Ultra Miniature UWB BLE Module for Distance Measurement and Location Services

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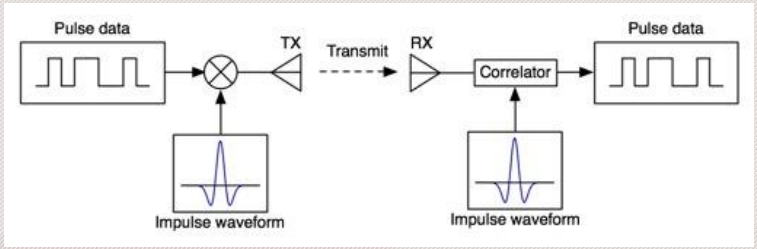
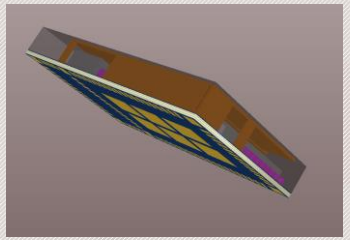
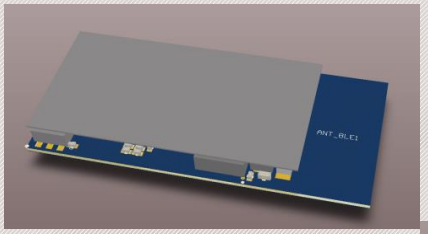
2nd November 2016

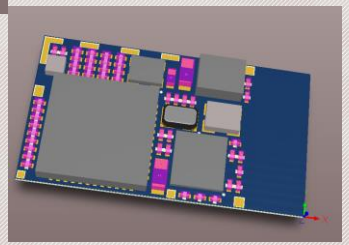
Agenda

- Insight SiP
- Introduction to IR UWB
- Bluetooth Smart
- ISP1510 Combo Module
  - UWB + BLE
- Module Design Aspects
  - Integrated Antennas
  - Module
- Demonstration
- Conclusions



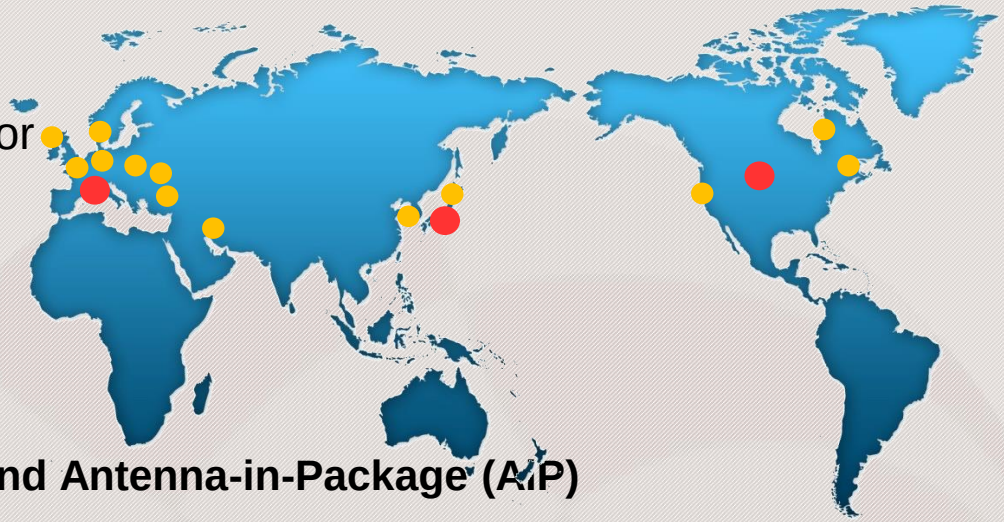






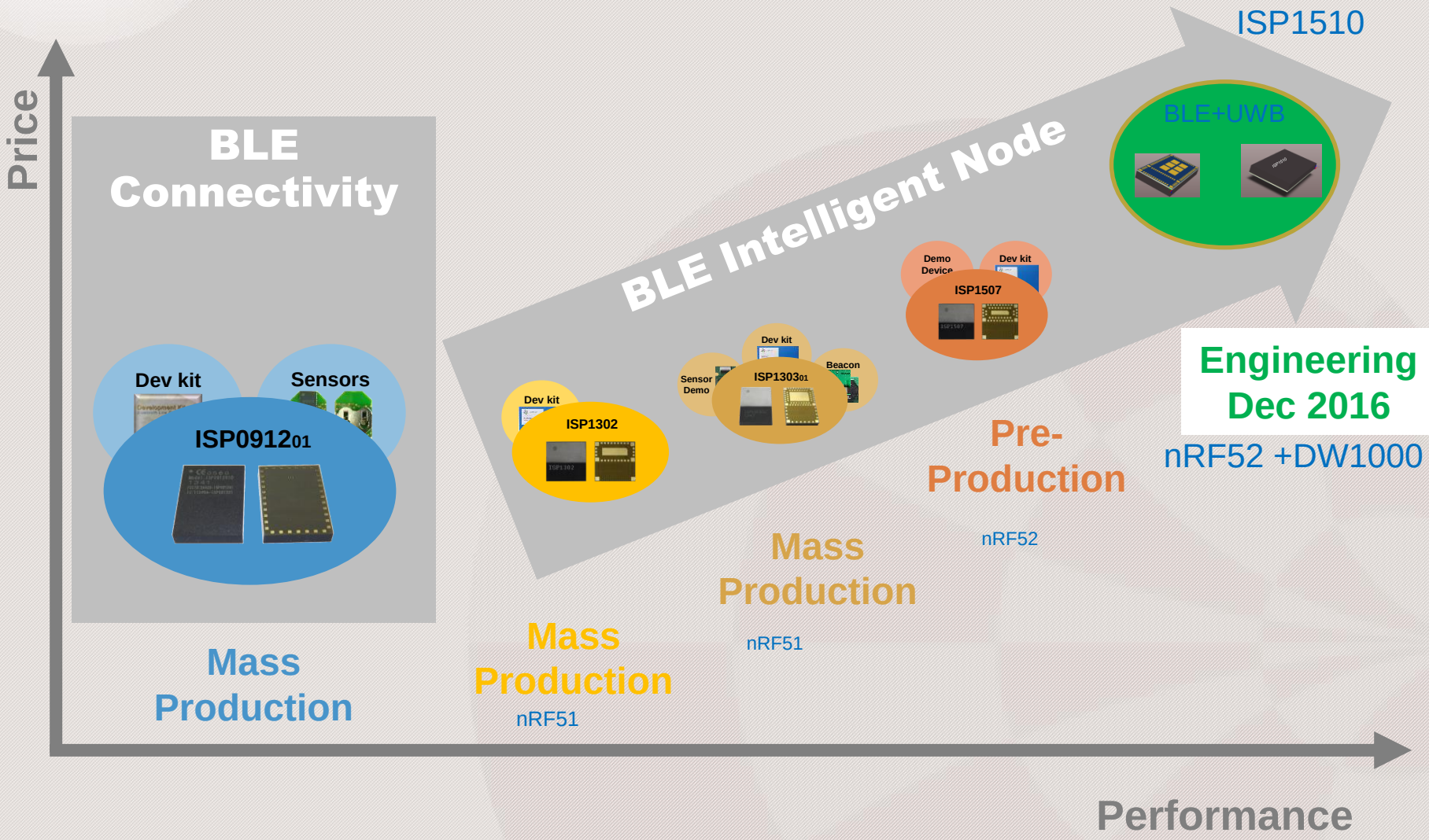
Insight SiP Profile

- **Established in 2005**
  - ✓ Founded by actual CEO and CTO
  - ✓ Core team from National Semiconductor
- **Product Lines**
  - ✓ Turn-key design services and creative packaging solutions
  - ✓ Standard modules for wireless electronic industry



- **Experts in RF System-in-Package (SiP) and Antenna-in-Package (AiP)**
  - ✓ Fabless company
  - ✓ Design & industrialization expertise
  - ✓ Design team : 9 PhD – 6 MSc
  - ✓ 12 to 15 new projects per year
- **Locations**
  - ✓ Europe – HQ and Technical team in Sophia-Antipolis (France) ●
  - ✓ North America – Subsidiary in Denver (USA) since 2008 ●
  - ✓ Asia – Sales office in Tokyo (Japan) since 2008 ●
  - ✓ Global network of distributors ●

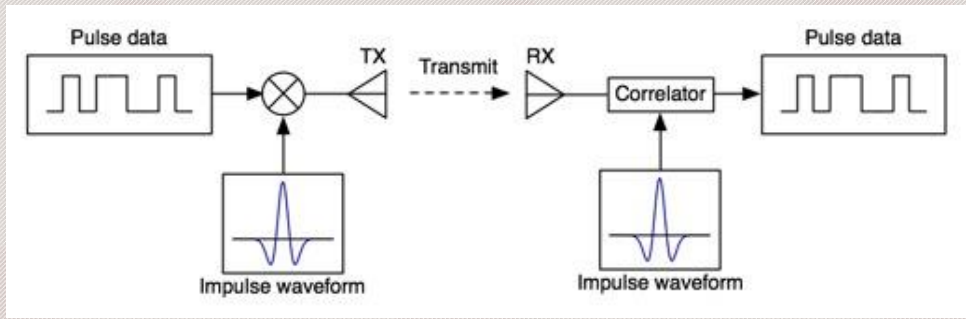
Insight SiP Product Roadmap



Introduction to UWB

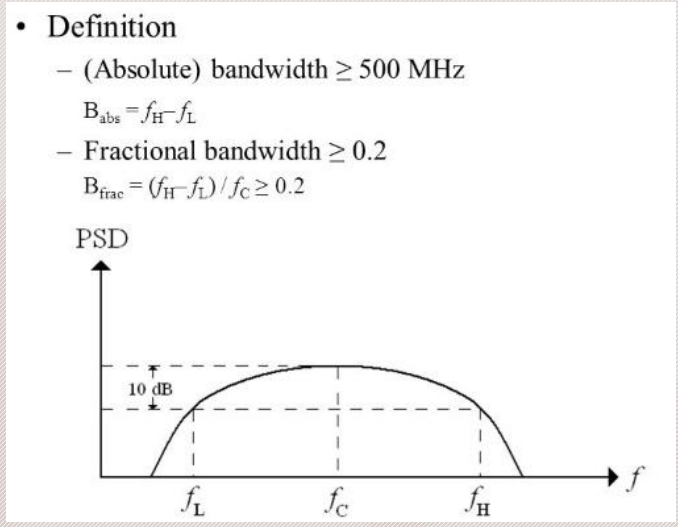
- UWB
  - >100 Years old
  - Phase 1 Wimedia
    - OFDM
    - High Power Consumption
    - No adoption
  - Phase 2 Impulse Radio
    - Short coded pulses
    - Time of Flight Measurement
    - Low data rates
    - Location based services

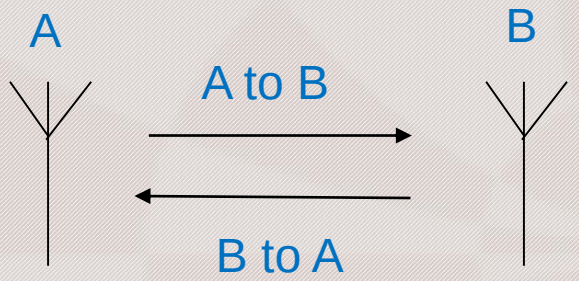
WiMedia



UWB Impulse Radio

- UWB Definition
- Pulsed UWB
  - Coded pulse train
  - Allows for data transfer
  - Allows for accurate time of flight measurement





Round time of flight = Tab + Tba + Twait

UWB Impulse Radio

- 802.15.4-2011 Standard
- Coding
  - Binary Position Modn
  - Binary Phase Shift Key
  - Symbol = 2 bits
    - 1 BPM 1 BPSK
  - Allows for sync
  - Allows for time of flight measurement
  - Allows for data transfer

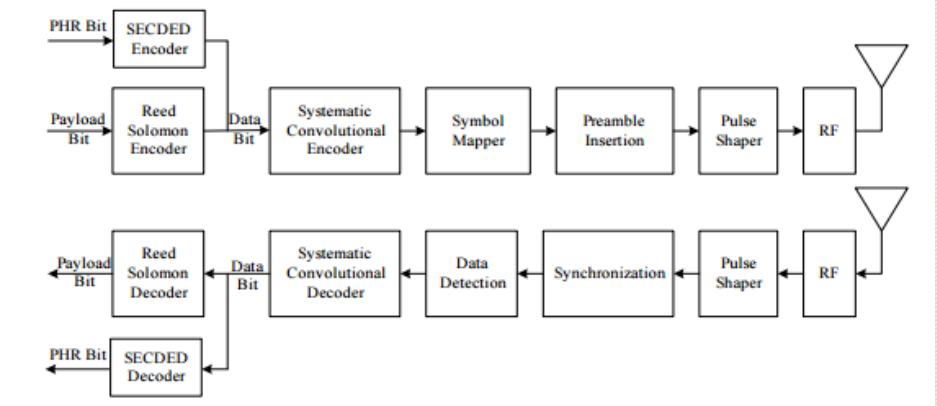
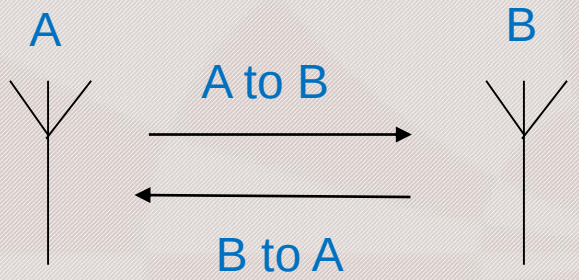


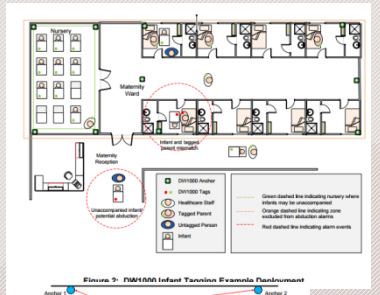
Figure 83—UWB PHY signal flow

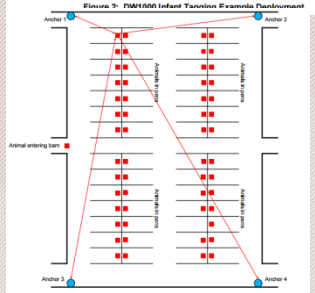


Round time of flight = Tab + Tba + Twait

Applications of UWB

- Healthcare
  - Infant Tagging
- Agriculture
  - Cattle monitoring
- Automotive
  - Keyless Entry
- Security
  - Building Access
  - Car Access
- Payment
  - Authorization at point of sale





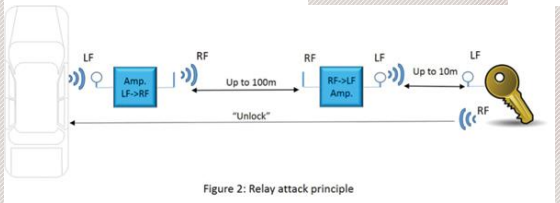
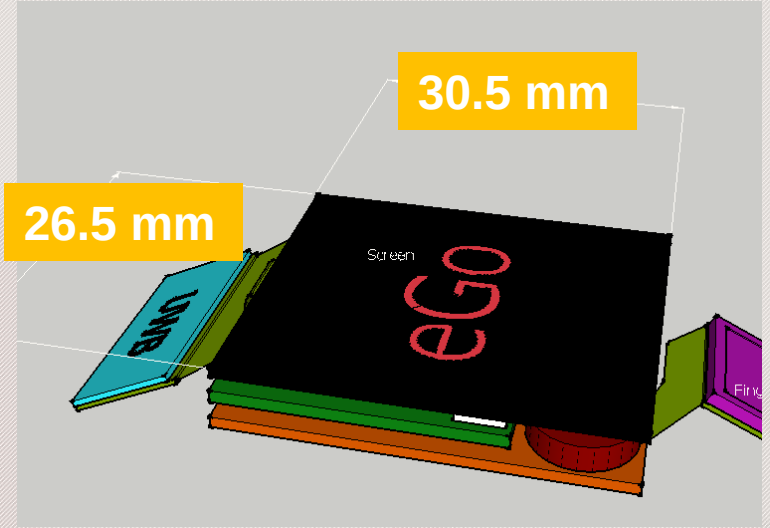


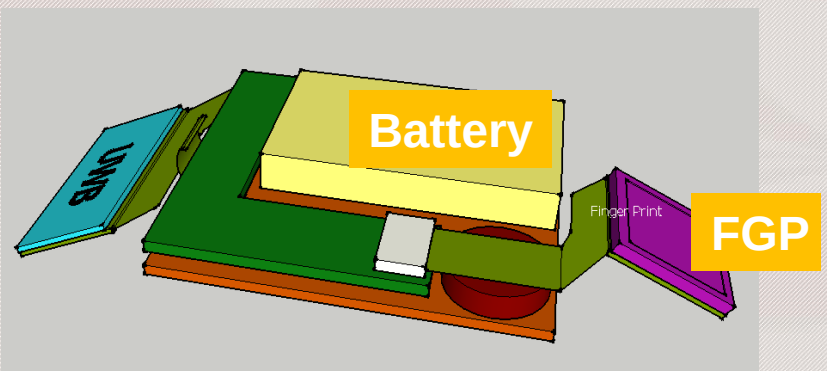
Figure 2: Relay attack principle

Catrene H20 Project

- Catrene Collaborative European Project
- Human 2 Object
- Secure Communication
- Distance Measurement
  - UWB ISP1510
- Finger Print
- Secure Element
- Safer than a Smart Card



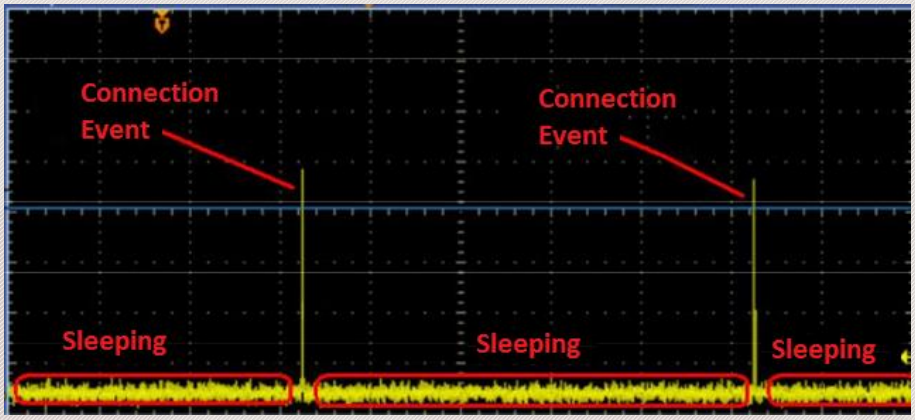
Overview main watch case
30 x 35 x 8 mm

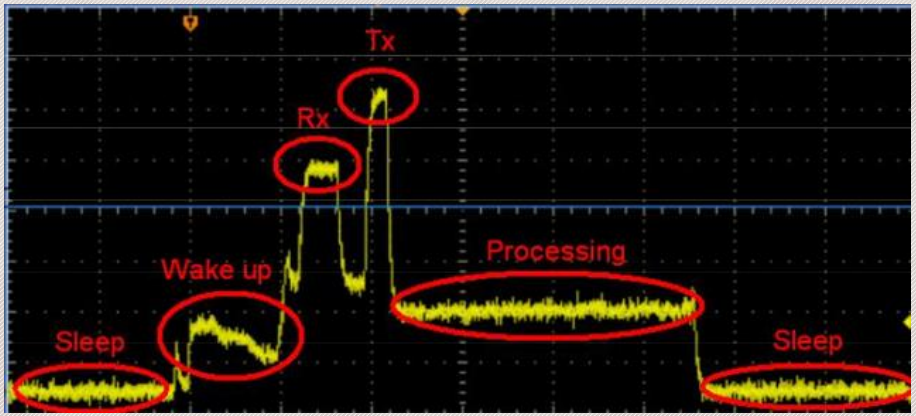


LCD Removed

Bluetooth Smart

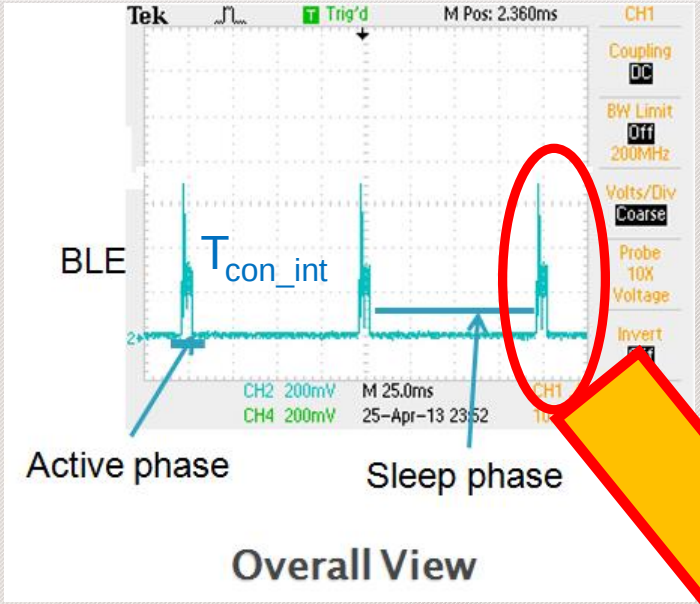
- Low power consumption
  - Tx Rx Current low (ca 10mA)
  - Device sleeps most of the time (10uA max)
  - Average current ➔
    - Sleep/On ratio
    - Quantity of data per connection
- Standard
  - Easy connection to Smart Phone
  - Most Smart Phones have Bluetooth Smart
  - Many existing GATT profiles



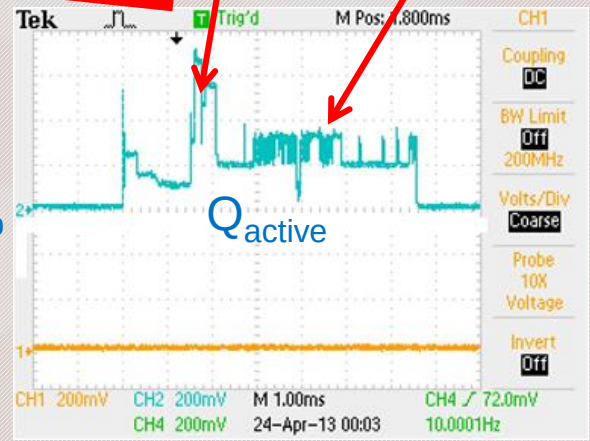


Bluetooth Smart Timing

- I_{avg} (uA)
- Q_{active} (C)
- T_{con_int} (mS)
- I_{sleep} (uA)
- $I_{avg} = I_{sleep} + Q_{active} / T_{con\_int}$



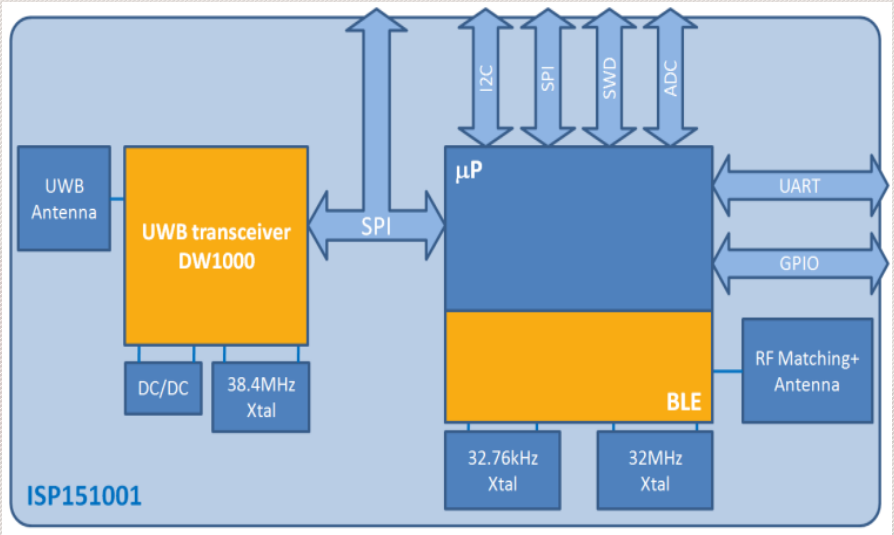
TxRx Processing

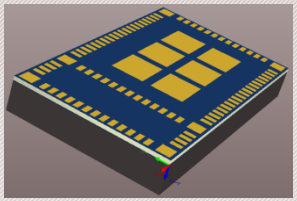


Low power mode dominates !

UWB BLE Combo Module

- Miniature UWB + BLE
- ISP1510
  - Decawave UWB solution DW1000
  - nRF52 BLE and Cortex M4 MCU
- Small, certified (FCC, IC,Telec, CE,..)
- Ready to use





16 x 9 x 2 mm

UWB Characteristics

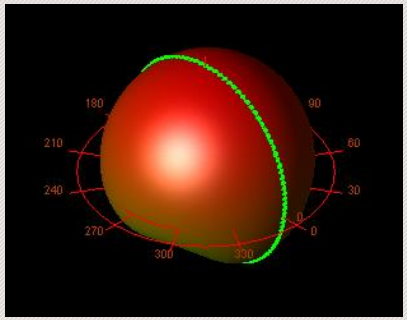
- Externally Controlled or using embedded M4 Cortex processor
- IEEE802.15.4-2011 UWB compliant
- Supply Voltage 2.8V to 3.6V
- Low Power consumption
- SLEEP mode current 1uA
- SPI Interface
- Fully integrated RF matching and Integrated Antenna
- Integrated 38.4 MHz Clock

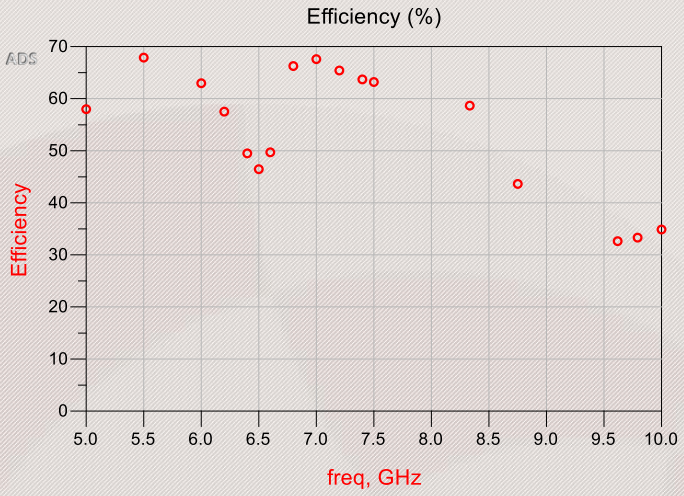
BLE Characteristics

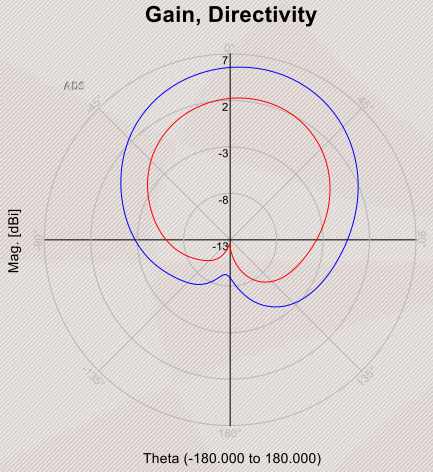
- Single Mode BLE v4.1 Slave or Master
- Based on Nordic Semiconductor nRF52 family
- 2.4GHz low energy RF Transceiver
- 32bit ARM Cortex M4 CPU
- 512kB Flash and 64 kB SRAM
- Analog and Digital peripherals
- Ultra Low Power Consumption
- Single 1.8 to 3.6 V supply
- Fully integrated RF matching and Antenna
- Integrated 32 MHz and 32.768 kHz Clocks
- NFC for BLE pairing

Design - UWB Antenna

- Integrated UWB Antenna
  - High Band 6 – 7.5 GHz
  - Patented structure
  - Over the IC type
  - >45% Radiation efficiency
  - Radiation above application PCB





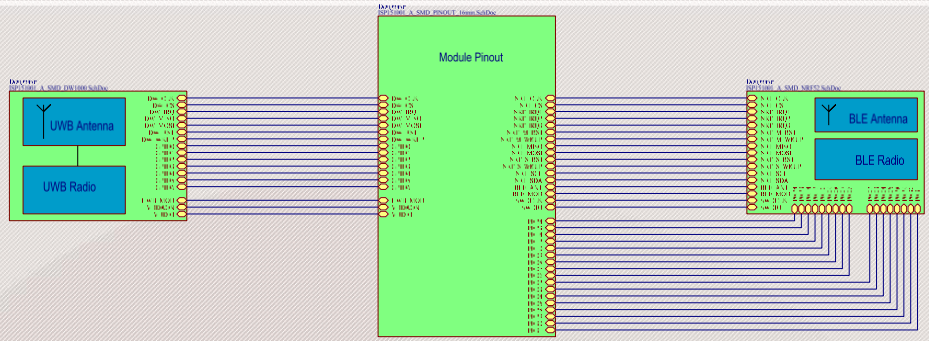


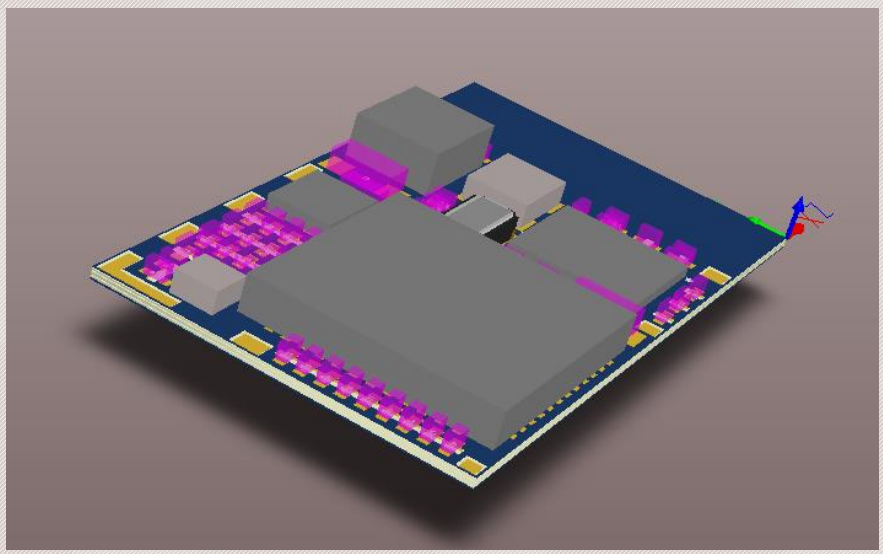
Design - BLE Antenna

- Integrated BLE Antenna
  - 2.4GHz band
  - Patented structure
  - On side of module
  - Designed in substrate
  - Radiation –quasi omni
  - Derived from Antenna in ISP1303/ ISP1302/ ISP1507

Design - Module

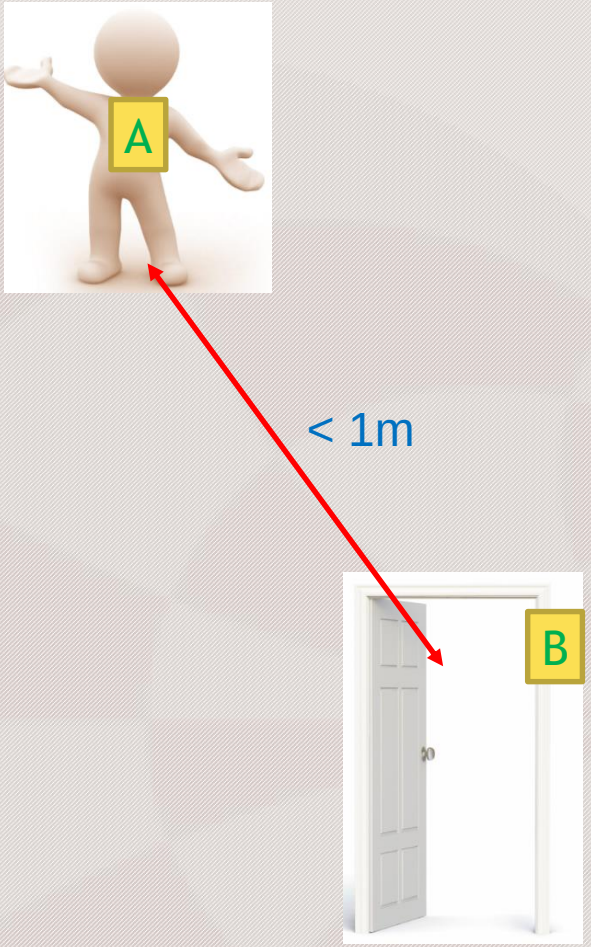
- Based on
  - DW1000 UWB ref design
  - ISP1507 with nRF52 (BLE
- UWB is QFN inside SIP
- BLE is WLCSP
- SMTs 0201
- Integrated DCDC 1.8V
- SPI internal or external
- SiP design using 4 layer organic substrate
- Tight design rules
- RF simulation using ADS



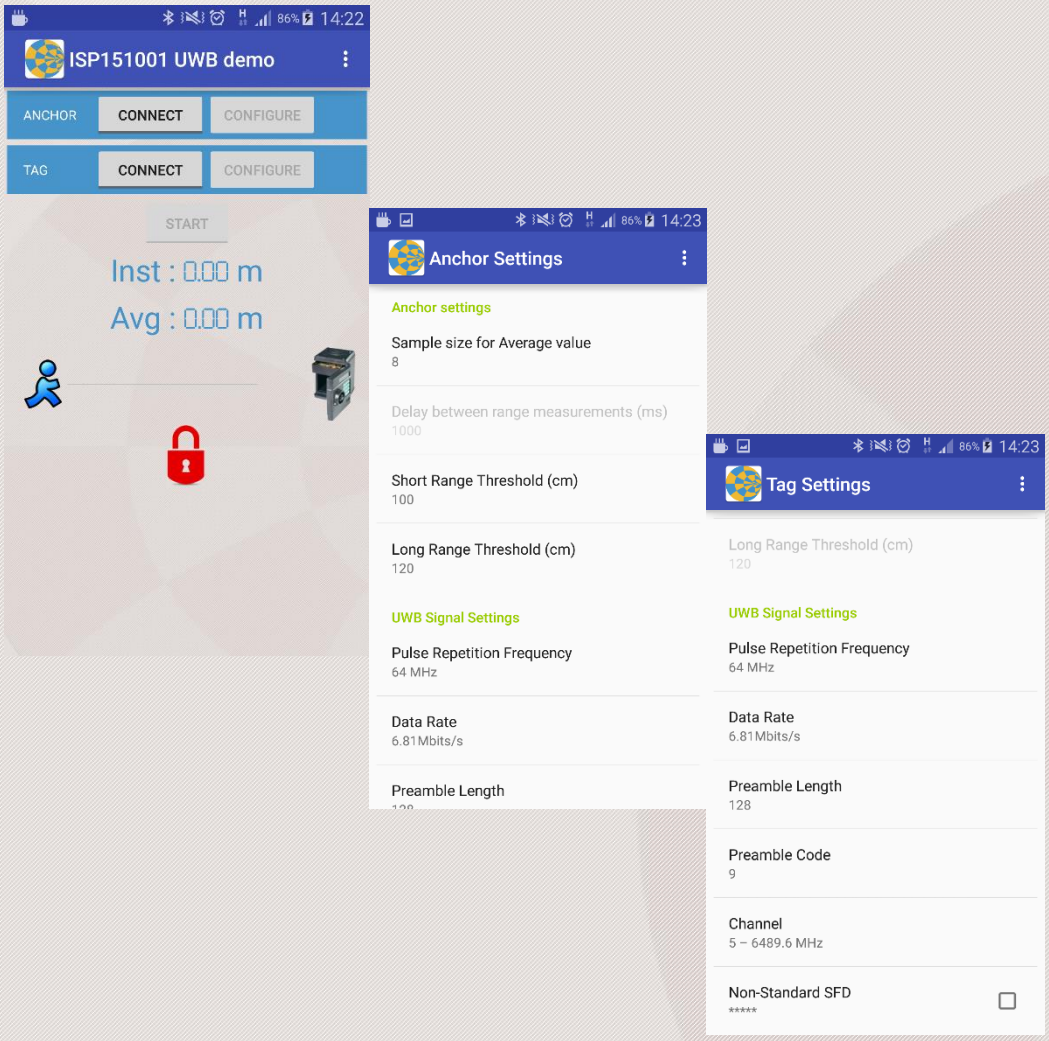


Demonstration

- Module A with Battery
- Module B connected to door
- Configuration by BLE of both nodes
- Display of distance on Smart phone
- Door opens when A is within 1m of door

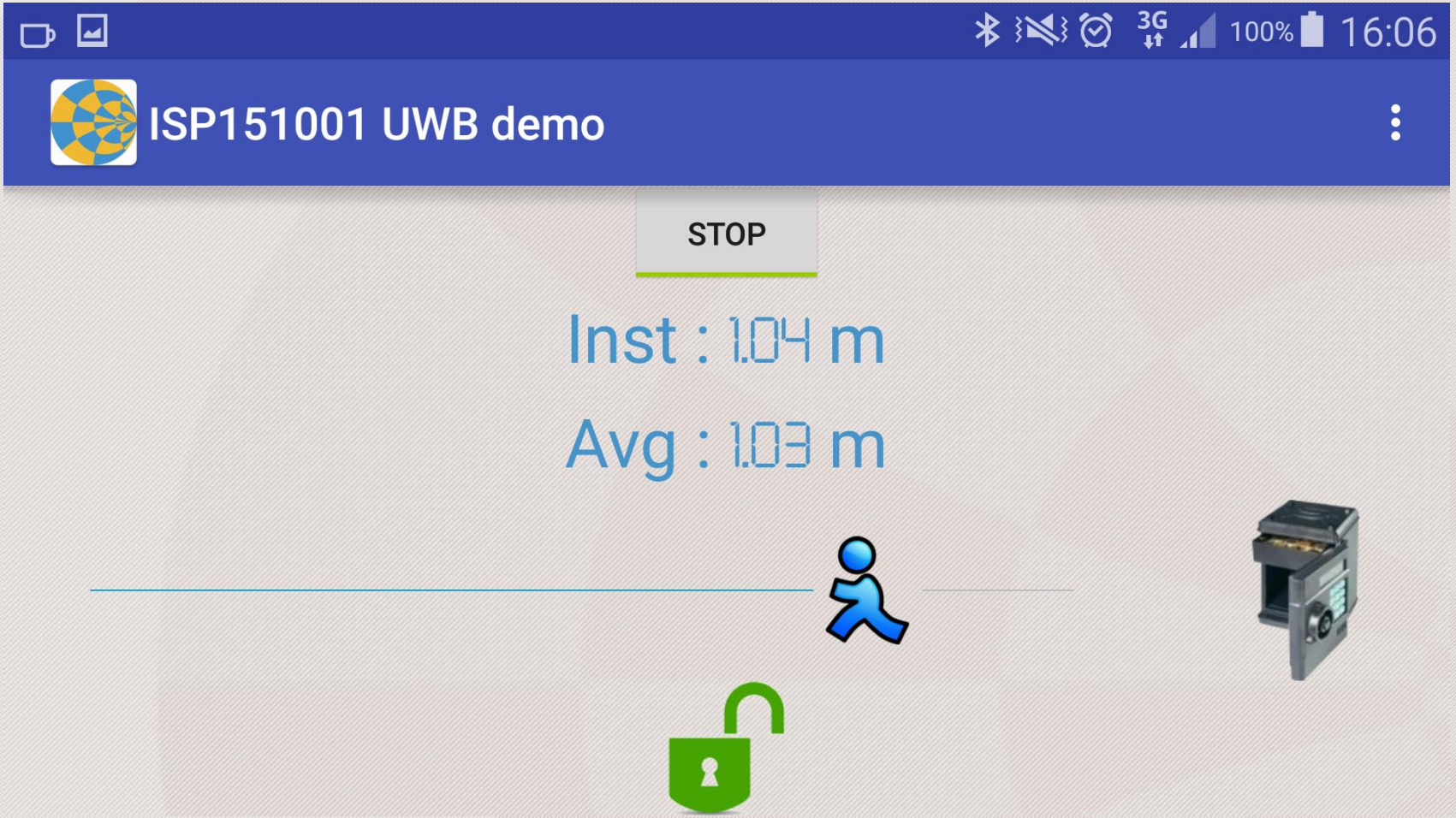


Configure Via BLE



- BLE Connect to each device
  - Configure one as anchor
  - Configure other as tag

Measure Distance



Conclusions

- Ultra miniature UWB/BLE module
- Simplifies deployment of UWB systems
- Configuration and readout via BLE on Smart phone
- No need to have detailed RF know how
- Takes the RF out of UWB

Conclusions