

# Low-Cost, High-Accuracy Indoor Positioning

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## ABSTRACT

In this paper, we describe an approach for using modified commercial off-the-shelf (COTS) technologies to implement a low-cost, high-accuracy indoor positioning system.

## Categories and Subject Descriptors

Modified Commercial off-the-shelf (COTS) Technologies

## 1. Approach

The device architecture is an FPGA + AD9364. The location algorithm is based on TOA using a 2.4 GHz ISM LFCW.

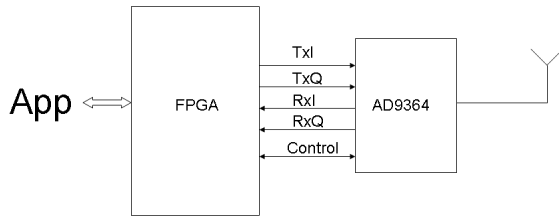


Figure 1: System Architecture

## 2. Approach Details

The algorithm is a super-resolution CIR (Channel Impulse Response) analyzing baseband IP core. It can obtain detailed CIR information of each main path, including time delay, amplitude and phase, in a multi-path environment. The phase attribute of CIR is correlated with the dielectric constant of the reflector. This can be used to perform an approximate classification of the reflector, which will lead to new application domains, such as anti-terrorism and passive IoT sensing.

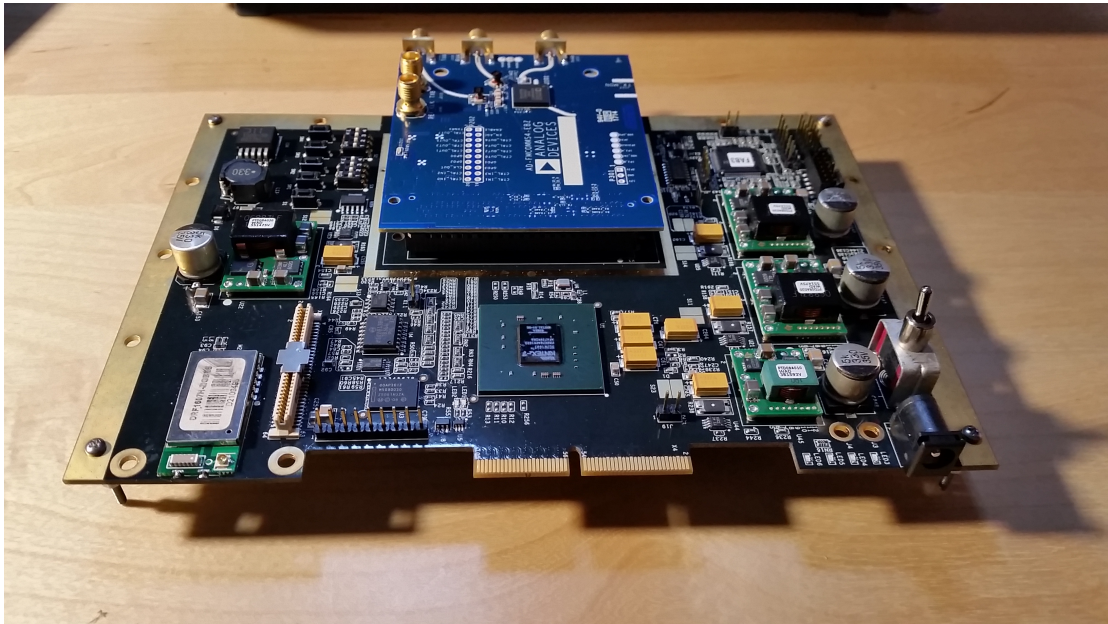
The mechanism is described as followed:

1. The initiator sends the LFCW to the opposite side.
2. The opposite side reflects back the signal.
3. The initiator analyses the reflected signal to get CIR (Channel Impulse Response) information of the transmit path and to distinguish the first arrived signal.
4. The initiator calculates the distance according the TOF of the first arrived signal.

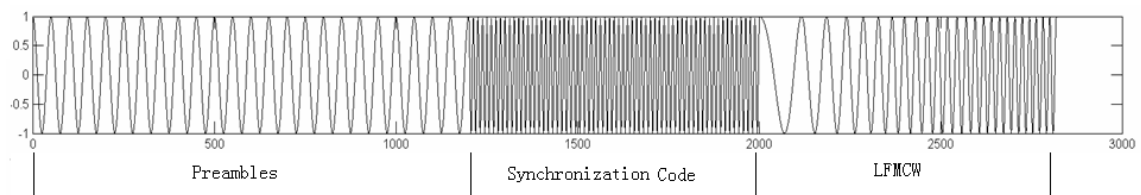
Since the LFCW occupies only 10 MHz of bandwidth, the baseband IP core can be integrated into Wi-Fi architecture to bring Wi-Fi the ability of location and the better CIR estimation for effective communication.

## 3. Deployment requirements:

Deployment requires ten pieces of 2.4 GHz RF endpoint devices as anchor nodes in the evaluation area, along with the requisite power supply for each anchor node.



**Figure 2: Example Device**



**Figure 3: Signal Structure**