Optimizing IoT Connectivity: A Field Study on LoRa Technology

Satya Sai Siva Rama Krishna Akula, Sumanth Dasari ,ShashiKumar Pannala, Lakshmi Gayathri Garikapati, Sindhu Reddy Alva, Neha Gatla, Lakshmi Durga Goduguluri

Advisor: Dr. Sejun Song, University of Missouri – Kansas City

Objective:

LoRa (Long Range) technology is a wireless communication protocol designed for long-range, low-power applications, especially suitable for the Internet of Things (IoT). Its Applications are Smart cities, agriculture, industrial IoT, and environmental monitoring. The motivation for adopting LoRa technology arises from the growing need for dependable, long-range connectivity in IoT applications. Unlike Wi-Fi and cellular networks, LoRa provides a solution that balances extended communication range, low power consumption, and cost-effectiveness, making it an ideal choice for widespread IoT deployment.

Current challenges

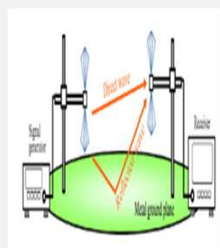
- Existing wireless technologies, such as Wi-Fi and cellular networks, often struggle to provide sufficient coverage over extended distances.
- Many traditional wireless communication technologies are characterized by high power consumption, which can be a significant drawback for IoT devices, particularly those powered by batteries.

LoRa Solutions for Wireless Challenges

- LoRa surpasses traditional wireless technologies in providing long-range communication.
- Enables connectivity in areas with challenging geographical footprints, addressing limitations of current technologies.
- LoRa prioritizes energy efficiency, allowing devices to operate on minimal power resources.

LoRa Range Measurement Testing Overview

- Measure how far LoRa signals can travel in different places. Configure the LoRa Devices of Both Sender and The Receiver. Set up LoRa with consistent settings for a fair test.
- Measure signal strength and analyze tools for reliability.
- Check signal range in clear sight and real-world environments.
- Record signal strength and reliability at different distances.Repeat tests with different settings to observe their impact.
- Check how LoRa handles interference sources.

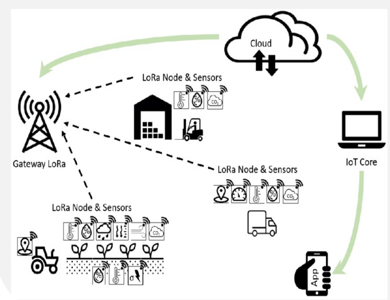


Results

Setup	Max Range (Successful Com > 70% times)	RSSI	SNR
Theoretical Limits (Optional)		None	None
Without Obstacles (Open Space)	60cm to 120 cm	-125	-9
Without Obstacles (Closed Space)	60cm to 120 cm	-125	-9
Without Obstacles (Metal Ground)	30 cm - 80 cm	-112	-7
With Obstacles (Open Space)	27cm to 85 cm	-110	-5
With Obstacles (Closed Space)	35cm to 55cm	-105	-3
With Obstacles (Metal Ground)	30cm - 40 cm	-117	-8

WORKING OF LoRa

1. LoRa uses a special method called Chirp Spread Spectrum (CSS) for communication.
2. CSS helps the signal resist interference and travel over long distances.
3. Spreading Factors (SF) control data rate and signal width, allowing for flexibility.
4. LoRa operates in global Sub-GHz bands, like 433 MHz, 868 MHz, and 915 MHz.
5. It has a network structure with nodes (devices) and gateways for data transmission.
6. Bi-directional communication supports both sending and receiving data.
7. Adaptive Data Rate adjusts parameters based on the signal, balancing efficiency and speed.
8. Low power consumption allows devices to operate on batteries for extended periods.
9. LoRa networks can scale up with more gateways and servers for diverse IoT deployments



Conclusion

- Successfully, we are able to test the LoRa device With Different Configurations
- Future work includes testing the devices for much more distance with the help of antenna

- https://github.com/saiakula997/Embedded_IoT_Project_Team-1
- https://umsystem.instructure.com/groups/102584/files/folder/Team_1_Final_Report