Review of Continuous SME Call 1st stage Experiment: Precision Agriculture With LoRa (PAWL)

PANGAEASA

Online Review

18/11/2020

- **Experiment description (max. 4 slides)**
  - Concept and objectives
  - Background and motivation
  - Experiment set-up
- **Project results (max. 3 slides)**
  - Measurements
  - Lessons learned
- **Business impact (min. 4 slides)**
  - Impact on your business, .. how did Fed4FIRE helped you ?
  - Value perceived, .. why did you come to Fed4FIRE ?
- **Feedback (min. 4 slides)**
  - Used resources and tools
  - Added value of Fed4FIRE

Experiment Description

CONCEPT

- Experiments related to energy efficiency and cost effectiveness of LoRa protocol for precision agricultural applications.
- Battery-powered IoT devices equipped with solar panel.
- Environmental sensors like air temperature/humidity, soil humidity, solar radiation etc.
- Sweet spot between regular transmissions and battery consumption.

Experiment Description

OBJECTIVES

1. Perform LoRa transmission experiments in order to evaluate the impact of the number of transmitted measurements and the polling interval to the overall battery life of the IoT device.
2. Provide insights to LoRa as an IoT technology and its feasibility in our use-cases for adoption in our company's arsenal of IoT technologies.
3. Prepare the ground of Stage 2 experiments which will be focused on the comparison with our existing ZigBee solution.
4. Extend the scope of experiments in Stage 2 in order to assess if the transition of our current GW from 3G/4G to LoRa will be cost efficient and reliable.

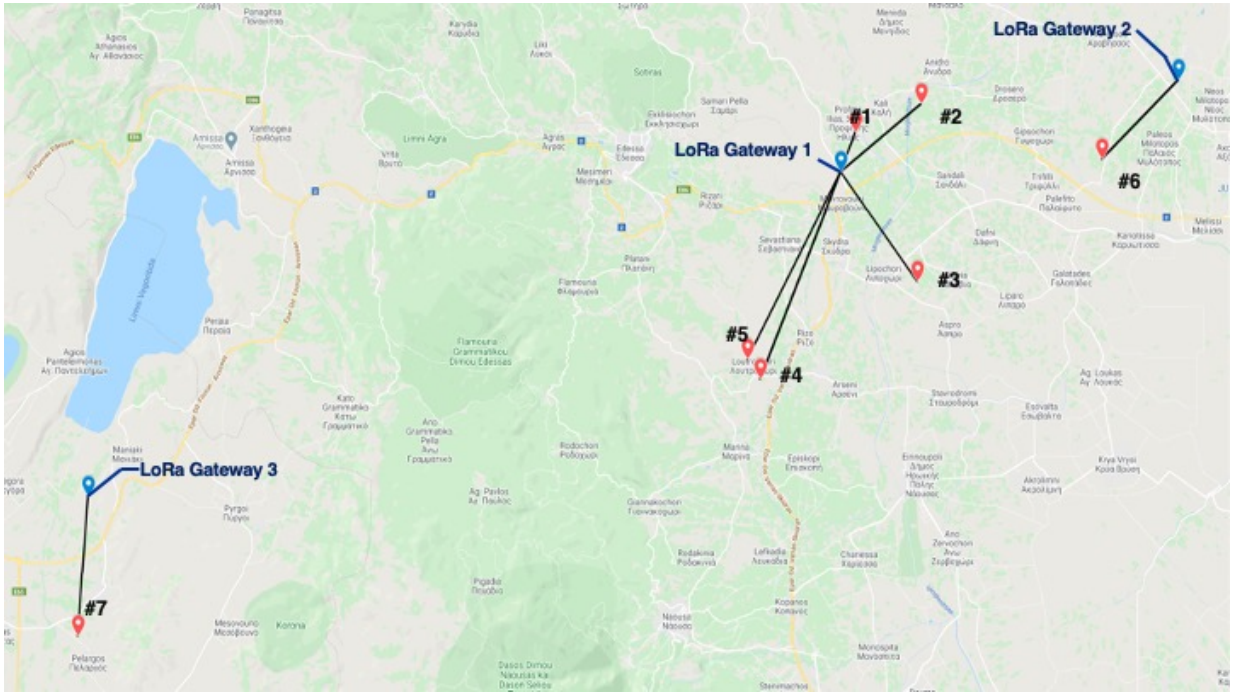
Experiment Description

BACKGROUND AND MOTIVATION

- Our company has been active in agricultural area of Thessaly in Greece, serving several farmers with tailor-made solutions for precision agriculture.
- Experiment/Consider new technologies for adoption.
- Increase cost effectiveness.
- Maintain performance and reliability.
- Experimentation in realistic environment.

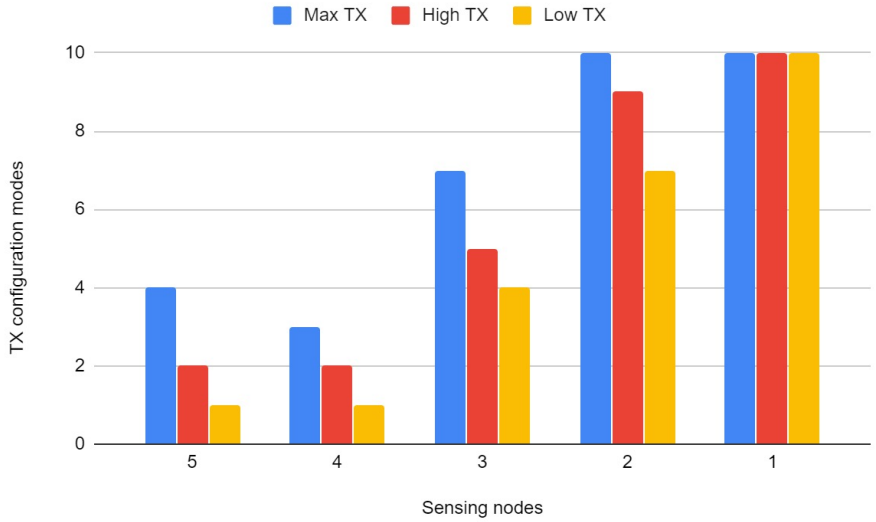
Experiment Description

NITOS AGRICULTURAL TESTBED

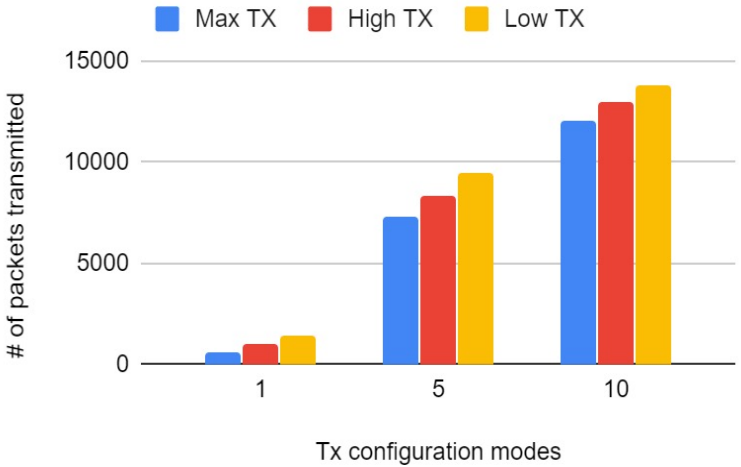


Project Results

MEASUREMENTS



Gateway #1 Connectivity



Total Transmissions per 5% of battery

Project Results

LESSONS LEARNED

- The most power consuming node can successfully send 572 packets by using 5% of its battery.
- This translates to a transmission every 2.5 minutes during a day.
- If we assume that the solar panel cannot replenish the battery for any reason, then the node can continue operating for 19 more days (20 days in total by using 5% of its battery every day).
- A realistic scenario of precision agriculture does not require updates every 2 minutes, but usually a 20-minute interval or more is used as temperature, humidity and other environmental conditions do not change so rapidly.
- That means a node performs in total 72 transmissions every day in intervals of 20-minute updates.
- In this scenario the node will use 5% of its battery in roughly 8 days, while it will need 160 days for depleting its battery if the solar panel will not be able to replenish its battery.
- The corresponding numbers for the less power consuming modes can reach up to several years of operation without the need of solar panel and given no hardware problems will occur.

Project Results

LESSONS LEARNED

- These encouraging results in terms of power autonomy, allow us to concentrate our stage-2 experiments in cost efficiency rather than power consumption and energy efficiency.

- We plan to compare LoRa modules with our existing ZigBee based solution and try to see differences in terms of connectivity, maximum range, cost of modules and make a list with pros and cons of each solution.

- Moreover, we would like to investigate LoRa as a possible backbone solution compared to our 3G/4G modules we are currently using for our gateways.

Business Impact

- With the completion of this experiment we were able to understand the autonomy of a LoRa module when it is used in an agricultural IoT node powered by battery and solar panel.
- We learnt how to use LoRa and what are the different configuration characteristics it offers like TX mode or the 3 different TX power levels.
- All this knowledge will help us towards designing and executing the experiments for the 2nd stage of our proposal.

Business Impact

- The value for our company lies in the fact that we were able to validate LoRa technology in real conditions.
- We didn’t have any prior experience with LoRa and through this experiment we are in position of considering LoRa as a candidate for replacing either our ZigBee modules or our backbone network, which is based on 3G/4G cellular technologies as a way to minimize costs for our precision agricultural solutions.
- If we could not run our experiment within Fed4FIRE+ open calls, probably we would not find the resources for R&D, like testing alternative technologies and solutions.

Business Impact

- We plan to continue our investigation on LoRa technology and perform more advanced experiments during our stage-2 proposal.
- By completing the stage-2 experiments that focus on comparing our existing ZigBee solution with LoRa, our company will gain new knowledge and a possible new technology for our products.
- We plan to compare LoRa with ZigBee solutions that promise extended communication range, like LoRa.
- If the findings are positive, then the company could provide precision agricultural solutions in even more cost-efficient model.

Business Impact

- As a small company, most of our focus is on developing and finalizing our current IoT solution which employs ZigBee and 3G/4G communication technologies. Allocating resources in testing new technologies would be rather difficult if not impossible.
- For us, being able to verify and benchmark real life solutions/implementations of LoRa products will give us the opportunity to investigate new technologies and alternatives to our current business model.

Feedback

EXPERIMENT ENVIRONMENT

- In our initial plan we had allocated 1 month for initial setup and configuration which was more than enough to set up and run our experiment. No additional components were needed.
- Having dedicated support through the Patron helped a lot to speed up processes and the experiment in general. It allowed us to focus on more critical components of our experiment.
- We were happy with the amount of resources and technologies provided by the different Fed4FIRE+ testbeds.
- We could evaluate LoRa transmissions in a realistic environment of agricultural fields in a reproducible way.

Feedback

ADDED VALUE OF FED4FIRE+

- We could not find any other funding opportunities that offered agricultural LoRa testbeds.
- The offering of Fed4FIRE+ enabled us to start thinking our experiment and do not worry about the deployment of LoRa nodes in realistic environment
- The diversity of available resources is possibly the most attractive characteristic of the federation as it can support a vast variety of experiments.
- Combined with the dedicated support by the testbeds, which speeds up the process of preparing and running an experiment, are the two most valuable things Fed4FIRE+ has to offer.

Feedback

WHAT IS MISSING

- Our needs were totally covered by the current tools and APIs.
- As a next step the federation or each testbed individually could think of mechanisms of orchestrating automated experiments.
- Having the testbed running your experiment for you, would have been the next level of support that someone could have expected.
- This way you focus only on describing the experiment and what you want to test to the testbed and the latter manages all the technical details for setting up and running the experiments.


Co-funded by the
European Union


Co-funded by the
Swiss Confederation

This project has received funding from the European Union's Horizon 2020 research and innovation programme, which is co-funded by the European Commission and the Swiss State Secretariat for Education, Research and Innovation, under grant agreement No 732638.

WWW.FED4FIRE.EU