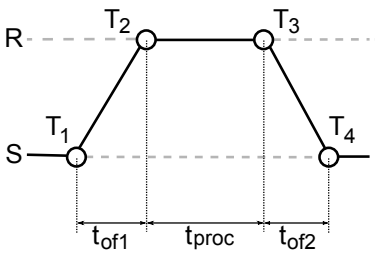
Bachelor Thesis

« Indoor Ranging Using Radio-Based Measurements »

Background

In the project Airport 2030 the Institute of Telematics investigates how passenger processes in airport terminals can be optimized using information technology. As an approach the Institute develops and assesses a device for digital boarding assistance, which integrates passengers into the IT automation chain in the terminals. An important part in this scenario is the development of an indoor navigation system.

Knowing the position is a fundamental requirement for every navigation system. Determining positions generally depends on accurate results, either from ranging or angulation. In this work, an *OpenRisc* based microcontroller with a transceiver which allows *time of flight* (ToF) measurements is used. To calculate a distance from a ToF measurement requires the clocks of the sender and receiver to be synchronized. Synchronizing clocks to the precision necessary to perform time of flight measurements is difficult.



One way of circumventing the issue of clock synchronization is to use *two way ranging* (TWR). In two way ranging, the sender sends a message to the receiver which sends the message back immediately. The receiver adds timestamps when the message is received and sent back. The sender uses timestamps of when it sent and received the message with the timestamps from the receiver to calculate a time of flight estimate. Since the two timestamps on sender and receiver side belong to the same clock, they can be safely deducted to calculate processing time and overall measurement time. To increase the quality of such measurements, this step is casted partially into hardware and accompanying software.

Work Description

The hardware which is used operates in the *Industrial, Scientific and Medical* (ISM) band at 2.4GHz. This band is used by many other applications such as WLAN, Bluetooth, medical equipment, home automation systems, and many others which influence the ranging process negatively.

This work aims at experimentally evaluating the quality of indoor measurements in areas with sparse and dense radio activity. In the second part of the work the ranging will be improved by observing channel activity at client and receiver side as well as combining and filtering measurements.

Requirements

Requirements: Interest in embedded systems, programming in C.

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