Rethinking LoRa Network Design: Overcoming Star Topology Limitations with Mesh Architecture

CEMSE Division - Communication Theory Lab
Ruba Alqahtani, Ghala Alqasem, Salah Abdeljabar, Mohamed-Slim Alouini
King Abdullah University of Science and Technology

جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Introduction

- Long-Range (LoRa) is a wireless communication technology designed for the Internet of Things (IoT), enabling battery-powered devices to transmit small amounts of data to a receiver over long distances by using lower bandwidth and slower data rates.
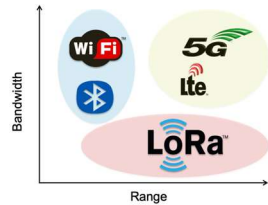
Figure 1: Wireless technologies

LoRaWAN Architecture

- LoRaWAN is the most used LoRa architecture nowadays. This architecture is a network protocol built on top of LoRa, using a star topology.
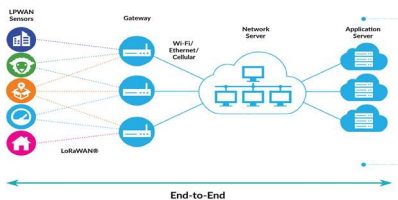- The LoRaWAN architecture consists of end-nodes, gateways, and a network server.

Figure 2: LoRaWAN Network

LoRa Star VS Mesh Topologies

- LoRaWAN faces several challenges in terms of coverage, node flexibility, and reliability.
- To overcome the limitations of the LoRaWAN model, Multi-hop LoRaMesh model was developed.
- In this model, nodes communicate with each other, and some serve as relay nodes that forward packets like routers.
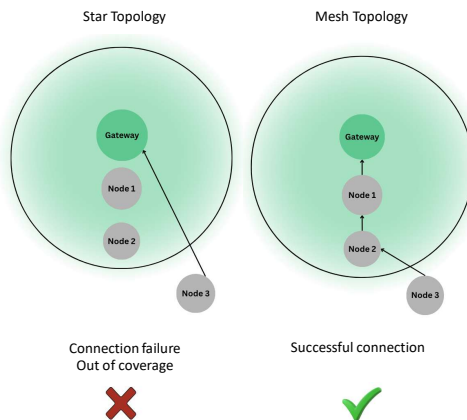
Figure 3: Star VS Mesh

Simulation

- To evaluate the effectiveness of LoRa-Mesh networking, we carried out a simulation study using **Meshtasticator**, an open-source platform that allows the representation of multi-hop networks and the analysis of results.
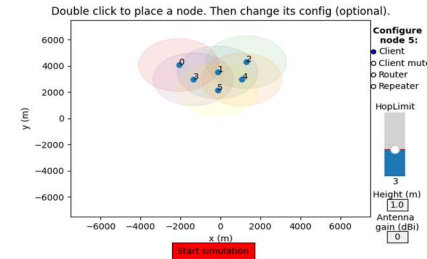- Flooding (broadcasting) was employed.

Figure 4

- As shown in **Figure 4**, six nodes were placed in a semi-hierarchical shape. Node 1 and Node 5 represent routers to enhance the coverage.
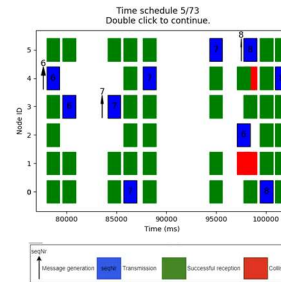
Figure 5: Time Schedule

Results

- Performance metrics were evaluated by increasing the number of nodes (up to 30).
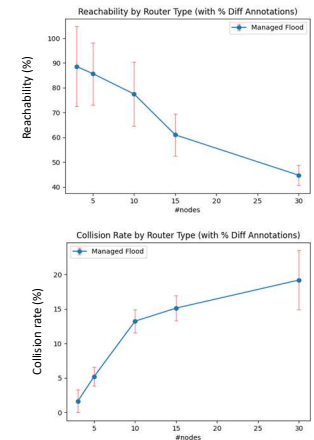- Increasing the number of nodes affects reachability and collision rates.

Figure 6: Simulation Results

Conclusion

- Current LoRa architecture suffers from several limitations.
- LoRa-Mesh networking presents a promising solution to improve the coverage and communication efficiency of LoRa networks, especially in rural or difficult-to-reach areas.
- Scan the QR code to access the list of supporting materials behind this study.