

Technical Paper

The Multi-Sensor Gateway

A unified communication scheme and orchestration actor for heterogeneous systems

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Abinsula Srl, Sassari, Italy

Context

Context

Connected world



Smart homes

Context

Connected world



Smart homes



Garden planners

Context

Connected world



Smart homes



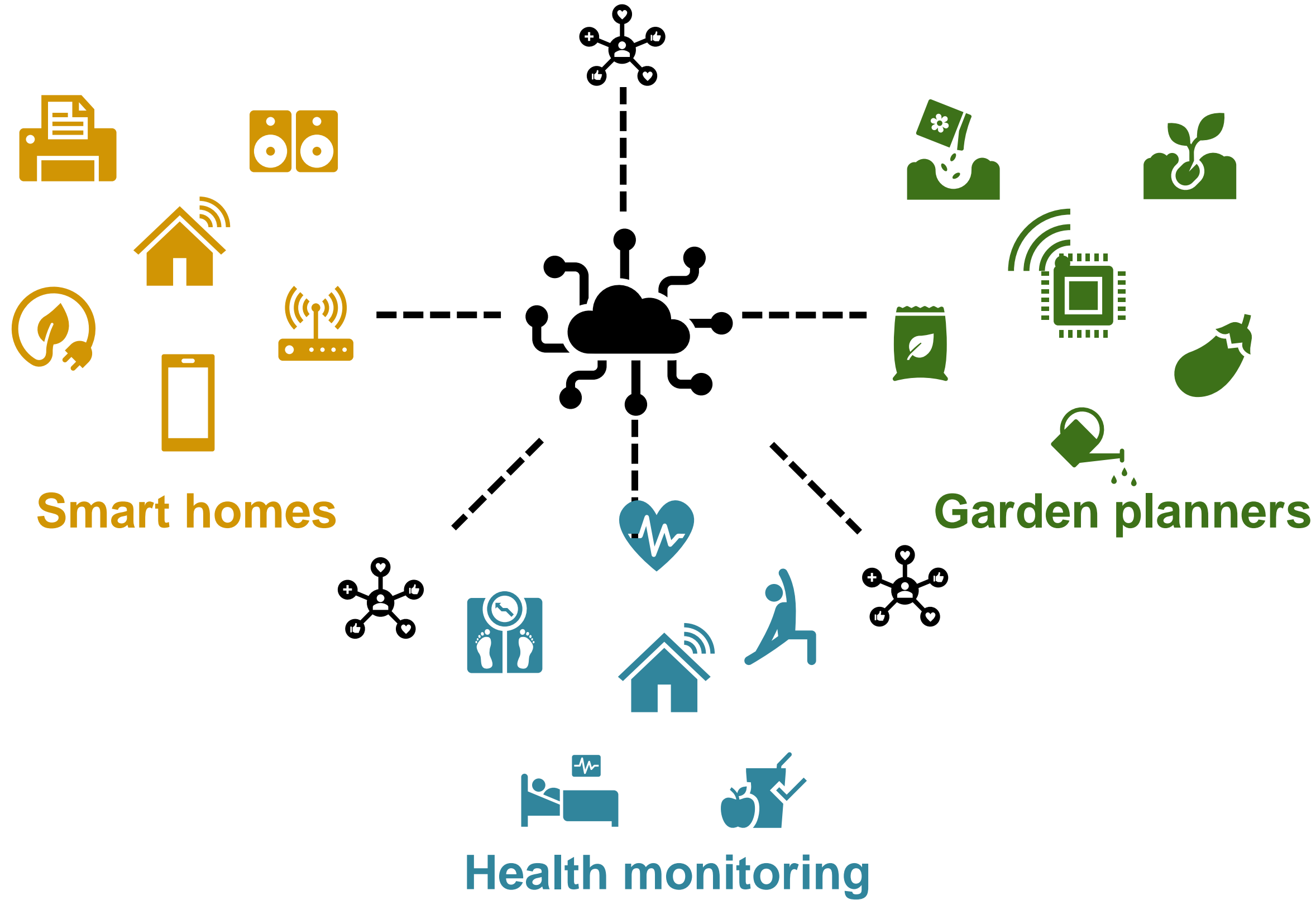
Garden planners



Health monitoring

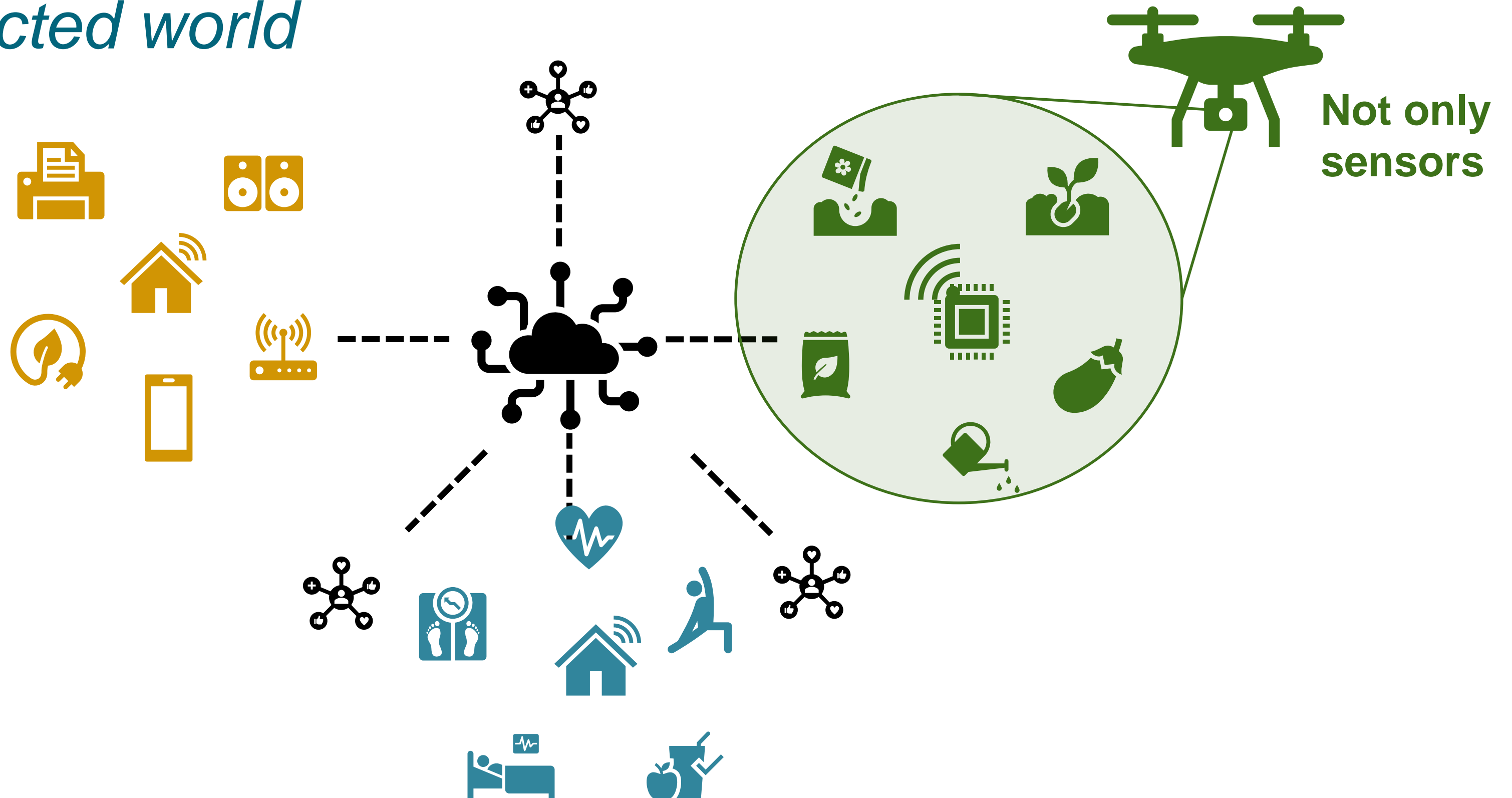
Context

Connected world



Context

Connected world



Multi-Sensor Gateway

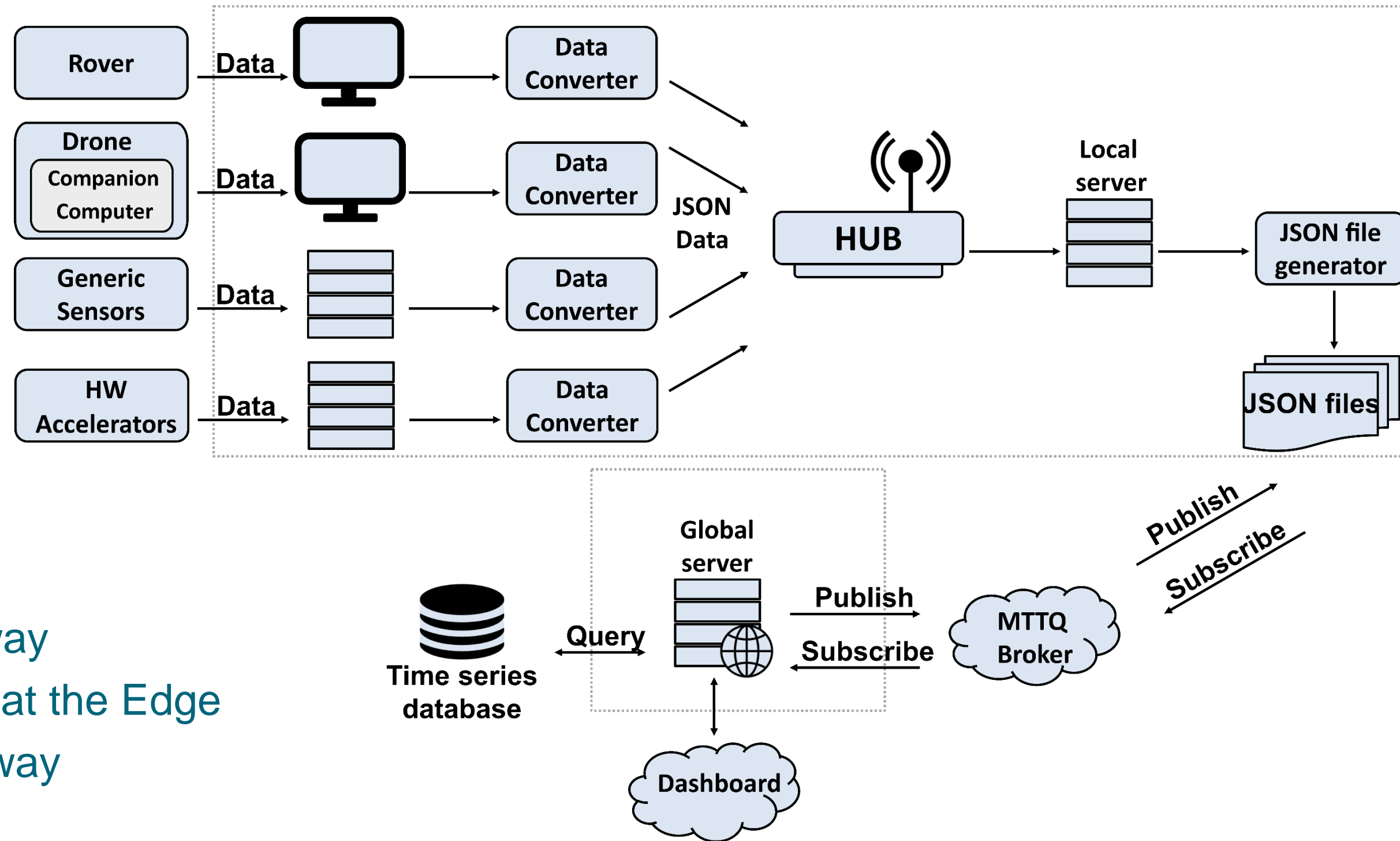
The Multi-Sensor Gateway

Overview

- The Multi-Sensor Gateway is based on the Abinsula Embedded Linux Distribution (Ability).
 - Open-source based
 - No vendor lock-in
 - Generic and modular component
 - Main communication protocols
 - User-defined interfaces.

The Multi-Sensor Gateway

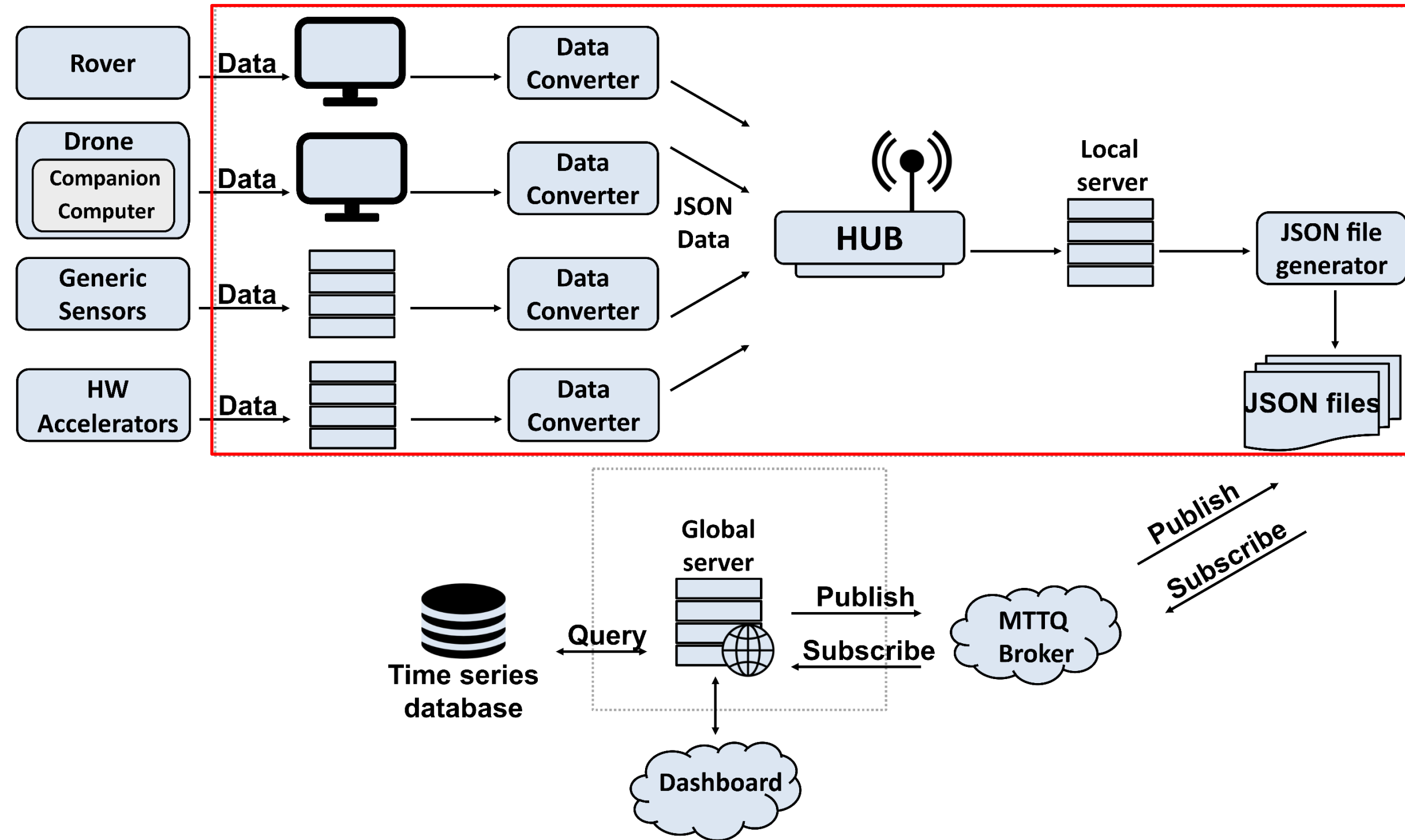
Overview



- It includes:
 - Edge gateway
 - Processing at the Edge
 - Cloud gateway

The Multi-Sensor Gateway

Edge gateway



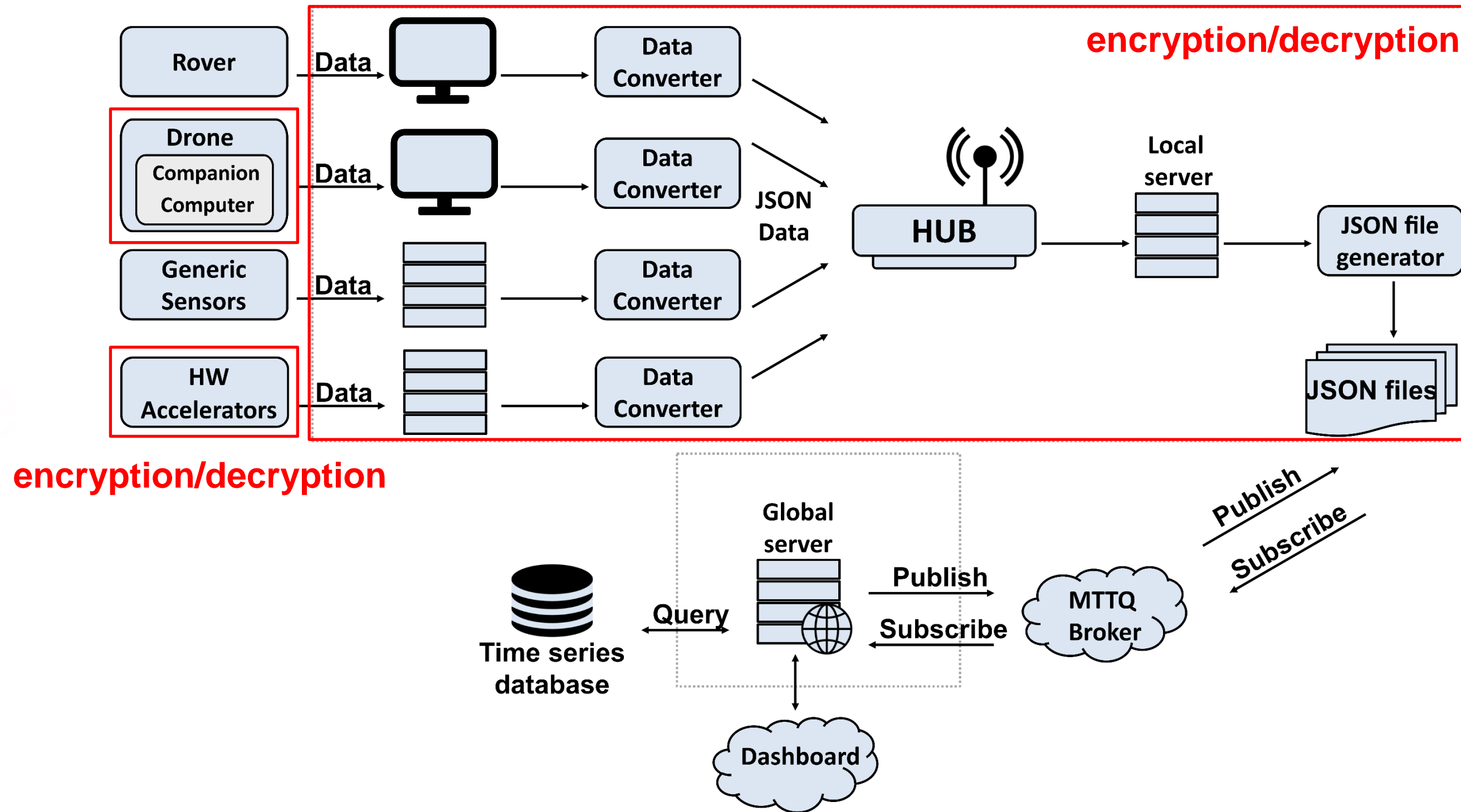
The Multi-Sensor Gateway

Edge gateway

Edge gateway communication	
Inputs	
From system elements	User-specific interface
From cloud gateway	JSON data
Outputs	
To system elements	User-specific interface
To cloud gateway	JSON data
Communication Protocol	
With system elements	User specified (REST, MQTT, UDP, TCP, GraphQL...)
With cloud gateway	MQTT
Physical layer protocols	
The ethernet is the only one currently needed, but it can be extended to support other different physical layer protocols i.e. Zigbee, ZWave, WiMAX LoRaWAN.	

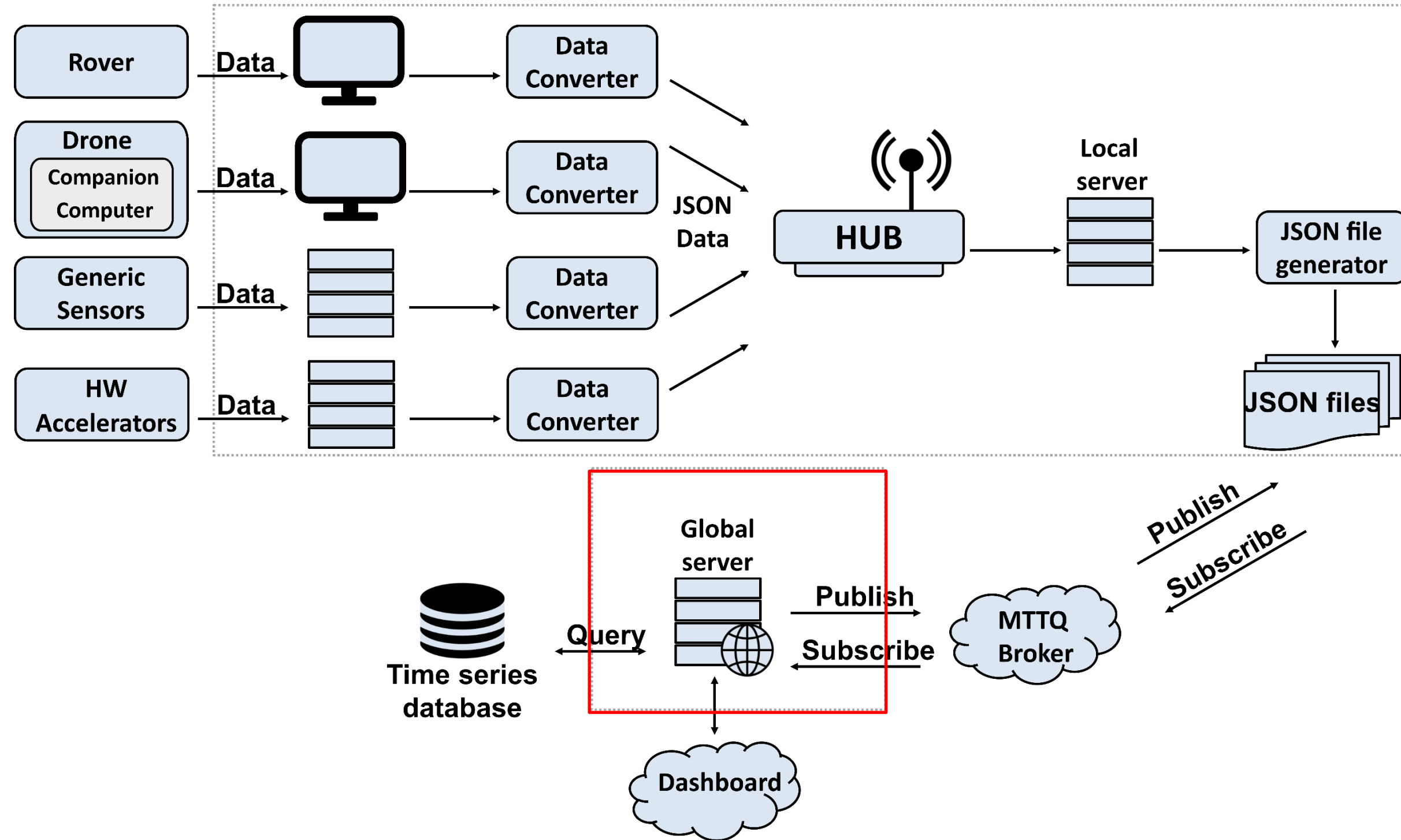
The Multi-Sensor Gateway

Processing at the Edge



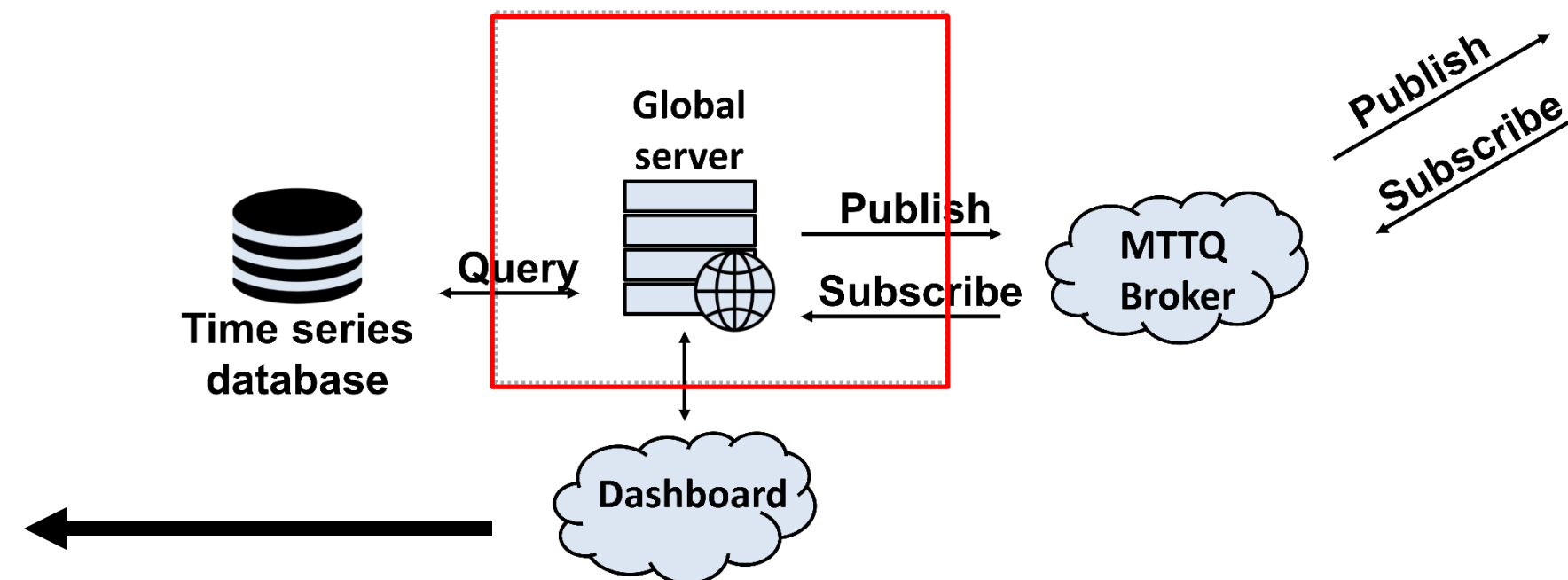
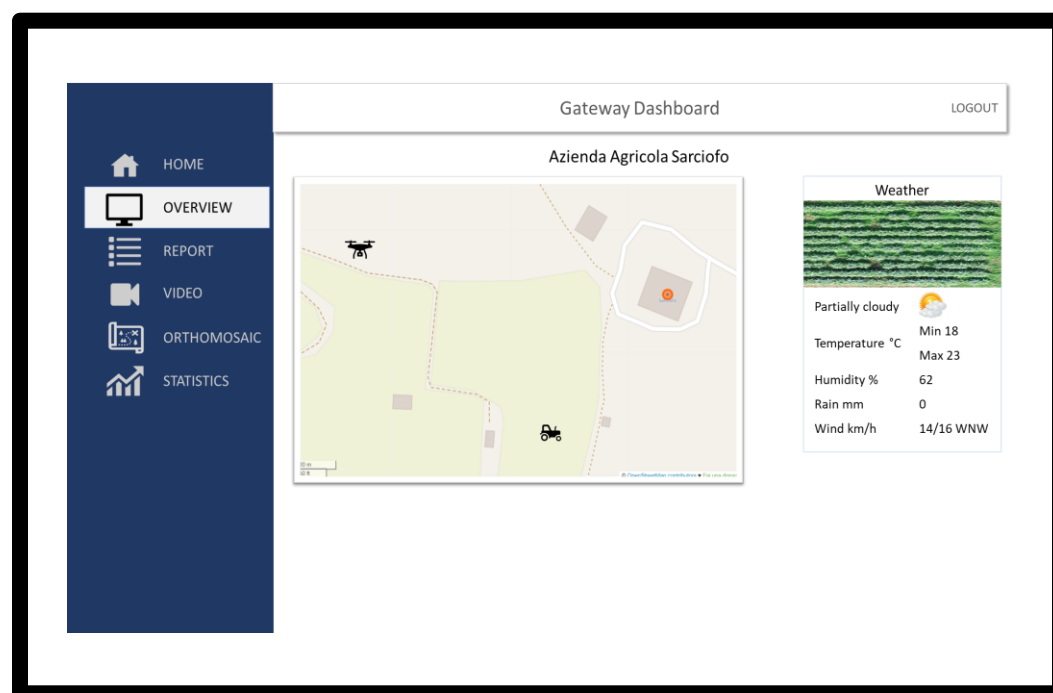
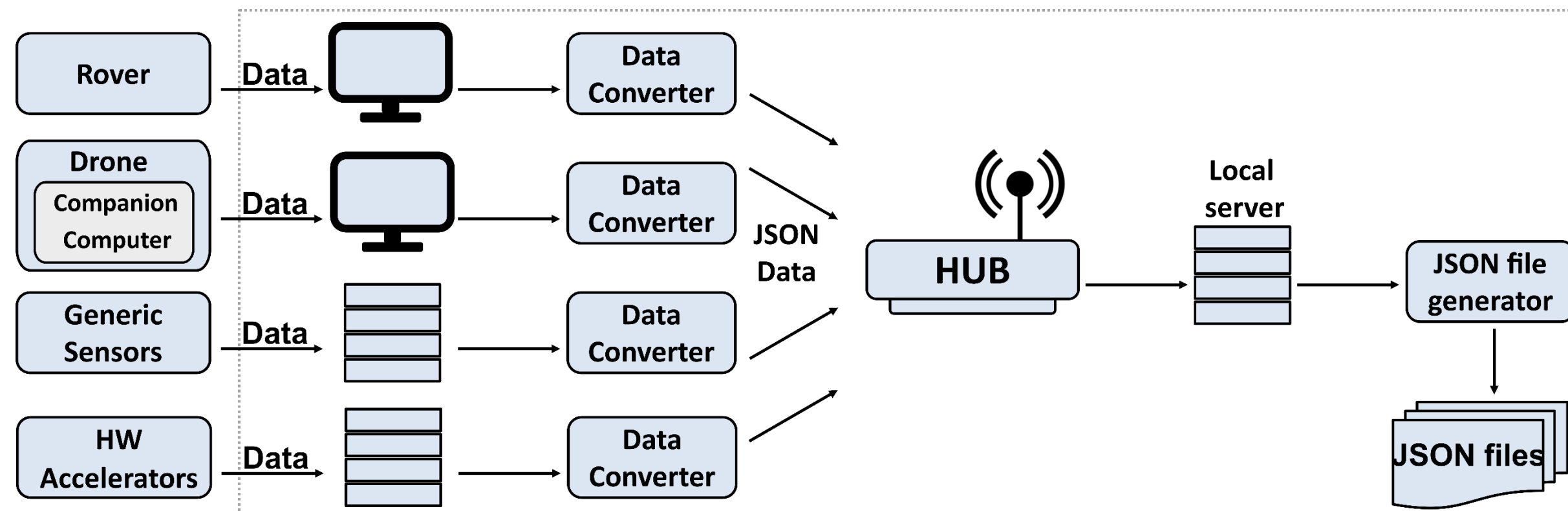
The Multi-Sensor Gateway

Cloud Gateway



The Multi-Sensor Gateway

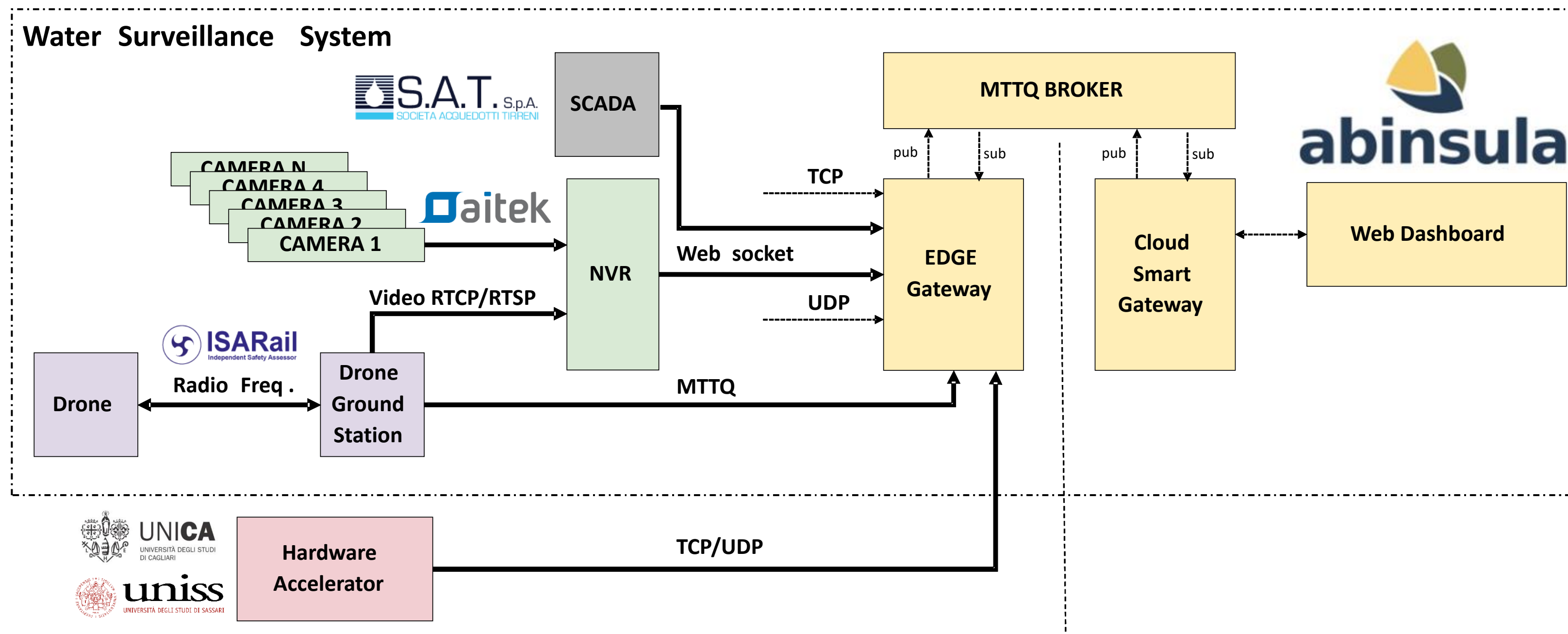
Cloud Gateway



Runtime
support

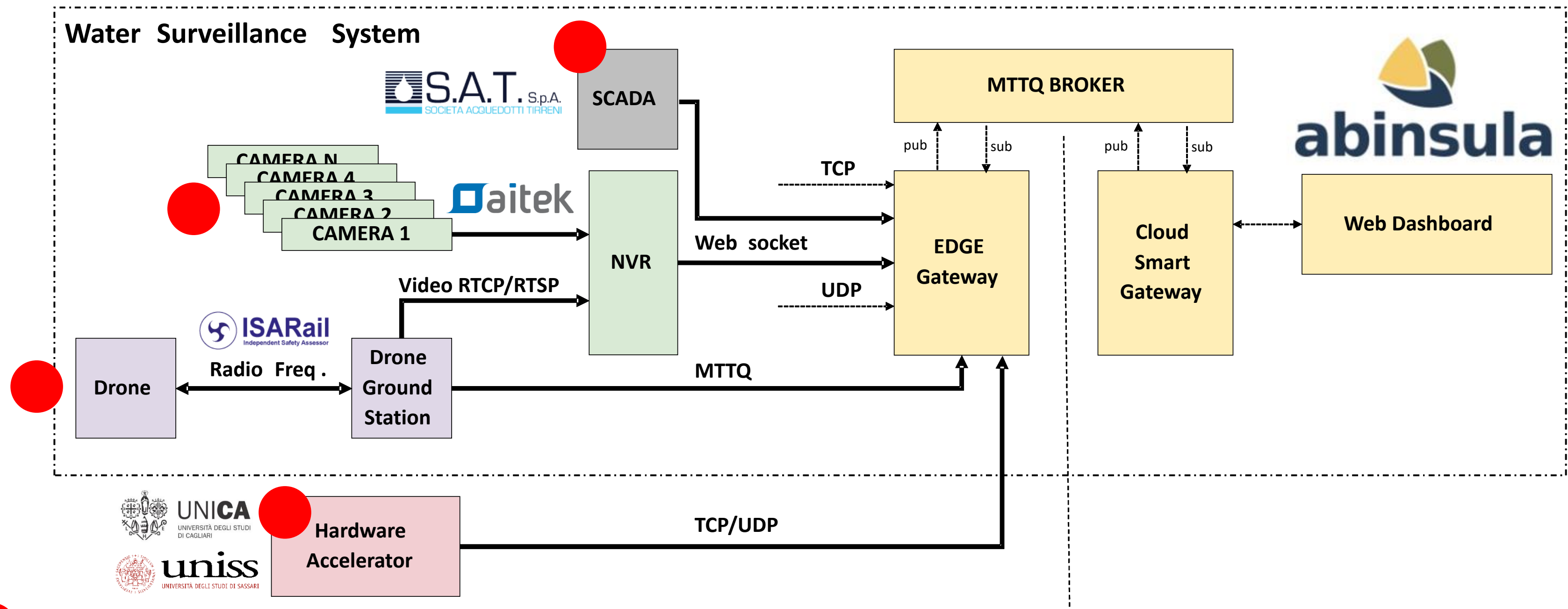
Runtime support

Water Supply Surveillance in FitOptiVis






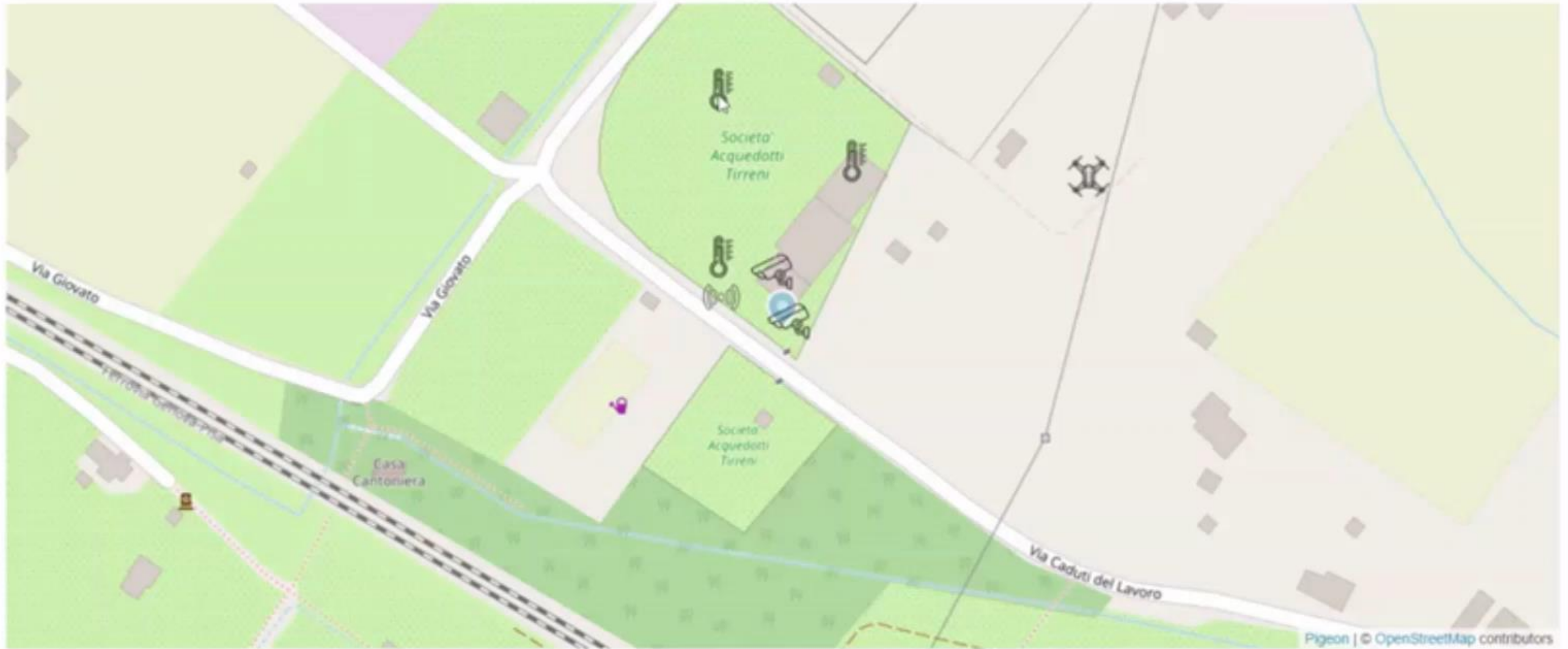
Runtime support

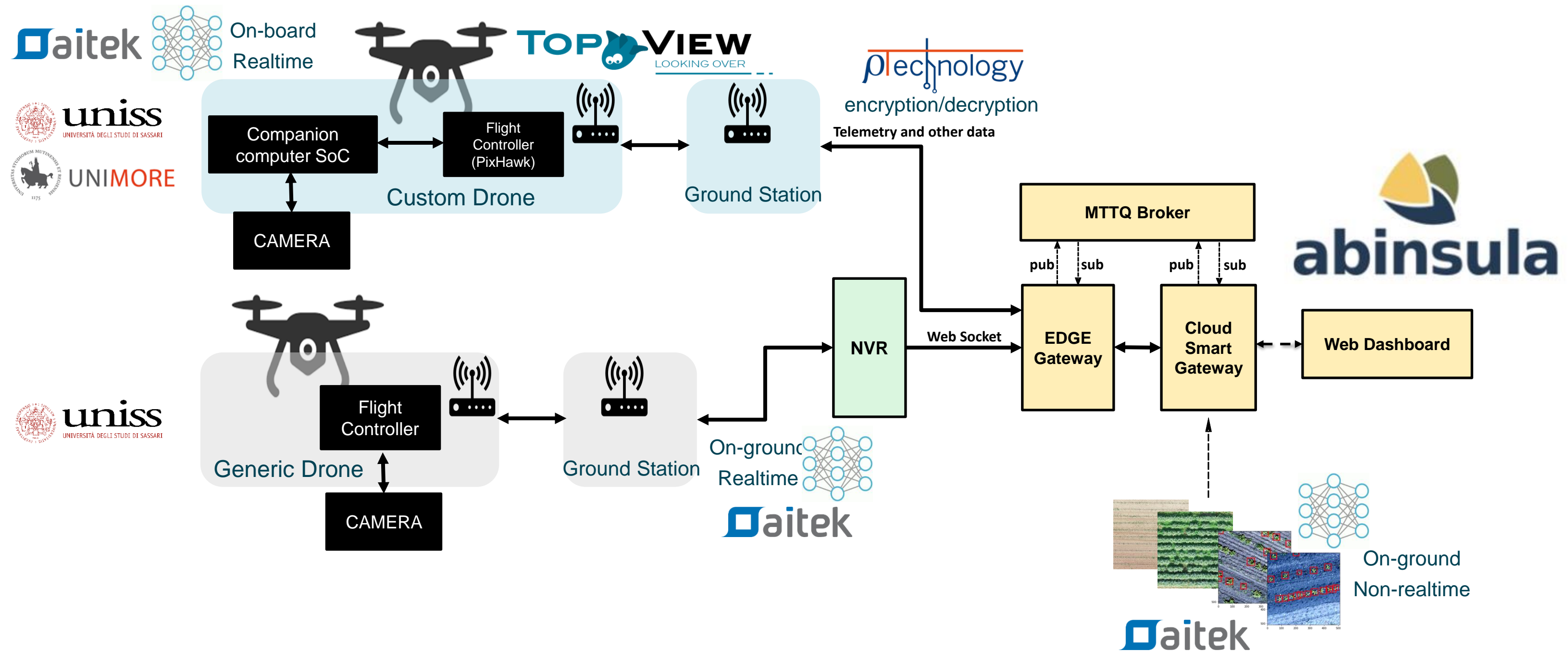
Water Supply Surveillance in FitOptiVis



● Multiple heterogeneous data sources

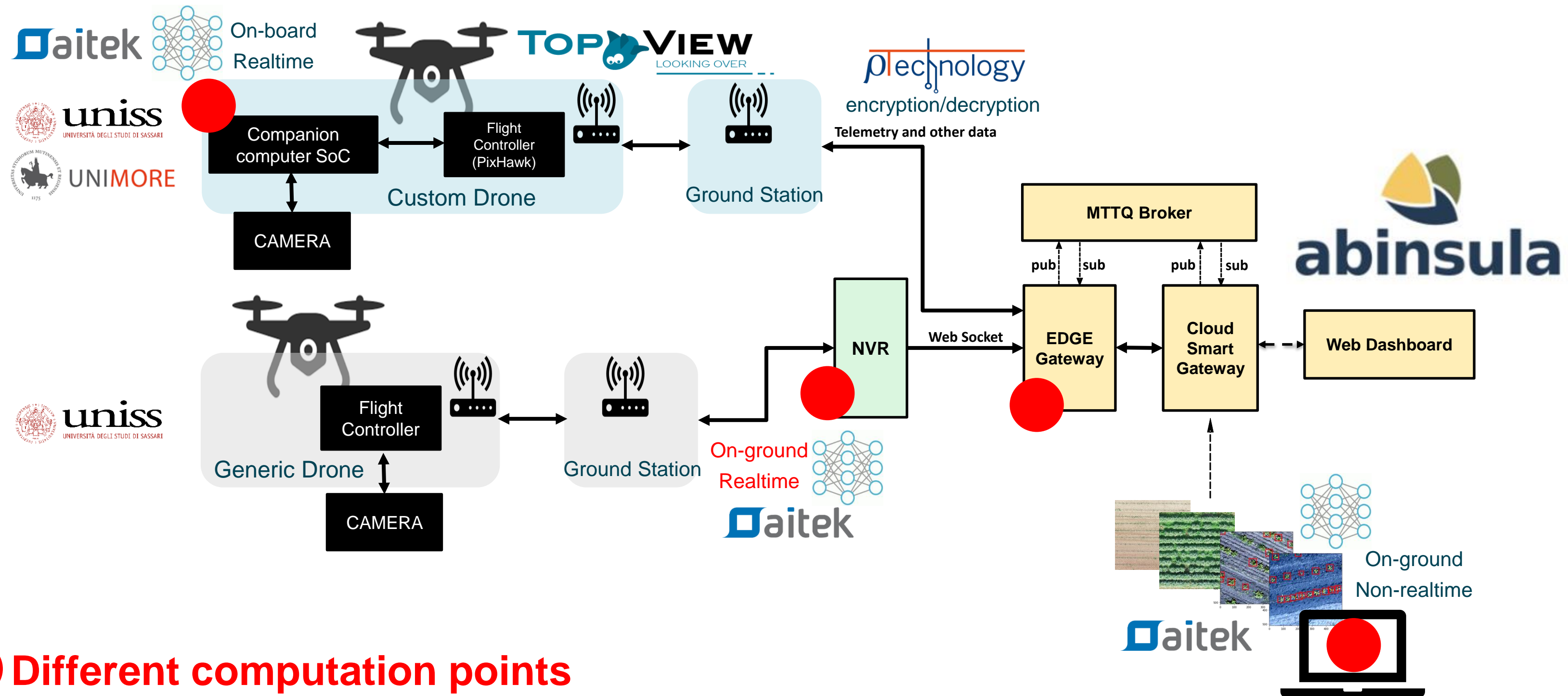
-  **Maps**
-  Settings
-  Video
-  Report
-  Events
-  Statistics





Runtime support

Precision Agriculture in Comp4Drones

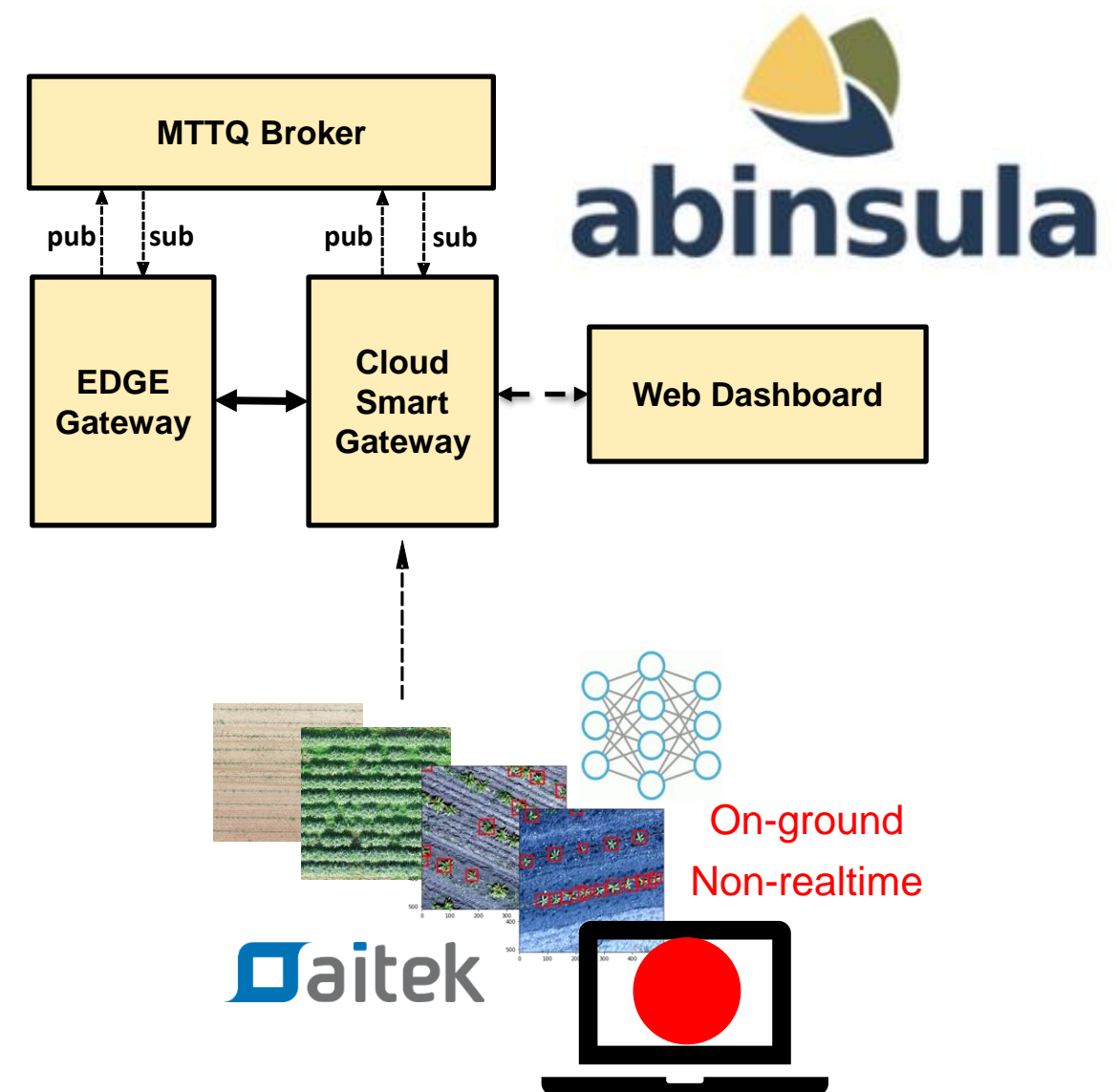
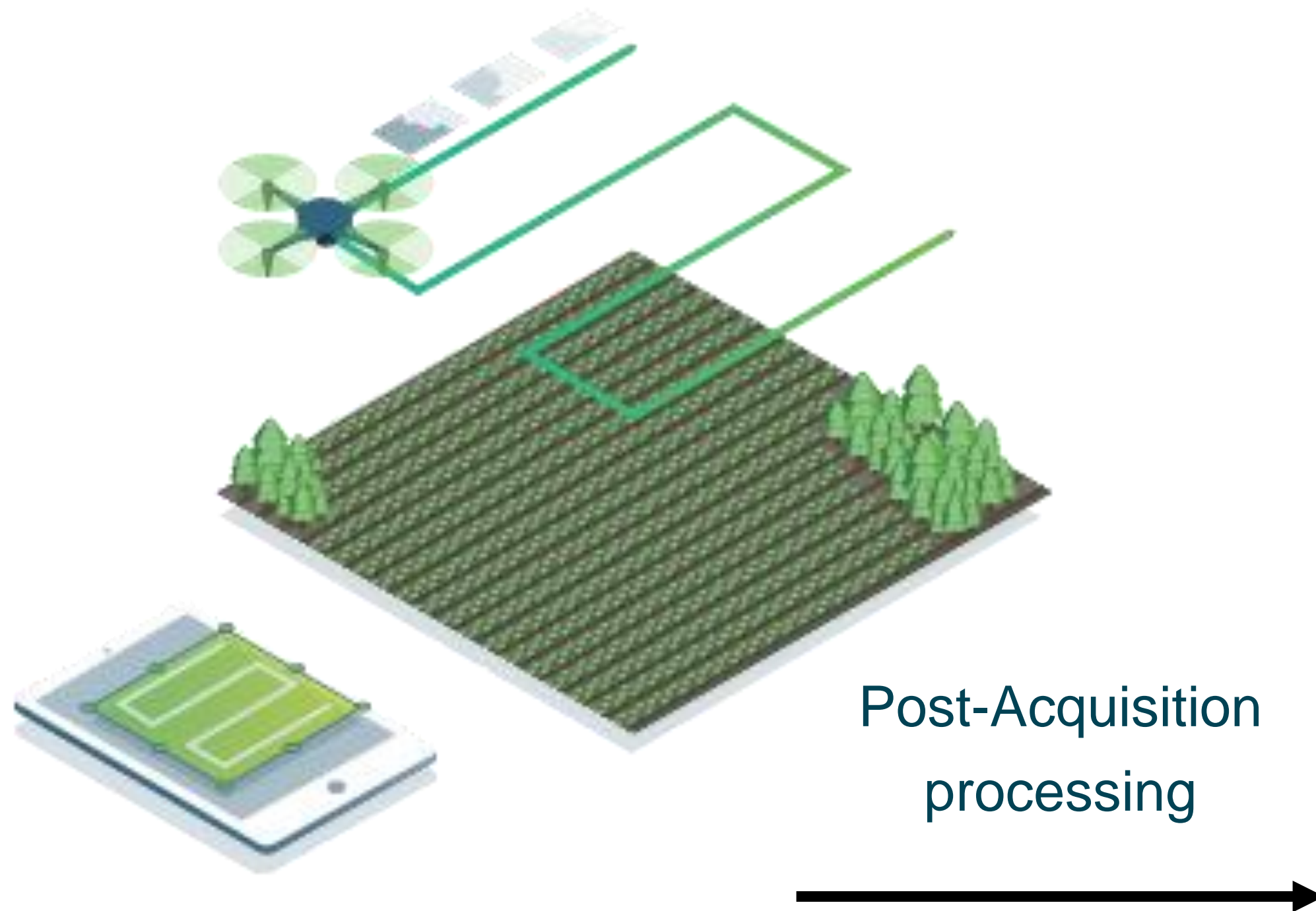


● Different computation points


Runtime support

Precision Agriculture in Comp4Drones


On-ground
Non-realtime




Runtime su Precision Agricoltura




HOME




OVERVIEW




REPORT



VIDEO



ORTHOMOSAIC



STATISTICS

Gateway Dashboard

LOGOUT

Azienda Agricola Sarciofo

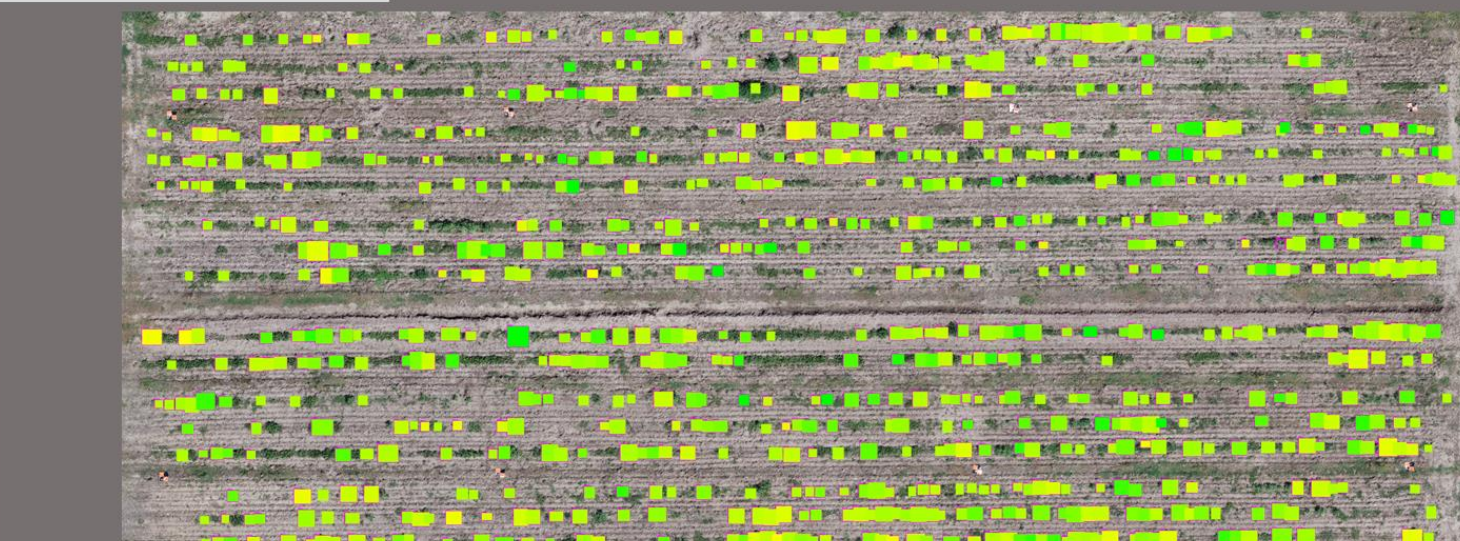
Detection

Heath Map

14 October 2021


Zoom

100%







On-ground
Non-realtime




HOME




OVERVIEW




REPORT



VIDEO



ORTHOMOSAIC



STATISTICS

Gateway Dashboard

LOGOUT

Azienda Agricola Sarciofo

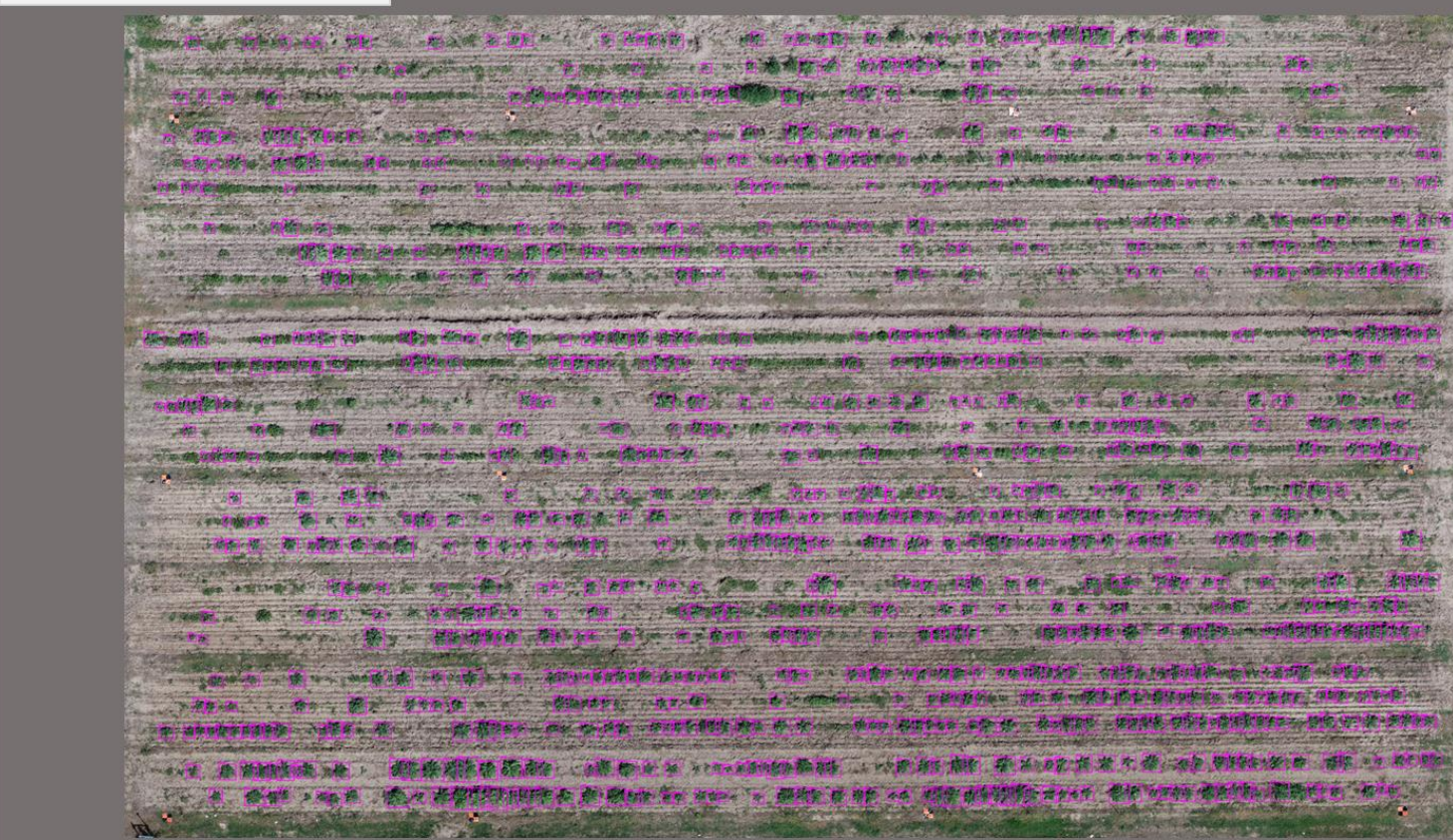
Detection

Heath Map

14 October 2021

Zoom

100%



Gateway Dashboard

LOGOUT

Azienda Agricola Sarciofo

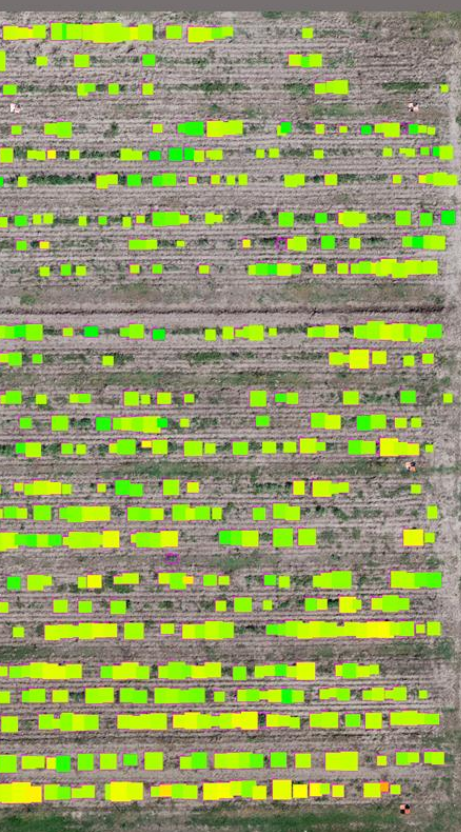
Detection

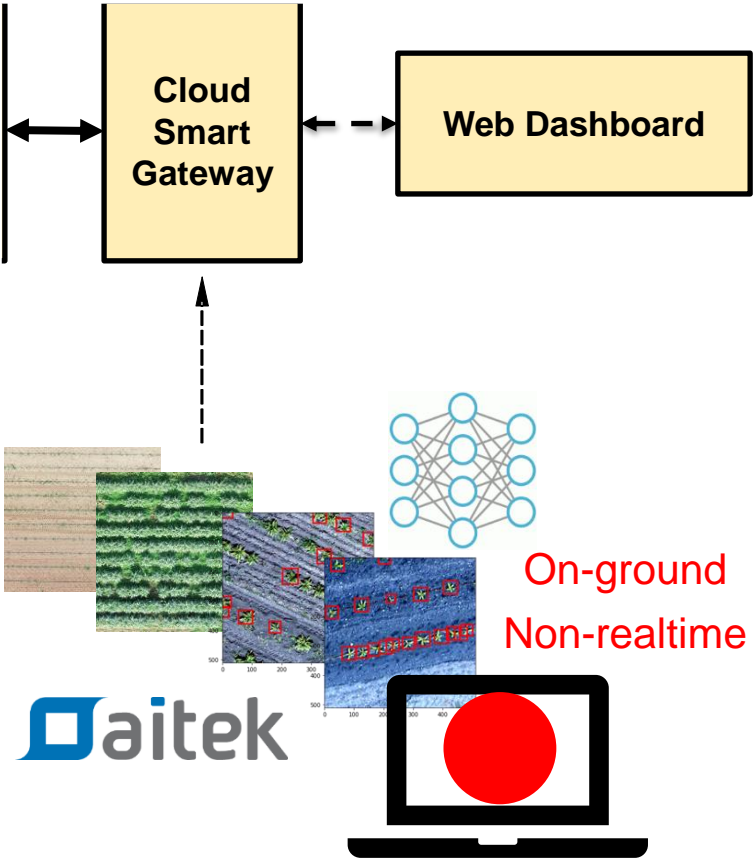
Heath Map

14 October 2021

Zoom

100%

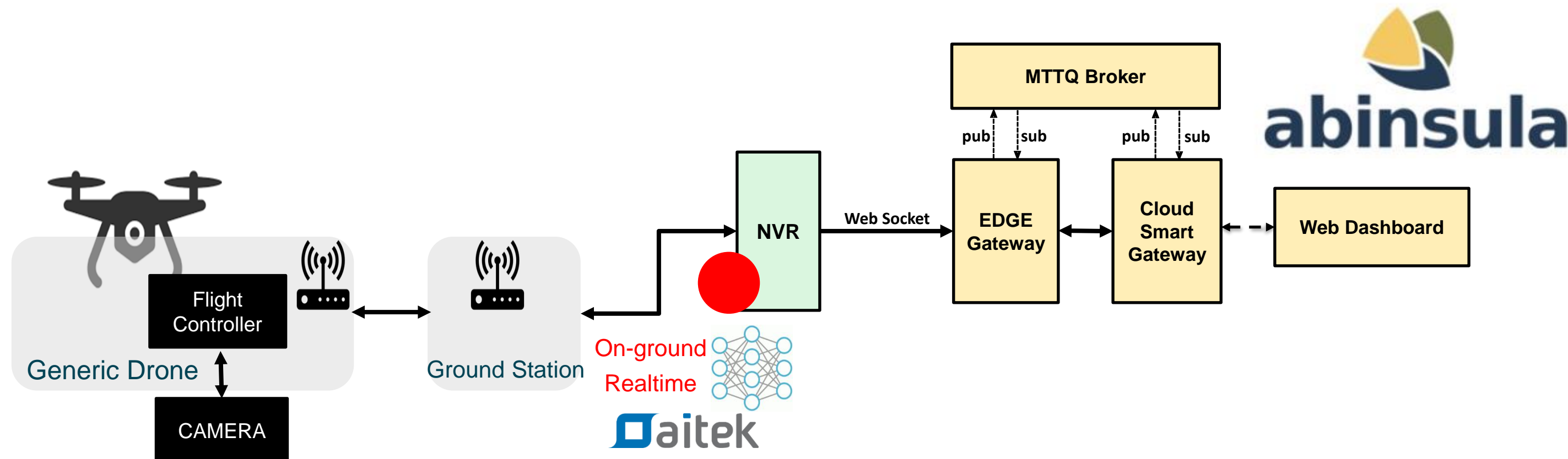




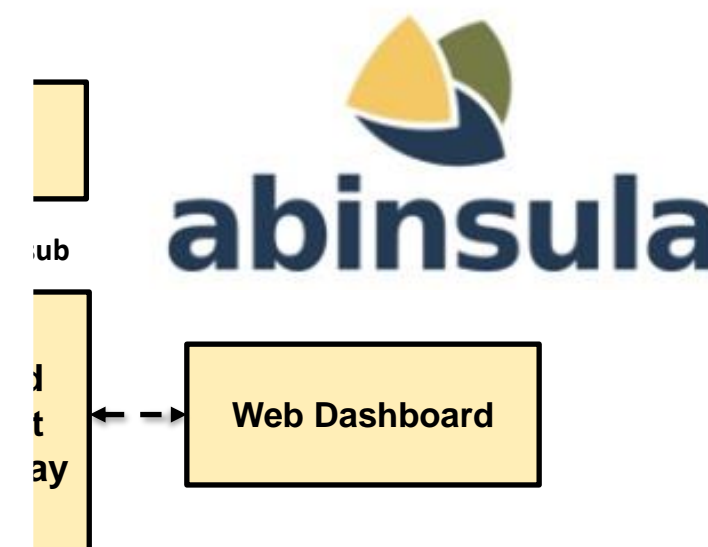
Runtime support

Precision Agriculture in Comp4Drones

On-ground
Realtime



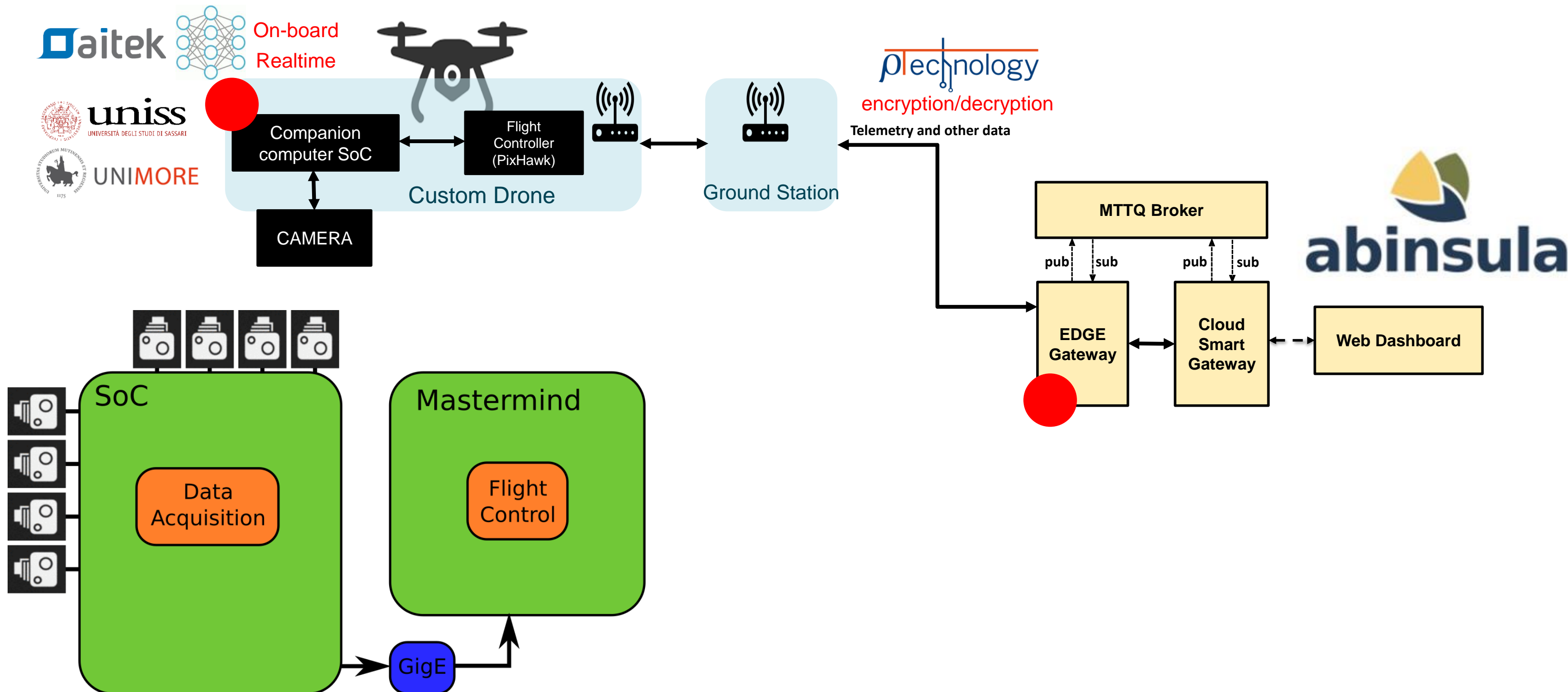
The screenshot displays the 'Gateway Dashboard' interface. On the left is a dark blue sidebar menu with icons and labels for: HOME, OVERVIEW, REPORT, VIDEO (highlighted), ORTHOMOSAIC, and STATISTICS. At the bottom of the sidebar is a black button labeled 'CAMERA'. The main area has a white header with 'Gateway Dashboard' and a 'LOGOUT' link. Below the header, it says 'Azienda Agricola Sarciofo'. A toggle switch labeled 'Runtime Detection' is turned on. The central part of the dashboard shows a live video feed of an artichoke field. Numerous red bounding boxes are overlaid on the plants, each labeled 'artichoke' followed by a confidence score (e.g., 0.89, 0.91, 0.85). A small white icon of a person is visible on the right side of the field. At the bottom center is the 'daitek' logo.



Runtime support

Precision Agriculture in Comp4Drones

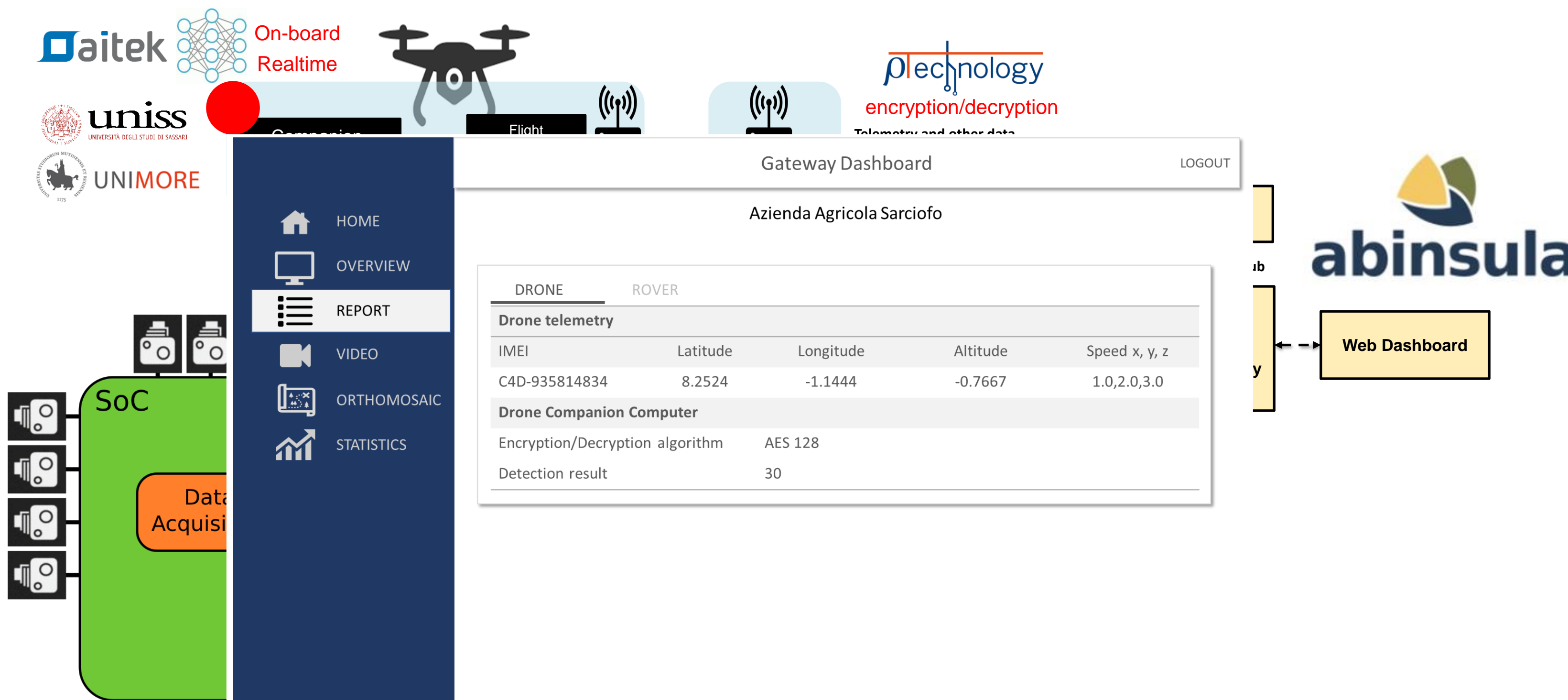
On-board
Realtime



Runtime support

Precision Agriculture in Comp4Drones

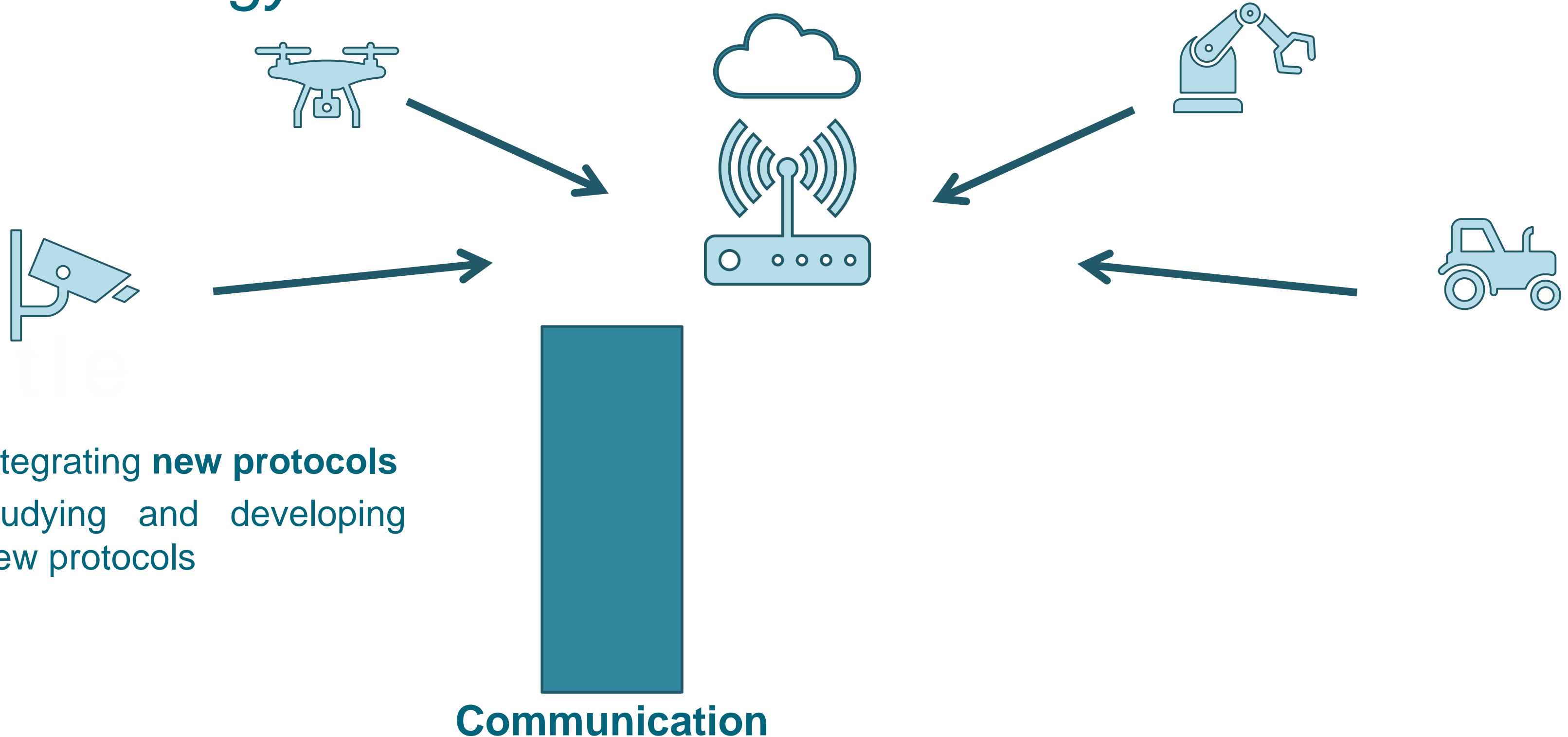
On-board
Realtime



Our strategy

Evolution of the Multi-Sensor Gateway

Our strategy



Evolution of the Multi-Sensor Gateway

Our strategy

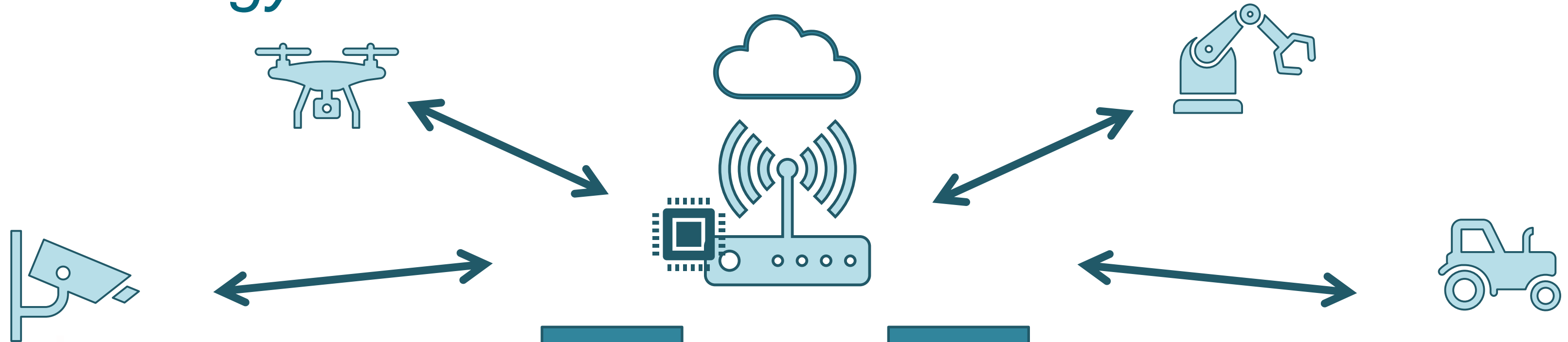


- integrating **new protocols**
- studying and developing new protocols
- use cases with **bidirectional communication**

Communication

Evolution of the Multi-Sensor Gateway

Our strategy



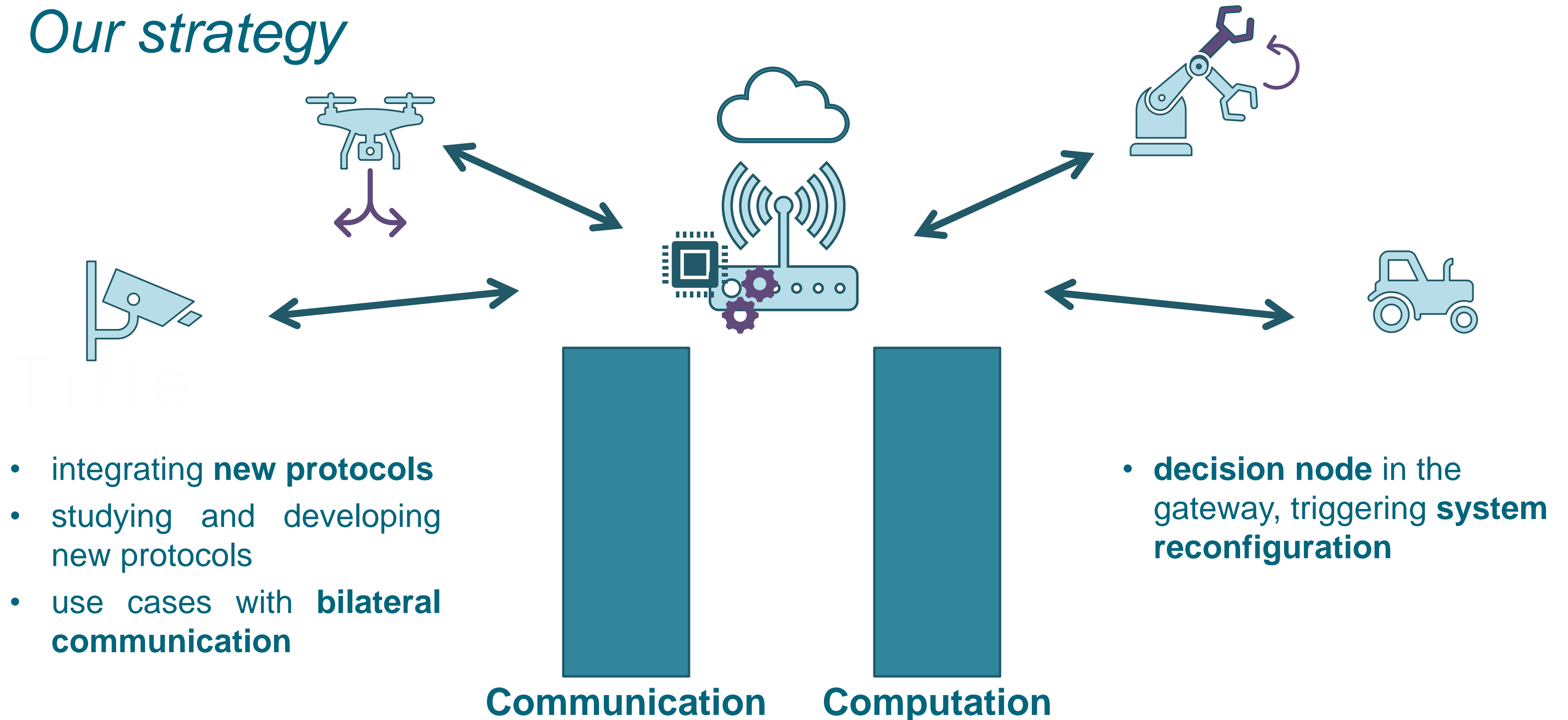
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- use cases with **bidirectional communication**

Communication

Computation

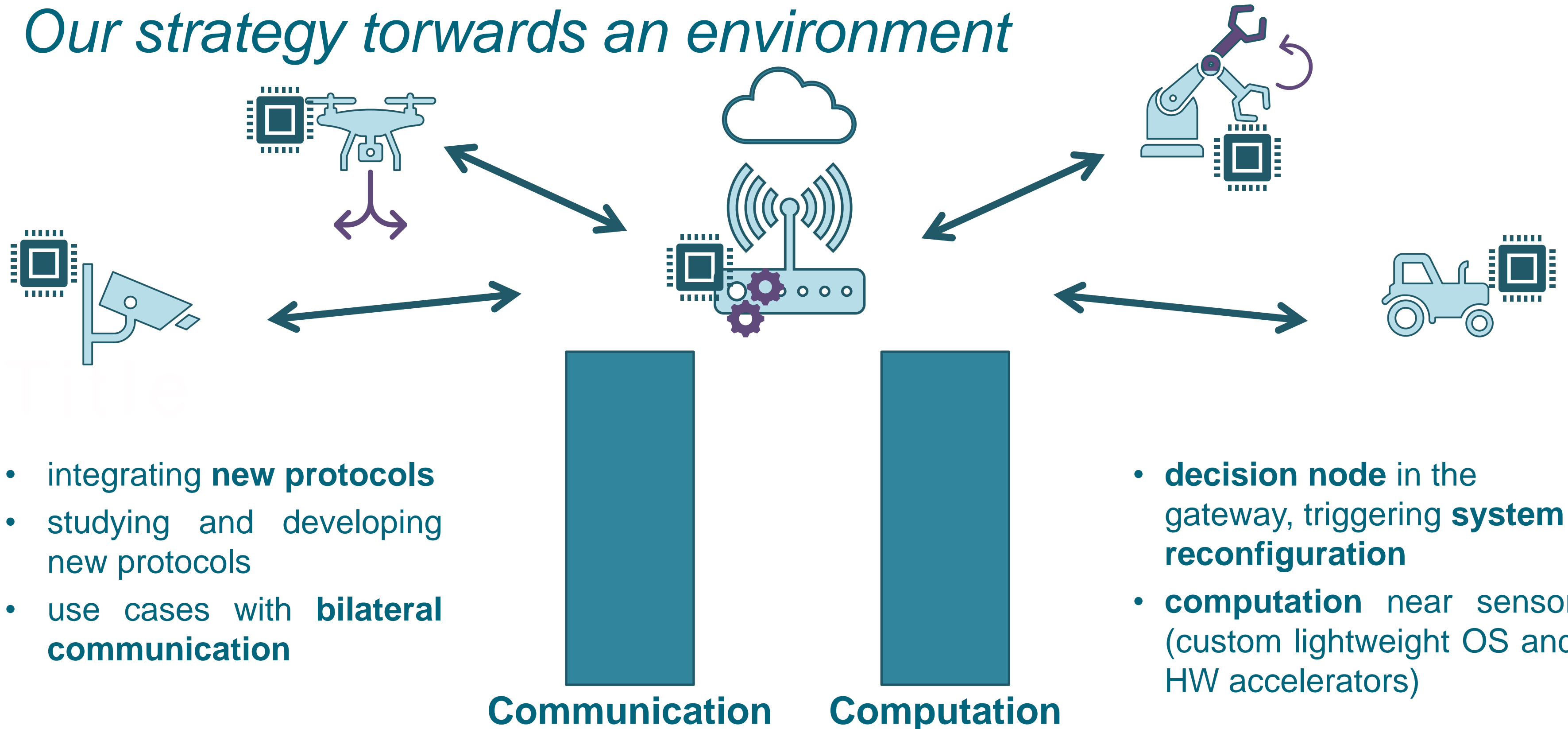
Evolution of the Multi-Sensor Gateway

Our strategy



Evolution of the Multi-Sensor Gateway

Our strategy towards an environment



Evolution of the Multi-Sensor Gateway

Our strategy towards an environment



CPS Workshop 2022 – Pula (Italy)

HW-SW management using a lightweight Yocto-based OS on a ZCU102

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- studying and developing new protocols
- use cases with **bilateral communication**

Communication

Computation

gateway, triggering **system reconfiguration**

- **computation** near sensor (custom lightweight OS and HW accelerators)

ONGOING

Acknowledgments



COMP4DRONES has received funding from the ***ECSEL Joint Undertaking (JU)*** under grant agreement No 826610.



FitOptiVis has received funding from the ***ECSEL Joint Undertaking (JU)*** under grant agreement No 783162.



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.

Questions

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