

## GOALS

Test the end-to-end valve control system composed of low-cost components and adapted to work in the EU in an environment with high levels of noise and interference to ensure it may work successfully in city deployments in European Union.

## CHALLENGES

Set up a suitable test plan in an environment that can provide a simulation of high levels of noise and interference.

Measure the system's behavior in RF space to ensure it works in a compliant way.

## DEMO SETUP

Deployment in Log-A-Tec Testbed:

- LoRaWAN Gateway and Valve Control Node

- 24 devices of Log-A-Tec Testbed

- Noise and Interference generation

- 3 tests executed with different Noise and Interference patterns

- Results collected and logged on Application Server and Node-connected PC

- Results programmatically analysed

- Emitted power of Valve Control devices measured with Spectrum Analyser.

## RESULTS

Results of 3 tests:

1. Test with LoRaWAN devices generating interference with 1 second sending rate from multiple devices and increasing output power from 2 dBm to 14 dBm

- Visible reduction in message delivery success rate

- Reliable system operation until including 4 dBm power of interfering devices

- Very unlikely (extreme) scenario to happen in real-world environment

## MORE RESULTS

2. Test with noise generation on single and multiple center frequencies with QPSK-SIN, data rate 250 kBit, from -5 dBm to 11 dBm with central frequencies ranging from 865 to 879 MHz, as well as pre-test with no reduction in success rate where all devices had a central frequency of 868.3 MHz.

- Success rate below 90% only at 9 dBm and 11 dBm

- Never below 75% success rate; very high resiliency

3. Test with 6LoWPAN communication interference: a minor reduction of 6% in success rate when one of the 21 6LoWPAN devices was bursting multicast packages; otherwise, no impact on success rate.

We have discovered a potential for improvement of Firmware in the Valve Control Devices which can lead to increased success rates message reception. We have also proven that the Valve Control Devices behave in RF space in accordance with the expectations after being updated to work in line with the LoRaWAN specification for EU.

## CONCLUSIONS

System which is based on LoRaWAN is very resilient to different sources of noise and interference, whereas only a high amount of interference with other LoRa devices could reduce success rate, which is extremely unlikely in real-world scenario.

Improvements for firmware implementation were identified.

System behaves according to the LoRaWAN specifications (correctly).

## POST MORTEM

We are now confident that our solution may work in city environments reliably, while we even discovered room for improvement which would otherwise be discovered only once it was deployed in the nature, saving us a lot of resources for the future steps in commercialization of the system.