

Developing a Location Finding System

AND90234/D

INTRODUCTION

Bluetooth® technology, which initially gained traction for its device communication capabilities, is now being widely used for device positioning. This relies on high accuracy location services which work by enabling one device to determine the presence, distance, and direction of another device.

Bluetooth technology provides unrivaled flexibility to enable powerful, cost-effective proximity and positioning solutions for applications such as:

- Asset tracking and management
- Indoor navigation
- Proximity marketing

- Personal item finding
- Building access control
- Automotive digital key
- And more ...

This application note introduces the basics of setting up a Bluetooth wireless-based location finding system using components from **onsemi**, Unikia and CoreHW.

A location finding system requires 3 components:

- Bluetooth-enabled tag(s)
- Localization engine
- Locator(s)

A typical system setup is shown below.

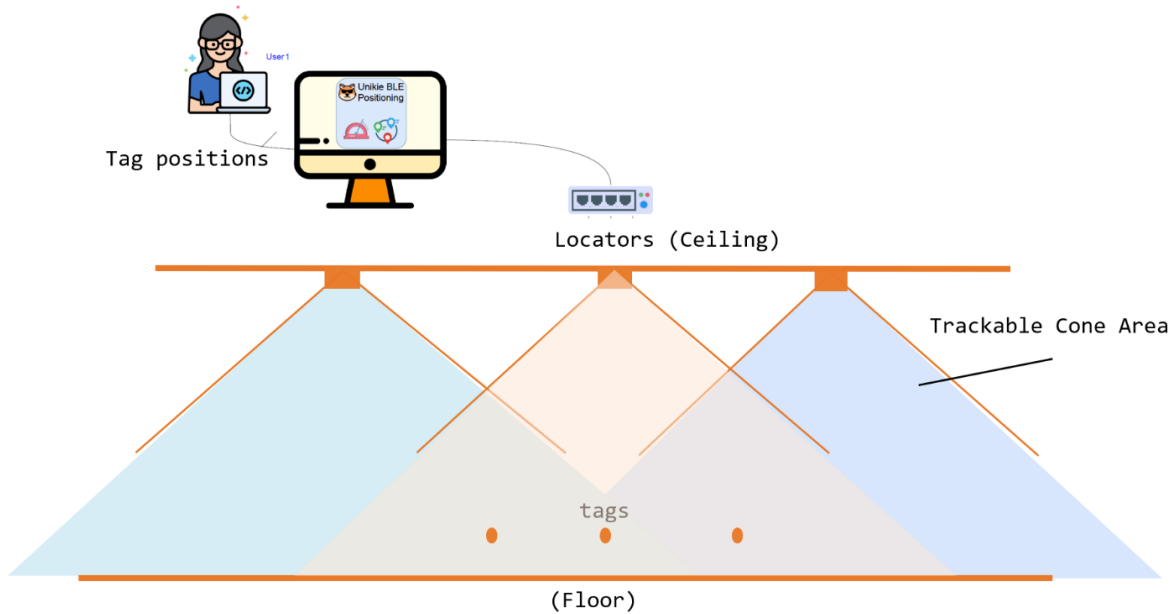


Figure 1. Location Finding System with Multiple Locators and Cones

BLE-ENABLED TAG

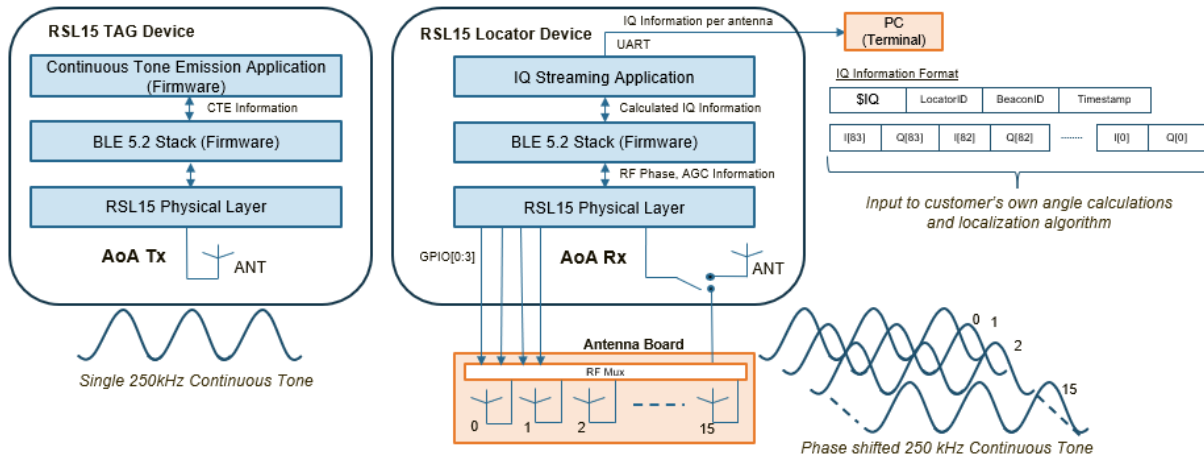
RSL15 Wireless-enabled MCU

RSL15 is an ultra-low power secure Arm® Cortex-®M33 processor-based Bluetooth Low Energy 5.2 wireless MCU designed for connected smart devices in industrial and medical applications.

RSL15 supports long range, Angle-of-Arrival (AoA) and Angle-of-Departure (AoD) as defined by the Bluetooth Low Energy standard, along with RSSI, for enhanced localization capabilities. With hardware root-of-trust and

software encryption, RSL15 provides the latest technology in embedded security. Its miniature size provides the perfect form factor for a tag, while its award-winning low power consumption extends product longevity. Download the [RSL15 datasheet](#) for complete technical details.

In addition to the hardware enablement, the comprehensive, yet easy-to-use RSL15 SDK includes tag firmware to enable application development. Download the [RSL15 Firmware Package](#).



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Localization Commands:
GAPM_PER_SYNC_IQ_SAMPLING_CTRL_CMD
GAPM_PER_ADV_IQ_REPORT_IND
GAPM_PER_ADV_CTE_TX_CTL_CMD

GAPC_CTE_TX_CFG_CMD
GAPC_CTE_RX_CFG_CMD
GAPC_CTE_REQ_CTRL_CMD
GAPC_CTE_RSP_CTRL_CMD
GAPC_CTE_IQ_REPORT_IND
    
```

Figure 2. Sample Localization Commands in the RSL15 SDK

Benefits:

- Industry’s lowest power – ideal for the edge
- Highest embedded security features available
- Long Range Localization support

LOCAL, EDGE OR CLOUD-HOSTED LOCALIZATION ENGINE FOR BLUETOOTH LOCALIZATION

Unikie BLE Localization Engine

Unikie provides the software algorithms and SW components needed to calculate the real-time positions of BLE tags. This localization software is packaged as the Unikie BLE Localization Engine. The localization algorithms have been co-developed and tested with CoreHW for several years and support CoreHW gen2 and gen3 antennas out of the box. It has also been optimized for **onsemi** RSL15 BLE tags that feature performance optimizing functions such as IQ averaging, sleep mode and return channel.

The Unikie Localization Engine consists of two software components; an angle calculation and a positioning module. The angle calculation module is optimized for low-footprint and high-performance operations either on edge servers or

locally on the locators. The position calculation module can be bundled with the angle calculation module on the edge server or deployed in the cloud, separately from the angle calculation. When calculating the tag signal angles on edge servers the locators can be cost-optimized.

The Localization Engine produces real-time positions of tracked tags and offers easy to use APIs for subscribing external enterprise systems to position changes of objects. The API also makes it easy to build data models, which may be used for gaining material flow insights, retaining utilization data and identifying behavioral patterns. Unikie can also develop customized data models and integrate real-time localization data to your existing enterprise systems.

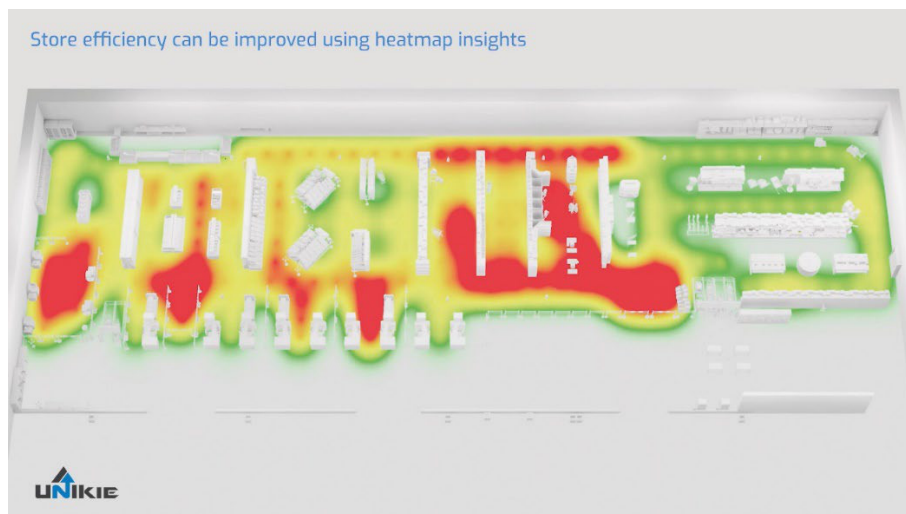


Figure 3. Heatmap Insights in a Retail Environment

Benefits

- High-performance BLE localization algorithms
- Modular software components for local, edge or cloud deployment
- Position Data APIs for integration to enterprise systems or data analyzers

ANTENNA ARRAYS FOR AOA AND AOD DIRECTION FINDING

CHW1010-ANT1-1.0, CHW1010-ANT2-1.0, CHW1010-ANT3-1.0

CoreHW designs and supplies antenna array boards in multiple form factors which enable outstanding position accuracy down to cm-level. These production-ready antenna boards are in 2400–2483 MHz frequency range with up to 16 single-ended antenna ports.

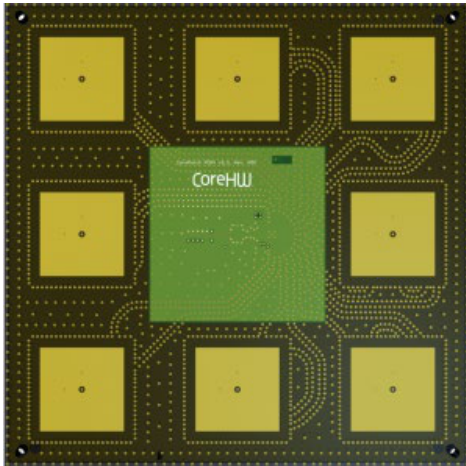


Figure 4. CHW1010-ANT1-1.0 Antenna Module

The antennas contain the CHW1010 SP16T Bluetooth AoA and AoD antenna switch for antenna selection, along with connectors for RF and digital control signals for easy interfacing BLE SoC control boards. This industry-leading antenna switch is designed to transfer the real-time location data with a powerful indoor positioning and outstanding power efficiency. Download the [CHW1010-ANT1-1.0](#), [CHW1010-ANT2-1.0](#), and [CHW1010-ANT3-1.0](#) product briefs.

Benefits

- Optimized phase balance between antenna chains
- No calibration required
- Excellent angle accuracy

Where to obtain the components

1. CoreHW Sales: sales@corehw.com
2. Digi-Key: [CHW1010-Ant1-1.0](#), [CHW1010-Ant2-1.0](#), [CHW1010-Ant3-1.0](#)

Who to contact for what issues:

3. For antennas technical support, contact product.support@corehw.com
4. For any other queries about the antennas, contact Mika Jäsberg at mika.jasberg@corehw.com

BUILDING THE SYSTEM

Below are the system components required, and where to obtain them.

Use the following resources to get you started:

- CoreHW Bluetooth Direction Finding Solution – [BLE Indoor Location System](#)
- Unieke Localization Engine – [Bluetooth Positioning](#)

Locator	Company	Part Number	Where
RSL15 HW	onsemi	NCH-RSL15-512-101Q40-ACG	Distributor
RSL15 SW	onsemi	NA	RSL15 CMSIS pack form onsemi website
CoreHW Antenna Boards	CoreHW	CHW1010-ANT1-1.0 CHW1010-ANT2-1.0 CHW1010-ANT3-1.0	Distributor CoreHW Sale
Antenna Board Models	CoreHW	Computational Antenna Model Files	CoreHW

Tags	Company	Part Number	Where
RSL15 HW	onsemi	NCH-RSL15-512-101Q40-ACG	Distributor
RSL15 SW	onsemi	NA	RSL15 CMSIS pack form onsemi website

Positioning Engine	Company	Part Number	Where
Local or Cloud Localization Engine	Unieke	NCH-RSL15-512-101Q40-ACG	License model by UNIKIE

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