# IOT.H2O - SUPERVISION AND CONTROL FOR WATER SYSTEMS BASED ON LOW-COST HARDWARE AND OPEN-SOURCE SOFTWARE

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Water JPI

2017 JOINT CALL

# Introduction

GOAL:

- Cost-effective system for monitoring and control of water systems based on open source software and low-cost hardware (e.g. Raspberry PI, Arduino, ESP32, …)

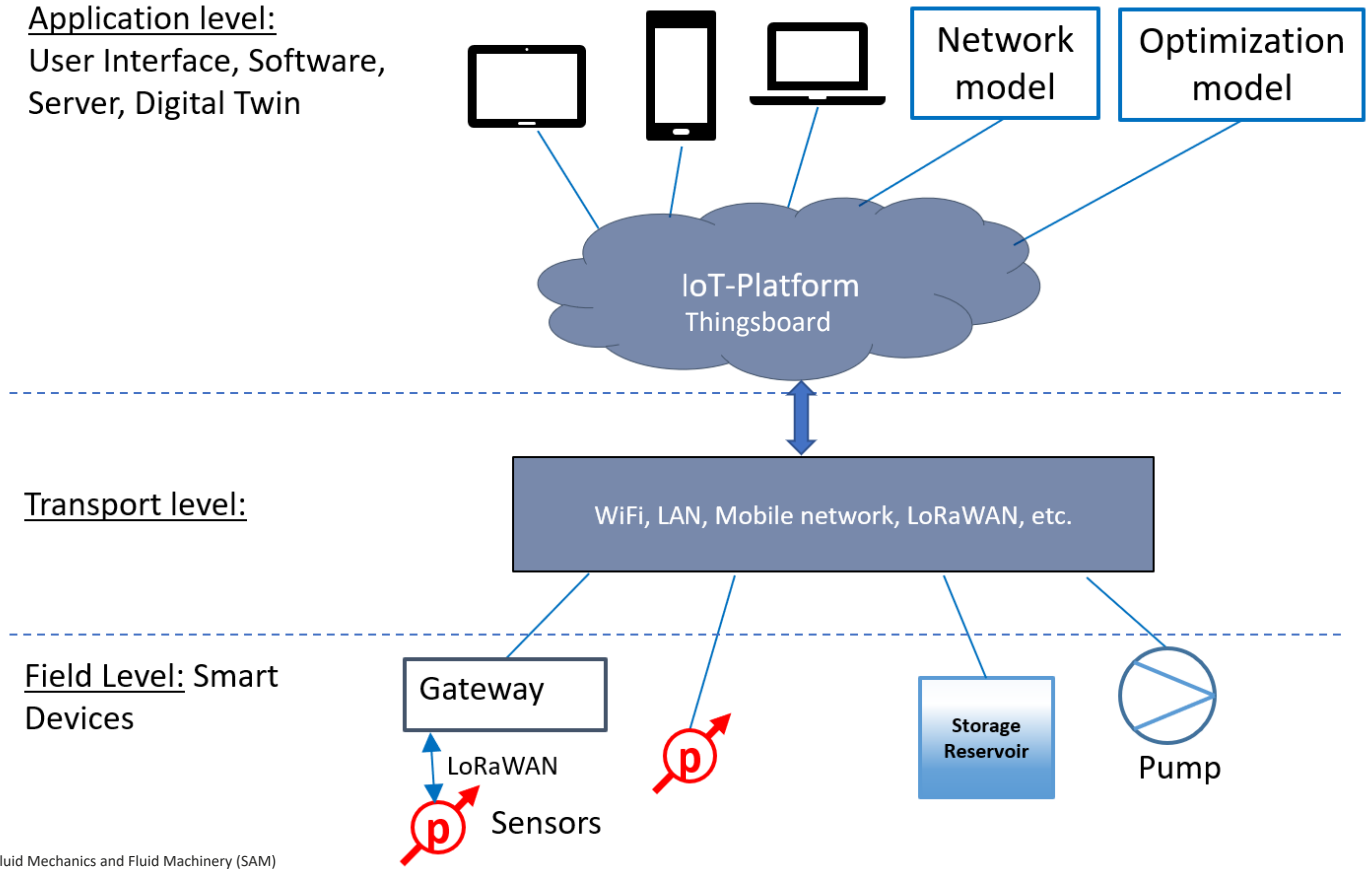
MOTIVATION:

- SCADA systems are used for monitoring and operation of major water transport and distribution systems
  - Complex and expensive
  - Often not achievable for small water utilities
  - Number of sensors which are connected to the SCADA system is usually limited
  - Water supply companies often monitor but do not evaluate data or the dataset is incomplete

METHOD:

- Internet of Things (IoT) concept is very promising for developing a cost-effective system with automated data processing for a high number of sensors

# IoT system - Overview



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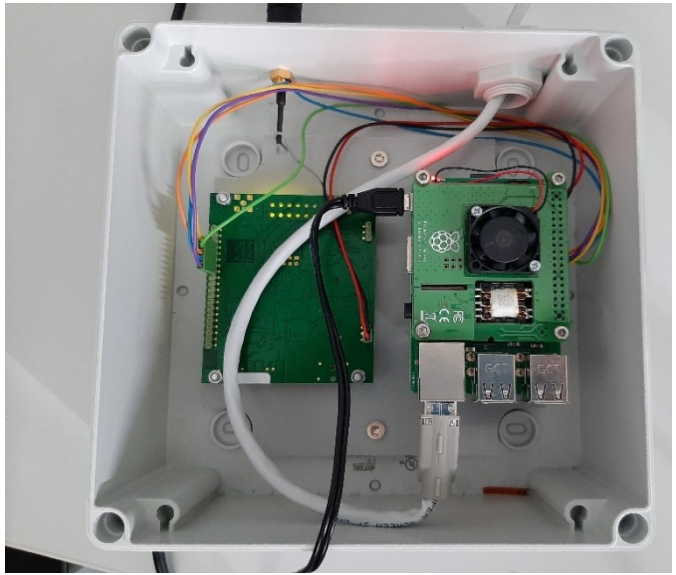
# Development of IoT-devices

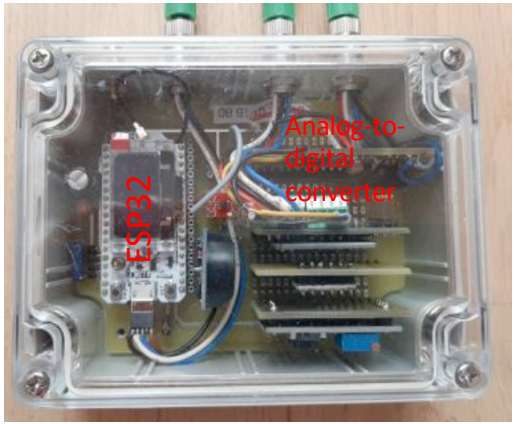
Gateway:

- Raspberry PI
- LoRaWAN concentrator



IoT device:

- Heltec ESP32WiFi LoRa32 (V2)
- Development of printed circuit board
- Voltage booster system (2 V - 10 V)
- “Level shifter” for in-system data communication



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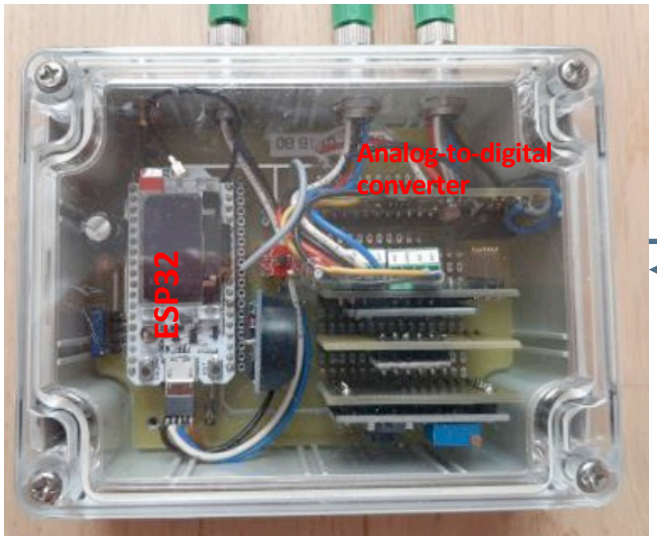
# Communication of WiFi-devices and IoT platform

- Message Queuing Telemetry Transport (MQTT)

- Additional devices can be added to the IoT platform by software changes
- Software models can publish virtual data to the IoT-platform

Power supply & Sensors




MQTT: publish & subscribe to messages

Remote procedure calls (RPC) for actuators

IoT-Platform Thingsboard



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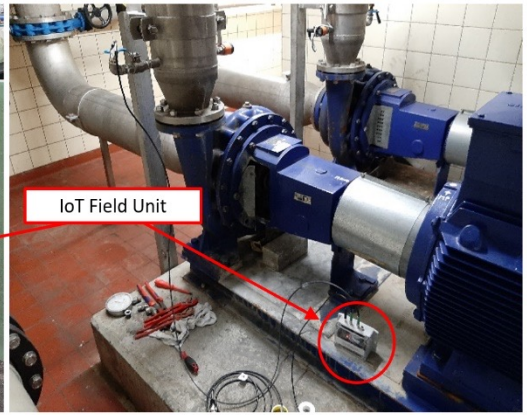
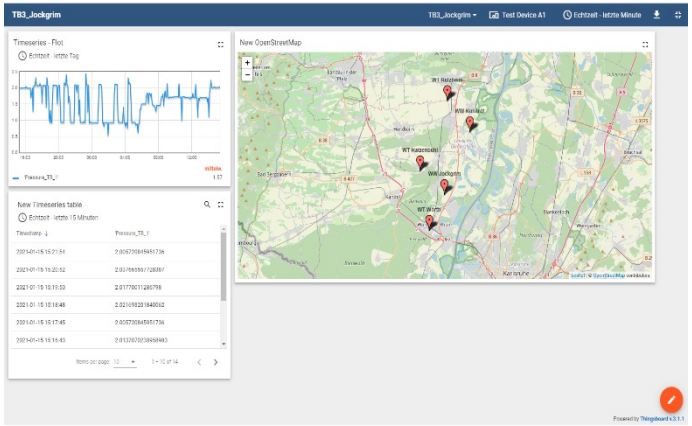
# Field deployment

- Zweckverband für Wasserversorgung Germersheimer Südgruppe (Jockgrim, Germany)
- Monitoring of well and distribution pumps since 2020



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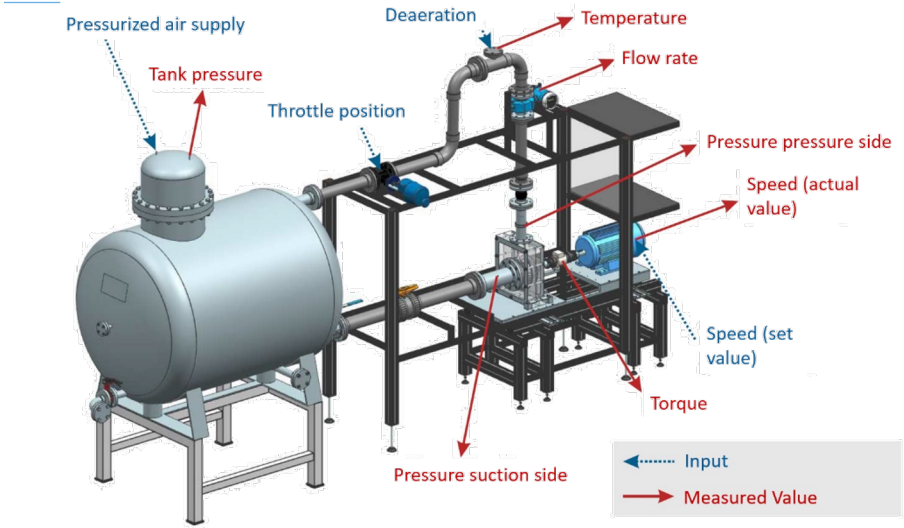
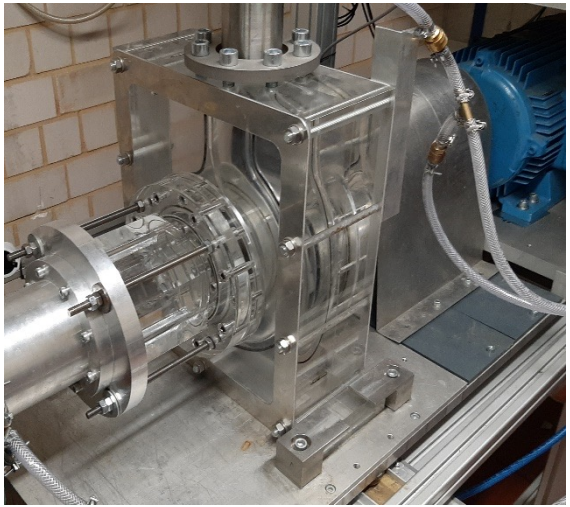
# Monitoring and control of pumps



Test rig:

- Initially controlled by a LabVIEW user interface
- IoT devices measure flow rate, pressure, speed and torque
- IoT devices for control of frequency converter & control valve

Design point of pump:

Q=100 $m^3/h$

H=27 m

Acrylic casing for flow visualization



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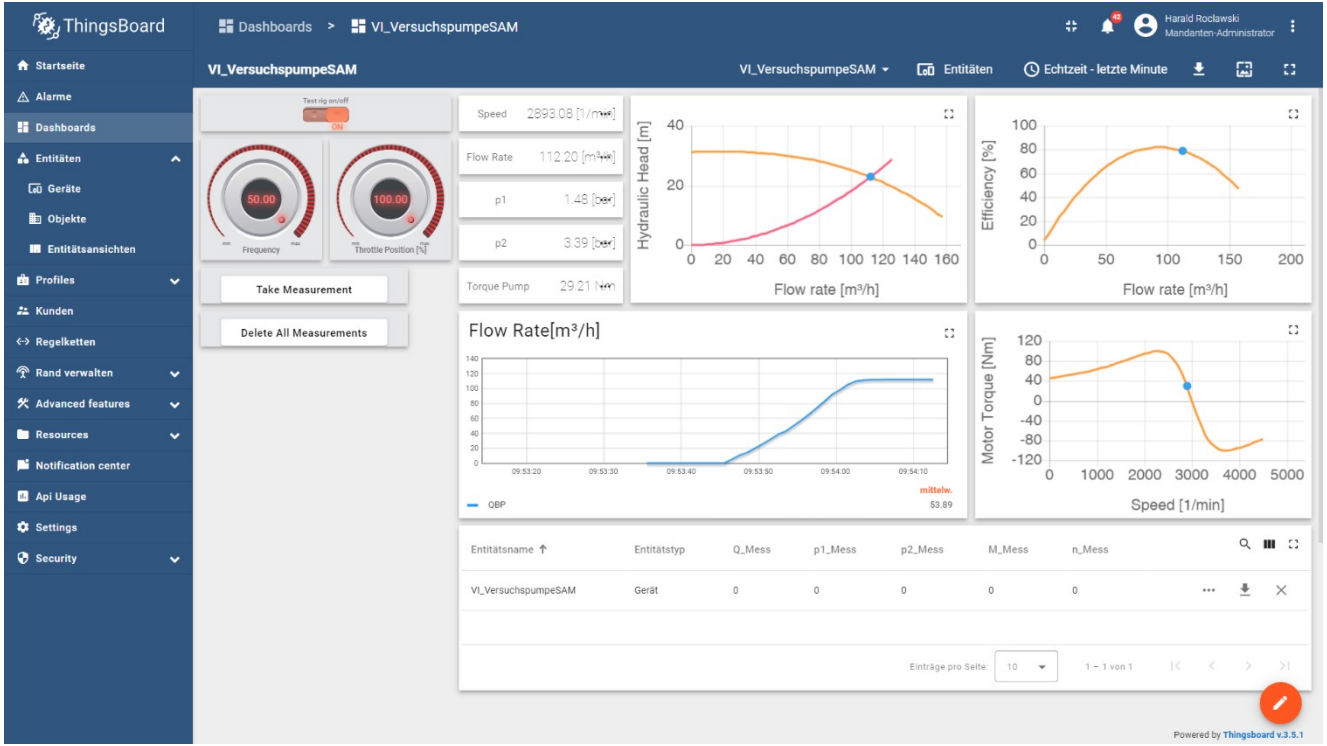
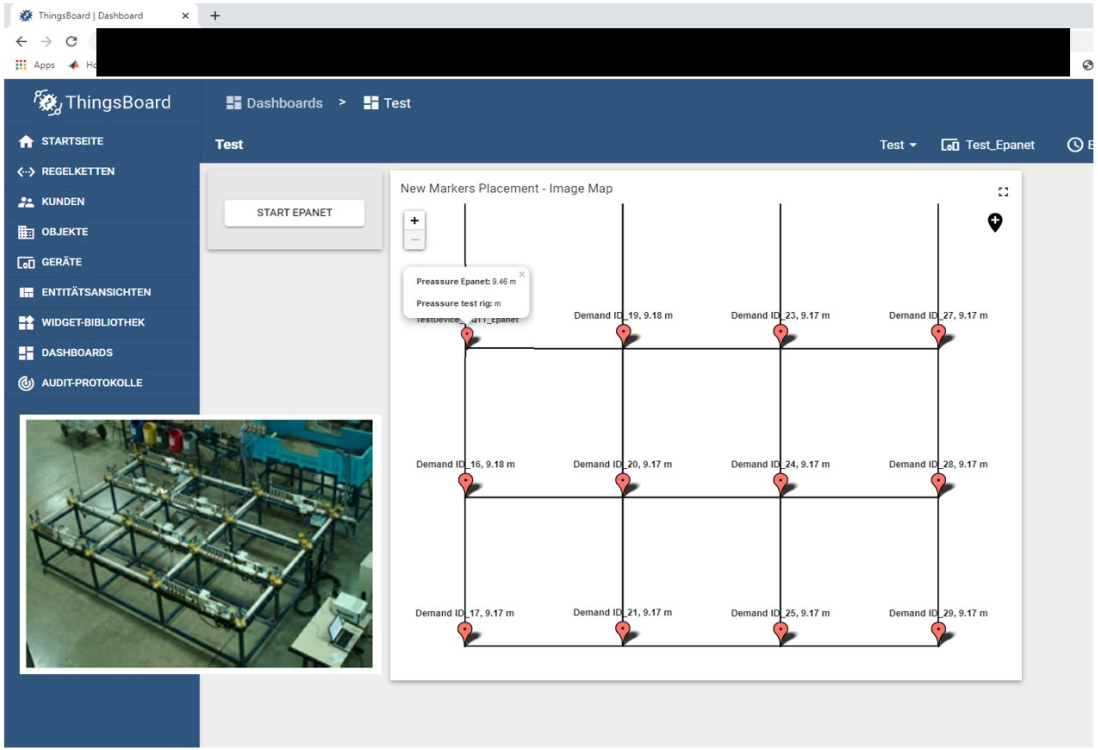
# Thingsboard Dashboard for Pump Monitoring

- Remote Procedure Call:
  - Start/stop
  - Pump speed
  - Control valve
- Visualization of:
  - Speed
  - Flow rate
  - Pressure
  - Torque
  - Head
  - efficiency



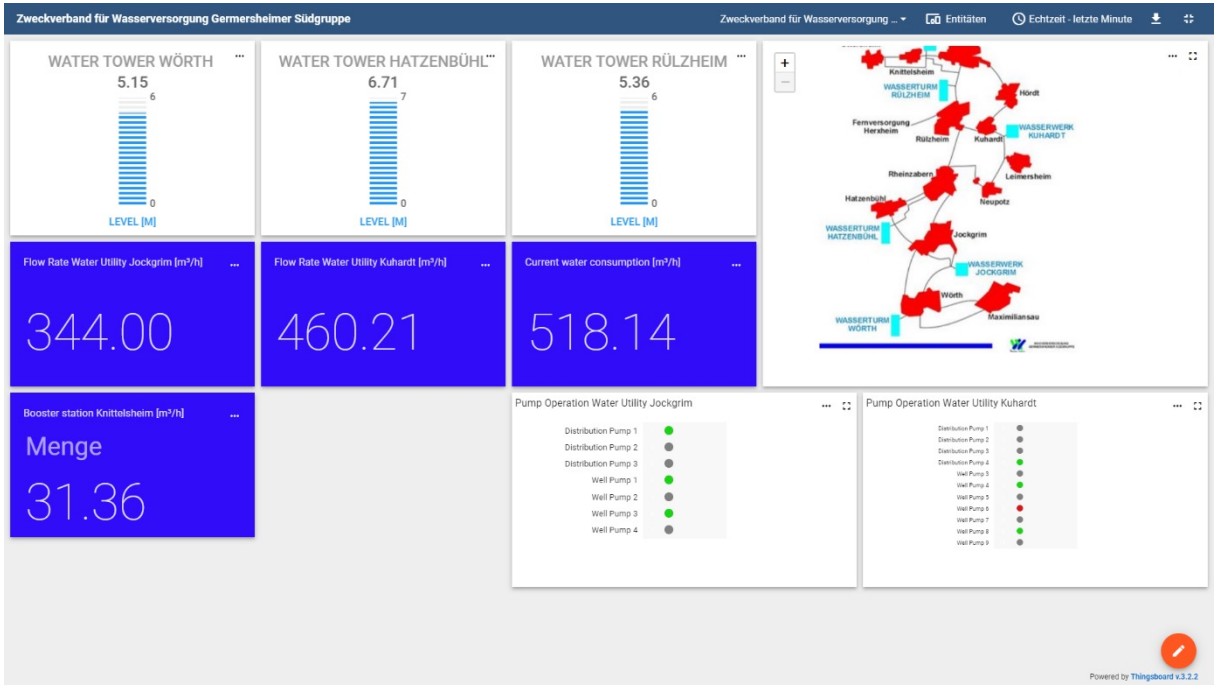
# Integration of Hydraulic Network Modelling Software Epanet

- Start of EPANET based on RPC communication
- Physical model of a water distribution system
- Comparing measurement and simulation in one tool



# Dashboard for water system of Germersheimer Südgruppe

- Combination of:
  - Data of IoT devices
  - SCADA-Data
  - Data of network simulation software
  - …



# Project partners – IoT.H2O

- RPTU Kaiserslautern-Landau, Germany,
  Institute for Fluid Mechanics and Fluid Machinery (SAM)
- Dr. Krätzig Ingenieurgesellschaft mbH (KI), Aachen, Germany
- Federal University of Minas Gerais, Brazil (CPH), Centro de Pesquisas Hidráulicas e Recursos Hídricos
- Liege University, Research group Hydraulics in Environmental and Civil Engineering (HECE), Belgium
- Institut national des sciences appliquées de Rouen, LITIS LAB, MIND Group, France

Associated partners:

- Zweckverband für Wasserversorgung Germersheimer Südgruppe
- EWR Netz GmbH

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# Backup

# Communication of LoRaWAN devices with IoT-Platform

IOT-device

LoRaWAN Gateway

LoRaWAN Server

Open-Source
software available,
e.g. The Things Stack

Node-RED

MQTT

IoT-
Platform

Internet connection (LAN, WiFI)



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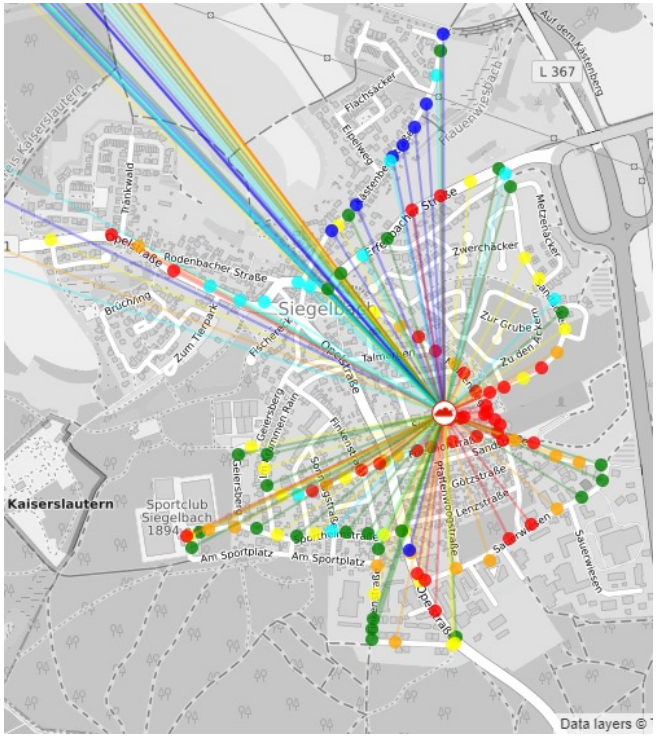
# LoRaWAN Range Test




- Temporary installation of gateway on university administration building
- Signal of IoT devices an be received within a range of approx. 5km in a direct line of sight
- Strong dependency on topography



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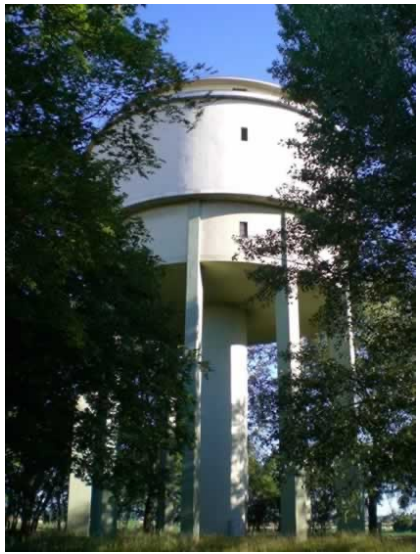
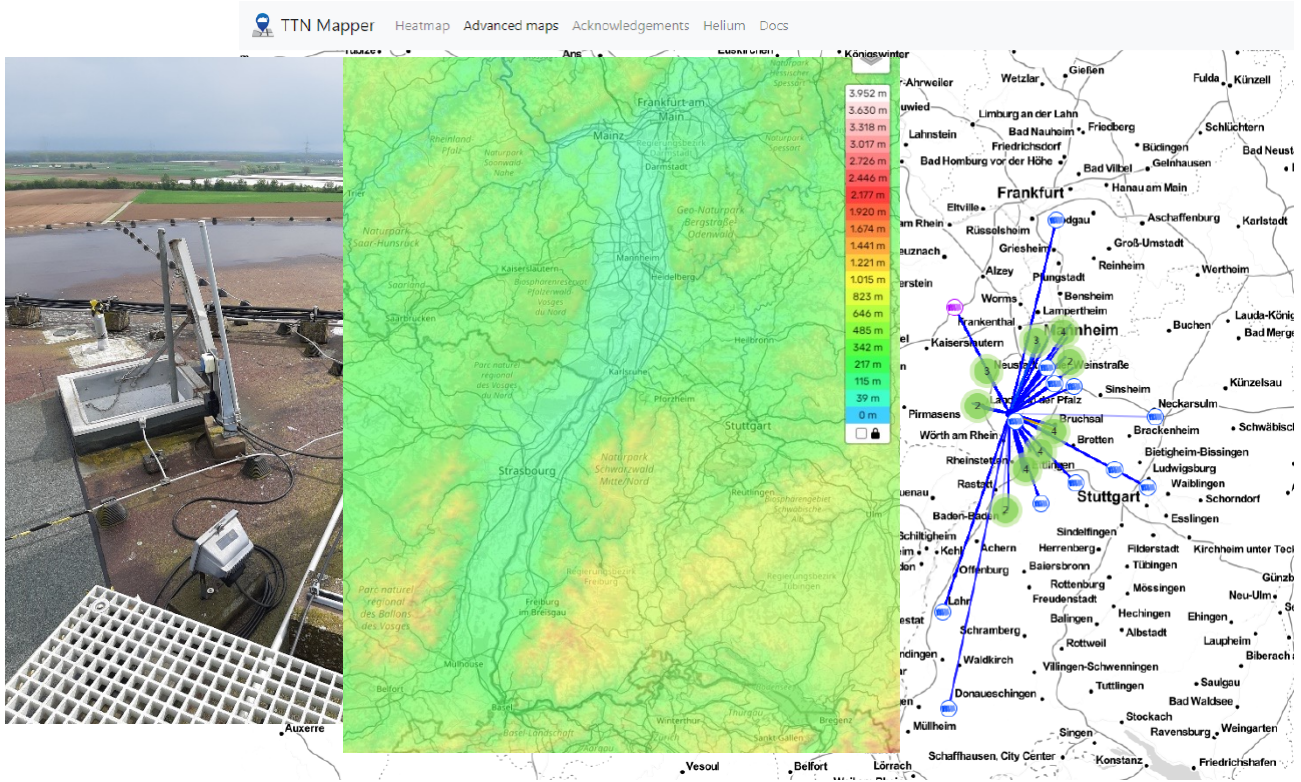
# Field deployment – water tower Rültzheim

LoRaWAN range
~145 km





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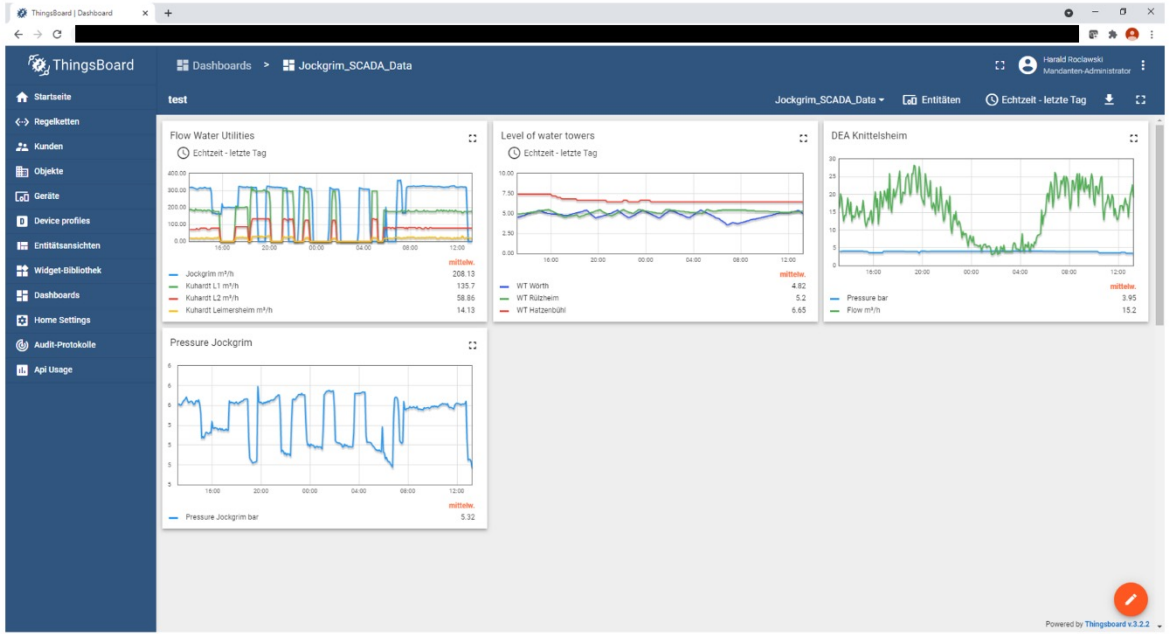
# Integration of SCADA-Data

- Raspberry PI
- library snap7 supports a direct communication with the Siemens S7 Programmable Logic Controller (PLC)
- data is read from the S7 PLC every minute and sent to Thingsboard as a JSON message by MQTT