THE GOVERNMENT
OF THE GRAND DUCHY OF LUXEMBOURG
Ministry of State

Department of Media, Connectivity
and Digital Policy

LUX5GCLOUD

Welcome

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WORKSHOP

"EMPOWERING FARMERS WITH DIGITAL TECHNOLOGIES"

Maria Rita Palattella, PhD
Senior R&T Associate
Lux5GCloud Project Coordinator

A LONG-TERM VISION FOR THE EU'S RURAL AREAS

TOWARDS STRONGER, CONNECTED, RESILIENT AND PROSPEROUS RURAL AREAS BY 2040

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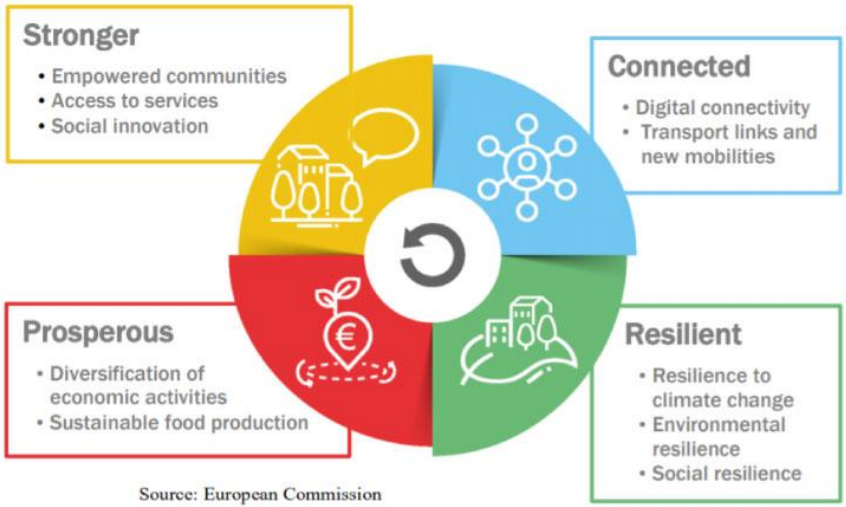

Source: European Commission

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THE KEY ROLE OF DIGITALISATION IN THE FUTURE OF RURAL AREAS

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Main Opportunities

- ❑ Access to markets and opportunities for new business models
- ❑ Enhance access to services
- ❑ Enhance productivity and resource efficiency
- ❑ Enable community-led innovation

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THE KEY ROLE OF DIGITALISATION IN THE FUTURE OF RURAL AREAS

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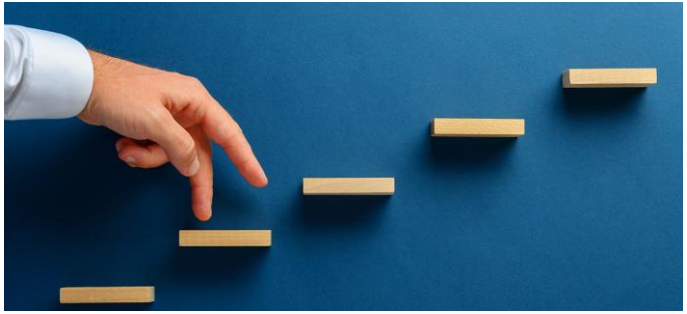
Main Challenges

- **Availability of connectivity**
  - **Rural and remote areas** remain **largely unconnected** to the Internet
    - Low population density
    - Large distances
    - Rough and difficult-accessible terrain
    - Policies and Regulations
    - Cost of deployment
    - Difficulty in attracting investment
    - Lack of technical knowledge
- **Affordability of connectivity**
- **Young people leaving rural areas**
- **Limited Digital Skills and Competences**
- **Missing bottom-up community initiatives**



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DIGITAL INFRASTRUCTURE

The FIRST STEP TOWARD RURAL DIGITALISATION

“**Digital infrastructure** is an **essential enabler for rural areas** to contribute to and make the most of the **digital transition**”, EC

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5G for enabling new services in rural remote areas

Glenn Van Bost, POST

HOW POST EMPOWERS RURAL COMMUNITIES WITH 5G > NOW

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WALDBËLLEG
COMMUNE DE WALDBILLIG

The DIGIWALD Project for Digital Inclusion

What	How
▪ Interactive City Communications Totems	⇨ Interactive screens – visit the POST Booth
▪ Digital Inclusion ▪ High Speed Internet for all ▪ Cover complex and difficult zones to connect	⇨ POST Internet + POST TV over 4G-5G (Fixed Wireless Access)
▪ Enable a Rural Smart City	⇨ Connected Water Meters

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HOW POST WILL EMPOWER RURAL COMMUNITIES WITH 5G > TOMORROW

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E.g. The LUX5GCloud Project outcomes and much more

What	How
▪ Improve your fields productivity through real-time crop control	⇨ 5G High reach connectivity ⇨ 5G Low Energy connected Objects ⇨ 5G Accurate Positioning services ⇨ 5G Secured communications
▪ Secure your fields / protect your cattle from predators enabling real time intrusion detection	
▪ Manage, maintain and secure your expensive Machines	

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POST EMPOWERING RURAL COMMUNITIES WITH 5G
> THE DAY AFTER TOMORROW

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If you can DREAM it,
You can DO it.

WALT DISNEY

POST EMPOWERING RURAL COMMUNITIES WITH 5G
> THE DAY AFTER TOMORROW

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If you can DREAM it,
You can DO it.
WALT DISNEY

… together with

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The Lux5GCloud Approach toward digitalised Agriculture

Dr. Maria Rita Palattella, LIST

DIGITAL TECHNOLOGIES ECOSYSTEM

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Many Technologies

- ❑ 5G Networks
- ❑ Artificial Intelligence
- ❑ Internet of Things
- ❑ Cloud Computing
- ❑ Earth Observation
- ❑ Block Chain

A common objective :

Provide sustainable digital farming solutions

Soil Moisture Monitoring

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Internet of Things and LoRaWAN connectivity

Dr. Maria Rita Palattella, LIST

LUX5GCLOUD FIELD – STUDY AREA

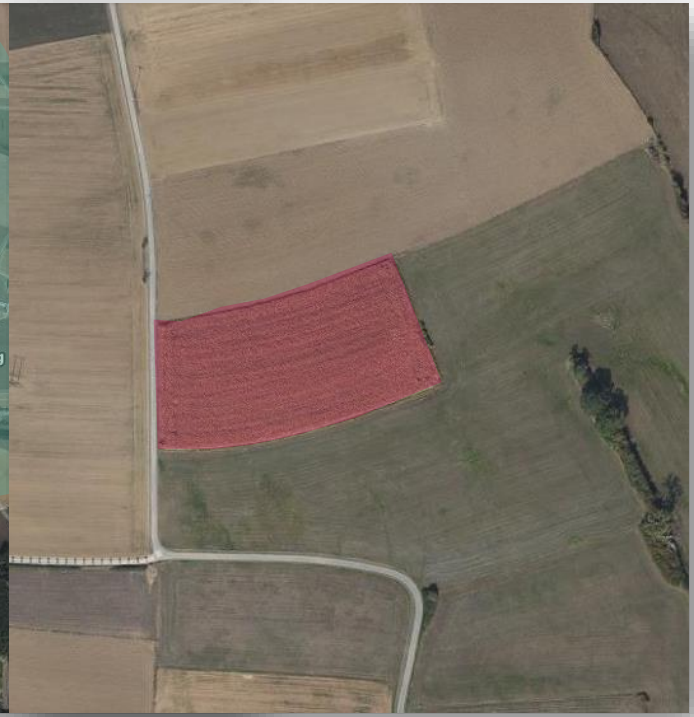
Waldbillig, Luxembourg

Waldbillig

5G Coverage

DIGIWALD Project

Crop



LUX5GCLOUD NETWORK ARCHITECTURE

Soil Moisture Sensors and IoT LoRaWAN Network

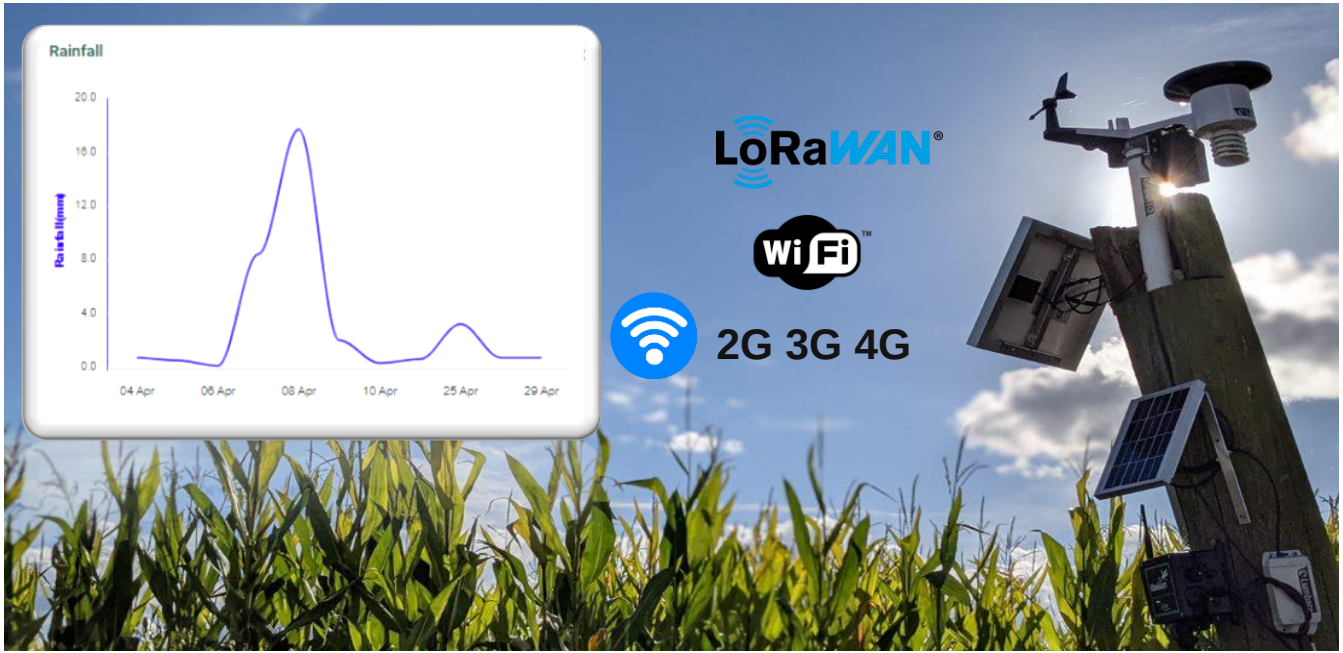
LUX5GCLOUD NETWORK ARCHITECTURE

Weather Station and Multiple Technologies

Real-Time Data

Weather Station Data

Air Temperature	11m ago	14.4	°C
Air Humidity	11m ago	92.2	%
Box Atm. press.	11m ago	966.0	hPa
Wind Speed	11m ago	1.5	mps
Wind Direction	11m ago	190.6	°
Illuminance	11m ago	6,825.0	lux
UV index	11m ago	0.1	
Rainfall	3h ago	0.1	mm



LUX5GCLOUD NETWORK ARCHITECTURE

From your field to your farm
One network Infrastructure for MANY users

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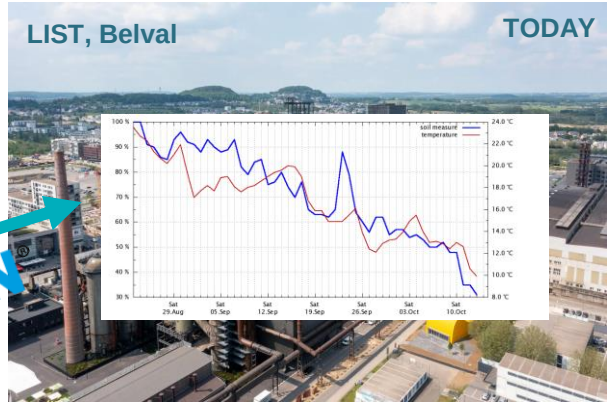
Soil Moisture Sensor

Weather Station

LoRa Gateway, Waldbillig

Provide coverage to different fields in the range of [5 – 20] Km.



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5G IoT camera:
Next level of computer vision decisions

Catalin Chitu, Frontier Connect

5G CAMERA

Lumbara Crop Eye

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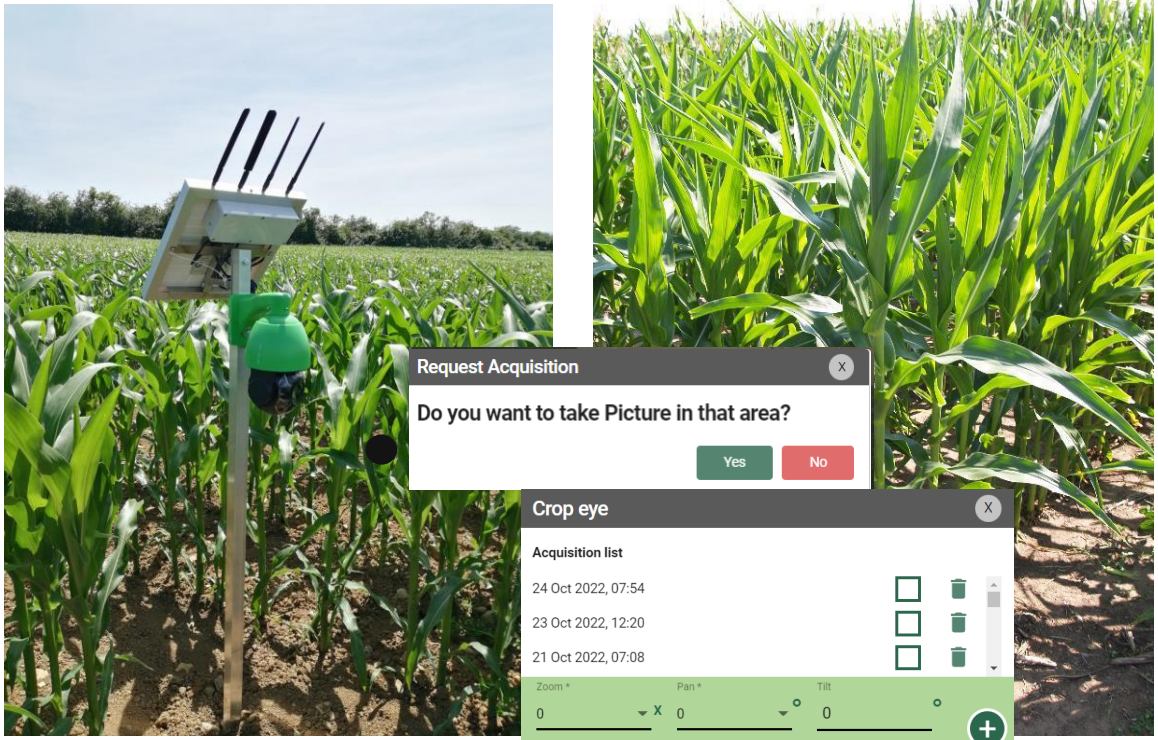

- **5G** Connectivity
- **Remote control** via app
- 360 degrees crop scanning
- Zoom / Pan / Tilt
- **High-resolution images**

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5G CAMERA

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Edge Computing, and 5G Connectivity to the Cloud

Cliquez pour ajouter du texte
Cliquez pour ajouter du texte

5G

CHDP

- High-resolution images captured with an advanced IoT 5G device
- Camera performing 360 degrees crop scanning, with **intelligent controlling zoom**
- Images transmitted over 5G to the Cloud Platform CHDP in almost real-time. Made available for the farmer, and any authorized user

TODAY: FIXED IN THE FIELD…

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5G CAMERA

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TOMORROW: MOBILE ON A TRACTOR

5G revolutionises agricultural machinery

- ❑ Remote control of automated machinery fleets
- ❑ Optimize individual plant treatments
- ❑ Detect animals, avoid accidents, protect the yield

Satellite Data and Machine Learning

Yu Li, LIST

EARTH OBSERVATION (EO) AND ARTIFICIAL INTELLIGENCE (AI)

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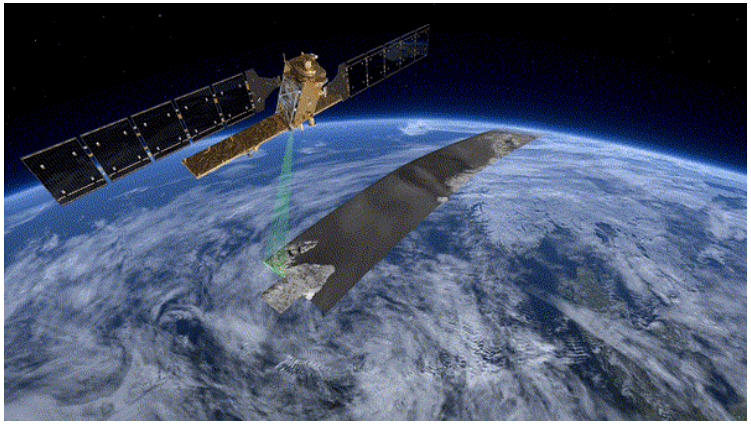
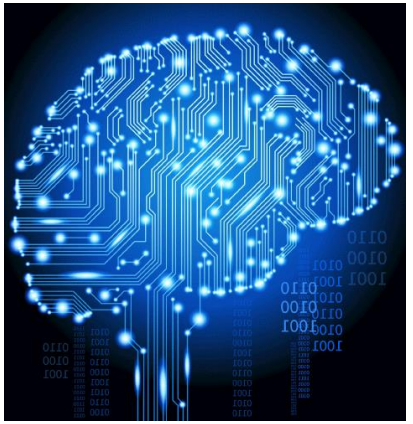


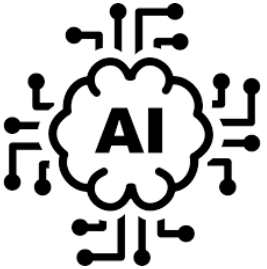
Artificial Intelligence

- Enabling machine with human-like capabilities (learning, reasoning, planning and creativity)
- Enabling to **uncover the complicated non-linear relationship between EO and physical parameters** of interest.



Earth Observation

- Information about planet Earth's physical, chemical and biological systems.
- Monitor and assess the status of, and changes in natural environment.
- Improving understanding of Earth system processes
- Supporting operational applications.



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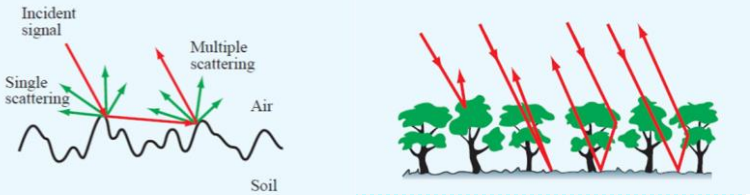
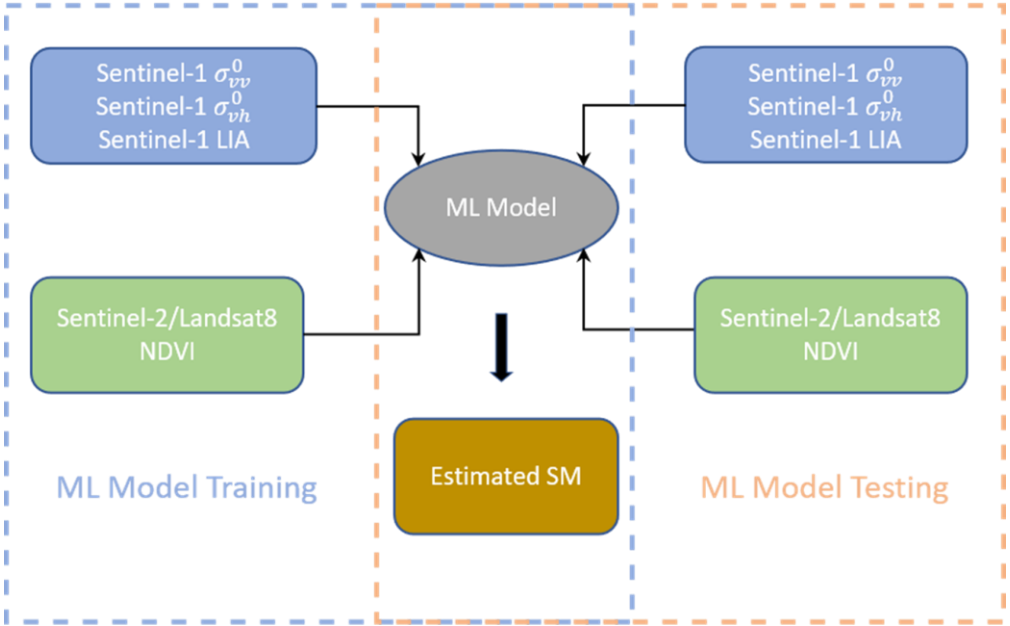
LUX5GCLOUD: EO DATA AND ML

Sentinel-based soil moisture estimation with Machine Learning

- **Input to ML Model**:
  - **Sentinel-1 backscattering coefficient**
  - **Sentinel-1 local incidence angle**
  - **NDVI Normalized Difference Vegetation Index**



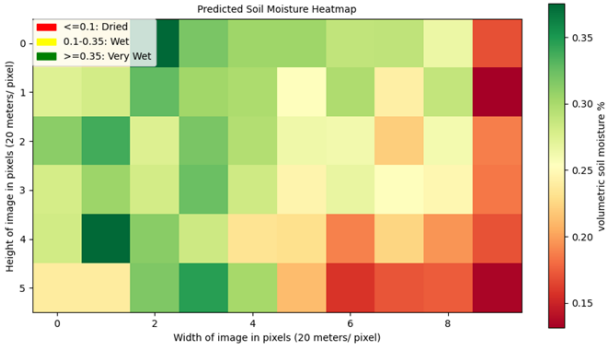
- **Output of ML Model**:
  - Soil Moisture Content (SMC)



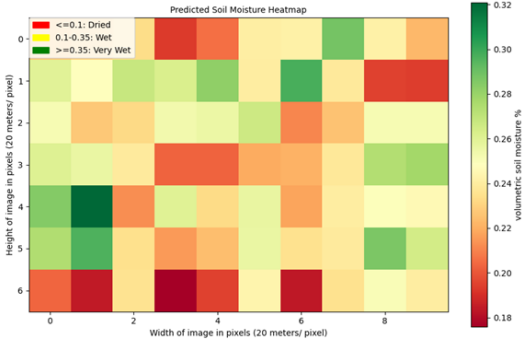
Drought Monitoring and Early Warnings

LUX5GCLOUD APPLICATION

Soil Moisture Mapping



12.04.2022



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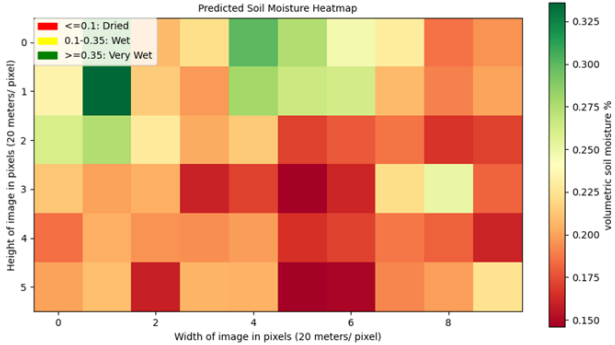

24.04.2022

The estimated soil moisture contents are displayed in a Soil Moisture heat map, allowing farmers to easily identify the specific areas of their field which are more affected by water stress.

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Secure Cloud Platform:

Bridge the gaps between Data security, accessibility, and monetization

Philippe Eymann, InTech.

Florent Cochet, CoDare

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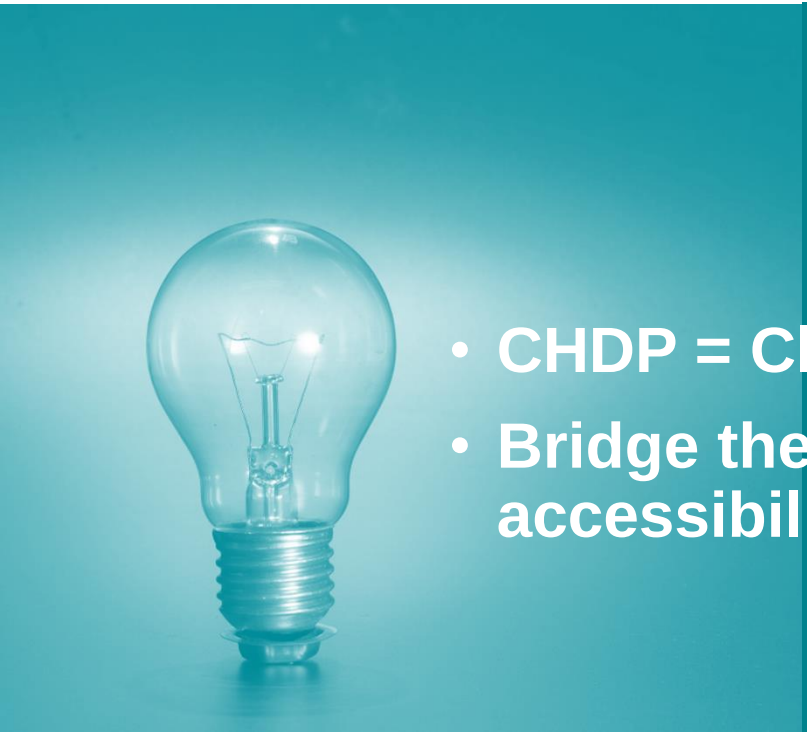
CHDP: WHAT FOR?



- CHDP = Cloud Hierarchy Data Platform
- Bridge the gaps between Data security, accessibility and monetization

DIGITAL AGRICULTURE CURRENT STATE

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REMOTE SENSING

Copernicus

esa

GOMX-4 BY GOMSPACE

HyperScout 2

INTELLIGENCE / DATA ANALYTICS

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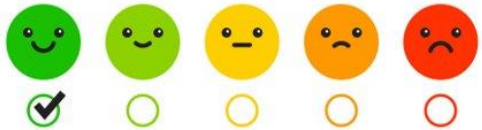
WATER STRESS?



IOT DEVICES

Frontier Connect

LoRa

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DIGITAL AGRICULTURE FUTURE STATE

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CLOUD HIERARCHY DATA PLATFORM

PROVIDER

Remote Sensing
IoT sensors
5G Camera
Machine
Learning

CONSUMER

Farmers
Universities
Government
Administration
Insurance

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CHDP CORE FEATURES

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1

SECURE

2

STORE

3

DISTRIBUTE / MONETIZE Data
Trigger customised data capture

BLOCKCHAIN AS A TRUST ENABLER

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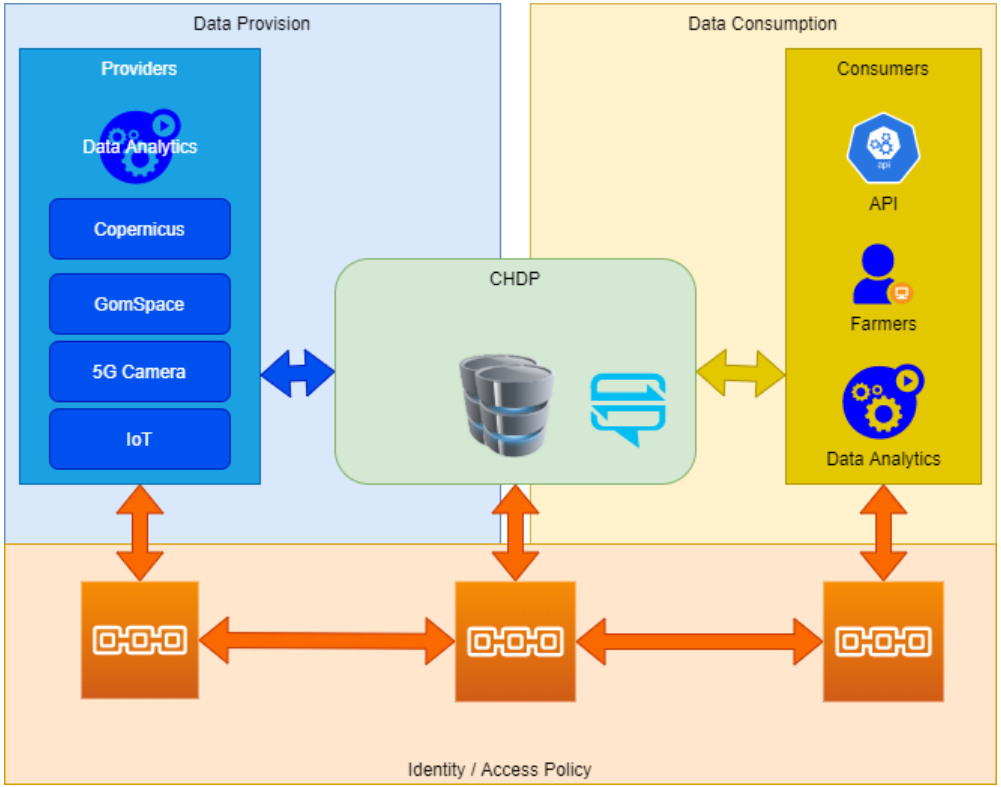
Why use Blockchain in CHDP ?

- **Security**: information is encrypted and cannot be altered, it is distributed among parties
- **Privacy**: information is available only for authorized users, through well defined access rules
- **Decentralized Governance**: rules are defined in smartcontracts which can be audited



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A *single* Integrated Approach for many digital solutions

Dr. Maria Rita Palattella, LIST

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DIGITAL FARMING SOLUTIONS

Lux5GCloud Soil Moisture Monitoring Application

DIGITAL FARMING SOLUTIONS

Fungal Disease Detection

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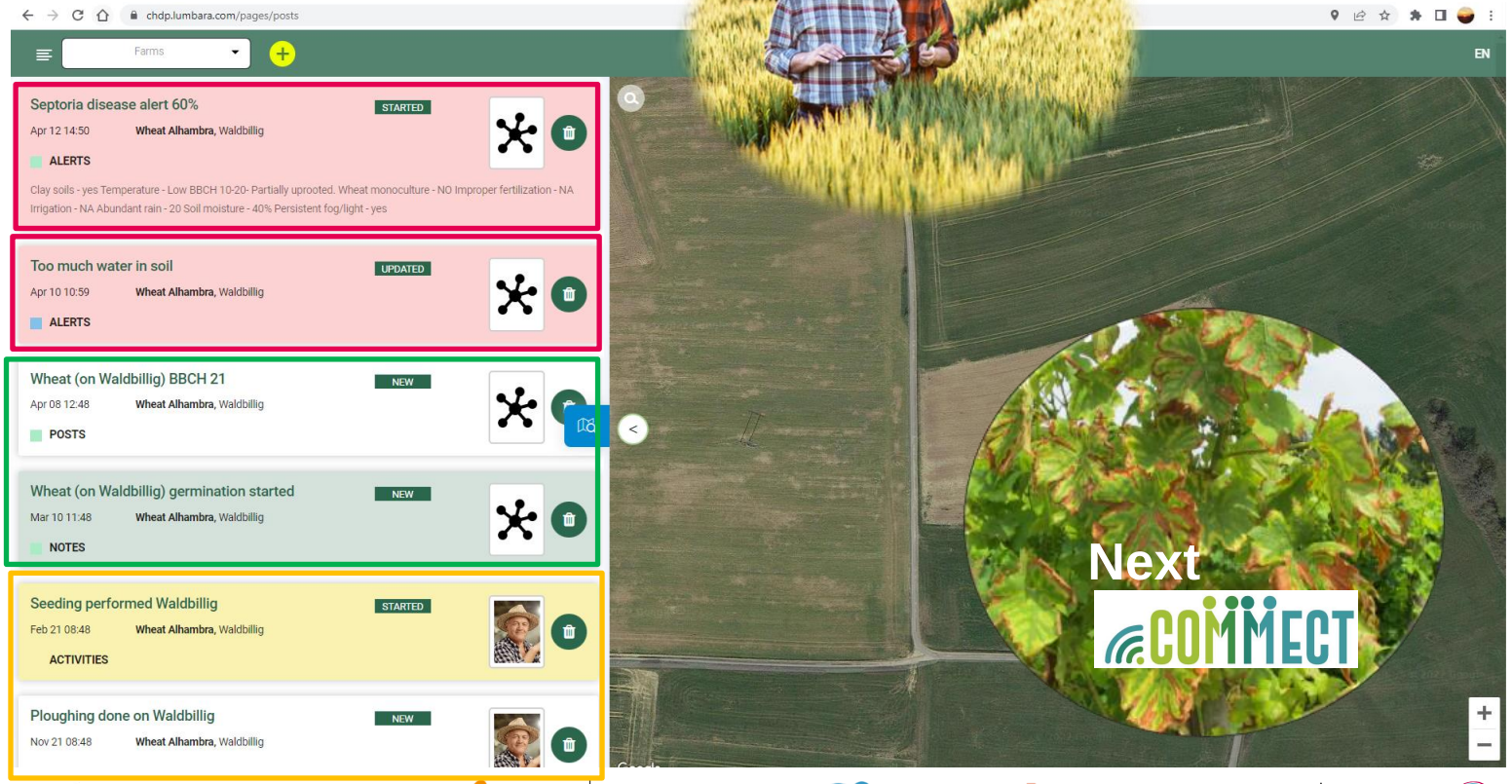

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DIGITAL FARMING SOLUTIONS

Continuous Monitoring

Weed Detection and Control

DIGITAL FARMING SOLUTIONS

Many More…
What's next?

COMMECT

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Workshops → Training → Development

COMMECT

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

Tell us your needs
We will design the best connectivity solution and digital application for you !

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Lux5GCloud

Exploiting the potential of 5G, IoT, EO, cloud and ML for sustainable digital farming solutions.

Thank you !

Get in touch to know more!

Project PI and Coordinator
Maria Rita PALATTELLA
mariarita.palattella@list.lu

https://www.list.lu/en/environment/project/lux5gcloud/

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