Precision Agriculture With LoRa (PAWL)

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.

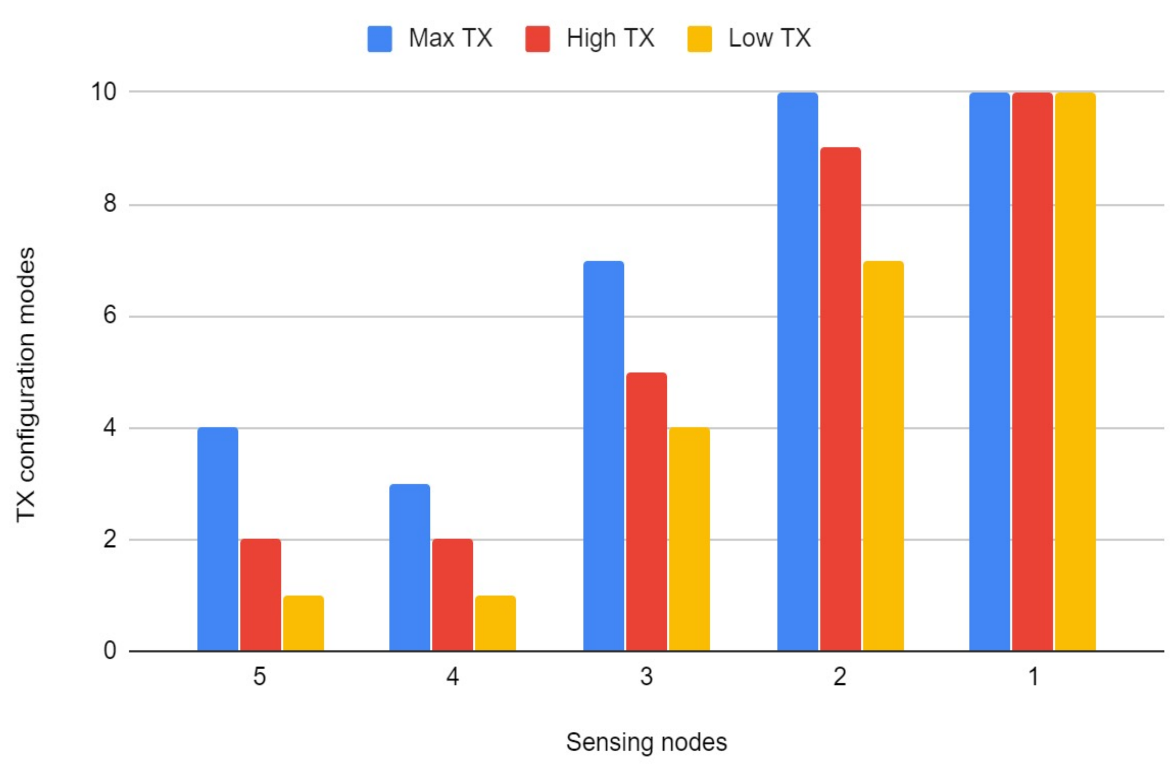
GOALS

- 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.
- 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.
- Prepare the ground of Stage 2 experiments which will be focused on the comparison with our existing ZigBee solution.
- 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.

DEMO SETUP

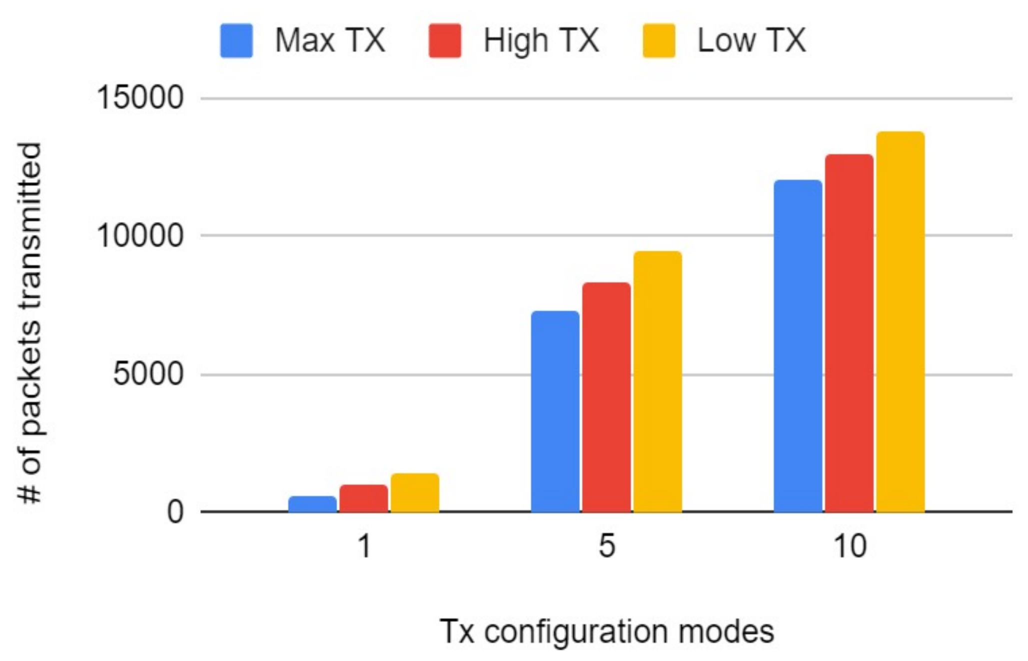
- Perform LoRa transmission experiments in order to evaluate the impact of the number of transmitted measurements and the polling interval to the overall battery life of the IoT device.
- The IoT nodes feature various sensors related with meteorological and agricultural measurements.
- The testbed offers a wide range of wireless links that differentiate in terms of communication distance, elevation and LOS/NLOS conditions.
- For each node, we also note the amount of payload bytes transmitted when transferring the respective number of sensed parameters, which includes 5 Bytes per environmental parameter plus 9 Bytes of own protocol overhead, while it does not include the LoRa preamble, header and CRC

RESULTS



Gateway #1 Connectivity

MORE RESULTS



Total Transmissions per 5% of battery

- 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.

CONCLUSIONS

- 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.

POST MORTEM

- 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.
- We plan to compare LoRa with ZigBee solutions that promise extended communication range, like LoRa.