The Bluetooth Low Energy (BLE) Beacon system operates by establishing a **low-power indoor infrastructure** that constantly broadcasts signals, which are then interpreted by receiving devices (like smartphones or gateways) to determine location, proximity, or monitor environmental conditions.

The sources detail the system's operation through three main components: the beacon hardware (technical core), the constant signal broadcasting, and the application-level interpretation (operational output).

Technical Functioning (The Beacon and the Signal)

At its core, the beacon is a low-power hardware device designed for reliable, maintenance-free operation.

1. Hardware and Connectivity

- **Chipsets and Bluetooth:** Rapidise beacons utilize either Inplay (IN100 D1 or Q1) or Nordic (nRF52805 or nRF52820) chipsets. These chips facilitate communication using **Bluetooth 5.3** or earlier standards, offering up to a **100m range** in open areas.
- **Power Efficiency:** The beacons are powered by non-rechargeable Li-ion coin cell batteries (CR2032 or CR2450) and are optimized for low power consumption, allowing for a typical lifespan of **3+ years**.
- **Advertising (The Signal):** The beacon's primary function is to continuously broadcast an **Advertising (ADV) packet** at set intervals (default is 5 seconds). This broadcast signal is the source of all system data.

2. Signal Content and Formats

The information broadcasted is packaged into various standardized formats:

- **Standard Formats:** All Rapidise models support **Apple iBeacon** and **Google Eddystone** formats (including UID, URL, and TLM). Custom formats are also supported.
- **Location Data:** The beacon broadcasts the **RSSI (Received Signal Strength Indicator) value** within the ADV packet. This is essential for **indoor location tracking through a gateway** or mobile application.
- **Sensor Data:** Advanced models (N2, N4) include real-time sensor data in the ADV packet:

    - The N2 broadcasts **Temperature & Humidity sensor data** every 5 seconds (default).
    - The N4 broadcasts sensor data (including Temperature, Humidity, and Light) every 10 seconds (customizable).
    - The N4 can also broadcast **SOS packets** if the PCB-mounted button is pressed.
- **System Status:** The **Battery voltage (%)** is also broadcasted in the ADV packet, ensuring maintenance-free operation and easy monitoring of battery status.

Operational Functioning (Data Processing and Application)

Operationally, the system uses the beacon infrastructure (or network) to solve specific business problems by translating raw signal data into actionable intelligence.

1. Positioning and Navigation

The core operational mechanism is trilateration or fingerprinting based on RSSI values:

- **Detection and Positioning:** A mobile application (such as the AIIMS Jammu Navigation Application) or a fixed gateway detects the signals of nearby beacons. The application then calculates the user's location based on the strength of these multiple beacon signals (RSSI values).
- **Real-Time Output:** This process provides **real-time accurate directions**. In the AIIMS Jammu case study, the deployment of over **1,000 Rapidise BLE beacons** achieved **sub-2m indoor positioning accuracy**.
- **Features:** Operational features include **Real-Time Positioning Accuracy** and **Accessibility-Optimized Routing** (which considers ramps and elevators).

2. Asset Tracking and Monitoring

Beacons deliver **real-time visibility, ROI, and control**.

- **Asset Tracking:** By affixing beacons to assets, their constant ADV packets allow efficient management, tracking movement, and preventing loss, helping to resolve the problem of "Invisible Assets".
- **Environmental Monitoring:** Models like the N2 and N4 enable the real-time tracking of temperature and humidity. This capability is critical for environments like the cold chain, helping to address the risk of spoilage of temperature-sensitive goods.

3. Customization and Maintenance

While many models (N1, N2, N3, N14) are designed for fixed, non-configurable firmware, the N4 model allows for flexible operational adjustments:

- **Configuration:** The N4 (and N3) can be configured using an **Android application** to customize parameters like beacon name, Tx power, advertising format, and interval.
- **Over-the-Air (OTA) Updates:** The N4 supports **Nordic DFU (Device Firmware Update) OTA**, allowing firmware updates to be pushed remotely, providing operational flexibility.
- **Safety Features:** The N4's Integrated IMU (Inertial Measurement Unit) enables operational features like **Motion Detection** and **Fall Detection**, supporting enhanced safety and security use cases.

In summary, the beacon system works like a **digital constellation** inside a building: each beacon is a small, steady star broadcasting its unique location signal. A smartphone acts as a **telescope** that measures the strength of these "starlight" signals, allowing the application (the navigational map) to pinpoint the user's exact position on the ground.