ACQUAOUNT IoT Sensor Network: Monitoring for Smarter Irrigation

The ACQUAOUNT project—Adapting to Climate change by Quantifying optimal Allocation of resources and socio-economic interlinkages—seeks to revolutionize water management in agriculture.

To support climate adaptation in agriculture, ACQUAOUNT has deployed an innovative network of low-cost, wireless sensors across four pilot sites in Italy, Lebanon, Jordan, and Tunisia. This infrastructure measures key parameters such as soil moisture, irrigation activity, and water availability, offering farmers, researchers, and water authorities the tools to monitor, predict, and act in real time.

By combining Internet of Things (IoT) and Web of Things (WoT) technologies, ACQUAOUNT enables automated, data-driven irrigation management that helps preserve aquifers and increase yields in water-scarce environments.

The ACQUAOUNT IoT & WoT network exemplifies a comprehensive approach to data-driven water management. With pilot deployments in Italy, Lebanon, Jordan, and Tunisia, the platform is ready for large-scale validation and stakeholder engagement. Edge analytics and incorporate additional data streams for holistic basin-wide decision support have been incorporated too.

How the Network Works

The sensor network was designed to be flexible, interoperable, and scalable, using a three-tier model that integrates a variety of data sources:

1. **Local LoRaWAN Networks**: Soil sensors, weather stations and flow meters installed in the fields transmit data via battery-powered LoRaWAN devices to a nearby gateway, then to the cloud. These devices operate with low energy consumption and wide coverage, ideal for rural areas.

2. **External IoT Platforms** : The system can also retrieve environmental data from existing services (e.g., FieldClimate, Nature 4.0), using dedicated WoT gateways that poll APIs on a daily basis.

3. **Independent or Legacy Sensors**: Devices that do not use cloud services (e.g., piezometers or GPRS loggers) send data directly to the platform via custom FTP/WoT protocols.

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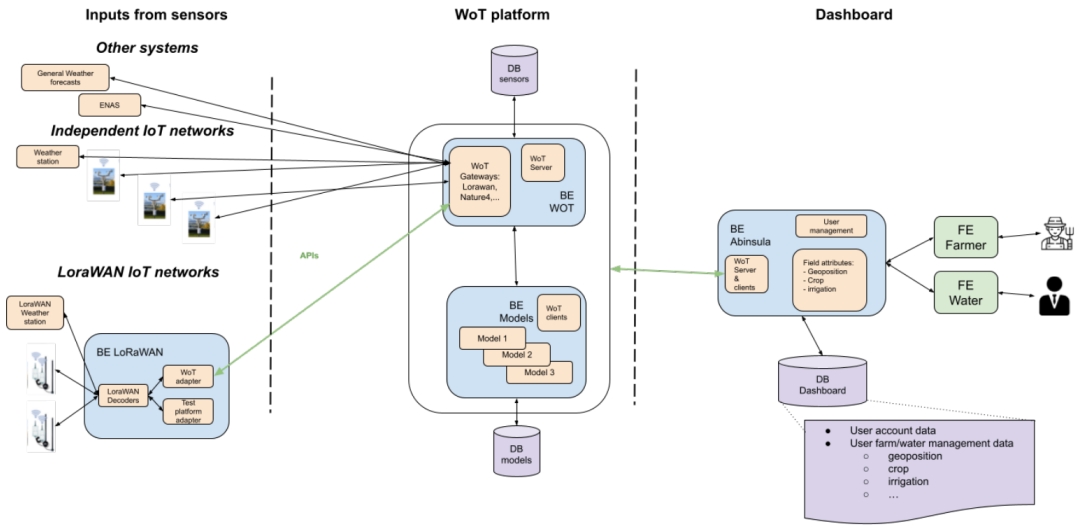

Figure1: Integrated data provider architecture

This hybrid model allows for flexible deployment across diverse technological and infrastructural contexts.

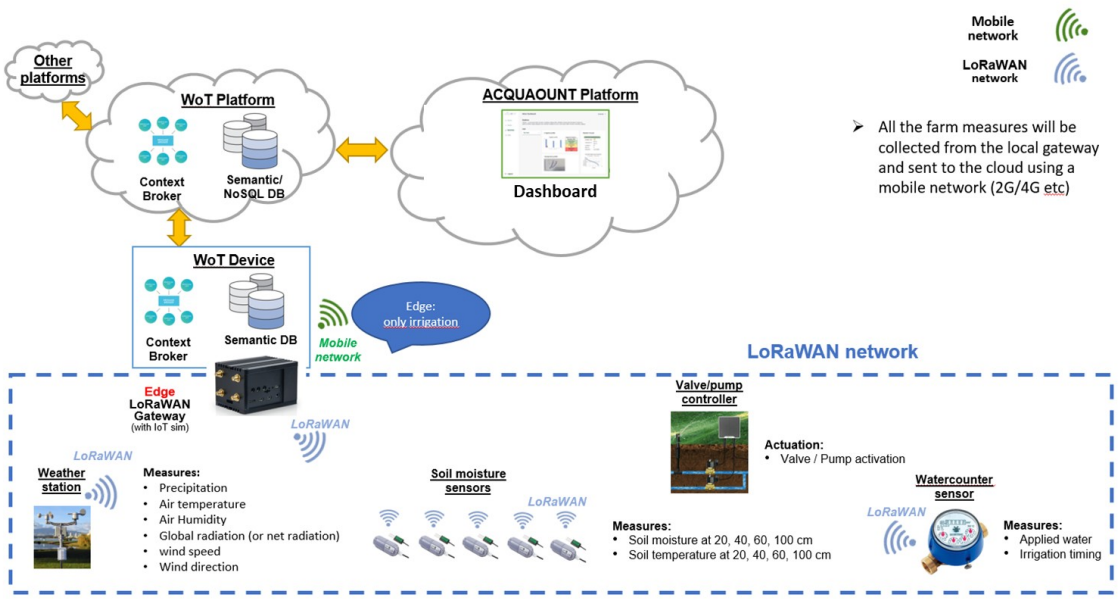

Figure2: Example of data communication from cloud to the field

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A Functional Prototype

A fully working prototype has been deployed and tested by Abinsula, showcasing the full data flow:

- Sensors: SenseCap (temperature/humidity), IQNexus (soil moisture), Maddalena (flow counters)
- Gateways: RAK7240 WisGate Edge Prime (LoRaWAN)
- Actuators: Milesight UC511 solenoid controllers for automatic valve and pump control
- Cloud stack: AWS IoT Core → Lambda functions → ThingsBoard → WoT Gateway

This setup supports bidirectional communication: it receives real-time data and sends back irrigation commands based on model outputs.

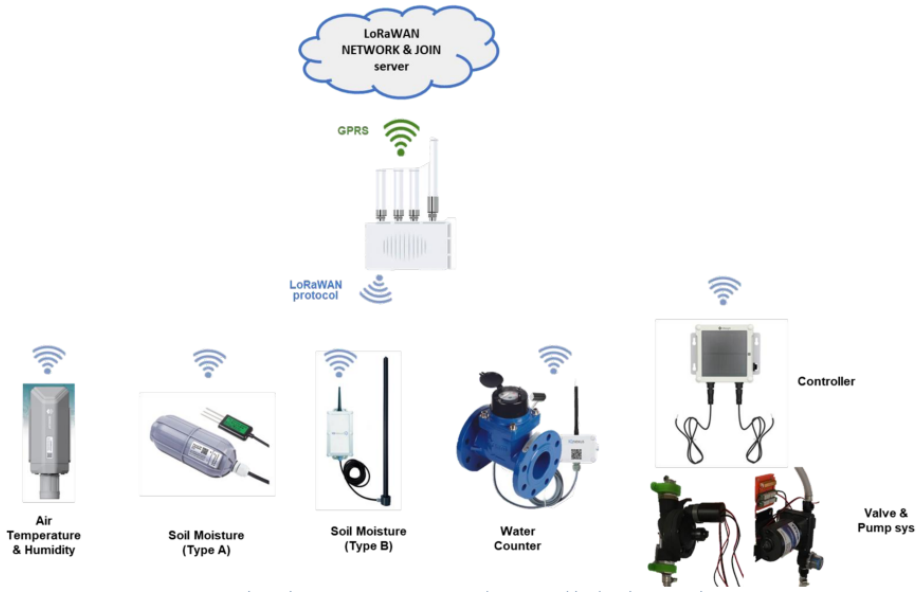

Figure2: Field prototype setup

ADVANTAGES - Why It Matters

The ACQUAOUNT network provides several advantages:

- **Interoperability**: Uses W3C Web of Things and OGC SensorThings standards for seamless integration and future expansion.
- **Real-time Decision Making**: Farmers and water managers can access up-to-date information for adaptive planning and optimized irrigation.

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- **Water Conservation**: Smart irrigation helps reduce waste and protect ecosystems by providing only the water crops truly need.
- **Autonomy and Resilience**: On-site edge computing ensures that core functions continue even during internet disruptions.
- **Scalability**: The modular design allows new farms and sensor types to be added quickly and cost-effectively.

By combining precision agriculture with digital innovation, ACQUAOUNT supports sustainable water use in a region highly vulnerable to climate change. The sensor network developed in the project is ready to be scaled and replicated in other Mediterranean and semi-arid areas.

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