Precision Agriculture based on IoT, Cloud, and Mobile Apps

VIRAL Project Workshop

Mostar, October 2020

Erasmus+
Enriching lives, opening minds.

Content

- Digital transformation
- Digitalization and smart agriculture
- Key enabling technologies
- Precision agriculture applications
- Project examples

Digital transformation

- Using ICT to **improve** or **create new** ways to implement **business models** and business **processes**.
  - Currently taking place **everywhere** around us.
  - Incidentally, even **COVID19 situation** turned out to be one of the main drivers on how we do business

Key elements

- Digital transformation
  - Infrastructure
  - Services
  - Entitlement

Digitalization and Smart Agriculture

- Smart agriculture:
  - How do we **improve** existing business processes and models?
  - Can we **create new** and innovative business models?
  - How to increase and **create** new **value**?

Application domains

- Arable Crops
- Fruit and Vegetables
- Livestock
- Supply Chain

Key technologies

- Internet-of-Things, IoT
- Cloud Computing
- Mobile devices
- Big data and data analytics
- Social media

Internet of Things

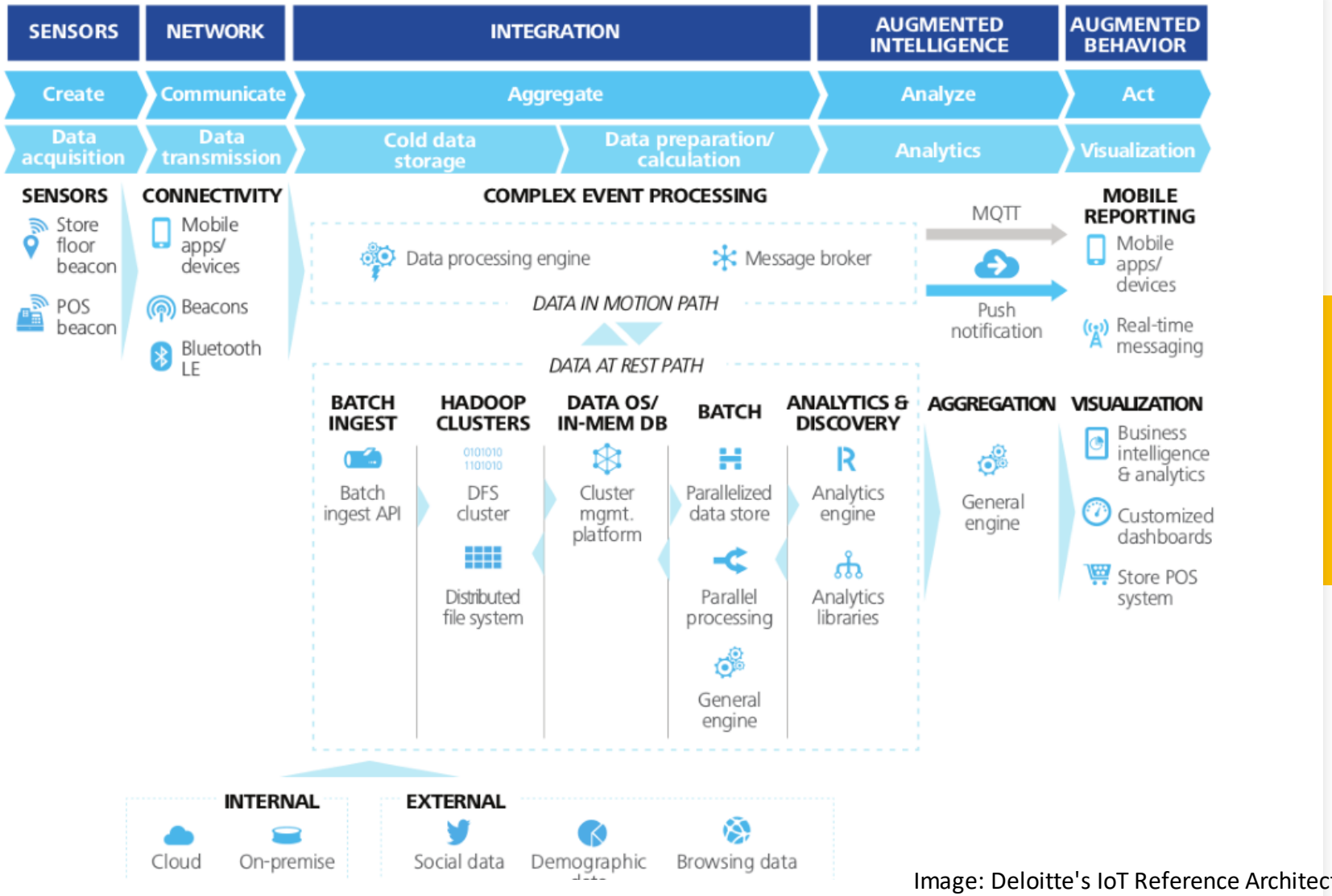


Image: Deloitte's IoT Reference Architecture

Cloud Computing

- Scalable Computer Resources
  - CPU and RAM
  - Storage space
  - Network and Internet
- Deployment models
- Service models
  - IaaS
  - PaaS
  - SaaS

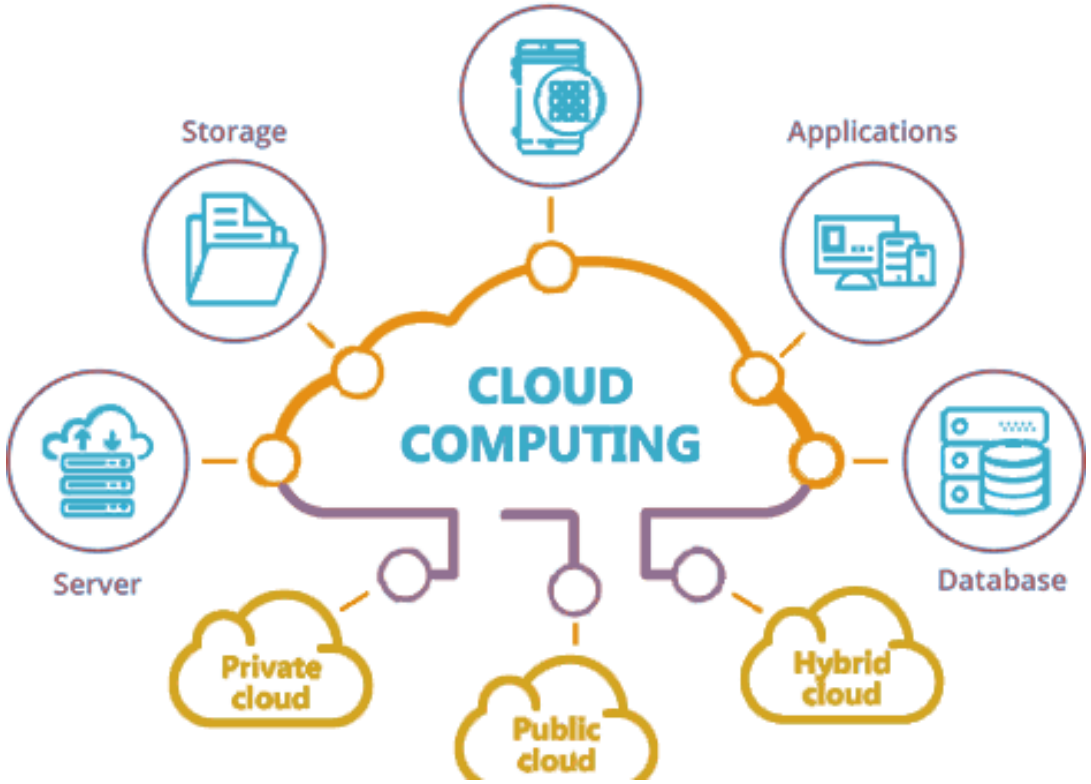


image: https://networkencyclopedia.com/cloud-computing/

Mobile devices

- Mobile phones and tablets
- User availability and business models
  - 24/7 anywhere
  - Any time
- Two-way communication:
  - Sensors, user input
  - Processing power
  - Remote data access
  - Visualization

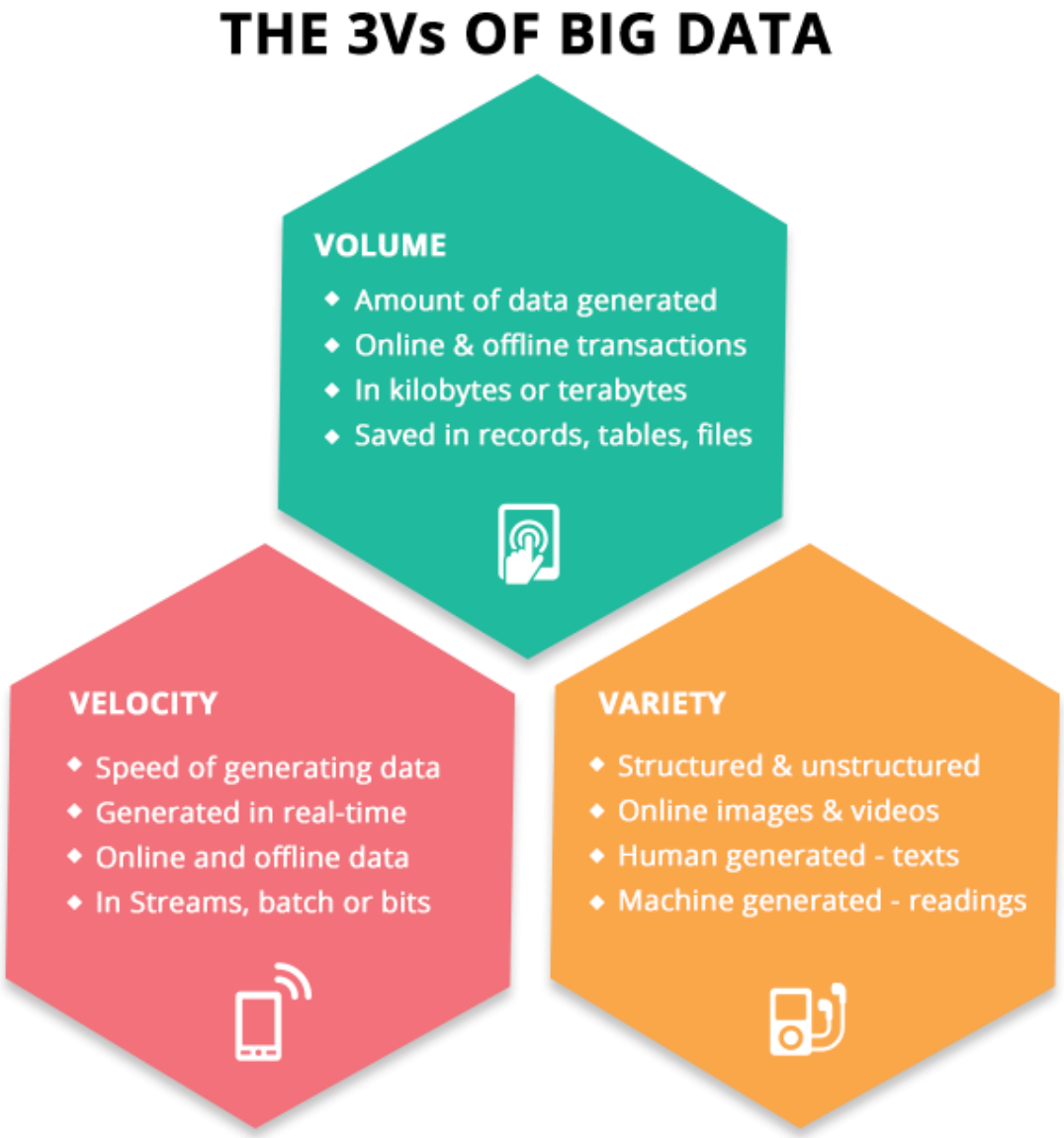
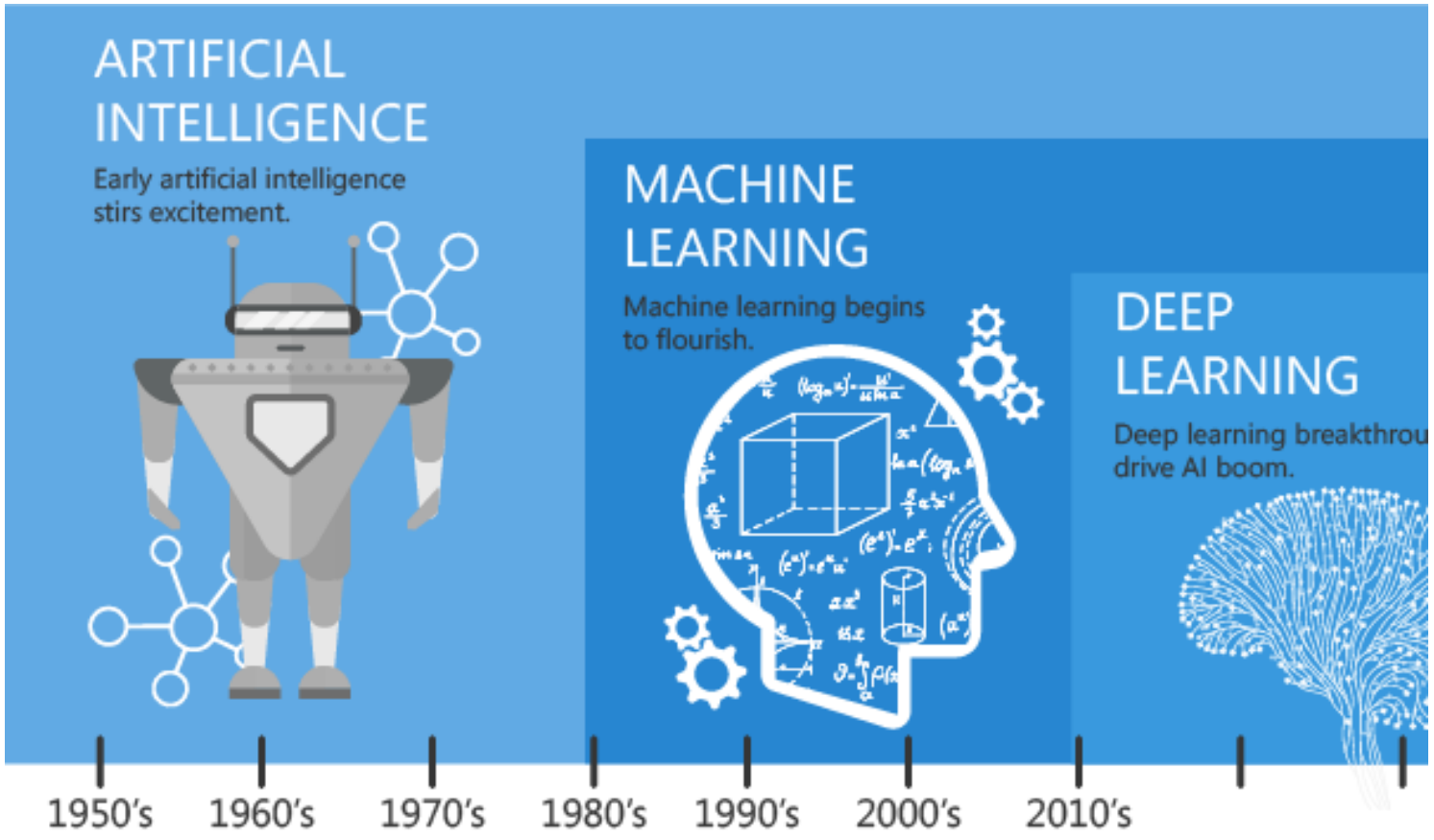


image: https://www.wishworks.com

Big data and Data analytics

- Big challenges
- Source of value
- The 3Vs



Chaudhuri , A. et al. Optical Character Recognition Systems for Different Languages with Soft Computing, vol. 352, page 9, 2017

Artificial intelligence and Machine learning

- New computing **paradigm**!
- **How** do we make a **model**?

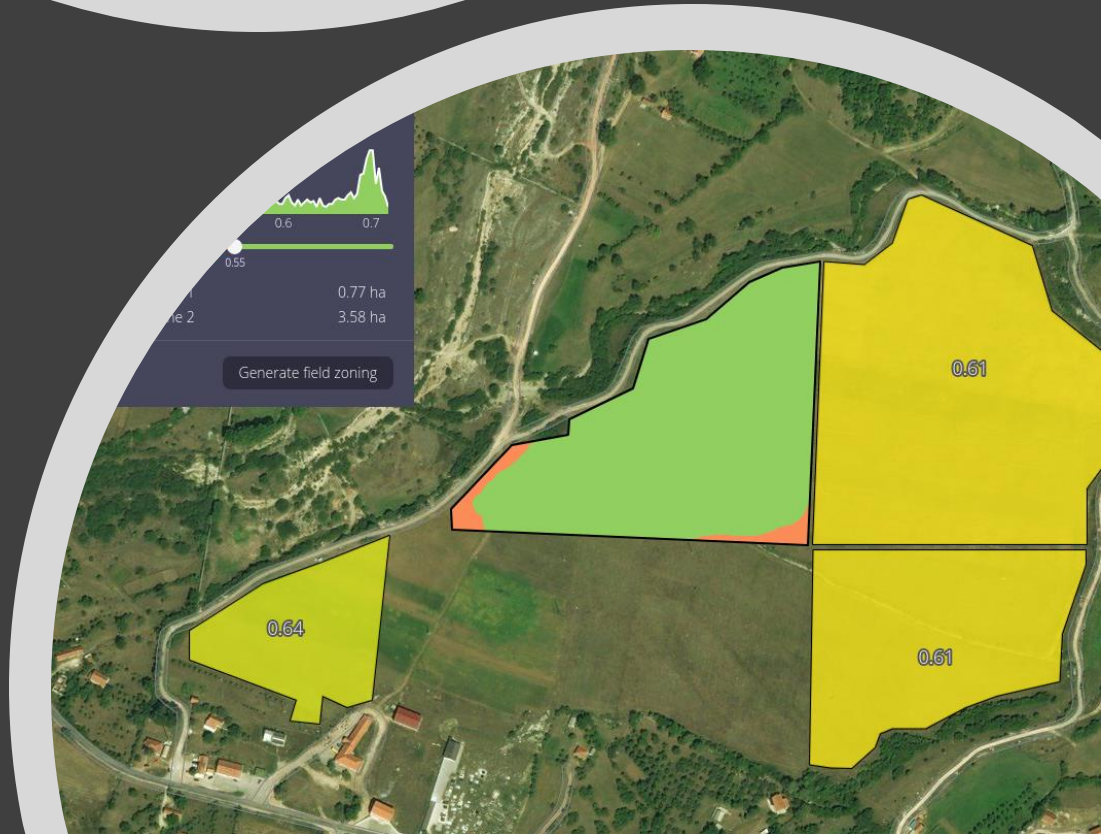
INPUT + PROGRAM = RESULT

Vs.

INPUT + OUTPUT = PROGRAM

Satellite and drone images

- New **possibilities**
- Different **types** of cameras, regular, spectral, thermal
- Image processing, calculating various **indices**
- **Combining** with other data



Social media

- New paradigm of social interactions
- Another source of data
- Extremely important, high-risk if mismanaged

Geographic Information System GIS

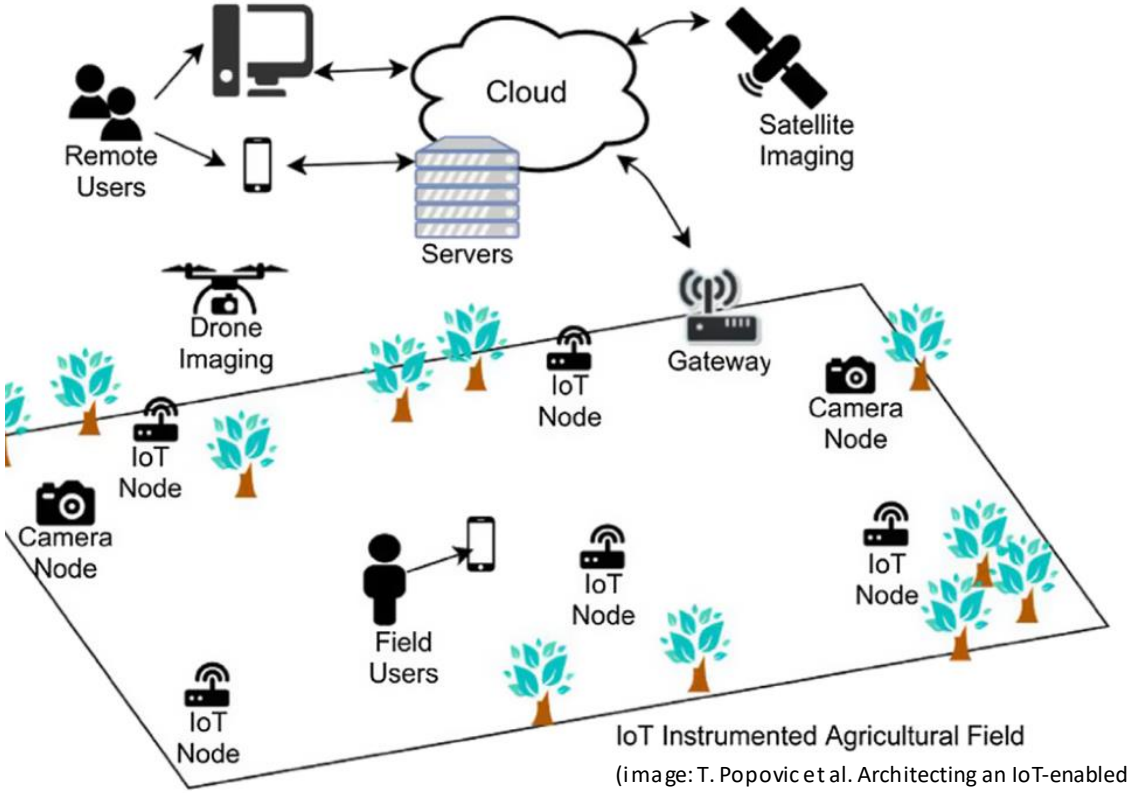
- Geospatial data
- Temporal data
- Visualization of data from various sources
- Multi-layered approach

Dual nature of ICT

- **Great** possibilities and **benefits**
- **Potentially** great **risk** if not implemented the right way

Smart agriculture

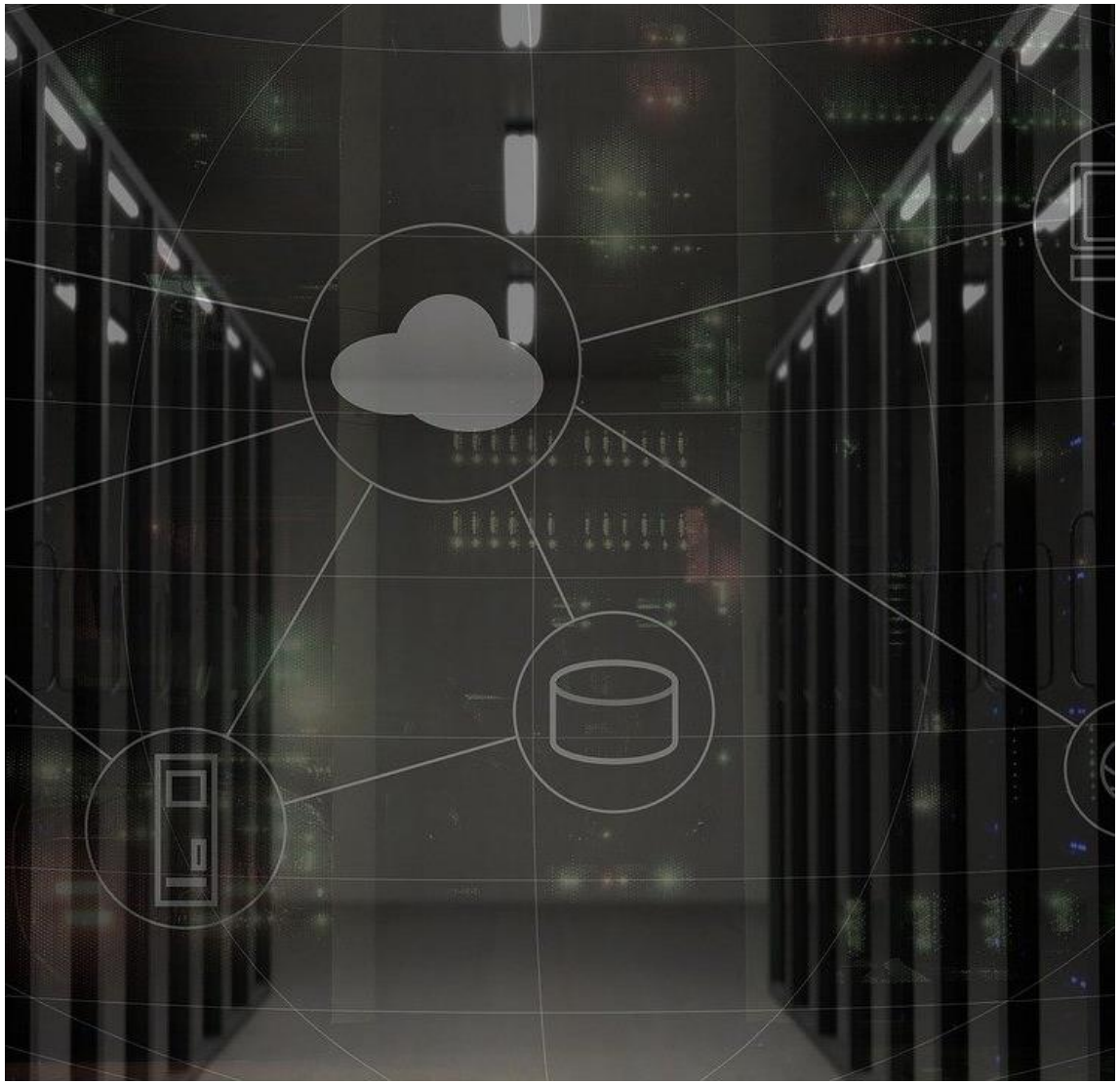
- **Context**



(image: T. Popovic et al. Architecting an IoT-enabled platform for precision agriculture and ecological monitoring: A case study, Computers and Electronics in Agriculture)

From data to making decisions

- Data collection and aggregation
- Converting data into information
- Extracting new knowledge from the information (ES, AI, ML)
- Supporting decision making process



Sources of data

- Various sensors and IoT equipment
- Sensors and cameras on drones, satellites, robots
- Sensors and tags on animals and plants
- Sensors on machinery
- Various types of users of mobile devices and computers
- Other Internet sources via API(sites, portals, social media)
- Etc...

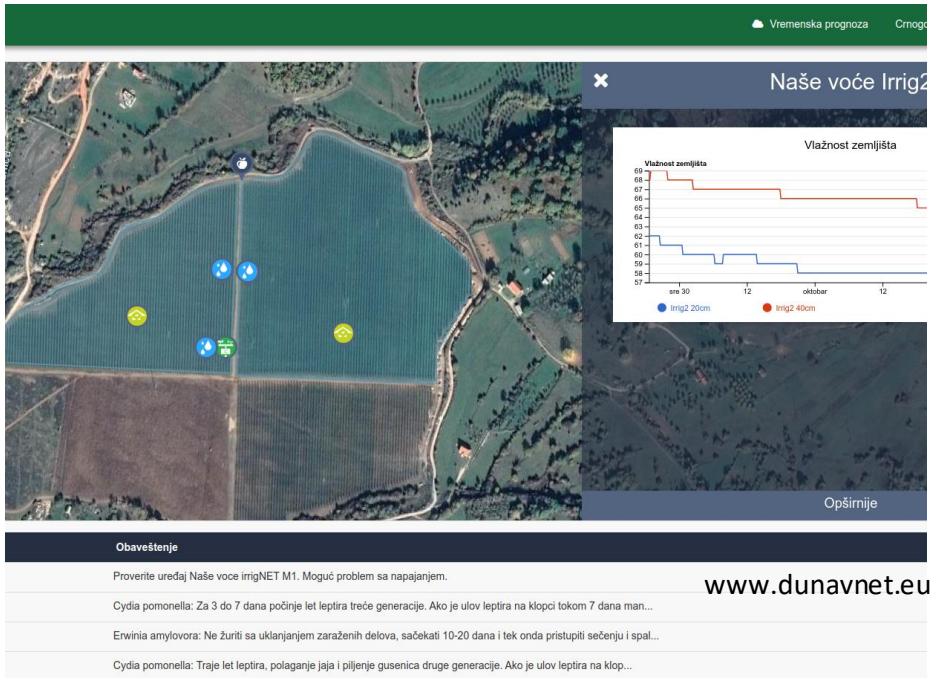
Use cases

- Weather conditions and **micro-climate**
- **Monitoring parameters** in fields, vineyards, orchard, livestock farms
- Agriculture **machinery** and fleet management
- Assessing **health** and **growth**
- **Detecting disease** or conditions for developing diseases
- **Growth** monitoring, detecting optimal **harvesting time**
- **Pest** control and spraying **optimization**
- **Irrigation** optimization

Benefits

Irrigation optimization Example

- Sensor
  - Soil moisture, Teros 10 (30cm/60cm)
- IoT node:
  - Mobile and/or LoRa communications
  - Solar and battery power
  - Embedded computing
- AgroNET platform in Cloud
  - Data Integration
  - Visualization
  - Decision Support: Irrigation Optimization
  - Web and mobile access and notifications



Irrigation Optimization Example

- Data collection and aggregation
- Various types of visualizations for different type of users
- Prediction models: heuristics, AI and ML
- Inclusion of domain experts' know how
- Decision making support: **do or do not turn on the irrigation valve!**
- The use of metrics to assess the benefits

Projects at UDG

- **TagItWine** – H202O TagItSmart
- **DIPOL** – Digital transformation of agriculture and food supply chain in Montenegro
- H2020 **DEMETER** – Building an Interoperable, Data-Driven, Innovative and Sustainable European Agri-Food Sector
- **VIRAL** ErasmusPlus – Vitalising ICT Relevance in Agricultural Learning

Horizon 2020
European Union Funding
for Research & Innovation

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Collaboration

- University of Donja Gorica
- 13. Jul Plantaže
- DunavNET

TagItWine

Horizon 2020
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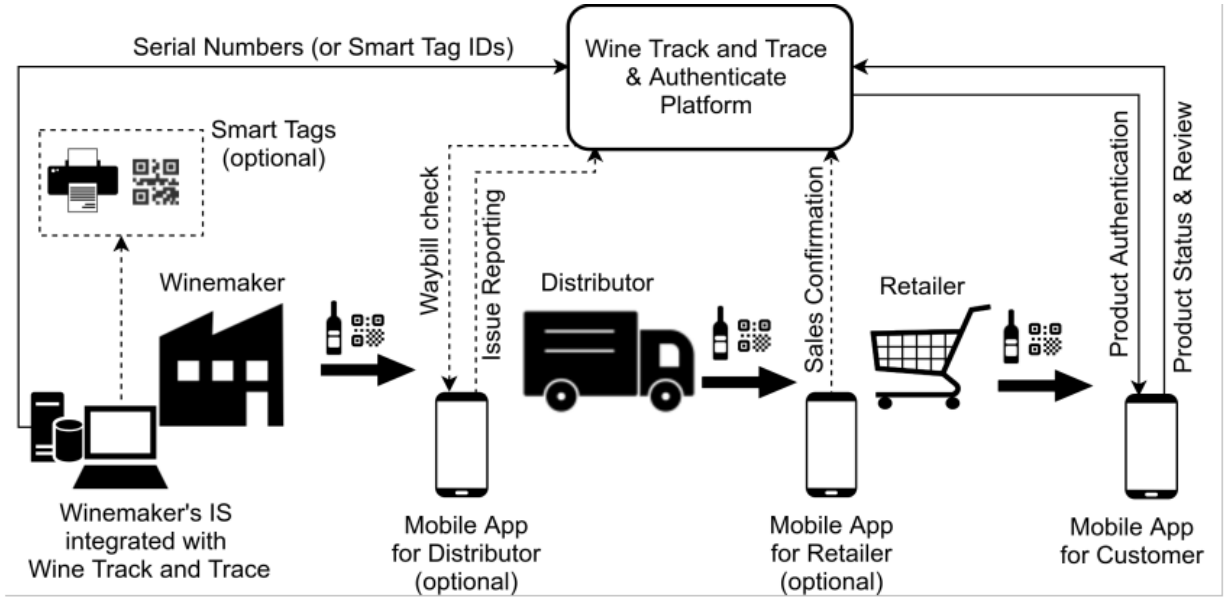
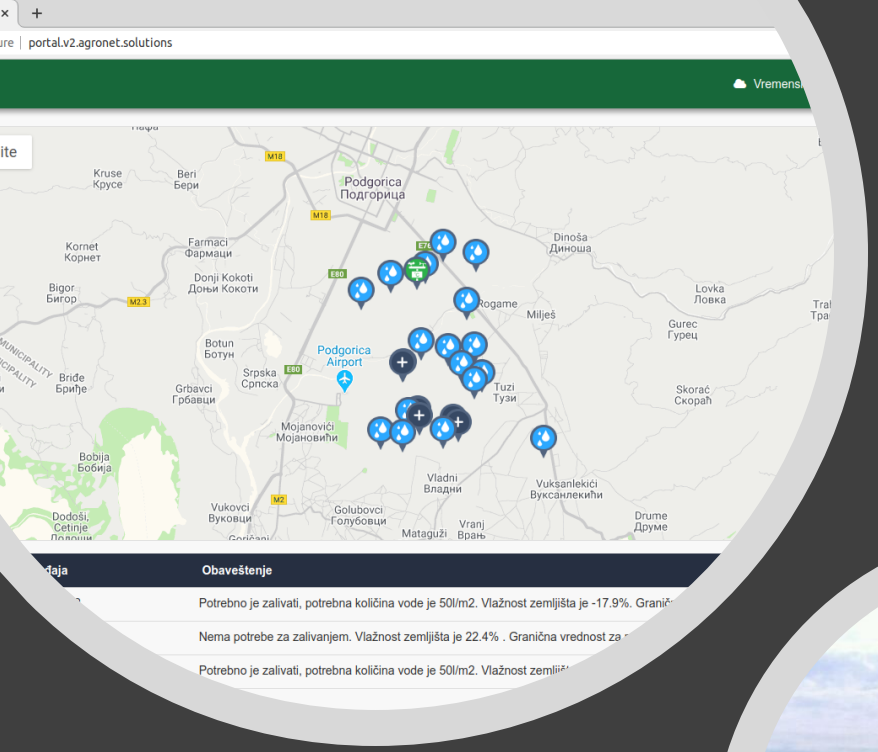
TAG IT SMART

- Use of active QR codes
- Food track and trace use case
- Counterfeit prevention and detection



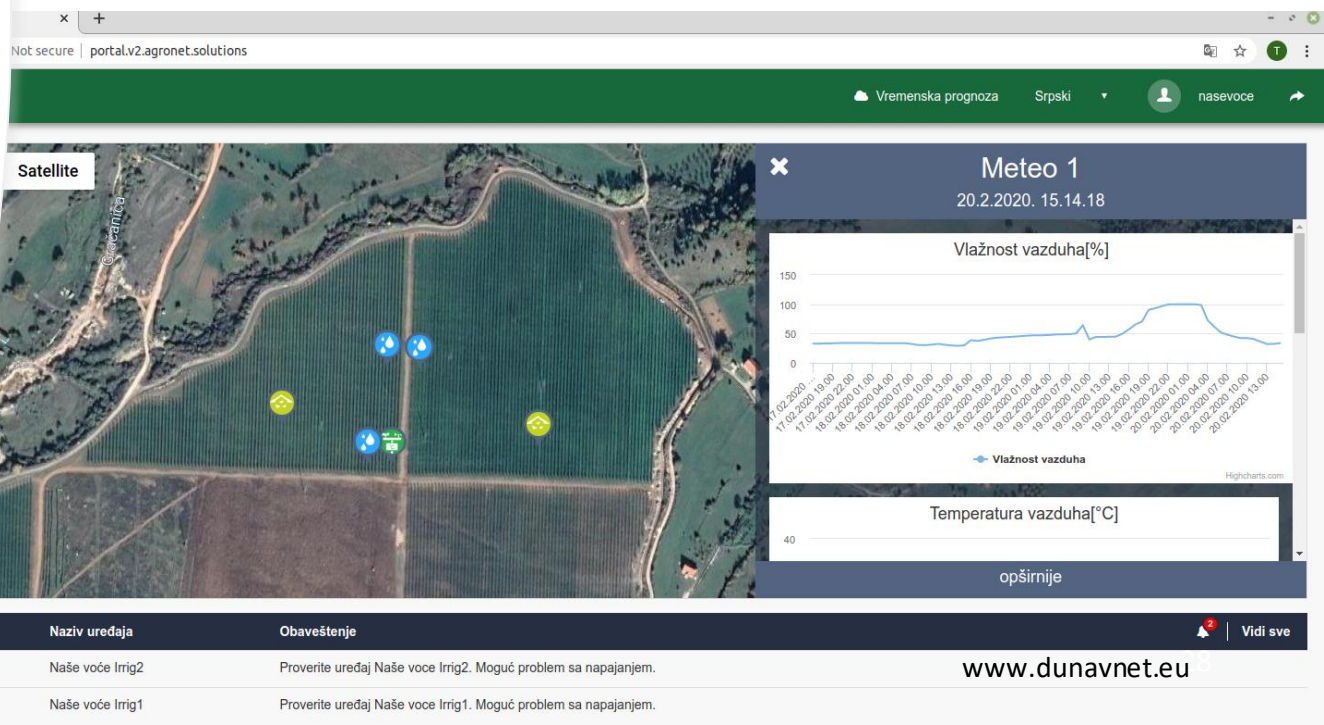


DIPOL

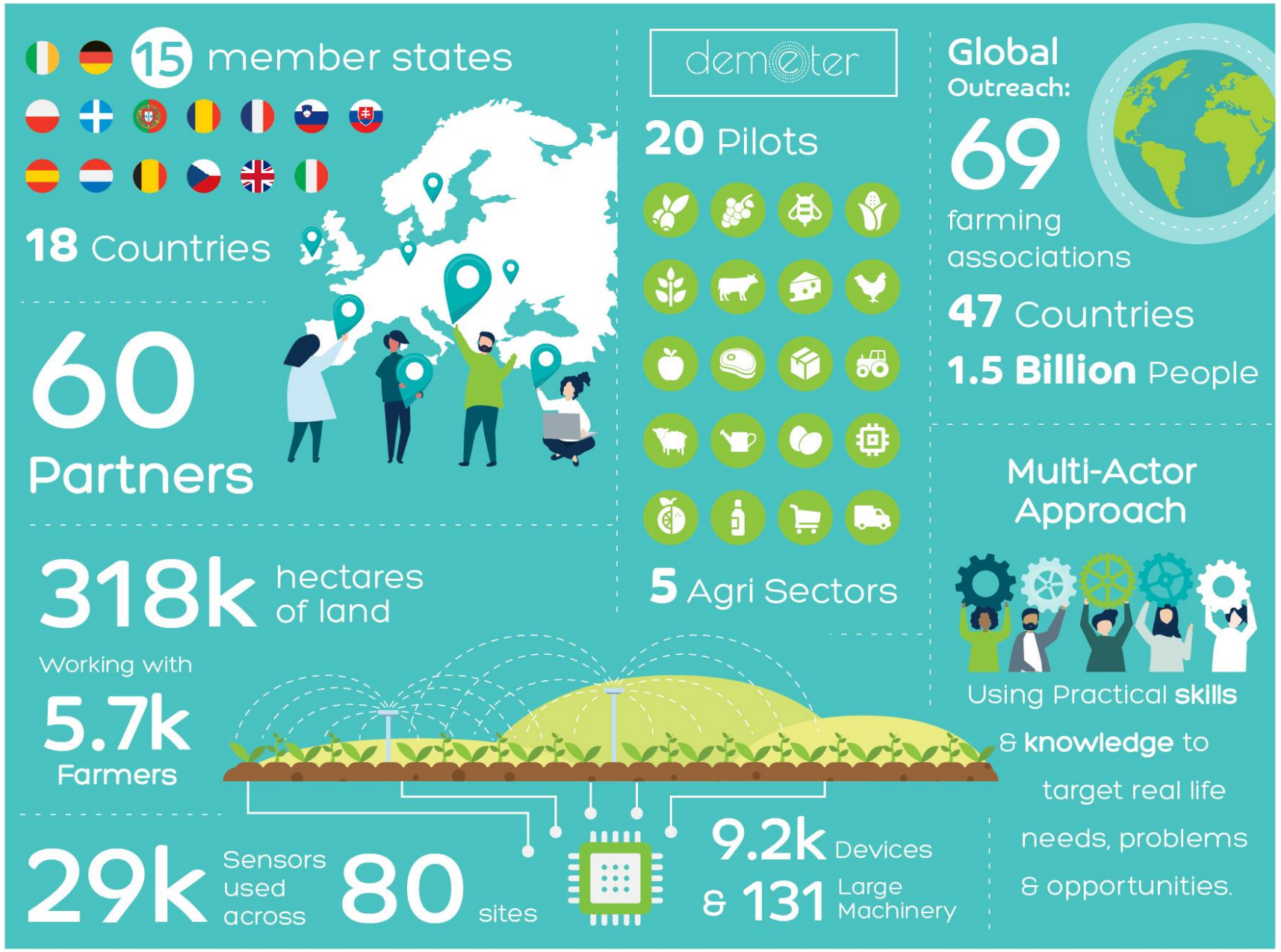
- Precision viticulture
- Precision agriculture in orchards
- Food supply chain

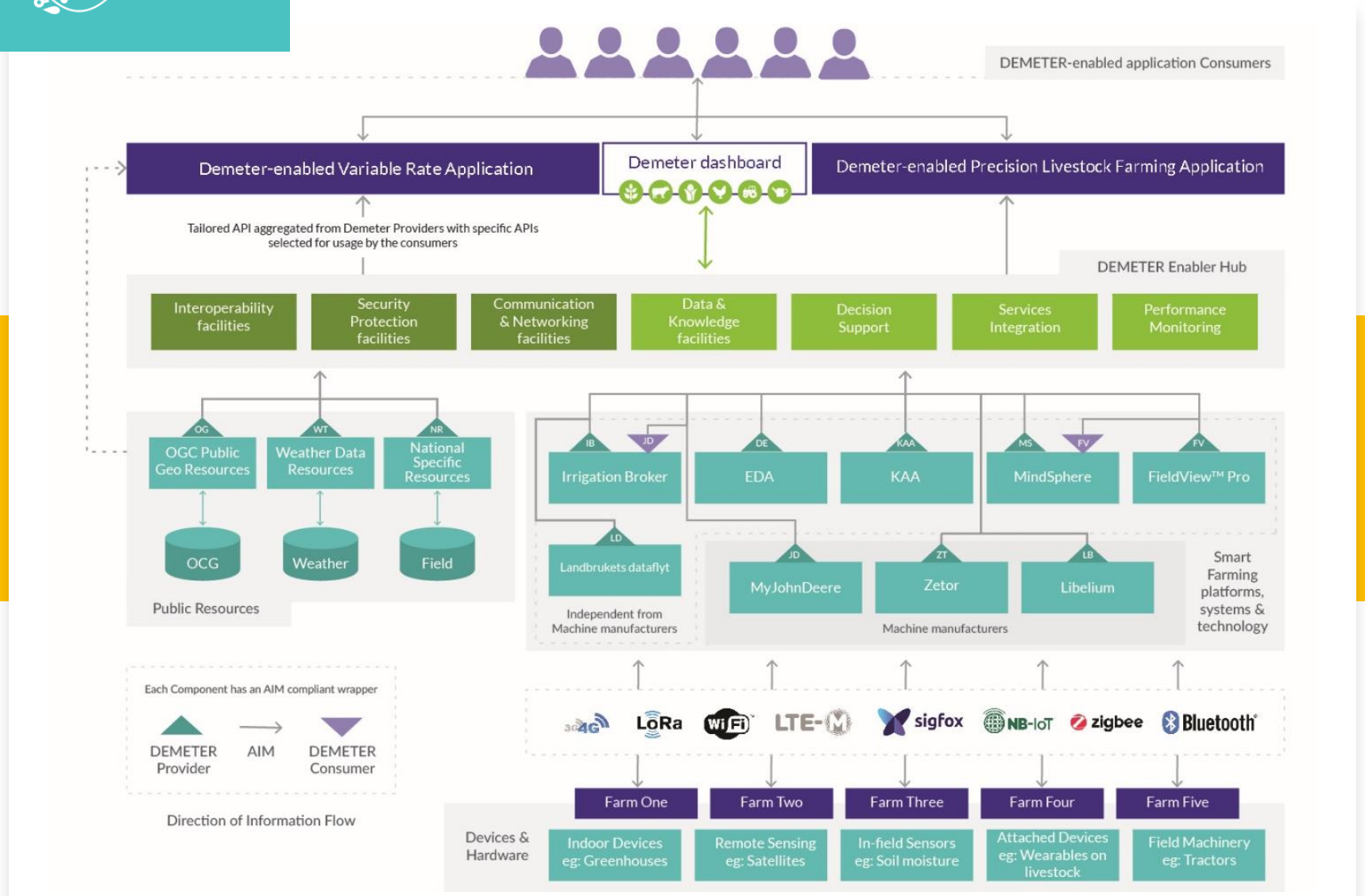
DIPOL: Precision Agriculture

- Data collection
  - Weather stations
  - Soil moisture
  - Leaf wetness
  - Pheromon traps with cameras
  - Weather forecast data
- Digital platform (AgroNET) and Use Cases
  - Data collection and visualization (Cloud)
  - Irrigation optimization
  - Disease prediction
  - Insect monitoring and Spraying protection



www.dunavnet.eu


15 member states
18 Countries
60 Partners
demeter
20 Pilots
5 Agri Sectors
Global Outreach:
69 farming associations
47 Countries
1.5 Billion People
Multi-Actor Approach
Using Practical skills & knowledge to target real life needs, problems & opportunities.
318k hectares of land
Working with 5.7k Farmers
29k Sensors used across 80 sites
9.2k Devices & 131 Large Machinery



H2020 DEMETER

VIRAL

- Educate educators
- Engage and educate farmers
- Engage business partners
- In-house and field labs
- Workshops / conferences / hackatons
- Partnership development

Conclusions

- Digital transformation and agriculture
- Importance of including ICT in agricultural learning
- Competitive advantage in agriculture
- The time is **NOW!**

Thank you!

- **VIRAL** project: http://viralerasmus.org/
- **DIPOL** project**:** https://dipol.udg.edu.me/site/
- **H2020 DEMETER** project: https://h2020-demeter.eu/