

## **MapBound: A Practical & Cost-Efficient Tracking Solution for Police Officers**

### **Objective:**

To develop a state-of-the-art, cost-efficient, and energy-saving tracking solution tailored for law enforcement officers. MapBound aims to address the challenges faced in real-time monitoring during large-scale public events, such as trade fairs or religious gatherings, while ensuring seamless operations in both outdoor and closed environments.

### **Problem Statement:**

Existing tracking systems for law enforcement lack practicality, energy efficiency, and affordability. Key issues include:

- Officers leaving designated posts during event monitoring (like trade fairs).
- Energy-intensive tracking devices that are unsuitable for prolonged operations.
- Poor signal reliability in crowded or enclosed areas due to GPS or cellular network limitations.

### **Proposed Solution:**

The MapBound system is built on two key components in order to overcome specific challenges:

#### **1. Mobile-Based Tracking with NAVIC:**

- Utilized the indigenous NAVIC satellite navigation system for high-precision location tracking.
- Integrated a mobile app for real-time monitoring, ensuring officer safety and consistent tracking.

#### **Advantages:**

- Independence from external GPS systems
- Enhanced compatibility with regional mobile networks

#### **2. LoRa-Based Band for Enclosed Areas:**

- Deployed LoRaWAN technology for energy-efficient and long-range tracking in challenging environments.
- Officers equipped with lightweight LoRa transmitters that operate effectively in crowded or obstructed spaces.

#### **Advantages:**

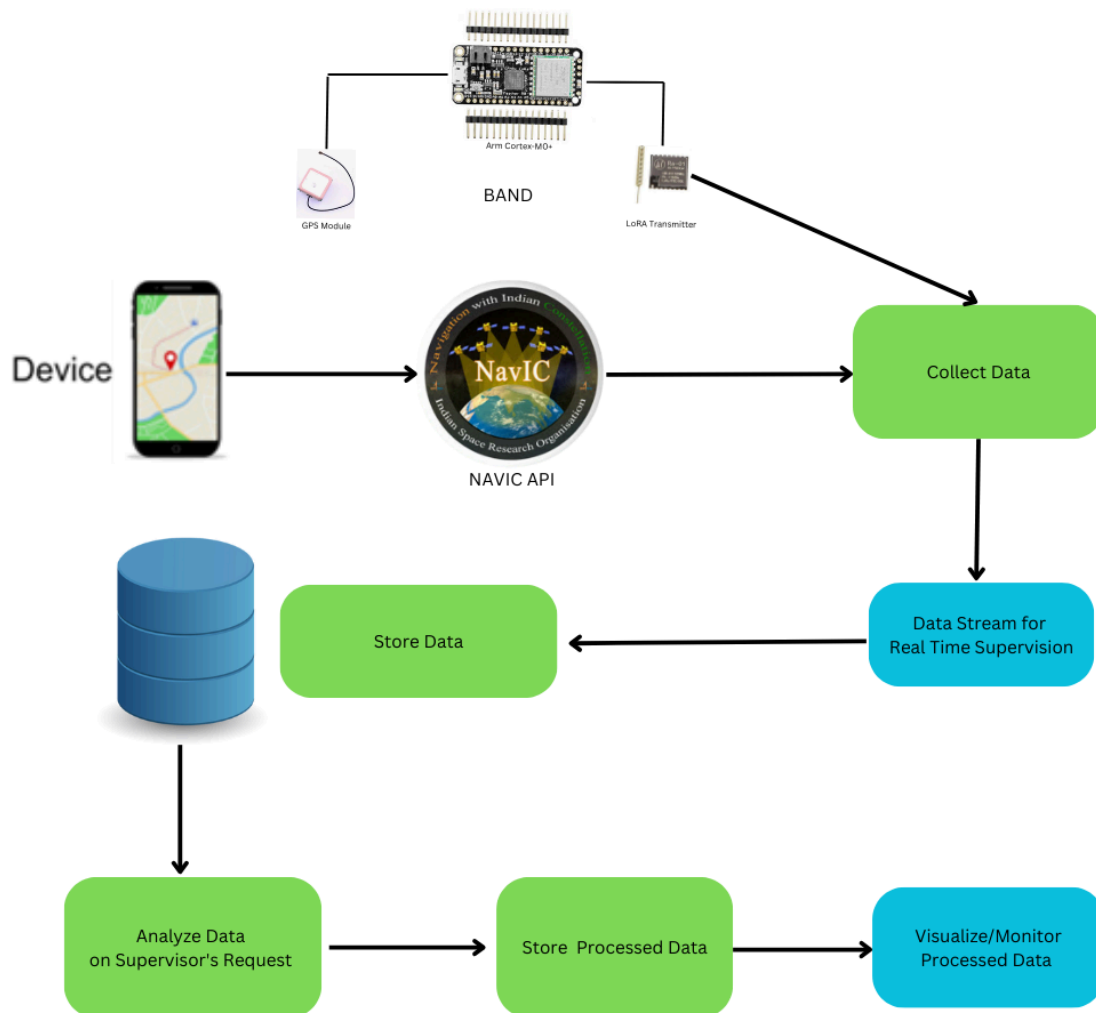
- Low power consumption/extended battery life
- Operation without direct line of sight

### Data Pipeline and Competitive Advantage:

Integrated a robust data pipeline combining NAVIC and LoRaWAN to optimize officer tracking and monitoring.

Overcame limitations of existing solutions by:

- Utilizing low-powered microcontrollers like ARM Cortex-M0+, ensuring extended battery life.
- Implementing cost-efficient hardware designs to reduce operational expenses.
- Providing advanced geofencing alerts with algorithms like Point-in-Polygon.



**Future Scope:**

MapBound has strong potential for scalability and technological enhancement, including:

- Adding hardware encryption for physical device security.
- Designing cost-efficient LoRa receivers with Forward Error Correction (FEC) to enhance signal reliability.
- Extending LoRa trackers for city-wide use by integrating them with existing cellular infrastructure.

**Conclusion:**

MapBound provides a cutting-edge, cost-effective tracking solution that addresses the specific needs of law enforcement officers. By integrating advanced satellite navigation, energy-efficient technologies, and robust data analytics, the system ensures real-time monitoring, officer safety, and operational efficiency during large-scale public events.