Open Thesis / Project

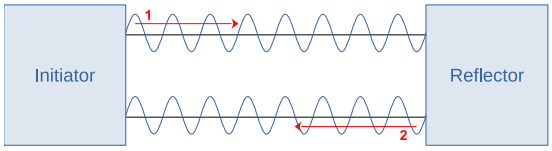
Evaluating the Localization Performance of Bluetooth 6.0's Channel Sounding

Thesis Type

Master Project / Master Thesis

Motivation

Bluetooth 6.0 introduces *Channel Sounding*[1], a technique that enhances localization accuracy by analyzing phase measurements across multiple RF frequencies. Using *Phase-Based Ranging* (PBR), an *initiator* transmits signals across different frequencies, to which a *reflector* responds, allowing distance estimation by leveraging phase shifts between transmitted and received signals. This advancement is particularly valuable for applications such as asset tracking, assisted living, and indoor navigation. Unlike traditional *Received Signal Strength Indicator* (RSSI)-based localization, which suffers from interference and limited accuracy, Channel Sounding employs multi-carrier phase ranging for improved reliability while maintaining Bluetooth's energy efficiency. This project/thesis experimentally evaluates Channel Sounding's accuracy, latency, robustness, and energy efficiency under various conditions, including multipath-rich environments and non-line-of-sight (NLOS) scenarios[2]. The gathered experimental results could then be used to explore optimization techniques such as advanced signal processing and machine learning-based corrections to address errors caused by multipath propagation and RF interference.



[1] `https://tinyurl.com/3vftk3xr`
[2] `https://tinyurl.com/3u9jjxxc`

Goals and Tasks

Within this context, students can explore several directions and perform different tasks, such as:

- Develop a prototype leveraging Bluetooth 6.0's Channel Sounding on an embedded platform (e.g., `nRF54L15-DK`, `xG24-PK6036A`);
- Conduct real-world experiments to assess accuracy, latency, robustness, and energy efficiency in multipath-rich and NLOS conditions;
- Implement and evaluate optimization techniques such as signal processing algorithms and ML-based corrections.

Target Group

- Students of ICE/Telematics;
- Students of Computer Science;
- Students of Electrical Engineering.

Required Prior Knowledge

- Strong interest in wireless localization and positioning technologies;
- Experience with embedded system development in C or Python (e.g., using Zephyr RTOS or similar platforms);
- Basic understanding of signal processing and ML techniques.

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