

## 1. User Documentation

This section of the final project report provides comprehensive user documentation for the Indoor Positioning Algorithm utilizing NB-IoT/LTE-M Systems. Aimed at future developers, researchers, and users, this documentation outlines the practical steps to understand, implement, and effectively use the developed indoor positioning system.

### 1.1. System Overview

The project delivers a robust solution for indoor positioning by integrating the precision of Observed Time Difference of Arrival (OTDOA) methodologies with the connectivity advantages of Narrowband Internet of Things (NB-IoT) and Long-Term Evolution for Machines (LTE-M) technologies. Designed to overcome the limitations of GPS in indoor environments, our system offers a new level of accuracy and efficiency in locating objects or individuals within buildings.

### 1.2. Installation and Setup

#### 1.2.1. Prerequisites:

- MATLAB environment for running simulations and adjusting the positioning algorithm.
- NB-IoT/LTE-M compatible modules and devices configured for deployment.
- A foundational knowledge of indoor positioning principles and signal processing.

#### 1.2.2. Installation Steps:

- Install MATLAB on your workstation, ensuring compatibility with the version used in project development.
- Download the project's MATLAB scripts and Simulink models from the provided repository.
- Configure your NB-IoT/LTE-M modules according to the manufacturer's instructions, ensuring they are ready for data transmission.

### 1.3. Operational Guidelines

#### 1.3.1. Running Simulations:

- Use the OTDOA\_Positioning\_Model2.slx Simulink model to simulate the indoor environment and signal processing.

- Execute the `compute_cross_correlation.m` function with your sampled signals to analyze the cross-correlation between different signal pairs.
- Generate TDOA measurements with the `generate_TDOA_measurements.m` script, using the cross-correlation results and your system's sampling frequency.

#### 1.3.2. Deployment:

- Follow the `calculate_transmitter_positions.m` script to set up transmitters within your target indoor environment.
- Collect real-world signal data and process it through the `otdoa_algorithm.m` script for position estimation, feeding in TDOA measurements, receiver positions, and the known speed of light.

#### 1.4. Troubleshooting and Support

- **Signal Processing Issues:** Ensure signal inputs are correctly formatted as vectors. Verify there are no empty or null values in your data sets.
- **Accuracy Concerns:** Re-evaluate receiver placement within the indoor environment for optimal performance. Adjust algorithm parameters to match environmental characteristics.

**System Performance:** Review NB-IoT/LTE-M module configurations for optimal signal strength and minimal interference.