TECHNISCHE UNIVERSITÄT
ILMENAU

Prof. (Jun.-Prof.) Dr. Florian Klingler
IoT Engineering
Website: www.tu-ilmenau.de/iot

RESEARCH PROJECT

Localization System in LoRa Wireless Networks

Motivation and Background

LoRa, short for Long Range, is a wireless technology known for its capacity to transmit small data payloads across large distances. Positioned as a cornerstone within low power wide area (LPWA) networks, LoRa plays a pivotal role in facilitating Massive IoT by catering to the specific requirements of low-power, battery-operated devices within the expanding IoT ecosystem. LPWA networks are categorized into two primary classifications. On one hand, there exists cellular LPWA, which harnesses the capabilities of mobile networks, including technologies such as Narrowband IoT (NB-IoT) and Long Term Machine Type Communications (LTE-M). In contrast, LoRa operates as a non-cellular LPWA network, utilizing various frequency channels and data rates to disseminate information via encoded packets.

LoRaWAN (LoRa Wide Area Network) serves as the network protocol responsible for connecting the LoRa signal, which carries sensor data, to the relevant applications [2]. Essentially, while LoRa represents the radio signal transmitting the data, LoRaWAN manages the communication protocol governing the transmission of this data throughout the network. The primary advantages of LoRaWAN lie in its provision of low-power, extensive range, and cost-effective connectivity for devices that do not demand high data transmission rates. It stands as an alternative to cellular connectivity when it proves too expensive or when Wi-Fi coverage remains inaccessible.

Research Project Goals

The objective of this research endeavor is to calculate and estimate the distances between network nodes within a network system [1]. The aim is to equip the system with spatial awareness of these nodes. This can further enhance the efficiency of data routing across the network [3]. To achieve these objectives, the project should utilize OMNeT++ network simulator assisted by FLoRa (Framework for LoRa), which is a simulation framework.

Milestones

- Read through scientific literature and standards for comprehensive understanding of LoRaWAN.
- Get familiar with a simulation tool and framework (e.g., based on OMNeT++) and statistics software (e.g., R).
- Use built INET models and orchestrate the same for simulating the network.
- Detailed report on results of the performed study.

Required knowledge (or willing to learn)

- A programming or scripting language (e.g., Python, R)
- Basic knowledge of C++ for handling OMNeT++ simulations.
- Scientific literature review, and writing.

References

[1] I. Aqeel, E. Iorkyase, H. M. Zangoti, C. Tachtatzis, R. Atkinson, and I. Aondonovic. Lorawan implemented node localisation based on received signal strength indicator. *IET Wireless Sensor Systems*, 13:117–132, 2022.

[2] J. Haxhibeqiri, E. De Poorter, I. Moerman, and J. Hoebeke. A survey of lorawan for iot: From technology to application. *Sensors*, 18:3995, 11 2018.

[3] R. M. Liaqat, P. Branch, and J. But. Lora based linear network applications, design considerations and open challenges: A review. In *Proceedings of the 20th ACM Conference on Embedded Networked Sensor Systems*, SenSys '22, page 913917, New York, NY, USA, 2023. Association for Computing Machinery.

Contact:
Florian Klingler: <florian.klingler@tu-ilmenau.de>

Website:
www.wnc-labs.org