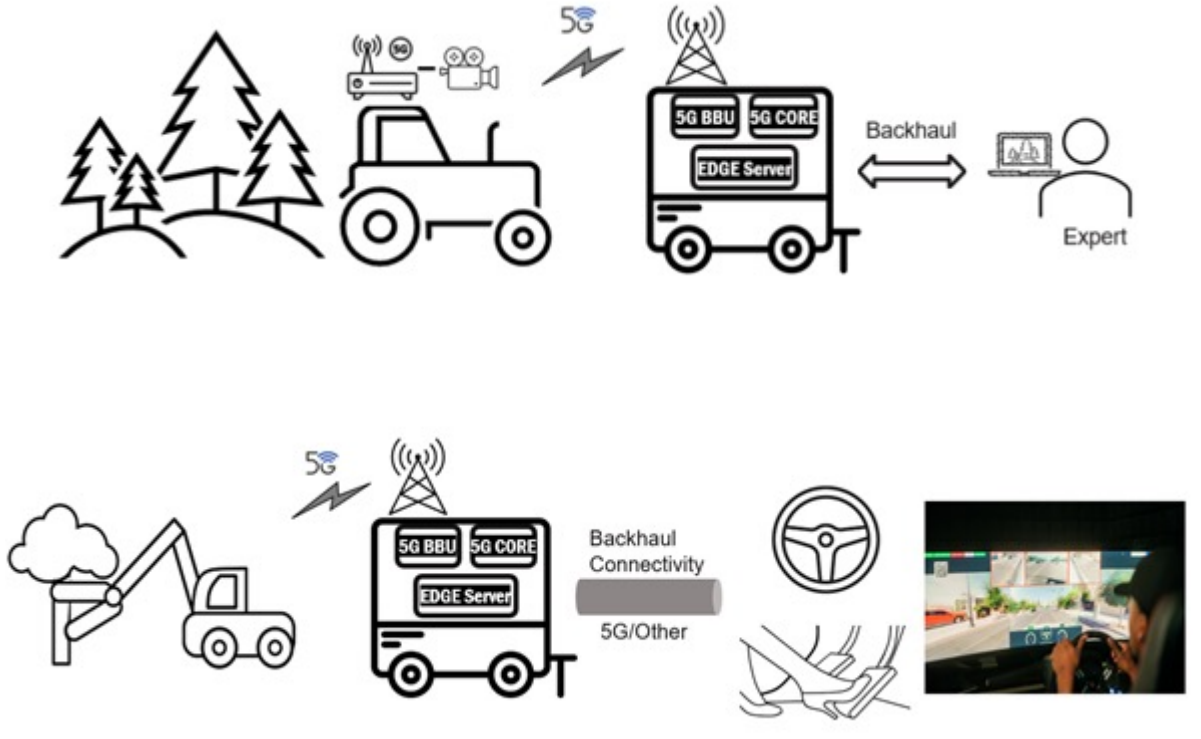


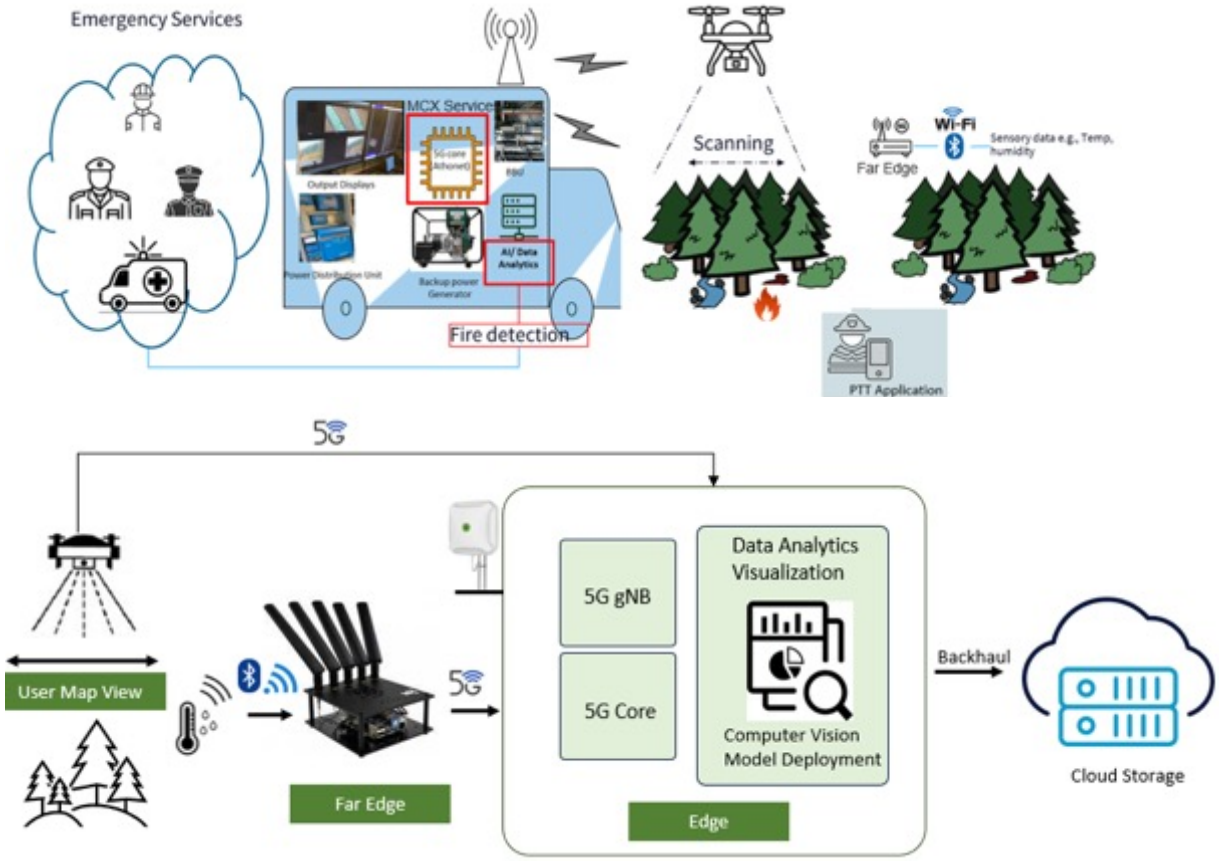
Figure. Remotely controlled Forestry Machinery concept

Use case and deployment plans for connectivity solutions

Use case 2.2: complex situational awareness services in the forest

- Provide the monitoring and surveillance environment to protect forests from different accidents like forests fires. It will also enhance the efficiency and safety of emergency personnel
- The LL will deploy the following major components:

-Drones
-Ground Sensors
-Edge Computing (Near Edge and Far Edge)
-Private 5G Network



COMMECT Living Lab #1

Digitalization of Viticulture

REMICH, Luxembourg

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture

Institut viti-vinicole

Digitalization of Viticulture

End users Needs

Plant Protection

Downy mildew control

Better risk forecast, with weather information

Site-specific activities

Management of drought stress

Site-specific irrigation and fertilization

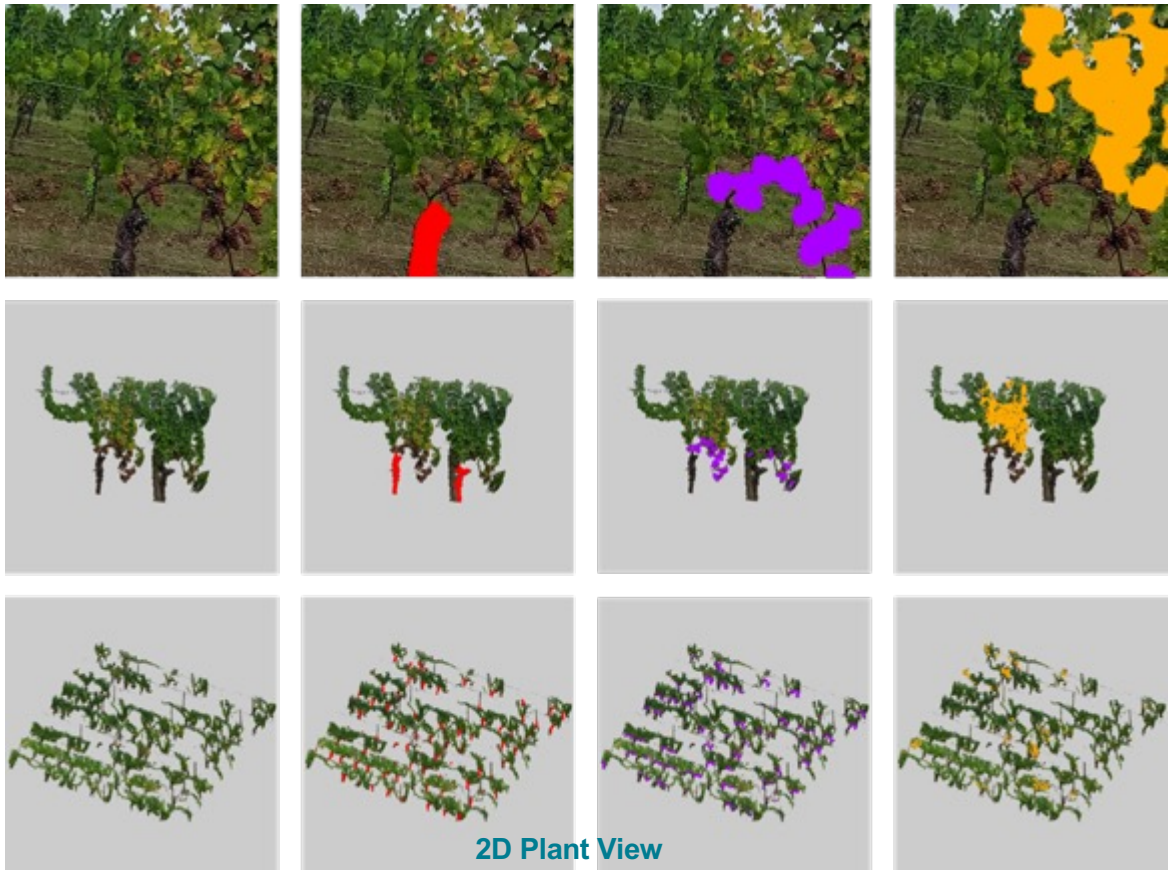
Digital tool for vineyard management

From data collection to planning

Single plant inventory, Leaf level symptom mapping, Local pattern analysis, Regional spatial information

35

Plant scale

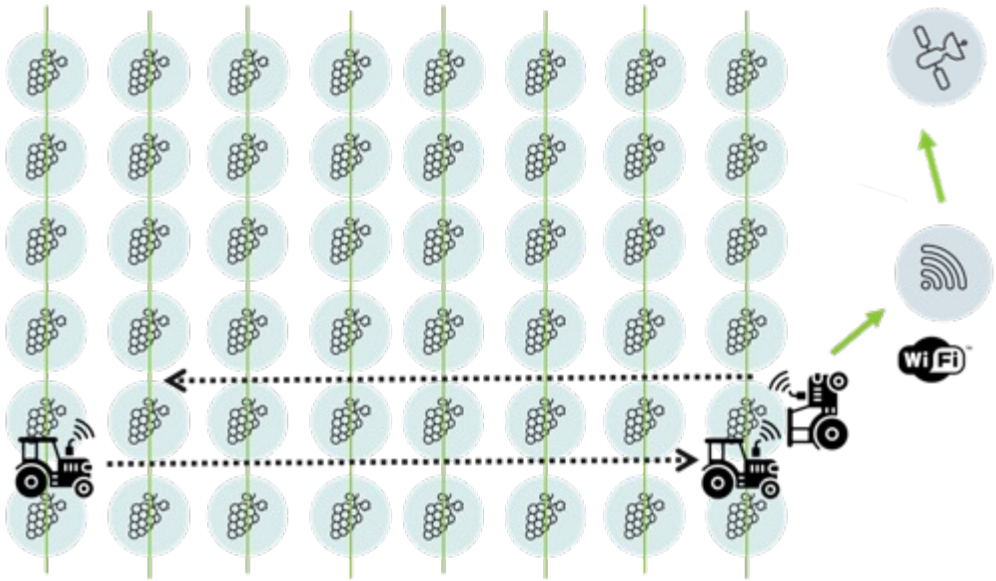


2D Plant View

3D Plant View

Plant scale

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture
Institut viti-vinicole



Images acquisition from camera on the tractor
via Wifi and satellite backhauling

First Test 18.04.2024

Second Test 15.05.2024

Questions from the Audience

Moderated by:
Luis Perez-Freire, AIOTI WG Agriculture Chairman (Gradiant)

Wrap up and end of the webinar

Raffaele de Peppe, 6G IA Governing Board Vice-Chair

Wrap up & Final remarks (1/2)

- **Mismatch between promise and expectations**
  - 5G adoption in agriculture still low in despite of excellent performances, few agri innovation projects based on 5G and beyond - 5GSA can be a trigger?
- **Enhanced 5G capabilities and new native 6G capabilities**
  - Need of high quality connectivity to develop new services - 6G mTC and low latency performances will be enhanced wrt to 5G
  - More coverage with satellite integration (3GPP standard) – private networks?
  - AIaaS and ISAC are new differentiating features in 6G
  - NaaS (API) can be key for secure exposure of network capabilities and innovation
  - Telco edge cloud to provide new services from inside the network
  - Digital twins to tie physical and digital worlds in agriculture
  - Autonomous (EV?) vehicles can be a game changers (tractors, drones), with less accidents and less manpower (?)

Wrap up & Final remarks (2/2)

- **Engagement with Agri-community is key to define 6G**
  - An online survey will be distributed amongst key verticals to gather inputs on key trends and use cases (SNS ICE project)
- **Socio economic drivers and barriers?**
  - Poor incentives to cover rural areas for operators (beyond regulatory constraints)
  - Environmental sustainability a driver?
  - Digital / Green Transition? Incentives to leverage?
  - Climate change an opportunity to accelerate?
  - Shortage of manpower in agriculture to drive adoption of autonomous robots/ vehicles'

Thank you for listening