imec

embracing a better life

ACCURATE & SECURE DISTANCE MEASUREMENT WITH BLUETOOTH

Imec's Secure Proximity technology provides unprecedented ranging accuracy on standard narrowband radio's like Bluetooth. Whereas today Bluetooth ranging systems achieve at best a 3 meter accuracy, with the new imec super-resolution ranging algorithms an accuracy of 30cm is within reach. It provides also a high level of security for smart locks as it is resistant against relay attacks.

Bluetooth ranging technology is already very popular and many localization systems exist based on beacons. Beacon technology generally estimates the distance between devices using the received signal strength (RSSI). Localization of Bluetooth devices is done by combining the distance estimate to several beacons, mounted at fixed and known locations, using triangulation with at least 3 anchors.

Due to many reflections in indoor environments, RSSI-based ranging is inherently inaccurate. Using a combination of a phase-based distance estimation protocol, and advanced signal processing, the imec ranging-technology is able to separate the Line-of-Sight component from multipath. The result is a robust ranging system with sub-meter accuracy. Unlike Direction of Departure (DoD) and Direction of Arrival (DoA) technology, the imec distance measurement works with only a single antenna at either side. With multiple antennas in combination with tracking, the accuracy of the distance measurement can be further improved to 30 cm. It can also be combined with a DoD-DoA implementation.

This high robustness against multi-path interference enables a range of challenging applications like smart locks or secure and easy commissioning of devices by being in the proximity of a device. The unprecedented performance and reliability allow proximity services to move from fairly relaxed use cases like proximity marketing in shopping centers, to more demanding applications like location based secure data access to for instance patient records by authorized personnel in a hospital room..

This performance is demonstrated on a standard Atmel (Microchip) 2.4GHz narrowband radio (AT86RF215), with tests confirming an accuracy better than 1m for 80% of the measurements. Adding more antennas improves the accuracy to approximately 30cm. This makes true indoor localization possible, and secure access to cars and smart locks for safe access to your home.

KEY FEATURES

- Location accuracy of 30cm
- Suitable for standard narrowband 2.4GHz radio e.g.: BLE4.0, 4.2, 5.0 and Zigbee / 802.15.4
- Time of flight (TOF) security against relay attacks
- Low processing power requirement e.g. no overhead at end-point, ARM CortexTM M4F at gateway side
- Supports single and multiple antennas on both sides, can be complemented with DoA and DoD
- Very robust against multipath reflections

APPLICATION FIELDS

- Secure Locks for Buildings and Automotive
- Asset localization & tracking
- Indoor navigation
- Proximity services, beacons
- Device commissioning by proximity

KEY BENEFITS

- Very high accuracy compared to RSSI ranging solutions
- Safe against against relay attacks
- Easy to implement on commercial chipsets, without need for radio hardware changes
- Suitable for narrowband, standardized communication platforms (BLE, Zigbee)

Wireless standards	IEEE802.15.4 (available) Bluetooth 5 under development Approach extendable to WiFi
Frequency band	2.40-2.48GHz (other bands with trade offs)
Line-of-sight accuracy	6 cm in pure LOS
Accuracy in multipath environment	<100 cm - ranging with 1x1 antennea <50 cm - ranging with multiple antennas <30 cm - localization and tracking
Measurement time	100us-10ms (depends on radio front-end)
Memory footprint	128 kB
MCU	<50ms on ARM Cortex M4F @120MHz & single side, other side no load.
Spoofing resistance	Phase-difference approach provides resistance against relay attacks. Protocol design for highly-secure applications Encryption & TOF
Other	Complementary to DoA/DoD in BT5.0

IMEC LOCALIZATION IMPROVEMENT OVER TYPICAL PERFORMANCE

Typical localization performance

imec localization performance
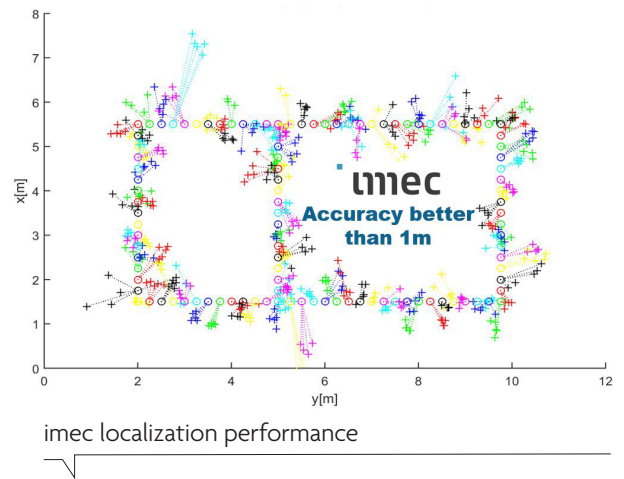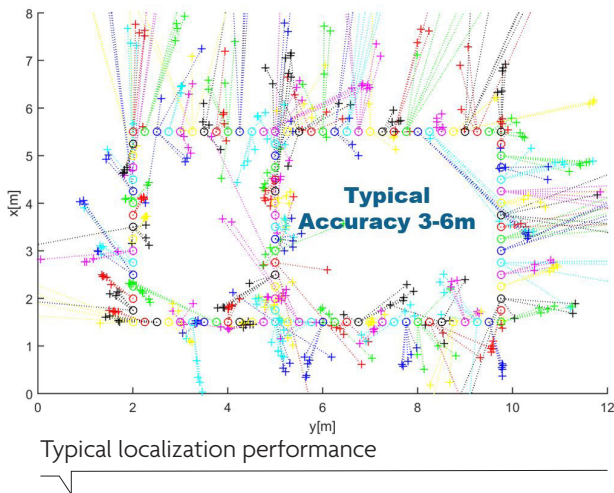
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