Precision Agriculture With LoRa (PAWL)

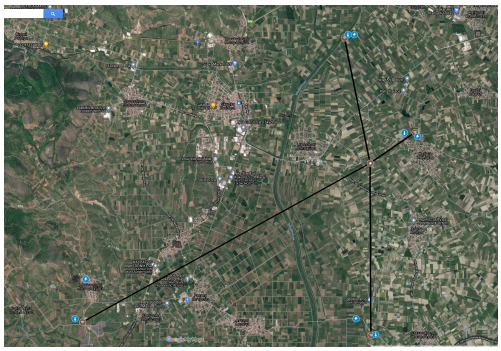
CONCEPT

- Experiments with LoRa and ZigBee.
- Precision agriculture applications.
- Installation of IoT agricultural nodes.
- Side-by-side analysis on data transmissions, coverage and power consumption.

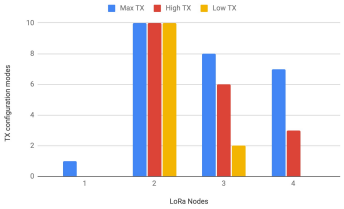
GOALS

- Install our existing ZigBee solution next to the existing LoRa nodes of the NITOS agricultural testbed.
- Conduct experiments in order to compare data rates, power consumption and coverage between ZigBee (extended range radio modules) and LoRa. The goal was to determine which one performs better in our use cases.
- Assess the cost-effectiveness of each solution based on various parameters like the number of required nodes and their costs.

DEMO SETUP



RESULTS



LoRa Nodes Connectivity

Parameter	SX1272 power level
'L'	0 dBm
'H'	7 dBm
'M'	14 dBm

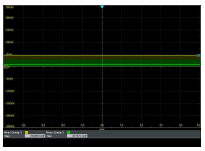
SX1272 Transmission power values

Mode	BW	CR	SF	Sensitivity (dB)	Transmission time (ms) for a 100-byte packet sent	Transmission time (ms) for a 100-byte packet sent and ACK received	Comments
1	125	4/5	12	-134	4245	5781	max range, slow data rate
2	250	4/5	12	-131	2193	3287	-
3	125	4/5	10	-129	1208	2120	-
4	500	4/5	12	-128	1167	2040	-
5	250	4/5	10	-126	674	1457	-
6	500	4/5	11	-125.5	715	1499	-
7	250	4/5	9	-123	428	1145	-
8	500	4/5	9	-120	284	970	-
9	500	4/5	8	-117	220	890	-
10	500	4/5	7	-114	186	848	min range, fast data rate, minimum battery impact

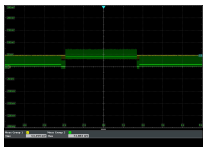
SX1272 Configuration modes

MORE RESULTS

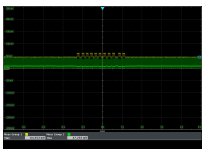
- Our Xbee radio modules could not compete to LoRa in terms of coverage, which resulted in deploying the same number of Xbee Gateways (4 in total) as the sensing nodes paired to each other.
- LoRa proves to be a more cost-effective solution compared to the Xbee solution since its extended coverage can reach up to 9km in our scenarios, while Xbee cannot cover more than 1.5km.
- Xbee could achieve data rates up to 10kbps.
- LoRa could achieve from 0.368 Kbps up to 4.304 Kbps.



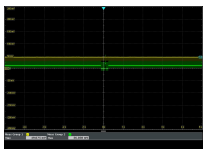
LoRa and Xbee in Receive Mode



LoRa TX mode 1



Xbee Transmitting



LoRa TX mode 10

CONCLUSIONS

- LoRa requires more power for greater coverage and lower data rates compared to Xbee.
- LoRa minimizes the need of additional Gateways, thus reducing the CAPEX and OPEX of a precision agricultural solution.
- LoRa can operate standalone with a battery and solar panel.
- LoRa radio module can be put to sleep mode.

POST MORTEM

- The offering of Fed4FIRE+ enabled us to start thinking our experiment and do not worry about the deployment of LoRa nodes in realistic environment.
- 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.