Capacity Enhancement of LoRa Networks using Successive Interference Cancellation

Project Overview:

LoRa is a long-range energy-efficient patented modulation drastically used in the field of Internet of Things (IoT) especially in the low power wide area networks (LP-WAN) applications within smart cities. LoRa is a patented chirp spread spectrum modulation which has recently gained a huge interest both in research and practically. The number of counties with LoRaWAN deployments is fast approaching 150 countries (currently standing at 142 countries)[1]. LoRa adopts the ALOHA medium access which results in multiple inevitable collisions that limit the LoRa capacity. However, the patented LoRa modulation has inherent potential for strong capture capabilities to survive some co-technology interference.

This project aims at enhancing the LoRa capacity by practically decoding both interfering LoRa packets. The stronger received packet is first captured by the receiver, then interference cancellation takes place in order to receive the other weaker packet.

In addition, the Interleaved Chirp Spreading LoRa (ICS-LoRa) is a newly developed LoRa based modulation which results from the interleaving of the nominal LoRa chirps. The ICS-LoRa chirp signals possess good correlation properties with the LoRa chirp signals. Thus, decoding a LoRa packet interfered by an ICS-LoRa packet result in better BER performance compared to a LoRa packet interfered by another LoRa packet. This needs to be evaluated and assured practically in this project.

Project Expected Results:

The project results are not only simulations but also practically implementing it over a software-defined radio (**SDR**) platform using the python software and the USRP devices present in our labs at the GUC campus. SDR is a radio in which some or all of the radio functionalities are software defined. This provides practical and more reliable results compared to simulations. Moreover, the commercial LoRa chip (which is also present in our GUC labs) will be also used to test its receiving capabilities of both interfering packets.

It would be highly preferable to write a **conference paper** at the end of this project.

Eligible Departments:

Communications	√

[1] https://lora-alliance.org/

Faculty of Information Engineering & Technology, IET
B.Sc. Thesis Summary

Software/Hardware:

Software: Python

Hardware: USRP, and the commercial Dragino LoRa Shield chip

Relevant References:

1. T. Elshabrawy and J. Robert, “Interleaved chirp spreading lora-based modulation,” IEEE Internet of Things Journal, vol. 6, no. 2, pp. 3855–3863, April 2019.
2. P. Edward, S. Elzeiny, M. Ashour, and T. Elshabrawy, “On the coexistence of lora- and interleaved chirp spreading lora-based modulations,” in 2019 International Conference on Wireless and Mobile Computing, Networking and Communications (WiMob), Oct 2019, pp. 1–6.
3. P. Edward, A. Muhammad, S. Elzeiny, M. Ashour, T. Elshabrawy and J. Robert, "Enhancing the Capture Capabilities of LoRa Receivers," SmartNets 2019; 2019 International Conference on Smart Applications, Communications and Networking, Sharm El Sheikh, Egypt, 2019, accepted and pending publishing.

Pre-requisites:

Wireless Communications, Modulation I, Modulation II, Python programming is a plus

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