Long Range Internet of Things for Emergency Notification Systems LoRIT

Dariusz Janusek

PerProt

F4Fp – SME – LoRIT

November 20, 2020

Motivation

EMERGENCY NOTIFICATION SYSTEM

Disaster leads to massive damage

Current communication systems require complex terrestrial infrastructure and/or short-range radio transmission

secure radio transmission of data from sensors over long distances enable reliable operation without terrestrial infrastructure

The occurrence of a disaster causes a particular threat to the survival of ground infrastructure

Objectives

LORA PARAMETERS

Transmit Power from −4 dBm to 20 dBm, with a step of 1 dB

Carrier frequency from 137MHz to 1020MHz with a step of 61Hz

Spreading factor from 6 to 12

Bandwidth from 7.8 kHz to 500 kHz

Coding rate 4/5, 4/6, 4/7 or 4/8

6,720 possible parameter settings

Proper configuration determines the **reliability of communication, transmission range, resistance to interference, power consumption and the airtime to transmit a data packet**

The development of an algorithm for automatic and autonomous **adjustment of radio parameters** of the LoRa link in such a way as to optimize the power consumption of the device, and most importantly, to **ensure reliable communication**

the aim of the experiment

Experiment set-up

CityLab testbed

campus of the University of Antwerp/imec

Node3: approximately 3 meters above ground

Node2: highest rooftop of the 4-storey building

Node7: approximately 4 meters above the street

Node14: on the roof of the building

Node20: on the roof of the building

Node24: on the roof of the building

Node33: at the City Campus' Inner Square, roughly 5 meters high

Three parameters were modified:

- transmit power (0dBm, 3dBm, 7dBm, 10dBm, 14dBm, 17dBm, and 20dBm)
- spreading factor (SF7, SF8, SF9, SF10, SF11, and SF12)
- bandwidth (125kHz, 250kHz, and 500kHz)

Three parameters were analyzed:

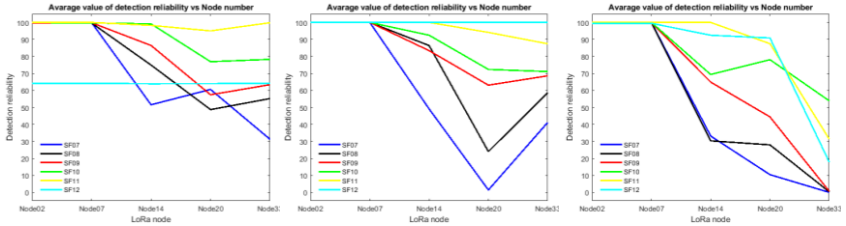
- communication reliability,
- radio signal strength indicator (RSSI),
- and signal to noise ratio (SNR).

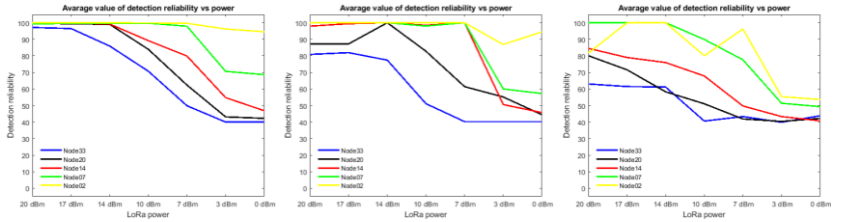
Single measurement session included 300 data packages.

measurements

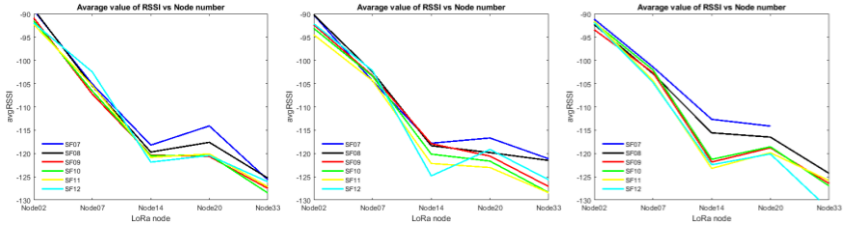
Measurements

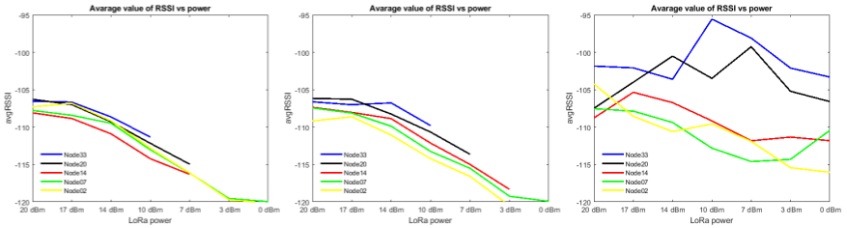
Packet Delivery Ratio



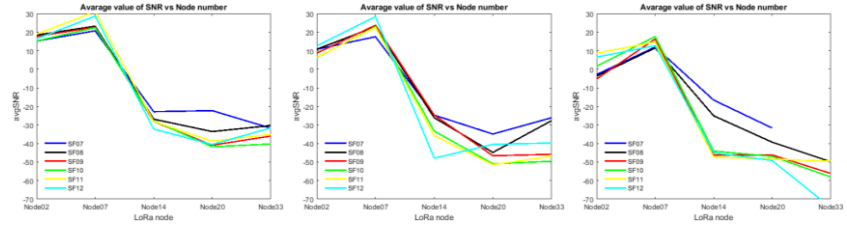


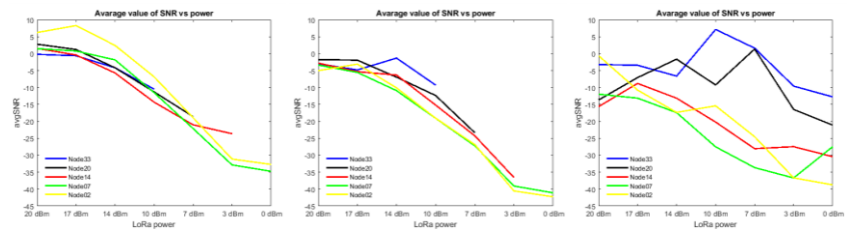
Radio Signal Strength Indicator





Signal to Noise Ratio





communication reliability good for narrow bandwidth and high spreading factor values

transmit power does not have as strong influence on communication reliability as it was in case of propagation conditions (for different locations of the nodes)

RSSI and SNR coefficients are strongly dependent on the propagation conditions spreading factor and transmit power

lessons learned

new practical knowledge about the functioning of the LoRa system

impact of the radio parameters on the reliability of communication in urban environment

The results of experiment carried out in CityLab testbed provided unique data for our company

A new algorithm for the automatic selection of optimal radio parameters of the LoRa link was developed

knowledge and experience are necessary to become a leader in the radio-electronics industry

BUSINESS IMPACT

Thanks to Fed4FIRE we started development of the LoRa based intelligent radio transceivers equipped with Artificial Intelligence, and dedicated for:

- **Emergency Notification Systems** used in the event of environmental disasters, war operation, and terrorist attacks
- **Security Systems** to ensure security of objects of special importance
- **Drone based IoT Systems**

reliable data transmission systems authorized to send confidential and secret information

BUSINESS IMPACT

Without Fed4FIRE:

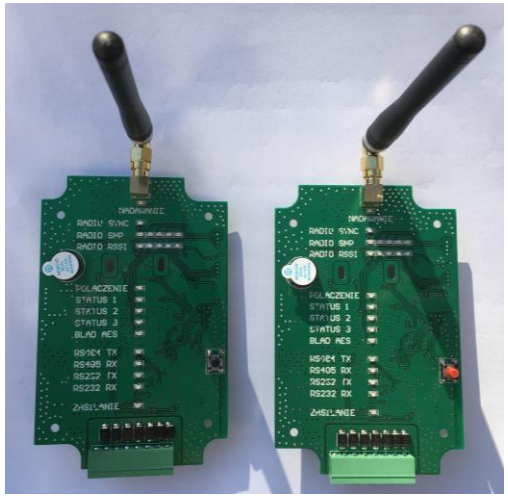
- ➢ expensive measurements in urban environment
- ➢ problem with access to radio stations at fixed positions for long time
- ➢ extended new product development time

With Fed4FIRE:

- ➢ accelerated process of development of new a product
- ➢ no need to build the entire measurement environment

value perceived

The new knowledge obtained during experiment was one of the key factors thanks to which we started a long-term cooperation with security systems manufacture



proprietary prototype of the LoRa-based transceiver

value perceived

CityLab testbed resources:

- network of nodes of LoRa transceivers in urban environment
- 24/7 available and operational (software and hardware)
- remote access
- easy and fast procedure to setup the experiment with use of JFed software
- automatic notification about the status of the experiment

feedback

LoRa link quality testing environment:

- user friendly and straightforward
- easy change of the measurement scenario
- remote node access via a SSH terminal
- documentation need improvement
- easy access to GitHub repository with appropriate software
- map visualization of available nodes

feedback

Fed4FIRE offered an experimental platform and tools that were fully sufficient to perform the experiment by our company

Access to financial support allowed to conduct the experiment in the CityLab testbed environment

Very quick, competent and professional support from CityLab stuff

All the competences that allow the company to conduct the experiment located in one place

feedback

We highly appreciate the competence and professionalism of CityLab team support

With the CityLab support we were able to start and run the experiment very quickly

feedback


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

PerProt