Open and Standardized Technologies for Accessible Smart Farming

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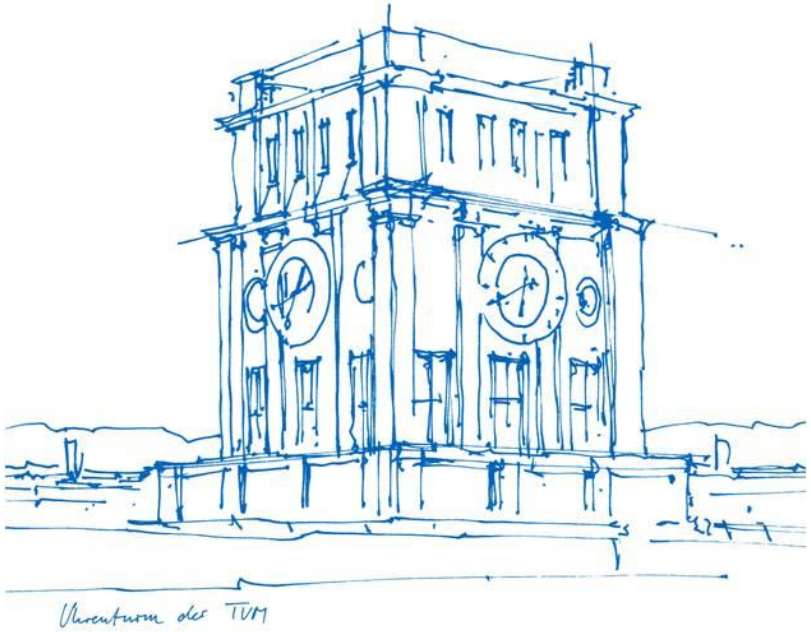
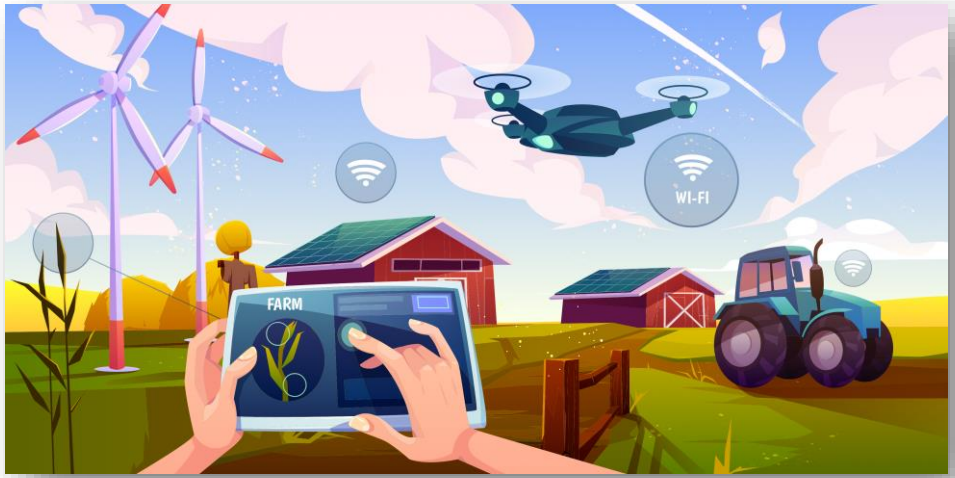


1. Introduction – Digitalization of Agriculture

- **Digital agriculture**
  - New and advanced technologies
  - Integrated into one system
  - Enable farmers and other stakeholders to improve entire chain of food production

- **Scope**
  - Sensors (including food sensors and ambient sensors)
  - Guidance and tracking systems
  - Variable-rate input technologies
  - Advanced imaging technologies
  - Automated machinery and agricultural robots
  - …



Source: Adobe Stock

1. Introduction – Digitalization of Agriculture

- **Farmers under pressure**
  - Climate change
  - Biodiversity loss
  - Public acceptance
  - …

- **Potential** of digital technologies in agriculture
  - Higher production efficiency
  - Reduced physical stress
  - More sustainable and resource-efficient production
  - Enhancing animal well-being
  - Increase production transparency
  - …

Source: Pixabay

2. Risks and Challenges of Adoption

Major **barriers** for farmers

- Higher investment **costs**
- Enhanced governmental **control** possibilities
- **IT-security** threats
- Higher **complexity** → dependence on external service providers
- Lack of system **openess** and **interoperability** → dependence on single/few service providers (**vendor lock-in**)
- Loss of **data sovereignity**

2. Risks and Challenges of Adoption

Vendor lock-in and data sovereignty

- **Phenomenon**: vendor try to get farmers locked into their data systems and policies

- **Instruments**:
  - **Contractual**: perpetual licenses, upgrades, and services fees (e.g. “free” hardware and payed software licenses)
  - **Technical**: closed systems that don’t communicate with other vendors’ systems due to proprietary standards → incentivize farmers to get all their equipment from one manufacturer

- **Consequence**: strong dependence on single vendor potentially leading to higher costs and lower data sovereignty

3. Open and Standardized Technologies - Powerful Alternatives

- **Open and standardized technologies**
  - Elementary components can be viewed, changed and used publicly and by third parties (e.g. source code)
  - Interfaces support interoperability
  - Often available free of charge

- **Main advantages** for farmers
  - Data ownership
  - Independence
  - Open for collaboration
  - Customizability
  - No binding license costs

3. Open and Standardized Technologies - Powerful Alternatives

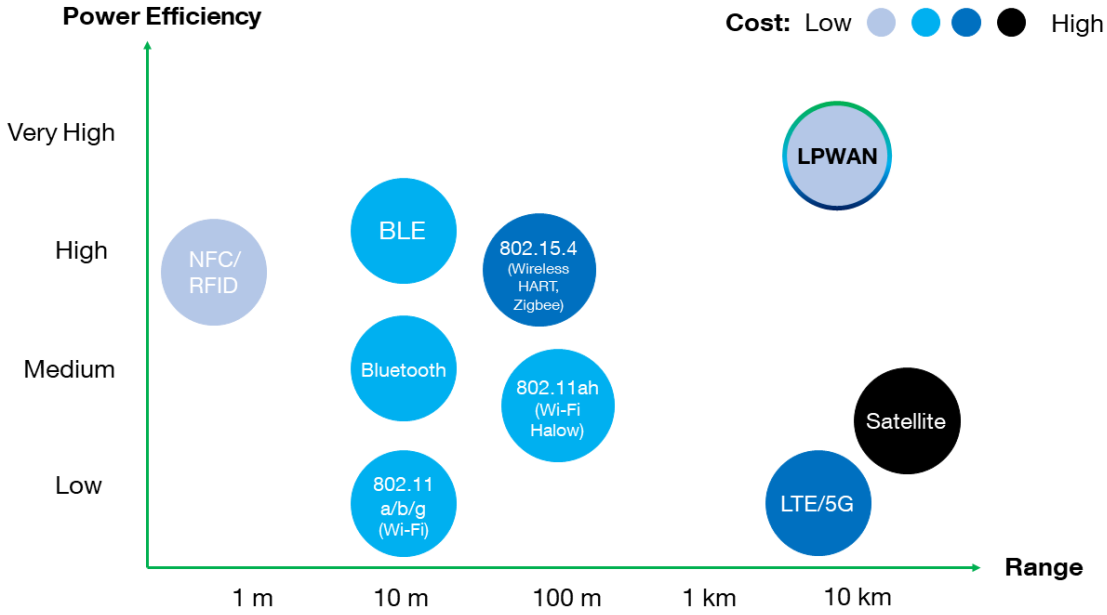
Example: Sensor Networks and IoT

- Common computer **network of sensor** nodes communicating via radio transmission
- IoT as the idea of a **common communication network** across all types of interconnected physical devices → sensor networks as part of the Internet of Things
- **Dynamically growing** variety and progress of technological solutions in all areas

3. Open and Standardized Technologies - Powerful Alternatives

Radio transmission technologies

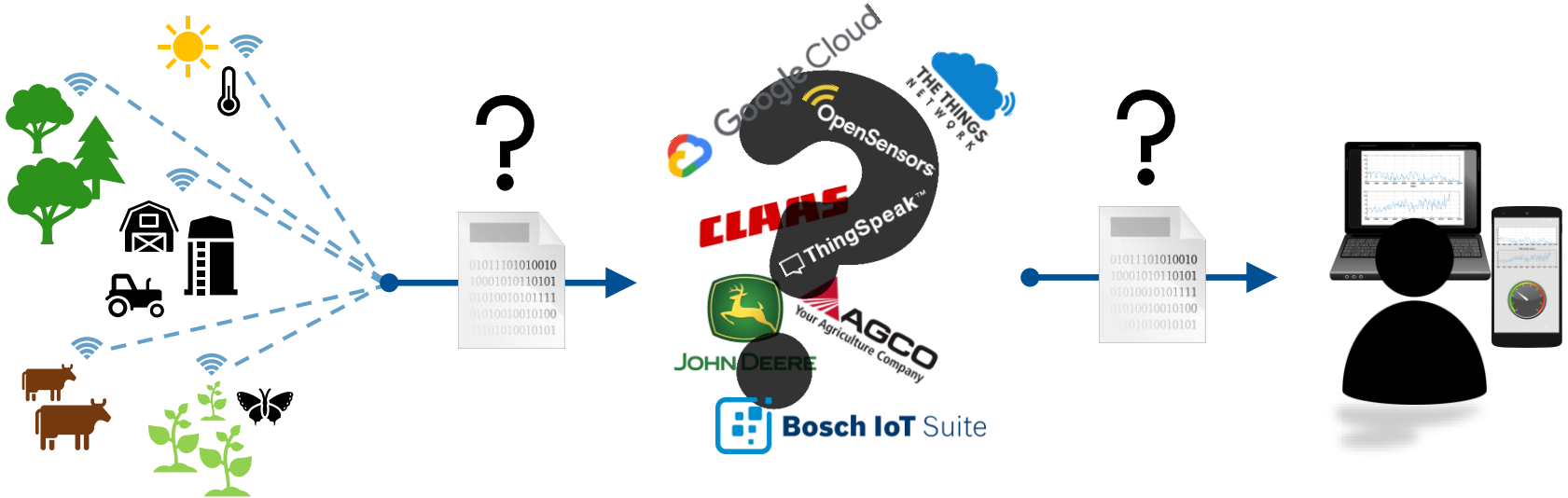
- All standardized but difference with respect to **license regulations** → unlicensed radio technologies free of charge
- Personal Area Network (PAN) and LAN operate on **unlicensed frequencies**
- **Licensed technologies** in LPWAN and cellular communication (e.g. 5G, NB-IoT)



3. Open and Standardized Technologies - Powerful Alternatives

Data Processing and Transmission Protocols

- Large variety of IoT platforms in general and specifically for smart farming
- Challenge of interoperability between platforms



3. Open and Standardized Technologies - Powerful Alternatives

Proof of Concept: Sensor Data Infrastructure at TUM School of Life Sciences at Weihenstephan

Baseline

- **Efficient data management** as an elementary basis for top-level research
- **Continuous and automated sensor data acquisition** by remote access in the agricultural sector poses challenges
  - High ranges
  - Energy restrictions
  - Costs for hardware and data transmission
  - Data security
- **Consequences**
  - Inefficient partial solutions → unnecessary expenditure of resources
  - Barrier to the development of innovative research ideas

3. Open and Standardized Technologies - Powerful Alternatives

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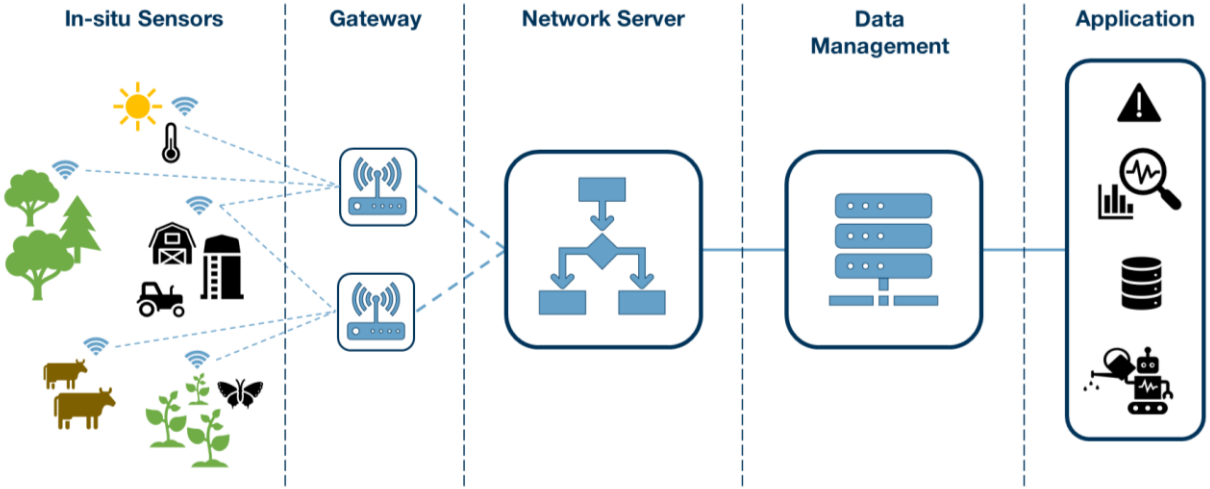
Solution approach

- Large area radio network coverage based on Long-Range Wide-Area Network (**LoRaWAN**) technology
- Comprehensive provision of **data processing services** from sensor to actual application based on **open, free and standardized** technologies



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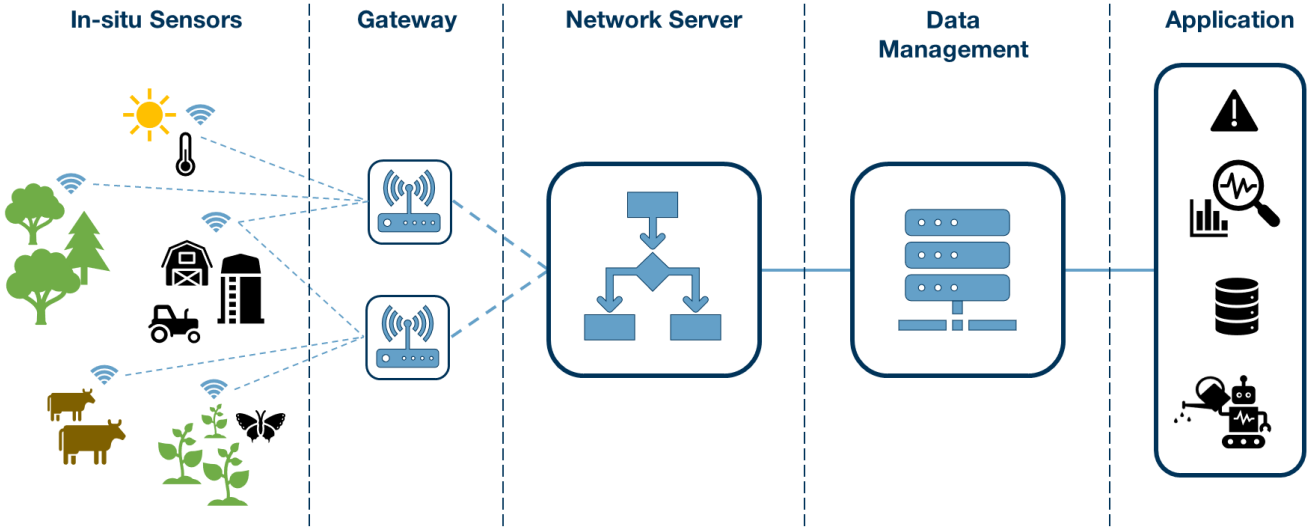

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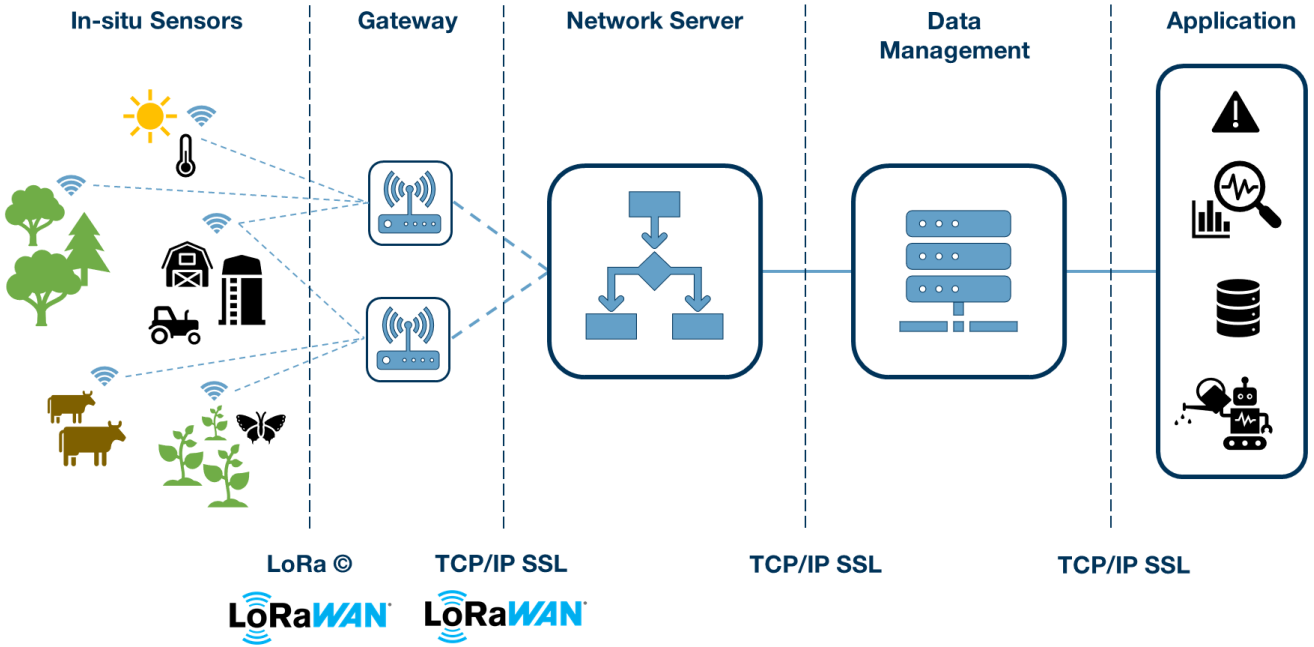

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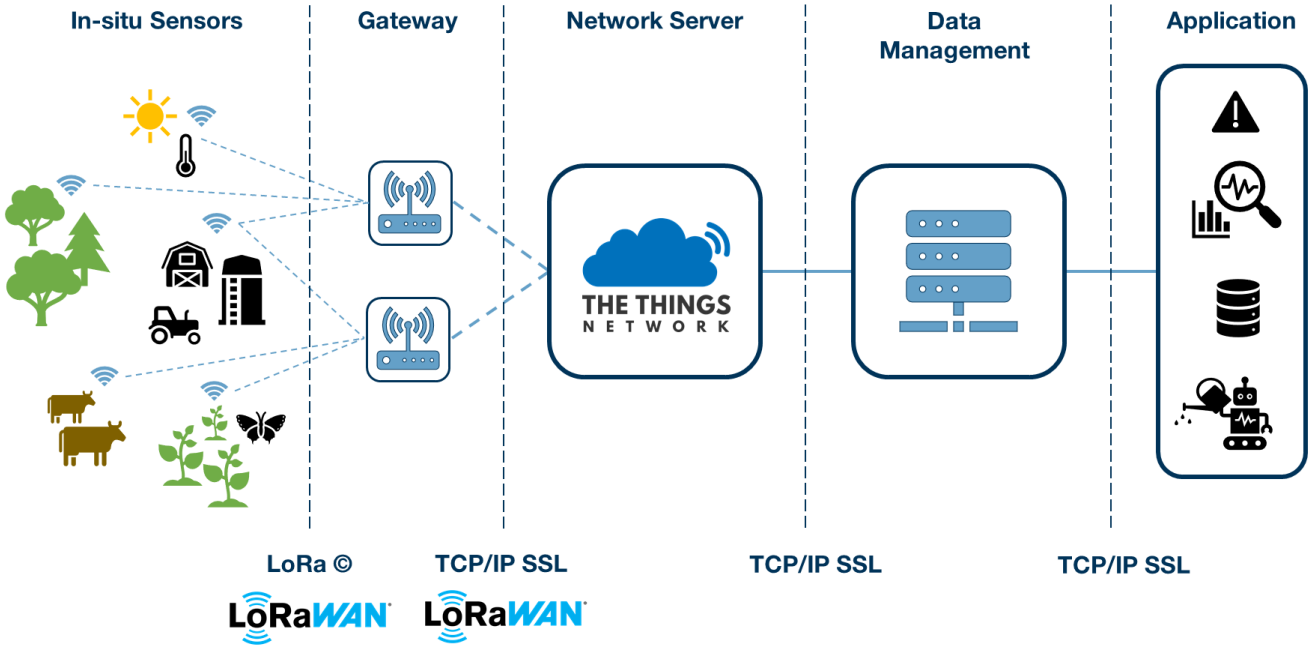

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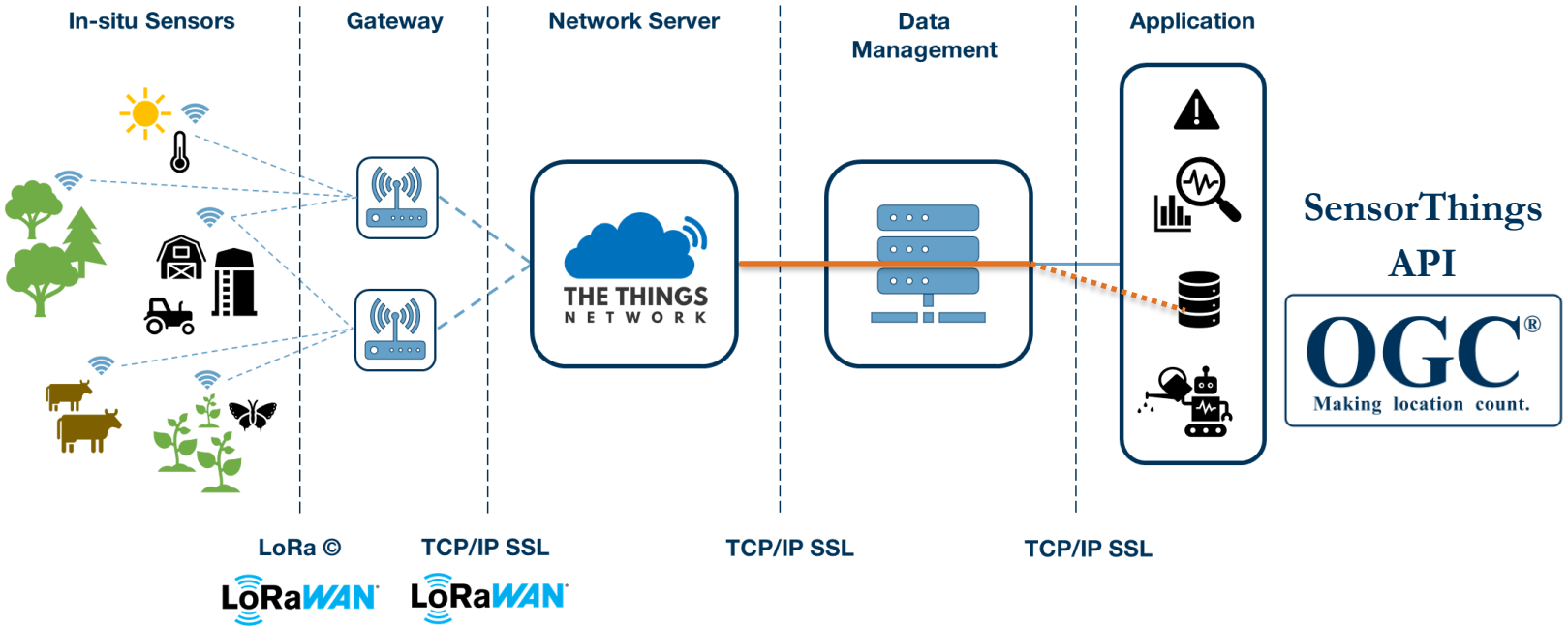

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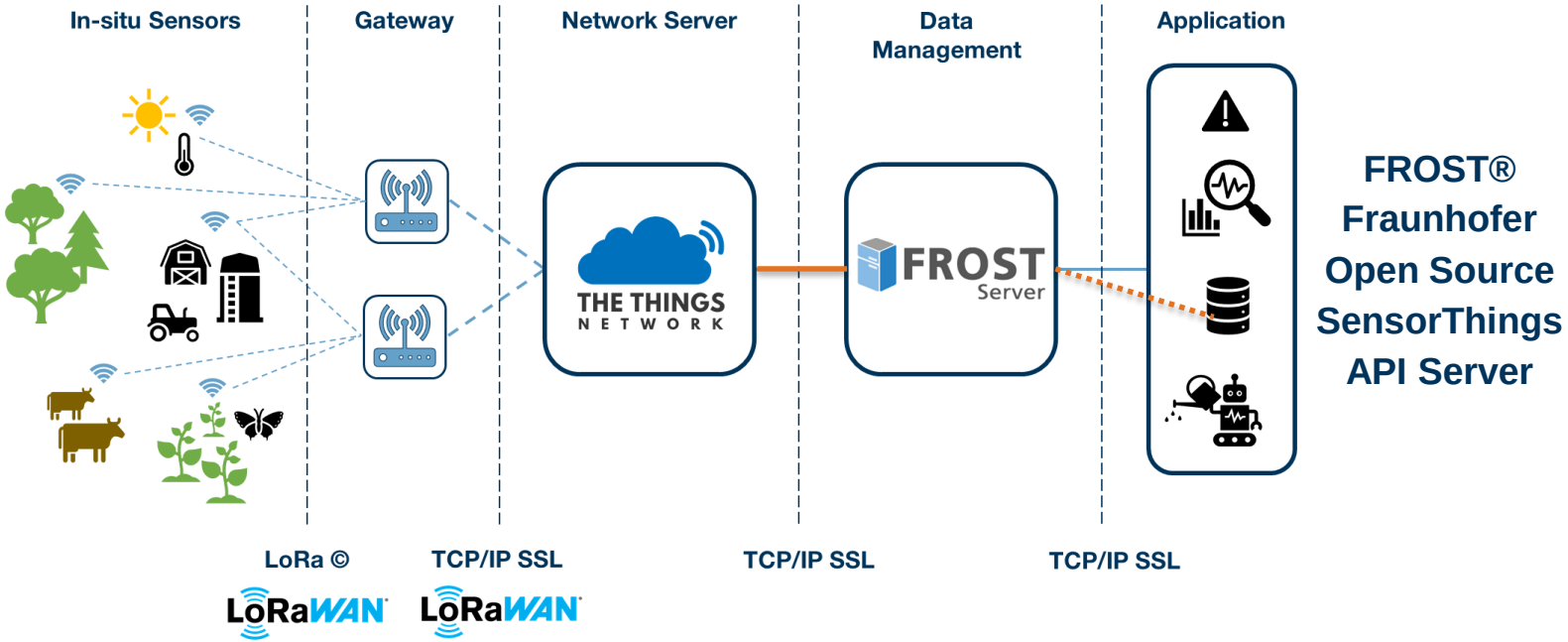

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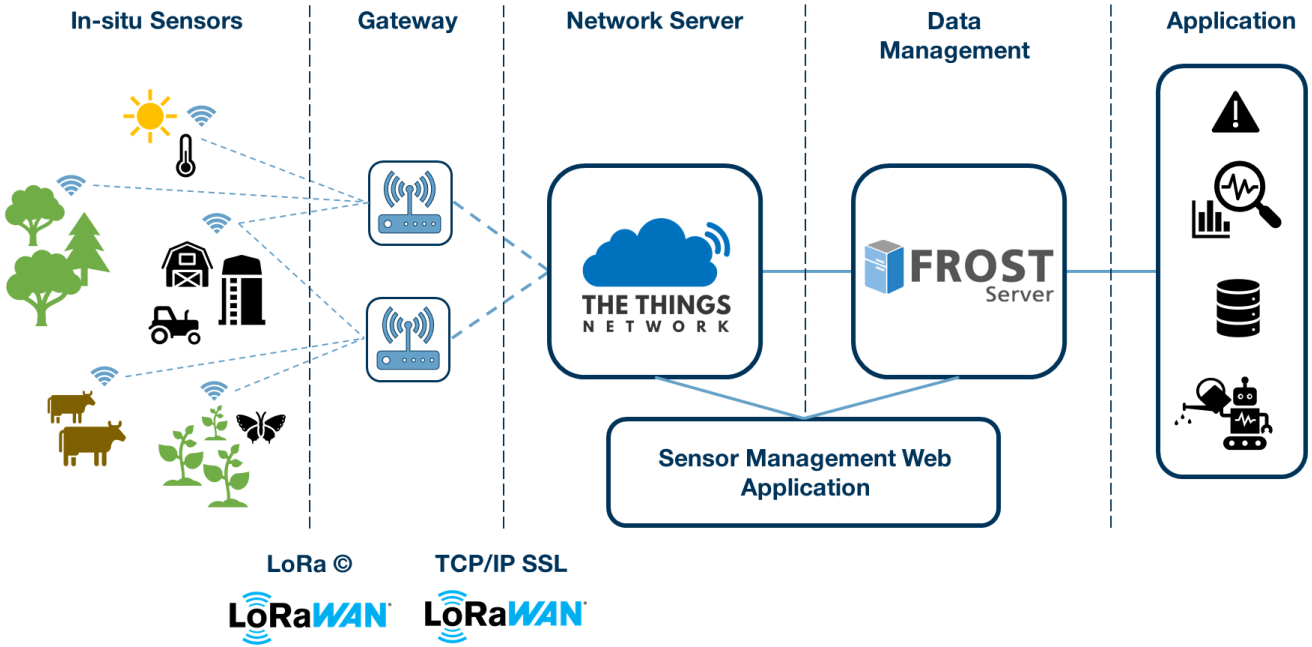

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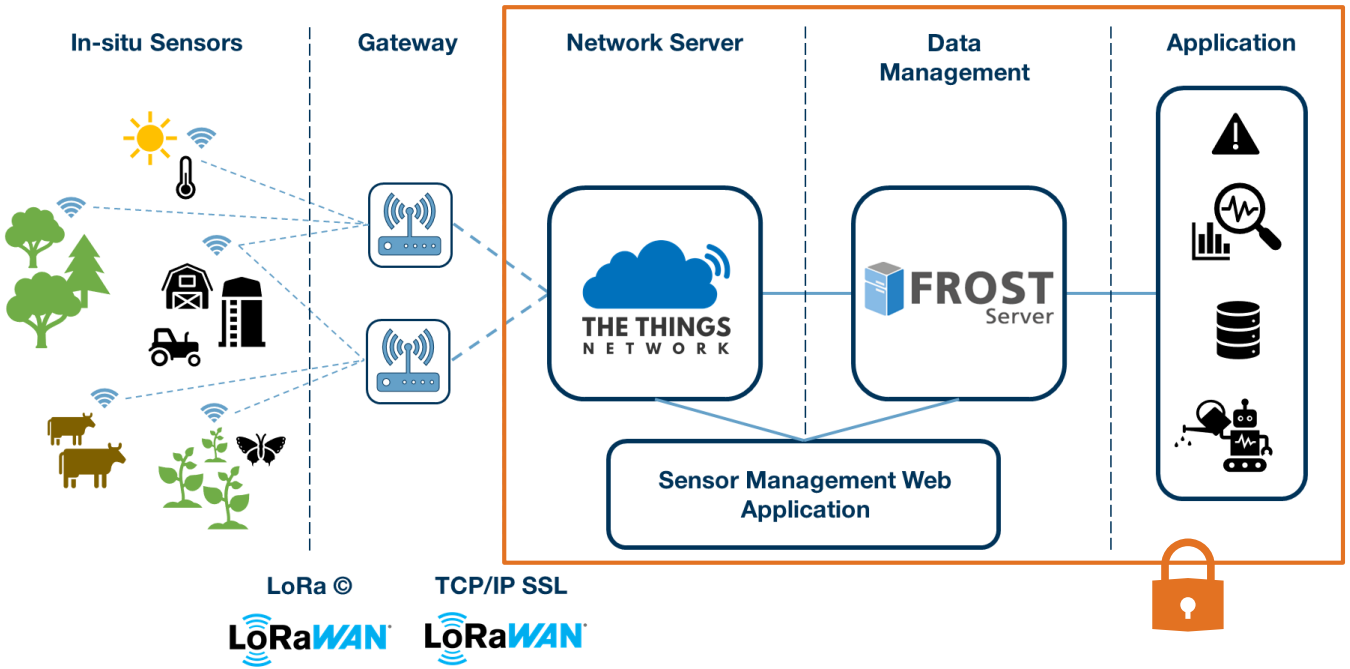

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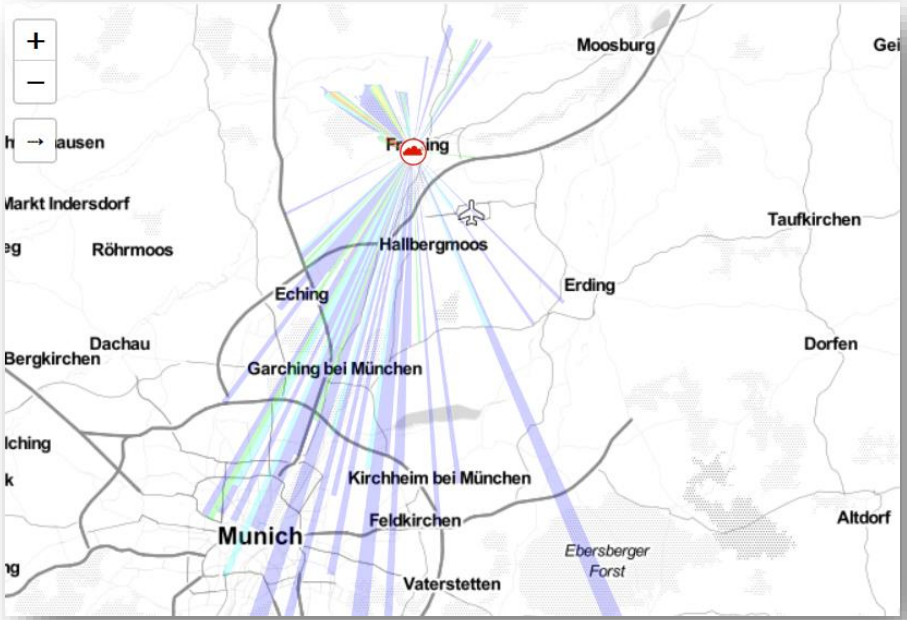

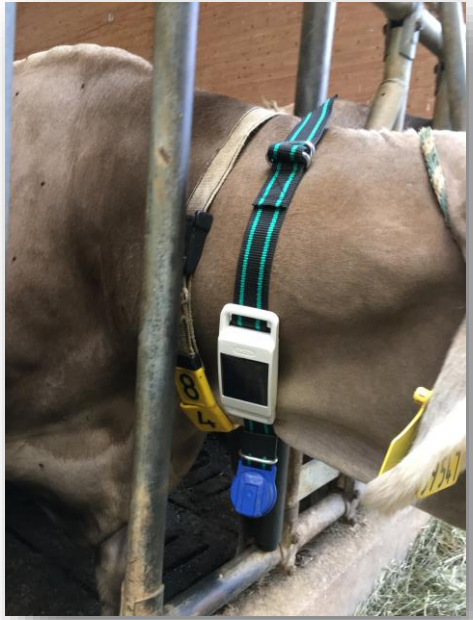

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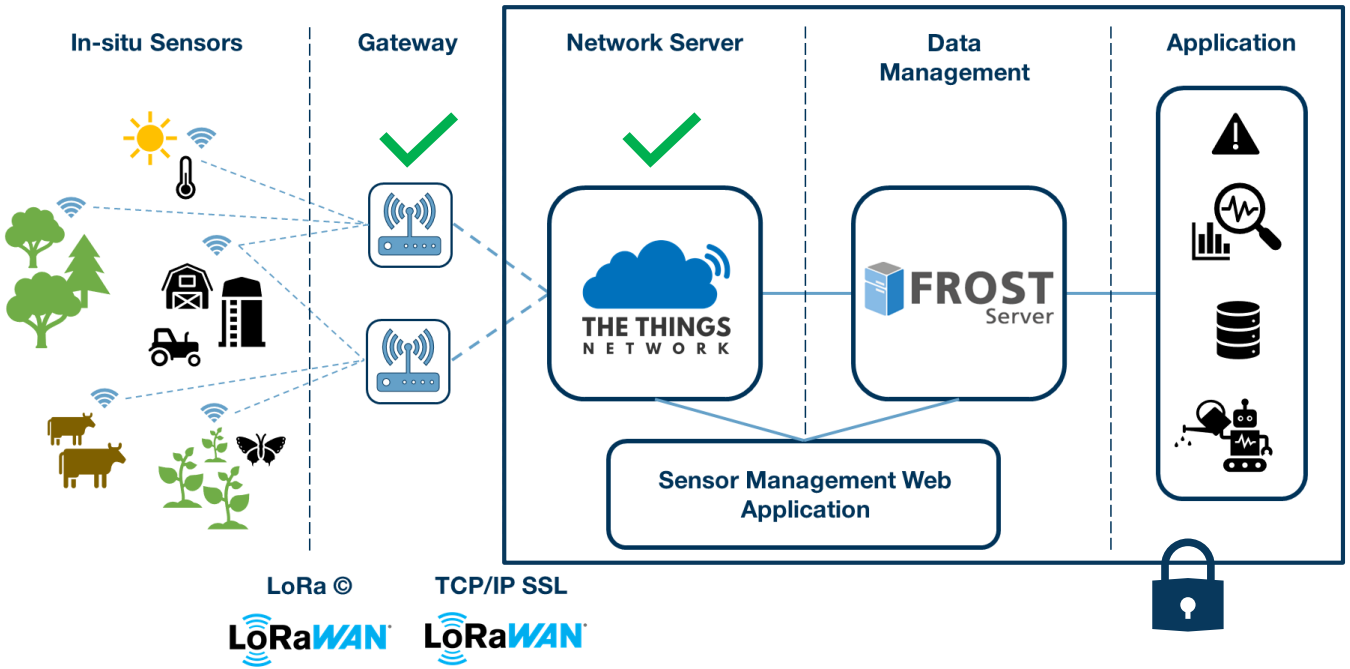

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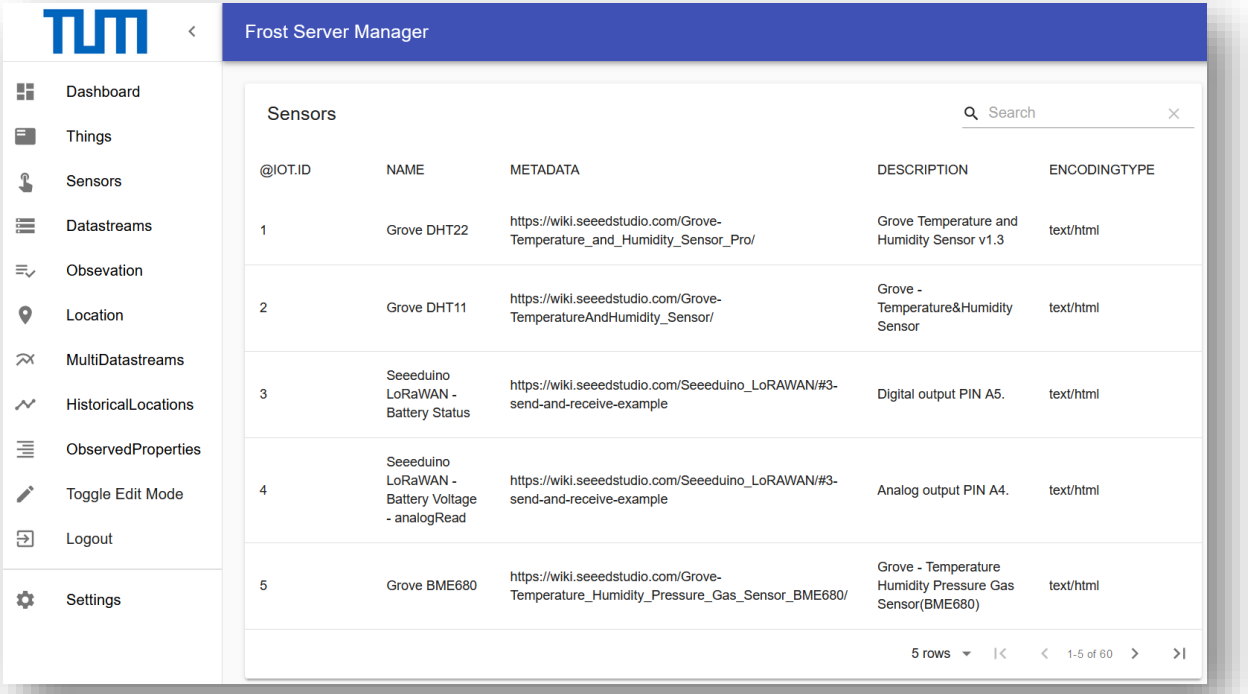

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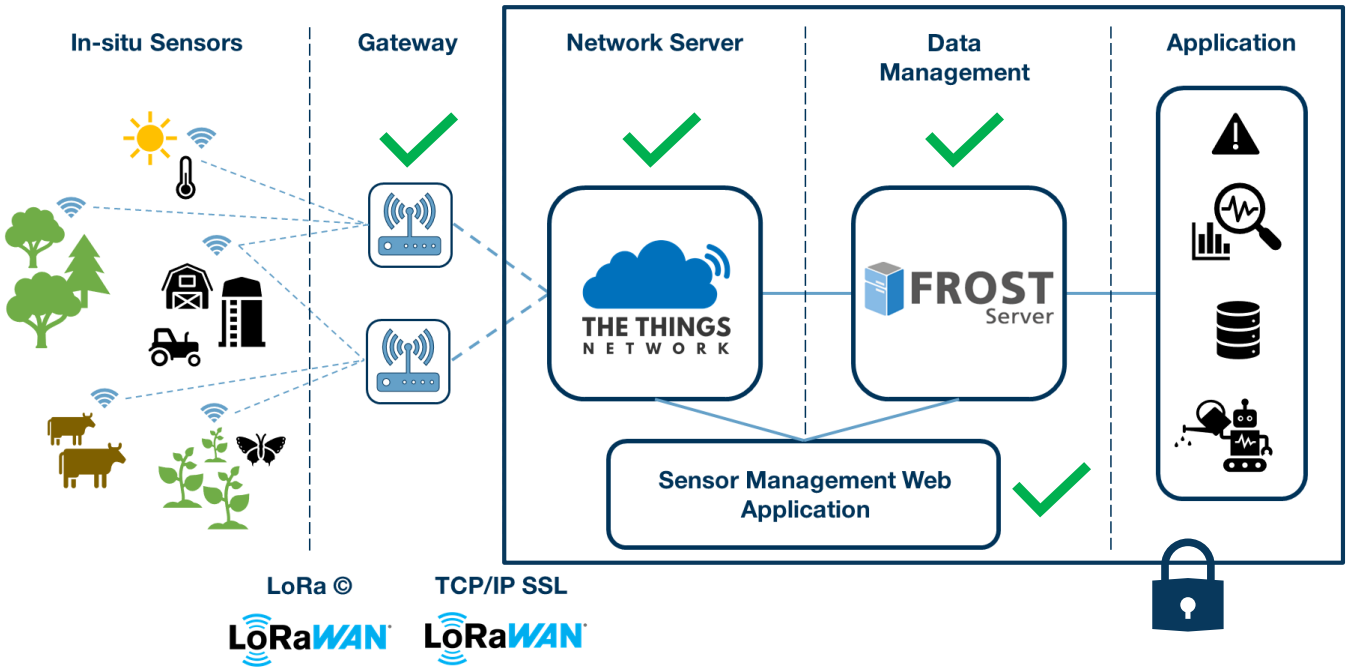

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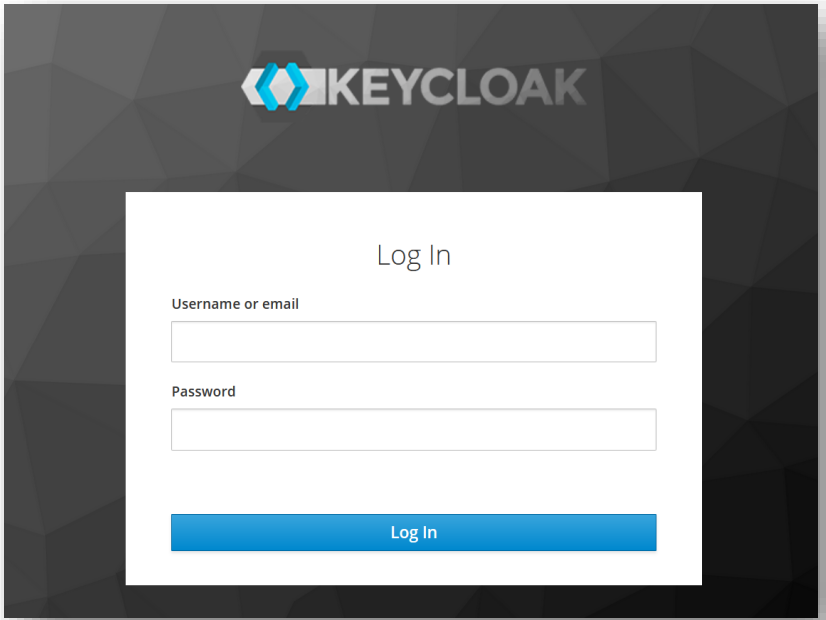

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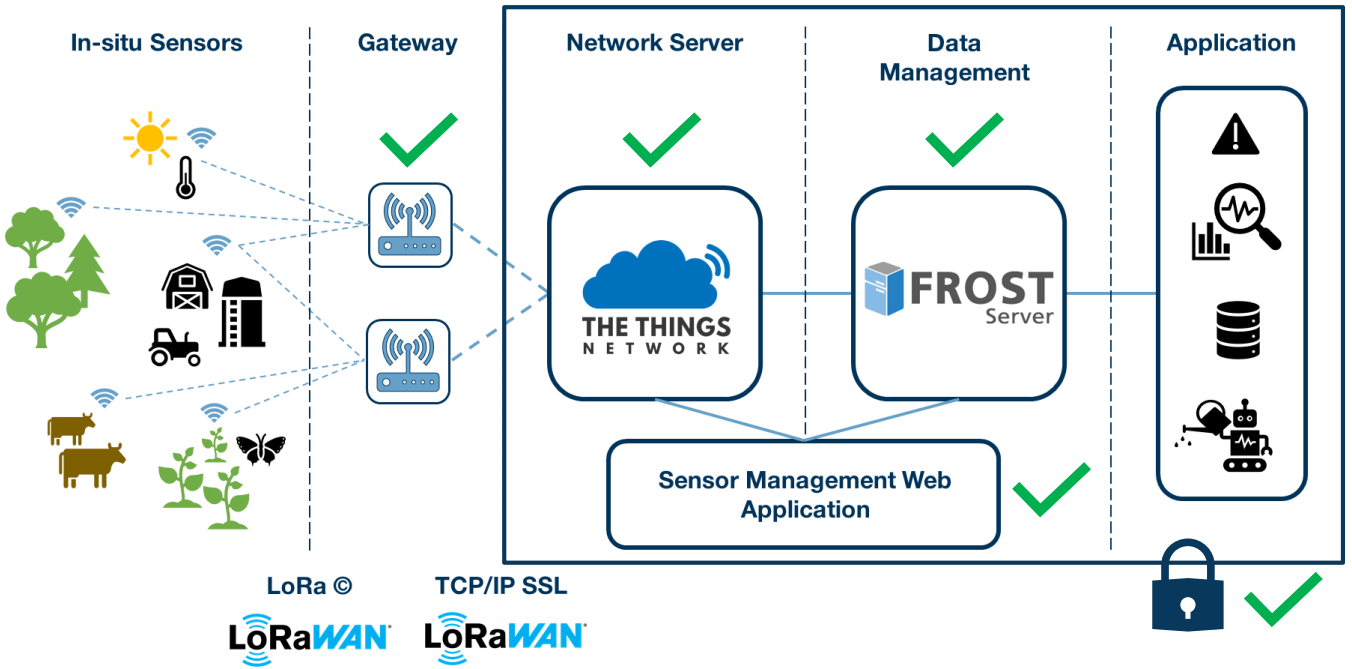

4. Conclusions

- Vendors of smart farming technologies often focus on **dominating market through vendor lock-in**
- Increasing **awareness for data security and interoperability** needs
- **Open, standardized and free technologies** are **on the rise** → user sovereignty and pressure on market players' current product designs
- Farmers can **build up own sensor data** solutions based on open technologies → but: expertise and maturity is not yet reached to convince the many → increasing digitalization of farming profession
- Reduced adoption fears and do-it-yourself possibility **lower barriers** to implementing smart technologies for farmers → **higher accessibility**

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