

Design and Implementation of a LoRa Communication System for Off-Grid Applications

Mr. Zeeshan Khan, Mr. Aktar Husain Mansoori, Mr. Tushar Porje

Final Year EEE Student

Sandip University, Nashik, India

Abstract: *Off-grid communication systems are essential for enabling connectivity in remote regions lacking conventional infrastructure. This paper presents a long-range (LoRa) point-to-point (P2P) communication system designed for applications such as environmental monitoring and asset tracking. The system integrates the Semtech SX1276 LoRa module, an ESP32 microcontroller to address challenges including limited data rates (0.3–5.5 kbps), environmental interference, and scalability. Field tests demonstrate a maximum range of 5.2 km in open environments, with a 20% reduction in urban areas due to multipath fading. By employing directional antennas and payload optimization, the system achieves a power efficiency of 1.5 μ A in sleep mode, enabling 7-day operation on a single charge. This work highlights LoRa's viability for off-grid deployments while underscoring the need for adaptive frequency allocation in congested spectra.*

Keywords: LoRa, off-grid communication, IoT, interference mitigation, P2P networks

