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Research Studios Austria
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Secure and Flexible Precision Farming - with Drones

- Markus Tauber – markus.tauber@researchstudio.at

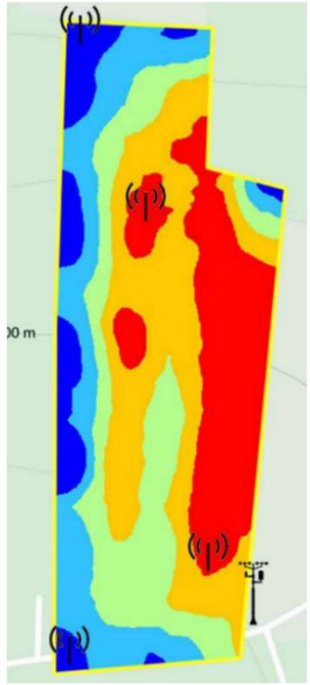
- Supporting small scale ecosystems near the consumer
- Results from R&D Projects Arrowhead Tools & Comp4Drones
- Structure:
  - Architecture
  - Security

Who we are

- Research Studios Austria, Not-for-Profit Research Organisation, since 2002 - ARC Seibersdorf (now AIT) Spin-Off
- **7 Research Studios** in Salzburg, Linz, Wien and Eisenstadt
- RSA Studios work on Geo-Informatics, IoT- & Cloud-Infrastructures, Digital Knowledge Transfer, Augmented & Virtual Reality up to Big Data Analytics

RSA Studio SDIS::Topics

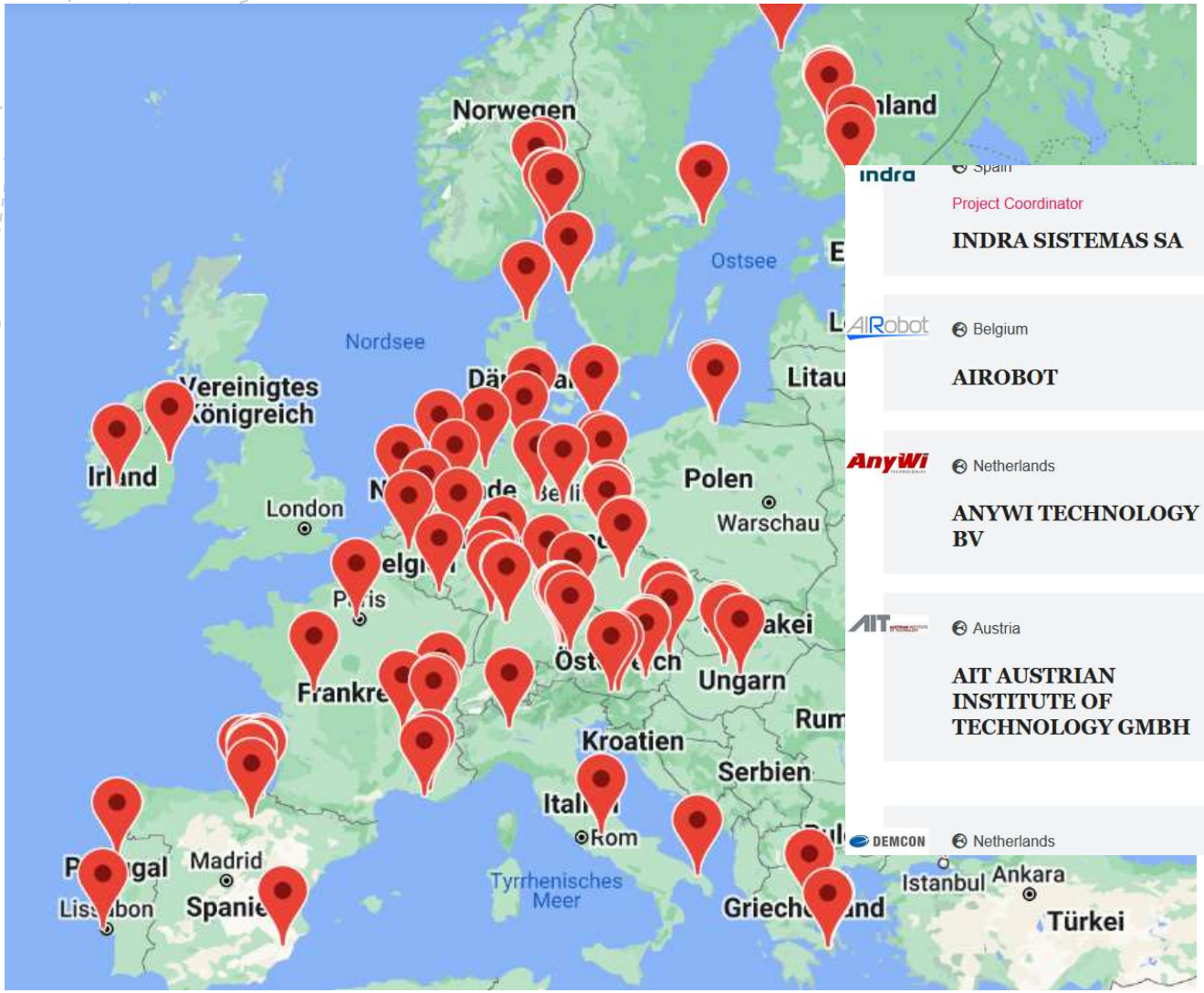
Digitalisation & Production, Industrial Production, Industry 4,0/5.0
AgriFood & Natural Resources
Data, IoT, Security



Comp4Drones

ECSEL Joint Undertaking
Electronic Components and Systems for European Leadership

This project has received funding from the ECSEL Joint Undertaking (JU) under grant agreement No 826610. The JU receives support from the European Union's Horizon 2020 research and innovation programme and Spain, Austria, Belgium, Czech Republic, France, Italy, Latvia, Netherlands.



Spain
Project Coordinator
INDRA SISTEMAS SA

Italy
ABINSULA SRL

Spain
ACORDE TECHNOLOGIES SA

Belgium
AIROBOT

Italy
AITEK SPA

Italy
AITRONIK SRL

Netherlands
ANYWI TECHNOLOGY BV

Netherlands
ALMENDE BV

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ATECHSYS ENGINEERING

Austria
AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH

France
Capgemini Engineering

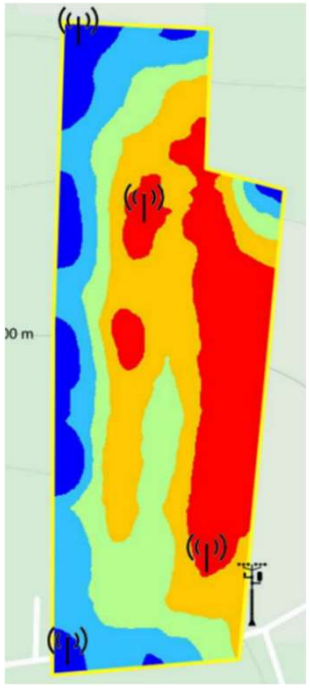
France
COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES

Netherlands

France

France

Mission Statement



Increasing challenges in food provision along with the need for environmental protection require a rethinking in the agricultural sector. **Digitalization** and automation approaches, such as **precision farming**, provide a promising approach to optimize resource usage and efficiency.

The provision of passive digital services for monitoring and managing **small scale farms** has the potential to reshape the sector, as it supports existing infrastructures and ecosystems **near the consumer** rather than introducing large scale automated agricultural systems which are more volatile to supply chain disruptions.

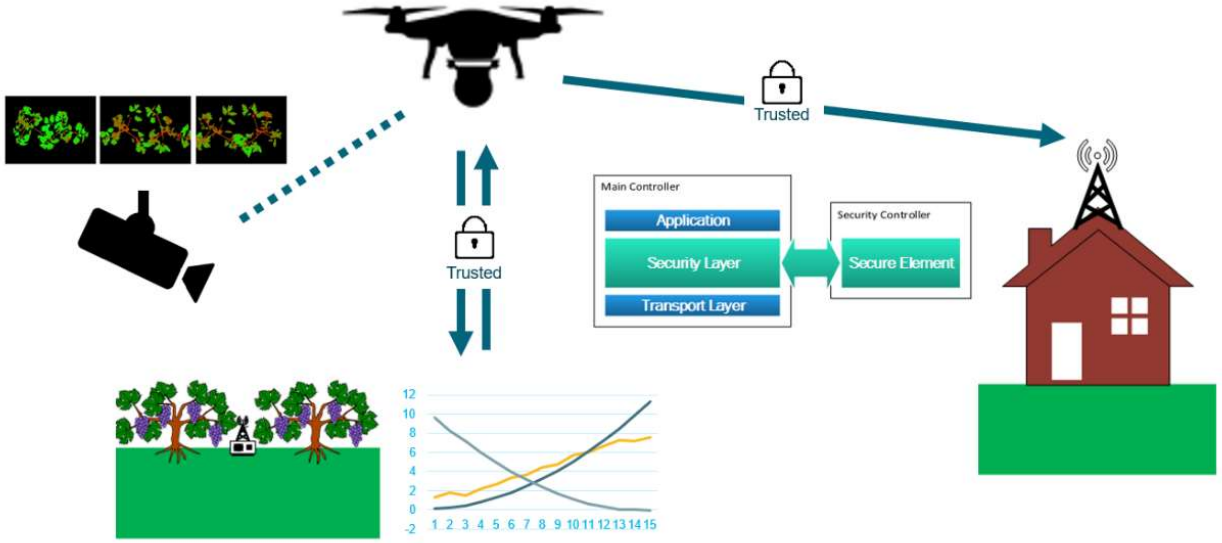
Climate change also contributes to more dynamic conditions at small scale, scattered and uneven farmland, resulting in non-homogeneous microclimate distributions.

This talk shows how such setups can be supported by digitalization and by using **monitoring as a service** – with a focus on **security**.

- Architecture

Demonstrator Comp4Drones

- Viticulture in a remote area with poor infrastructure
- Monitor condition of plants and soil
- Drone as a gateway and an earth-observation platform
- Mobile Sink



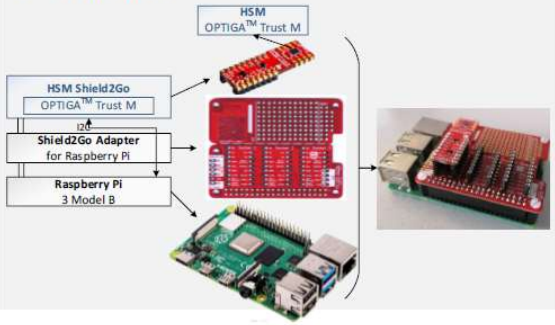
Stakeholder
Weinbau Martin Moravitz
Small Austrian SMEs Wine producer
Vineyards of about 6ha

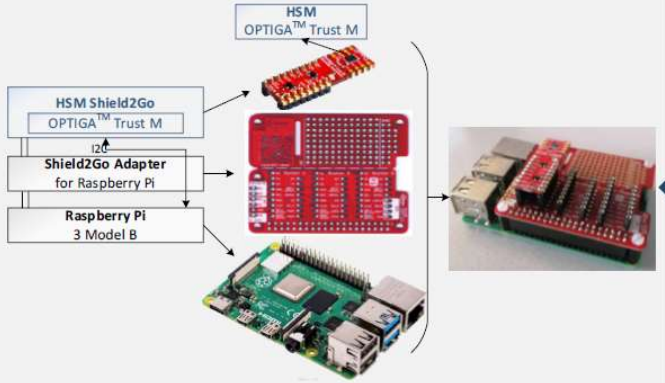
Demonstrator Setup

Sensor to Drone to Base Station Communication

Sensor (Client)	(Server) Drone (Client)	Base Station (Server)
› Variant A	› Raspberry Pi Model 3 B › Shield2Go Adapter for Raspberry Pi › OPTIGA™ Trust M Security Shield2Go	› PC or another Raspberry Pi

TLS

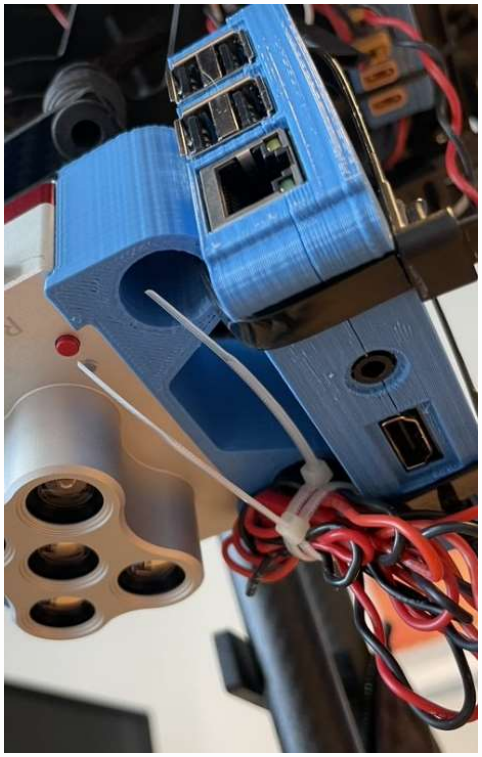




TLS

Sensor Integration

Land-bound sensor node

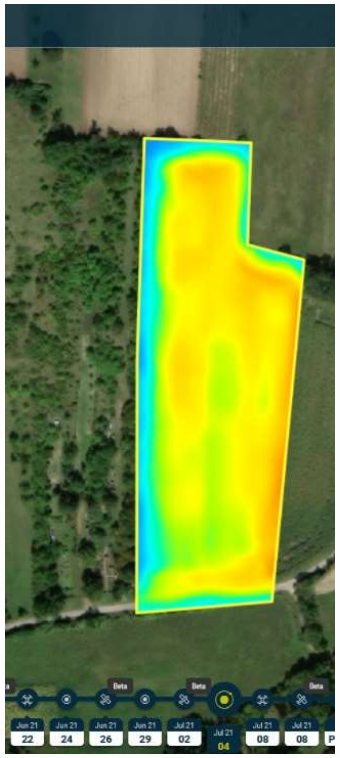


Drone Gateway 1

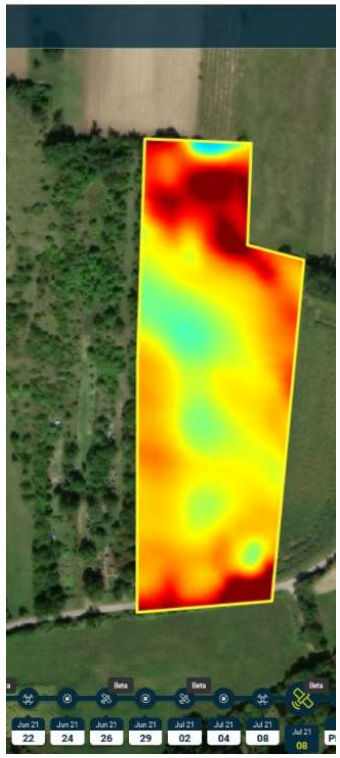
Drone Gateway 2

Field test

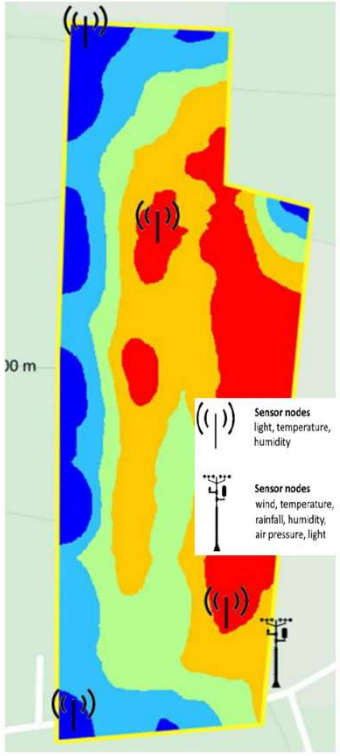
Data analysis – micro climate zones & MaaS



Multispectral Image – 2 months accumulated NDVI

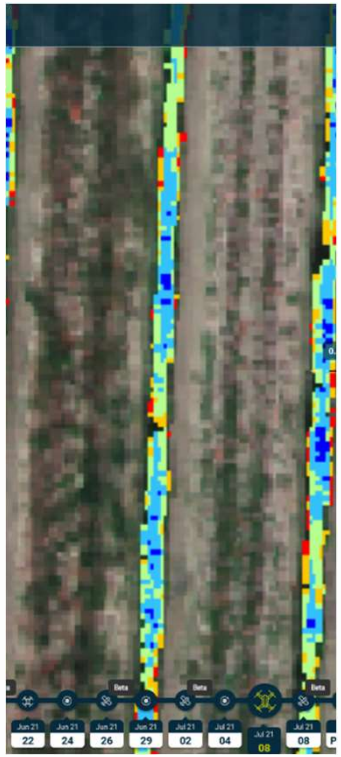


Radar Sensor – Vegetative Growth



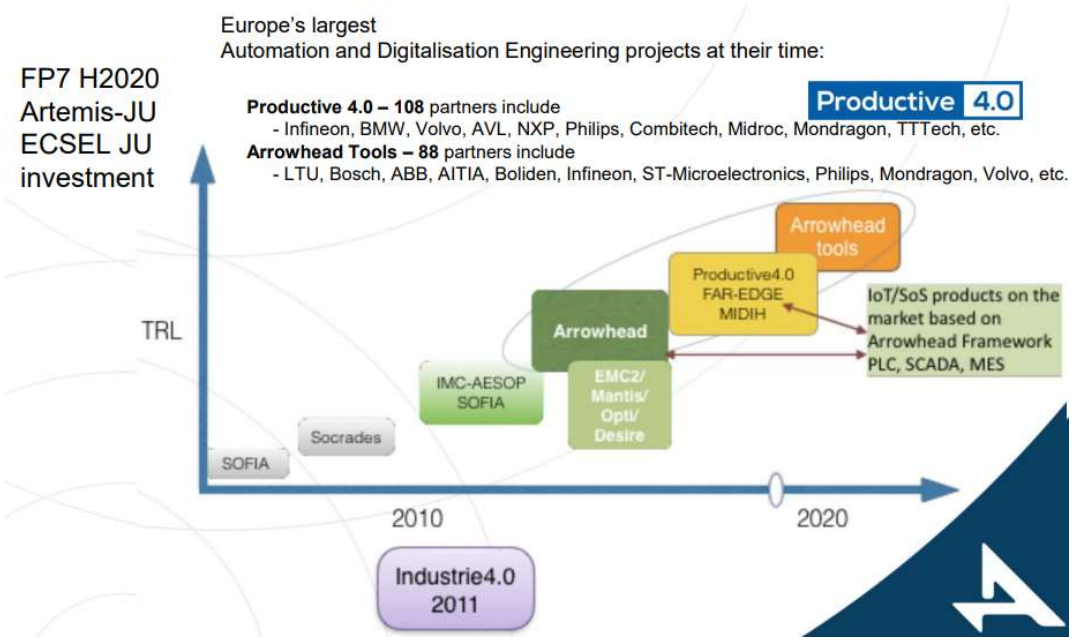
Sensor positions depending on water status

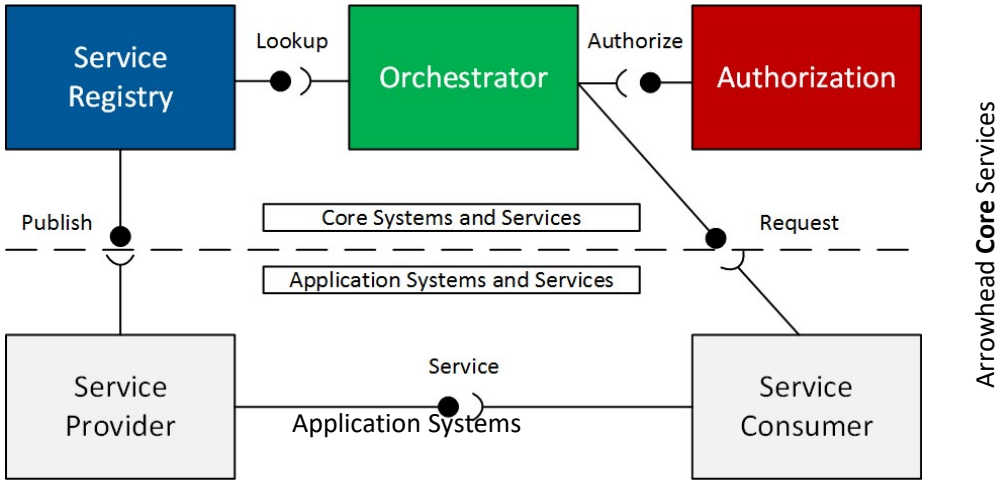
Multispectral Drone Sensor - Plant Cell Density



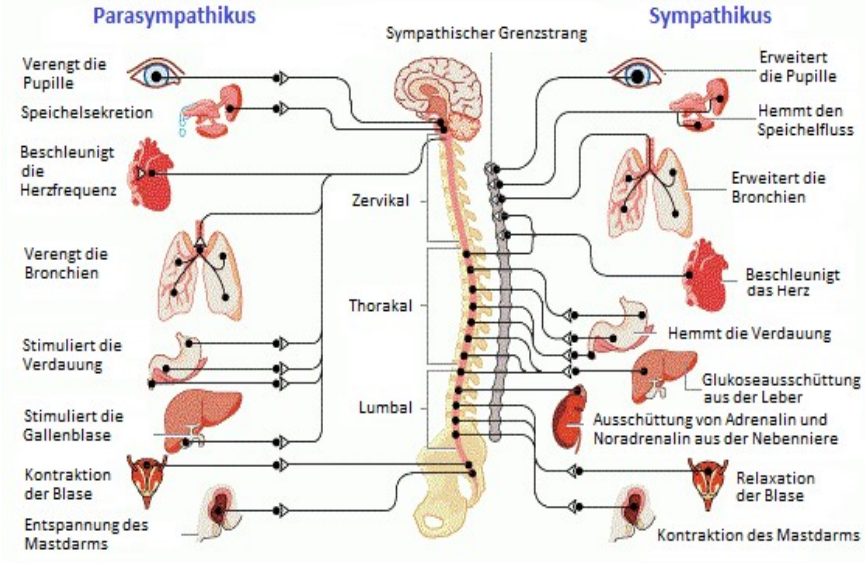
Data from each single plant


COMP4DRONES
Flexible Security
ARROWHEAD
TOOLS


Europe's largest
Automation and Digitalisation Engineering projects at their time:
FP7 H2020
Artemis-JU
ECSEL JU
investment
Productive 4.0
Productive 4.0 – 108 partners include
- Infineon, BMW, Volvo, AVL, NXP, Philips, Combitech, Midroc, Mondragon, TTTech, etc.
Arrowhead Tools – 88 partners include
- LTU, Bosch, ABB, AITIA, Boliden, Infineon, ST-Microelectronics, Philips, Mondragon, Volvo, etc.
Arrowhead tools
Productive4.0 FAR-EDGE MIDIH
IoT/SoS products on the market based on Arrowhead Framework PLC, SCADA, MES
Arrowhead
IMC-AESOP SOFIA
EMC2/ Mantis/ Opti/ Desire
Socrades
SOFIA
TRL
2010
2020
Industrie4.0 2011


Service Registry
Lookup
Orchestrator
Authorize
Authorization
Publish
Core Systems and Services
Request
Application Systems and Services
Service Provider
Service
Application Systems
Service Consumer
Arrowhead Core Services

Flexible Security: Autonomous Computing



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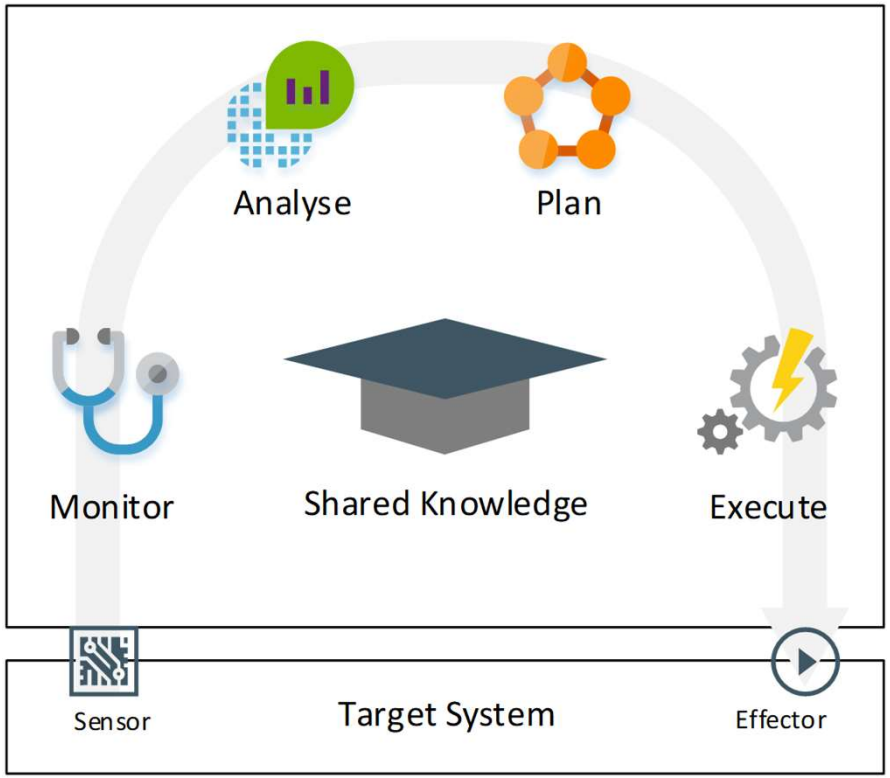
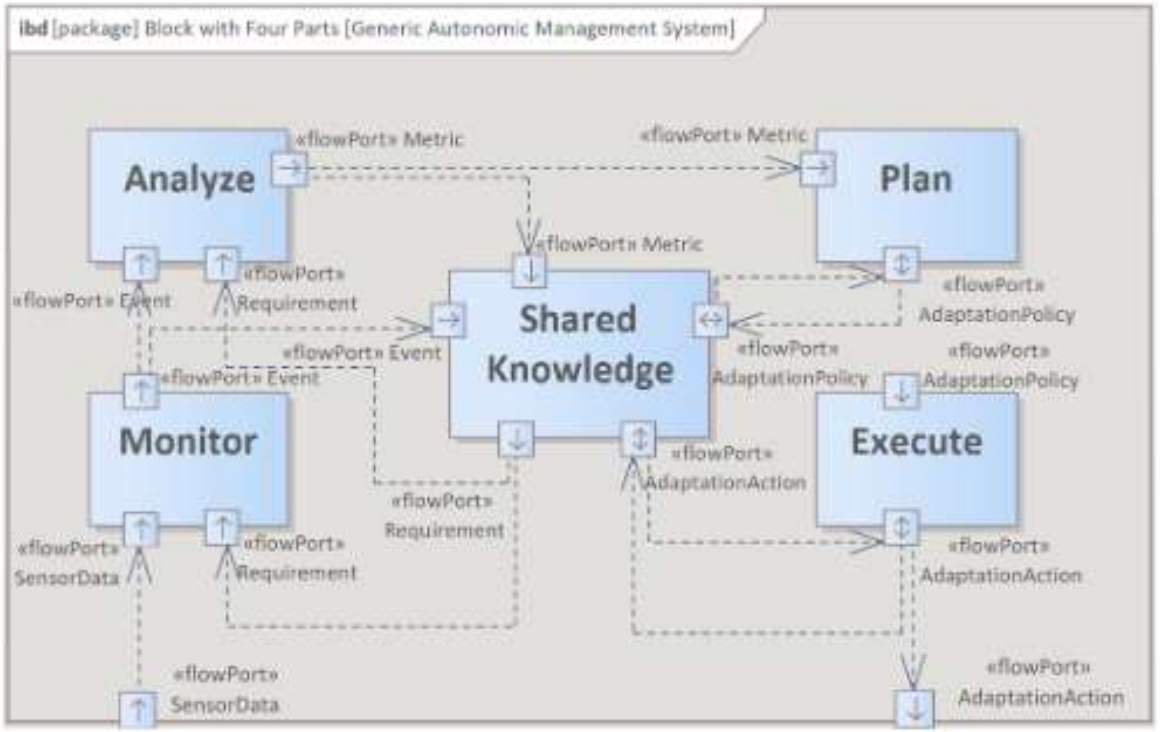
J. O. Kephart and D. M. Chess, "The vision of autonomic computing," in *Computer*, vol. 36, no. 1, pp. 41-50, Jan. 2003, doi: 10.1109/MC.2003.1160055.

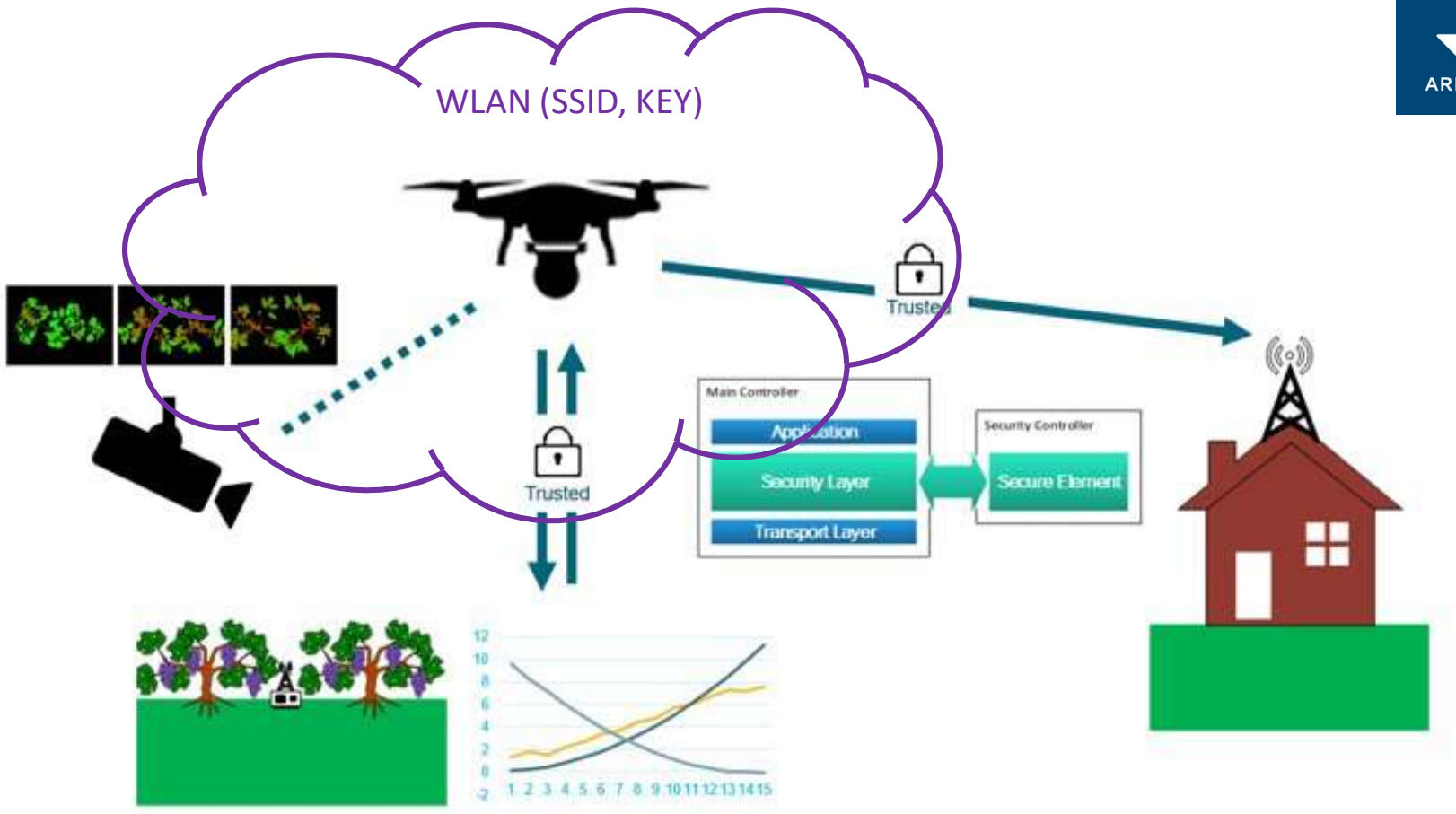
MAPE-K

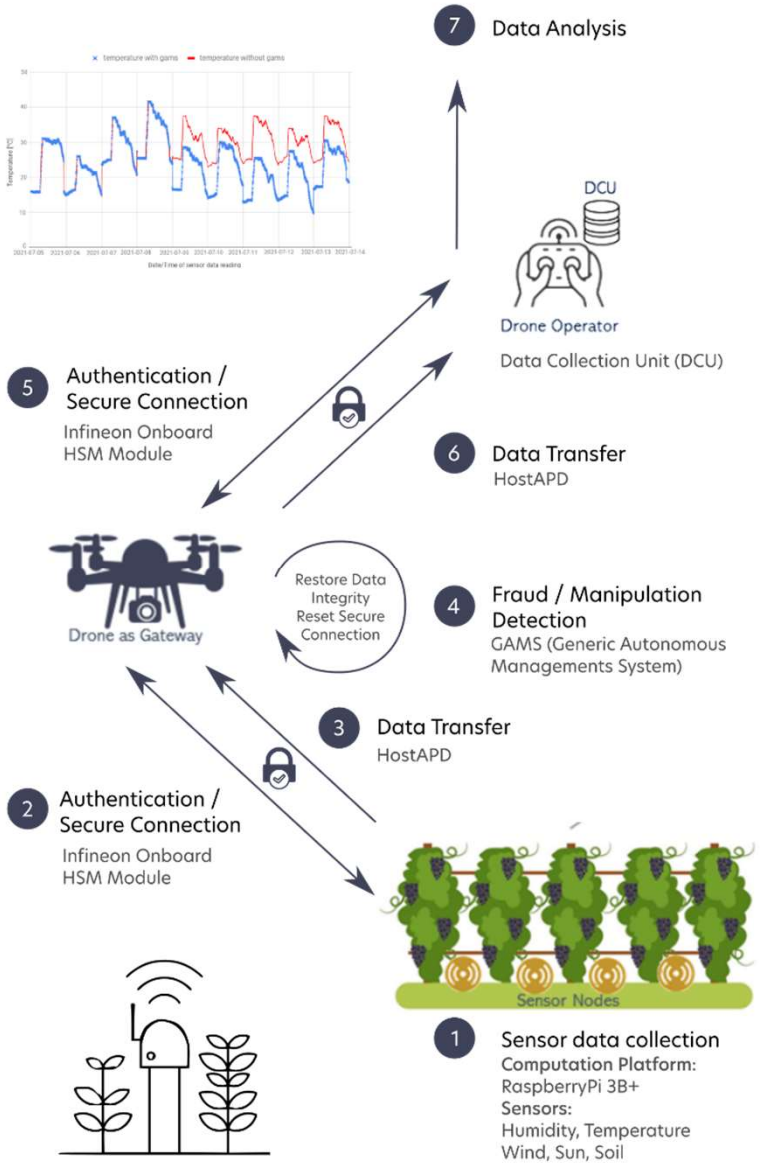
- Self-adaptation: runtime actions changing structure, functionality and/or parameters of a system, according to environment, user or self-sensing information.
- Self-adaptation is based on autonomic management approach
- Autonomic management approach is based on a feed-back autonomic control loop (FCL) consisting of four phases, also known as MAPE-K



MAPE-K @ Arrowhead




WLAN (SSID, KEY)
Trusted
Trusted
Main Controller
Application
Security Layer
Transport Layer
Security Controller
Secure Element


7 Data Analysis
DCU
Drone Operator
Data Collection Unit (DCU)
5 Authentication / Secure Connection
Infineon Onboard HSM Module
6 Data Transfer
HostAPD
Drone as Gateway
Restore Data Integrity Reset Secure Connection
4 Fraud / Manipulation Detection
GAMS (Generic Autonomous Managements System)
3 Data Transfer
HostAPD
2 Authentication / Secure Connection
Infineon Onboard HSM Module
Sensor Nodes
1 Sensor data collection
Computation Platform:
RaspberryPi 3B+
Sensors:
Humidity, Temperature
Wind, Sun, Soil

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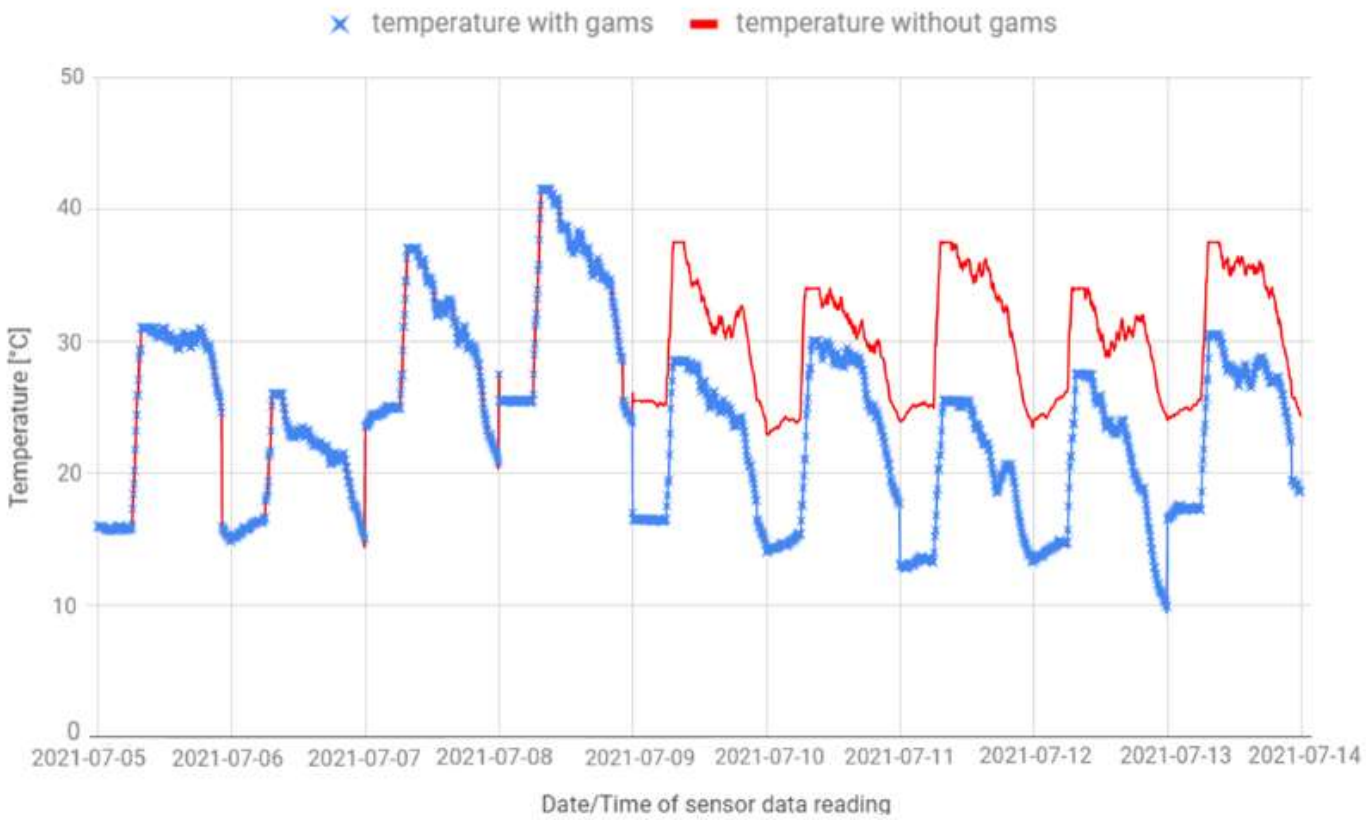
Result – impact on detected malicious nodes



Output

- S. Maksuti, M. Zsilak, M. Tauber and J. Delsing, "Security and Autonomic Management in System of Systems", Infocommunications Journal, Vol. XIII, No 3, September 2021, p. 66-75., DOI: 10.36244/ICJ.2021.3.7
- S. Maksuti, A. Bicaku, M. Zsilak, I. Ivkic, B. Péceli, G. Singler, K. Kovács, M. Tauber, J. Delsing "Automated and Secure Onboarding for System of Systems," in IEEE Access, vol. 9, pp. 111095-111113, 2021, doi: 10.1109/ACCESS.2021.3102280
- S. Maksuti, A. Bicaku, M. Zsilak, I. Ivkic, B. Péceli, G. Singler, K. Kovács, M. Tauber, J. Delsing "Automated and Secure Onboarding for System of Systems," in IEEE Access, vol. 9, pp. 111095-111113, 2021, doi: 10.1109/ACCESS.2021.3102280
- …

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Further Engagement

- http://mfi50.icb.at
- Dissertation
- Jobs
- …

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4th Workshop on Management for Industry 5.0 – MFI5.0

@

IEEE/IFIP Network Operations and Management 2023 Symposium

8-12 May 2023 | Miami, FL, USA

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IMPORTANT DATES:

Submission deadline:
Jan. 15th, 2023

Author notification:
March. 1st, 2023

Final submission:
March. 10th, 2023

DESCRIPTION

The transition from ISA-95 to RAMI4.0/IIRA based automation for production automation in Industry 4.0 is ongoing. This includes the integration of legacy OT with emerging IT technologies. Another aspect is automation/digitalization across value networks involving a multitude of stakeholders in complex relationships. This organically leads to the consideration of multiple factors, firstly the human in the loop i.e. industry 5.0, and therefore dependencies like privacy, security and connectivity. Consequently, Management for Industry 5.0 covers three thematic themes: (1) connectivity, infrastructure, and security, (2) cyber-physical systems/system-of-systems, and (3) the human in the loop.

The recent developments of communications technology show a strong involvement of wireless communications even on the factory floor. This brings new requirements to integrate wireless and cellular technology, in particular 5G/6G and their resilience, into both OT and IT communication. Moreover, these technologies open a new class of management with more flexibility and challenge traditional industrial communication concepts including security aspects. Consequently, other fields like agriculture or logistics can benefit from the same strategies applied to industry 5.0 if not already seen as part of I5.0. Requirements such as privacy, dependability, or trustworthiness are key enablers of service- and data-driven automation, also and to some extent specifically in other production domains which facilitate electronic components and systems e.g. digitalization in production of food.

The consideration of previous mentioned aspects allows the formation of large to very large Systems of Systems (SoS). Such SoS will involve technologies like e.g. IoT, AI, Analytics, Big data and legacy technology. All in all, aiming for efficient production of products or services. Architectures like RAMI4.0 and IIRA have been presented but are still in early stages. Implementation platforms and frameworks are as well in early stages. Even less maturity is seen regarding engineering and management of such complex automation and digitalization solutions, which consider dependencies across all levels of abstraction for automatically or autonomically control digitalized production infrastructures. Autonomous decisions require trustworthy and reliable data, operations, and decisions. However, trust related to e.g., industrial AI may mean different things depending on the type of stakeholder it concerns and will also require the consideration of management and organizational aspects.

Finally, the inclusion of human actors in complex production contexts is crucial for the success and impact of these production systems in the real world. Trust in autonomous systems, acceptance of human-robot collaboration, competence development, training and knowledge management are among the challenges that Management for Industry 5.0 is facing. This includes explainable AI in production contexts and workplace integrated learning in the smart factory.

FOCUS ON:

The workshop will focus on several core engineering and management issues, focus topics are:

- Migration Management
- Operational Management
- Security Management
- Deployment Management
- Management of Networked Components in Industry 4.0/5.0 scenarios
- Transition of I4.0 to I5.0
- Automation evolution Management and Engineering
- Product Life Cycle Management
- Product Planning Management
- Manufacturing Change Management
- Manufacturing Process Management
- Manufacturing Operations Management
- Management of Digital Twins
- Cyber Physical System of Systems

Additional topics may be considered given adequate proposal, therefore.