Project Report: CBR3A – UB Site

Activity 1

Testing BLE Beacon Performance with and without a Metal Box

Design

The test was designed to evaluate the performance of a BLE beacon both inside and outside a metal box, simulating conditions where the beacon represents a device within a bus. The beacon was configured to operate at its maximum Tx power, and its connectivity to a BLE scanner was monitored to assess signal strength and data transmission reliability under both conditions.

Method

To conduct the test, a BLE scanner application was used alongside a BLE beacon configured to transmit at its maximum power. The beacon was placed inside a metal box to simulate its placement within a bus and then tested again outside the box for comparison. The BLE scanner recorded signal strength, connectivity stability, and packet loss rates for both scenarios. This approach ensured that the data captured reflected realistic operating conditions for the beacon in a typical IoT setup.

Implementation

The experiment began by positioning the BLE scanner at fixed intervals from the beacon. For the first scenario, the beacon was placed outside the metal box, and signal performance metrics were recorded. In the second scenario, the beacon was placed inside the metal box, and the same metrics were collected. Both setups utilized the beacon’s maximum transmission power to ensure consistency in the results.

Experiment

Distance	Beacon On Box	Rssi	Note
5 Meter	FALSE	-83	
10 Meter	FALSE	-88	
15 Meter	FALSE	-92	
20 Meter	FALSE	-94	
25 Meter	FALSE	-95	
29 Meter	FALSE	-97	Maximum Distance to detect consistently
5 Meter	TRUE	-86	
10 Meter	TRUE	-90	
13 Meter	TRUE	-93	
15 Meter	TRUE	-95	But often not detected

The test results demonstrated a clear difference in performance between the two scenarios. When the beacon was outside the metal box, it maintained a stable connection with the BLE scanner over longer distances, with minimal packet loss. However, when the beacon was inside the metal box, the signal strength dropped significantly, and packet loss rates increased, limiting the effective range. These findings highlight the impact of environmental factors, such as metal enclosures, on BLE signal transmission and emphasize the importance of proper beacon placement in IoT applications.