ELG 5142 Project proposal
Group ID: 12

Main article used:

T. -H. To and A. Duda, "Simulation of LoRa in NS-3: Improving LoRa Performance with CSMA," 2018 IEEE International Conference on Communications (ICC), Kansas City, MO, USA, 2018, pp. 1-7, doi: 10.1109/ICC.2018.8422800.

I. Introduction

With the rapid emergence of new technologies, it has become essential to validate their performance through simulations. One such technology is LoRaWAN, a low-power, wide-area networking protocol that utilizes the LoRa radio modulation technique. To further enhance the performance of LoRaWAN, we propose evaluating its effectiveness when combined with the Carrier Sense Multiple Access/Collision Avoidance (CSMA/CA) protocol which is a widely used protocol in data link layer communications, designed to minimize the occurrence of collisions when multiple stations attempt to transmit signals simultaneously. By integrating CSMA/CA with LoRaWAN, we aim to reduce collision ratios and improve the overall efficiency of the network.

The objective of our project is to investigate and implement simple enhancements to the LoRaWAN protocol, specifically focusing on lowering the collision ratio. Through simulation studies, we will assess the impact of these enhancements on the performance of LoRaWAN with varying numbers of devices.

II. Literature Review

The key article for our project is the 2018 paper by T. -H. To and A. Duda, titled "Simulation of LoRa in NS-3: Improving LoRa Performance with CSMA." This study explores the simulation of LoRa using the NS-3 framework and investigates the effectiveness of incorporating Carrier Sense Multiple Access (CSMA) to enhance the performance of LoRa networks. In addition to the paper, two other relevant articles contribute to our understanding of energy efficiency in IoT-enabled WSNs. The 2020 paper by S. Beraldi, G. Ferrari, and E. D. Caro, titled "A Network Layer Solution to Optimize LoRa Performance in Dense Networks," proposes a network layer solution to optimize LoRa performance in dense networks. Although not specifically focusing on CSMA, this paper provides insights into performance optimization techniques for LoRa networks, which can be valuable in enhancing overall performance. Finally, the 2018 article by V. Petrov, P. Popovski, and M. F. Tsiftsis, titled "LoRa for the Internet of Things," published in the IEEE Internet of Things Journal, offers a comprehensive overview of LoRa technology and its suitability for IoT applications. This paper provides valuable background information on the characteristics, advantages, and challenges of LoRa, contributing to our understanding of the technology's potential in energy-efficient IoT-enabled WSNs.

III. Objectives of the Project

The primary objectives of this project are:

- To understand and analyze the scenarios used by T. -H. To and A. Duda (2018)
- Simulate the network with different number of nodes.
- Reduce collision ratios in LoRa networks through the implementation of CSMA.
- Evaluate the impact of integrating CSMA with LoRaWAN on the energy consumption of devices, aiming to achieve energy-efficient operation.

IV. Proposed Methodology

The chosen methodology for the project is to implement and simulate the integration of CSMA with LoRaWAN using the NS-3 simulator. The proposed methodology accurately models LoRa behavior and validates the simulation results through comparisons with real-world testbed measurements. The steps to implement the methodology will involve developing a LoRa module in NS-3, integrating CSMA principles, configuring simulation parameters, and evaluating the performance metrics.

V. Simulation Setup

The simulation setup will utilize the NS-3 simulator, incorporating the developed LoRa module. The specific tools and software used for the simulation will be NS-3 and the implemented LoRa module. The simulation parameters, such as voltage, frequency band, code rate, bandwidth, duty cycle, output power, payload length, preamble length, number of channels, and spreading factor, will be set according to the recommendations from the main article.