

# BouWatch

## Project Assignment: ranging using the BLE AoA technology

BouWatch develops systems for securing construction sites. The core product are mobile camera masts that are placed at the site. The cameras are capable of detecting trespassing and producing an alarm that is sent to a control room for validation and follow-up.

At such sites, a range of valuable manual tools is commonly in use. Equipping these tools with Bluetooth (BLE) beacons becomes increasingly popular. The recent 5.1 version of BLE allows locators to apply direction finding based on Angle of Arrival (AoA). This provides an opportunity to locate BLE devices, i.e., pinpoint locations of construction tools on site.

Ideally, object localization in 3D requires both direction (angle) and range between the locator and the device. Even though the AoA feature does not aim at ranging, an initial study showed that ranging should also be possible using the so-called constant-tone extension (CTE) and the frequency hopping feature of the BLE standard. The CTE feature of BLE provides the possibility of measuring the phase of received signals. This may allow for ranging using the phase differences between transmissions on different frequencies. However, as shown by a previous investigation, direct phase measurements provide insufficient accuracy, so a major challenge is to design an algorithm that enables accurate distance estimation from phase measurements.

### Assignment

The purpose of this assignment is to continue the existing work and develop a solution for estimating the distance from a device to a locator, using commercial off-the-shelf BLE hardware that includes the AoA/CTE feature. Some elements of this assignment are:

- Investigate the BLE AoA/CTE feature;
- Investigate principles for estimating distance using phase difference and multiple frequencies;
- Investigate the stability of phase measurements in commercial off-the-shelf BLE hardware;
- Design one, or more, algorithms for estimating the distance between a device and a locator;
- Optimize the algorithm(s) using simulation;
- Build a proof-of-concept (PoC) demonstrator using off-the-shelf evaluation boards;
- Measure performance in the PoC.

This assignment is conducted in close cooperation with the Radio Systems group at EEMCS/UT and the BouWatch research and development department.

### Company

BouWatch is a young and successful international company providing construction site security and safety solutions. BouWatch is a market leader in this segment, and strongly growing. The company is also unique in having in-house control rooms, services people, production and research and development. The R&D is done by BouWatch Technology, which is mainly located in Enschede.

The BouWatch systems provide the safety and security on many very scattered locations throughout western Europe, and blend video, IoT and user information into a single system of relevant alarms and access control systems.