

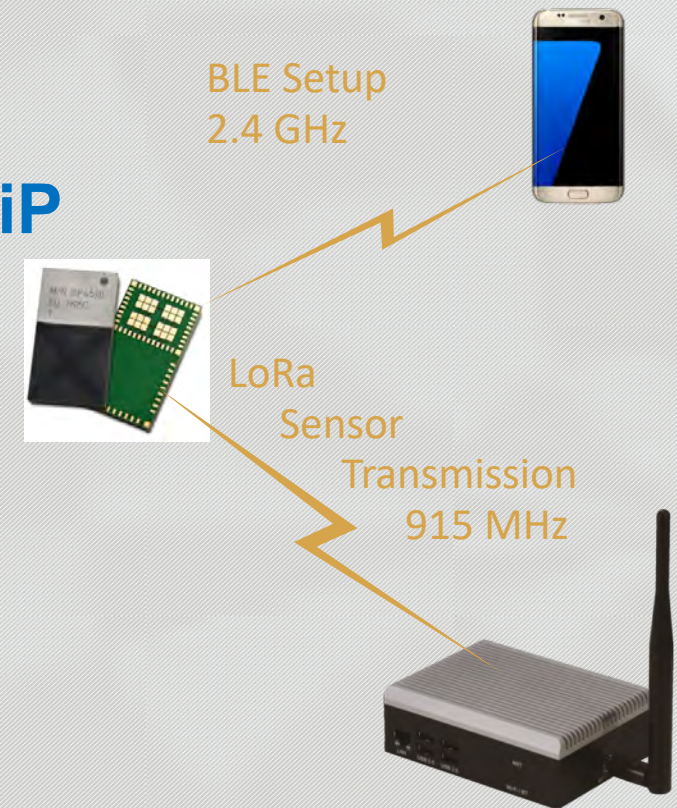


Insight SiP
It's all in the package

Design of Miniature Multi-Mode SiP Modules with Two Integrated Antennas

Chris Barratt
CTO & Founder Insight SiP France
Webinar MEPTEC June 17th 2020

- **Insight SiP**
- **What is “Heterogeneous SiP”**
- **What & Why “Antenna in Package”**
- **Combo Module BLE + LoRa**
- **Electronic part design process for SiP**
- **Antenna design process for SiP**
- **Twin antenna design**
- **Overall Integration**
- **Performance**
- **Other twin antenna solutions**





Insight SiP
It's all in the package

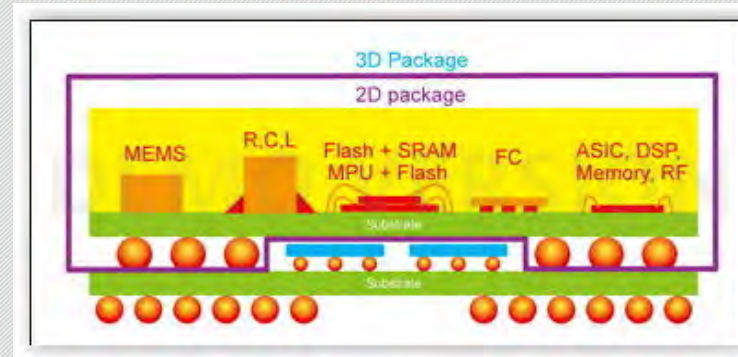
INSIGHT SiP

- **Insight SiP**
- **Established in 2005**
- **Ultra – miniaturization thru SiP**
- **Design and Fab - RF SiP Modules**
- **BLE, LoRa, UWB, NBIoT,...**
- **Innovative Antenna in Package**
- **HQ on French Riviera near Nice**
- **Worldwide sales thru distribution**

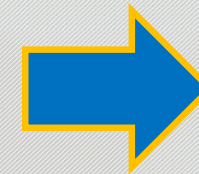




HETEROGENEOUS RF SiP

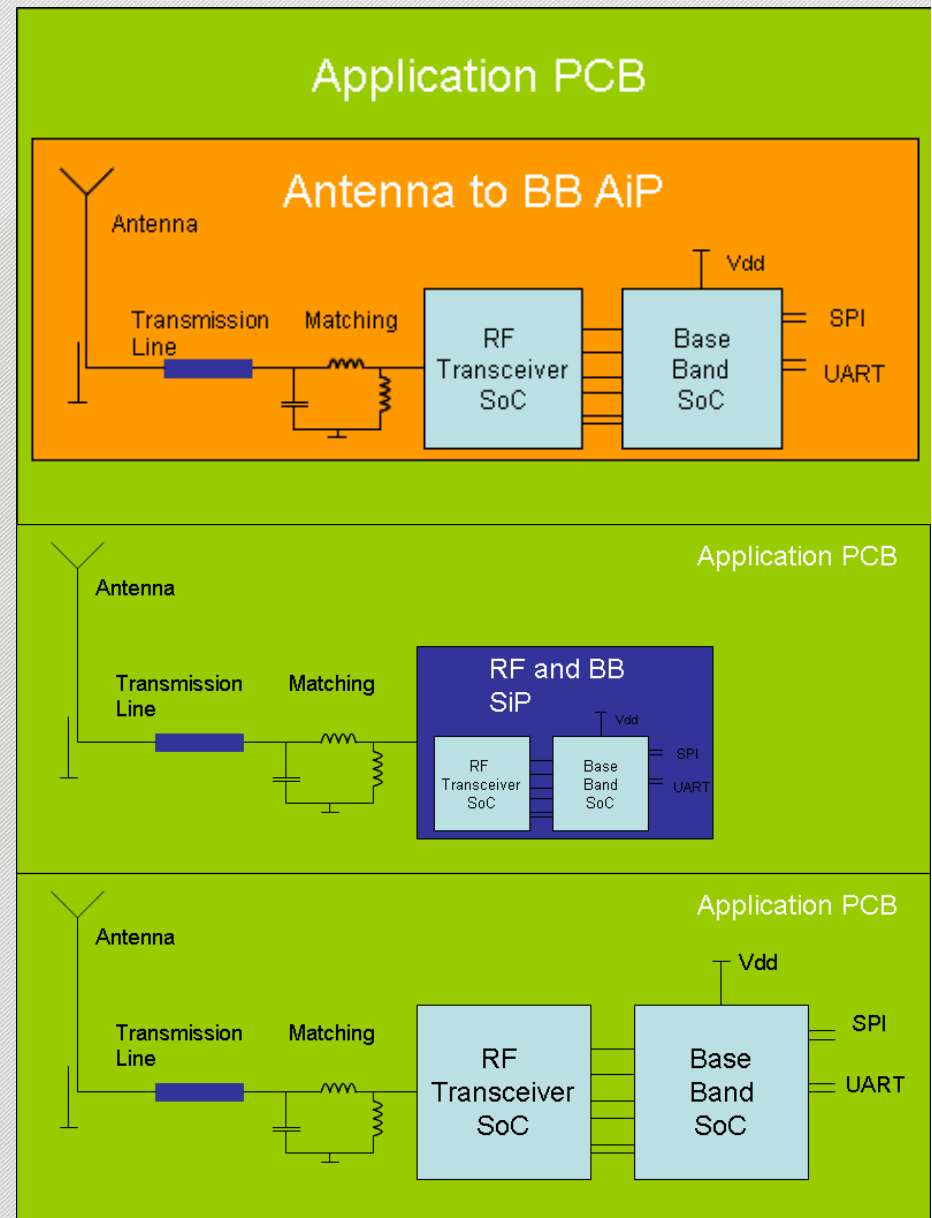
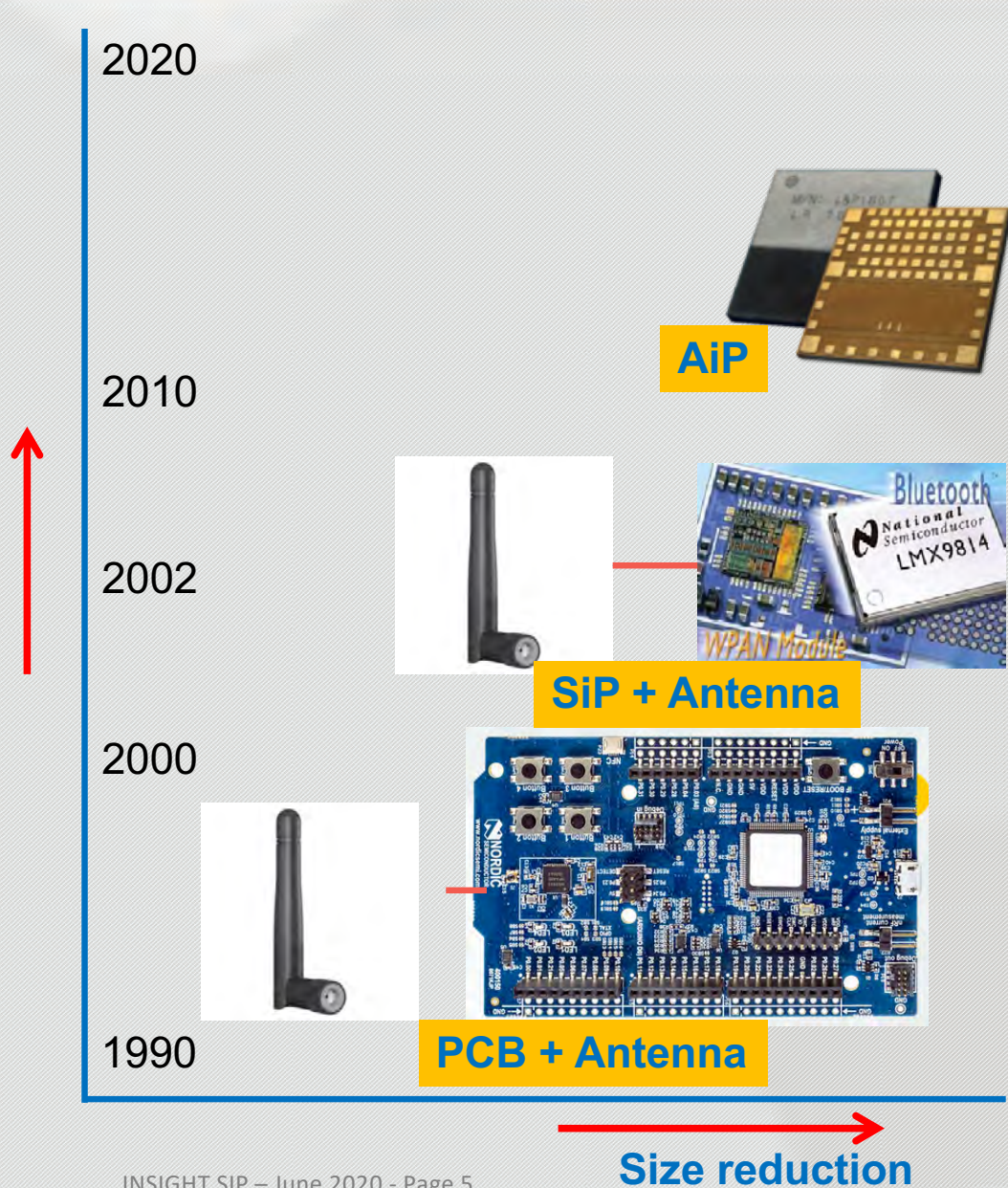


- + **Complete 3D RF System Including**
- + **Multiple SoCs in different Tech Nodes** (*CMOS, GaAs, SiGe....*)
- + **Multiple Packaging Techniques** (*Flip_chip, Wire-bond, Package in Package*)
- + **Passive Integration** (*SMDs, Integrated Passives (glass, silicon, ceramic),...*)
- + **Different Substrate Technologies** (*BT, LTCC, Si,..*)
- + **Built In Antennas** (*in substrate, in/on molding, custom part,..*)

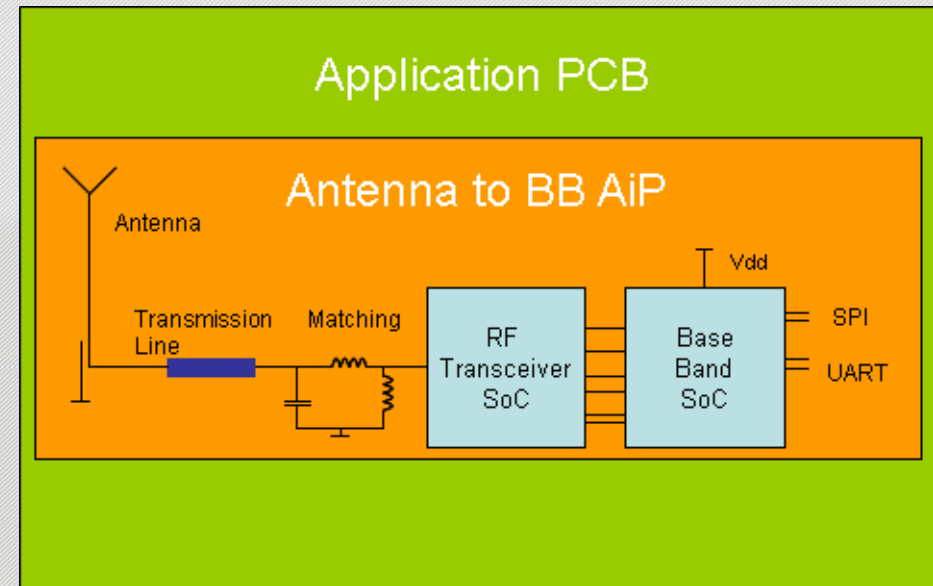


- + **Smallest size**
- + **More reliable**
- + **Lowest overall cost**
- + **Reduced Time to Market**

From PCB to SiP to AiP



- **Antenna in Package**
 - Final step to put ALL system in one package
 - Plug and Play
 - Removes need for RF expertise at system level
 - Eases Radio certification

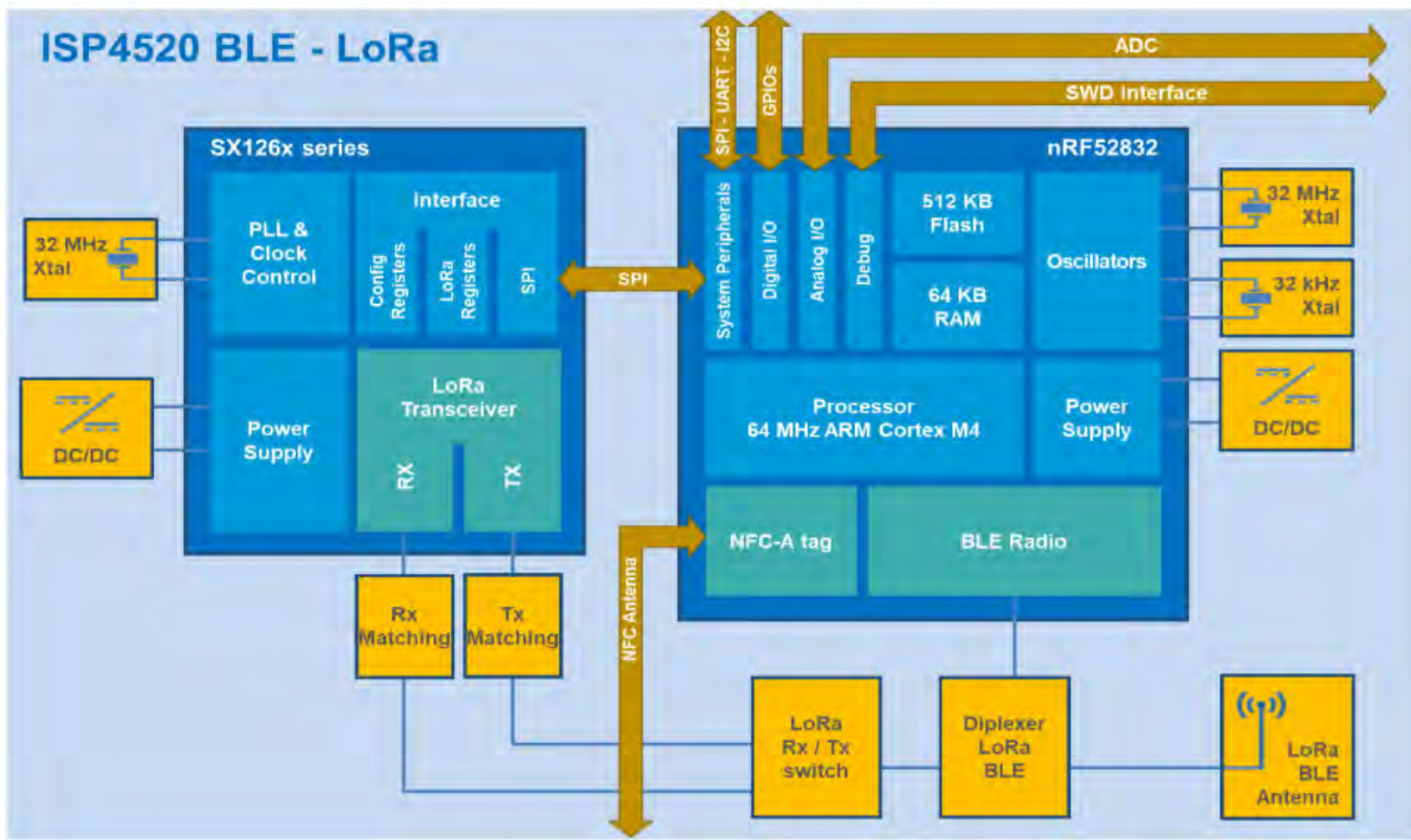


Size reduction



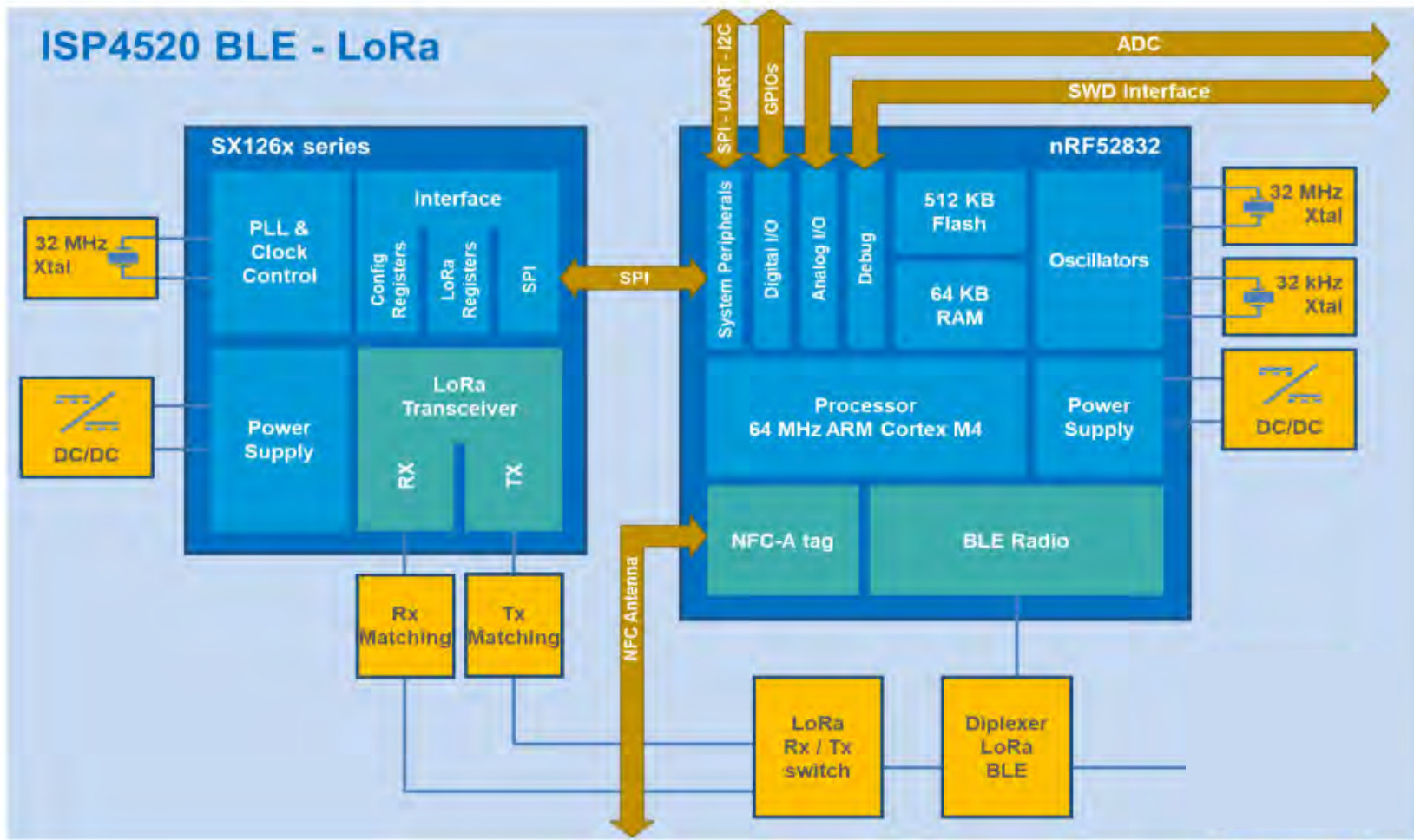
- **2005 – 2008 Original R&D at ISP**
- **2008 world first AiP patented by ISP**
- **2010 First BLE module AiP ISP191201**
- **2014 2nd gen AiP ISP1301**
- **2014 Murata module uses AiP concept**
- **2016 3rd gen AiP ISP1507**
- **2017 1st gen 2 antenna AiP ISP1510 UWB + BLE**
- **2018 SiLabs AiP BLE module**
- **2019 1st gen 2 antenna AiP LoRa + BLE**

DESIGN EXAMPLE ISP4520



9.8 x 17.2 x 1,7 mm

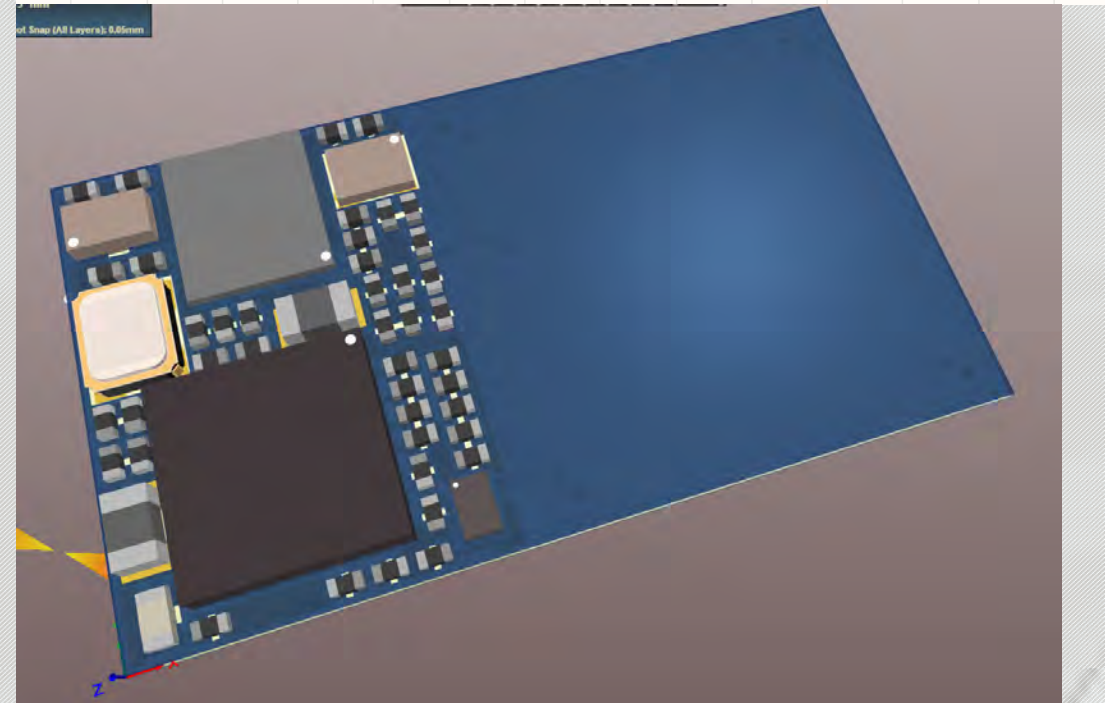
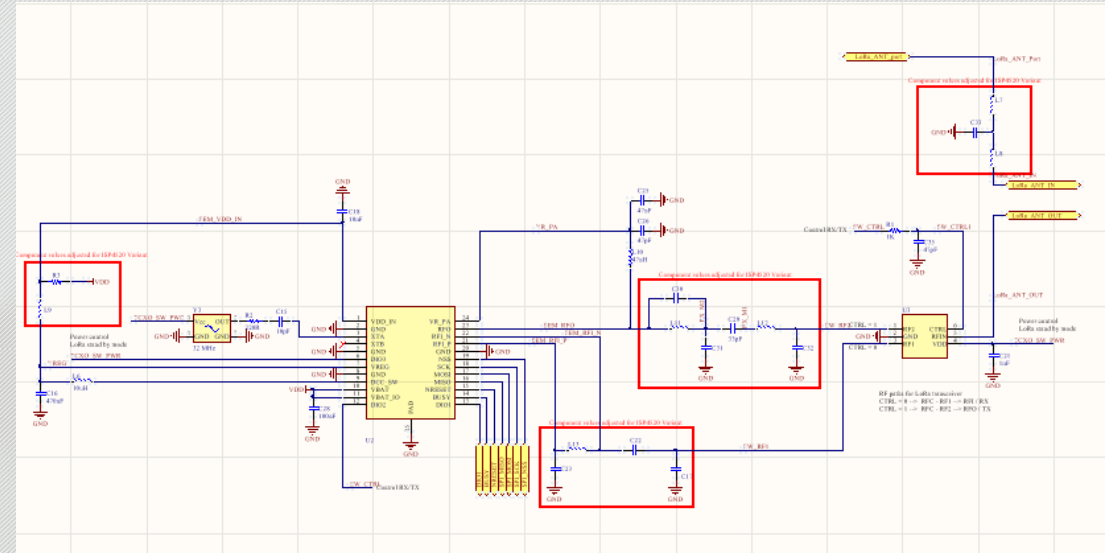
Complete self contained LoRa node with baseband and BLE
Includes dual band antenna and all frequency control & matching



9.8 x 17.2 x 1,7 mm



- ✚ Schematic to Layout
- ✚ Toolsets
 - ✚ Altium
 - ✚ Allegro SiP
 - ✚ Expedition
- ✚ Capture Schematic
- ✚ Place Components
 - ✚ Tight spacings 200um
- ✚ Route Substrate
 - ✚ Best design practice
 - ✚ Careful shielding
 - ✚ Iterative
 - ✚ Key task for quality





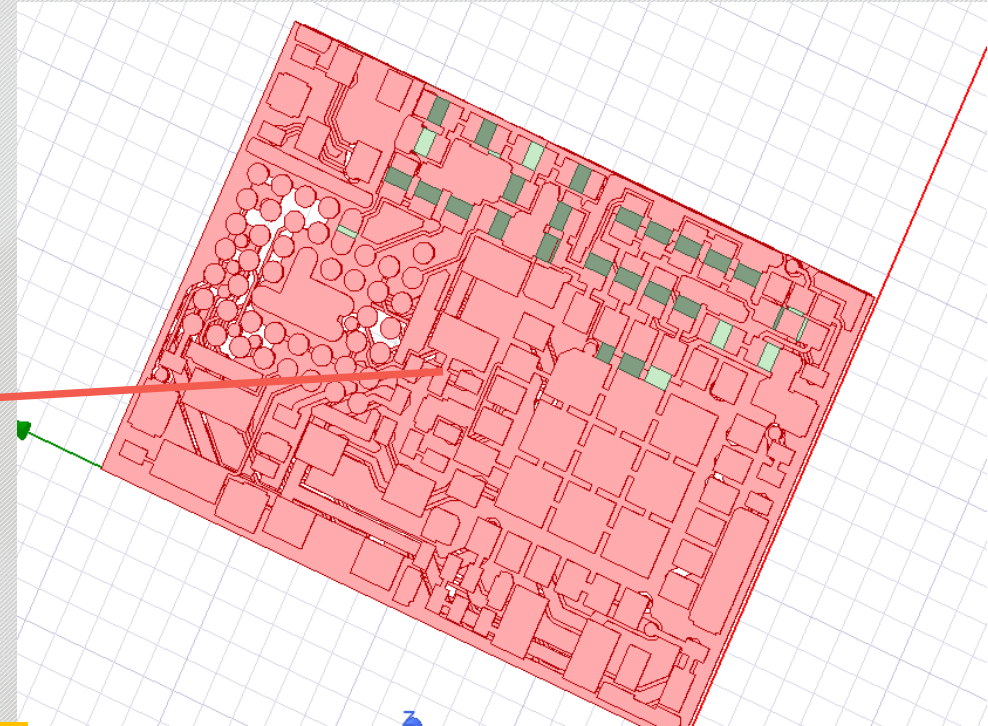
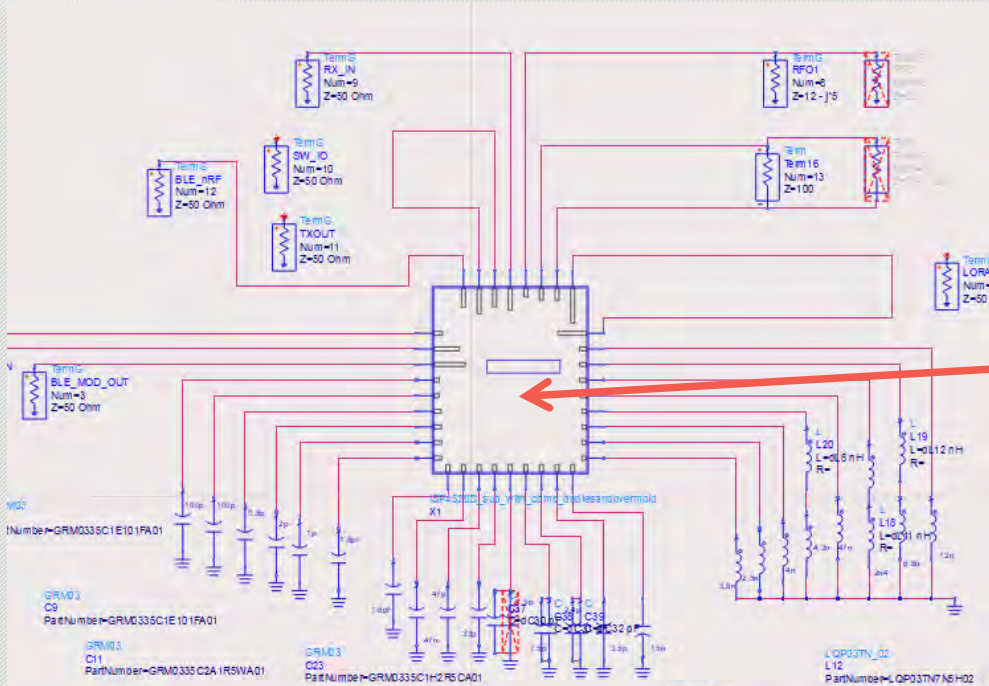
- # Extract 3D layout of substrate
- # Simulate with 3D Electromagnetic Tool
 - # Ansys HFSS (or CST or ADS FEM)
- # Create n port s parameter model
- # Export to schematic simulator
 - # Keysight ADS
- # Add components and optimize
 - # Keysight ADS
- # Feedback to adjust substrate design



Reduce
of design spins
Improve
Performance
Time to Market



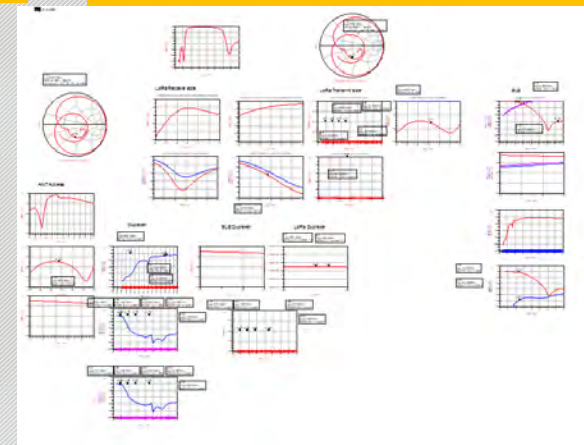
DESIGN OF ELECTRONICS



RF Schematic to optimize & validate Keysight ADS

3D EM simulation in ANSYS HFSS

Results for 10RF paths



+ Integrated Antenna Design Constraints

+ Miniaturization to fit into the package

- ✓ Size reduction of 2 to 3 times of discrete antennas

+ Must use standard SiP technology

- ✓ LTCC or Organic substrates
- ✓ Structures in or on mold compound
- ✓ IPD (silicon or glass based passive devices)
- ✓ SMT components down to 01005

+ Performance Margins

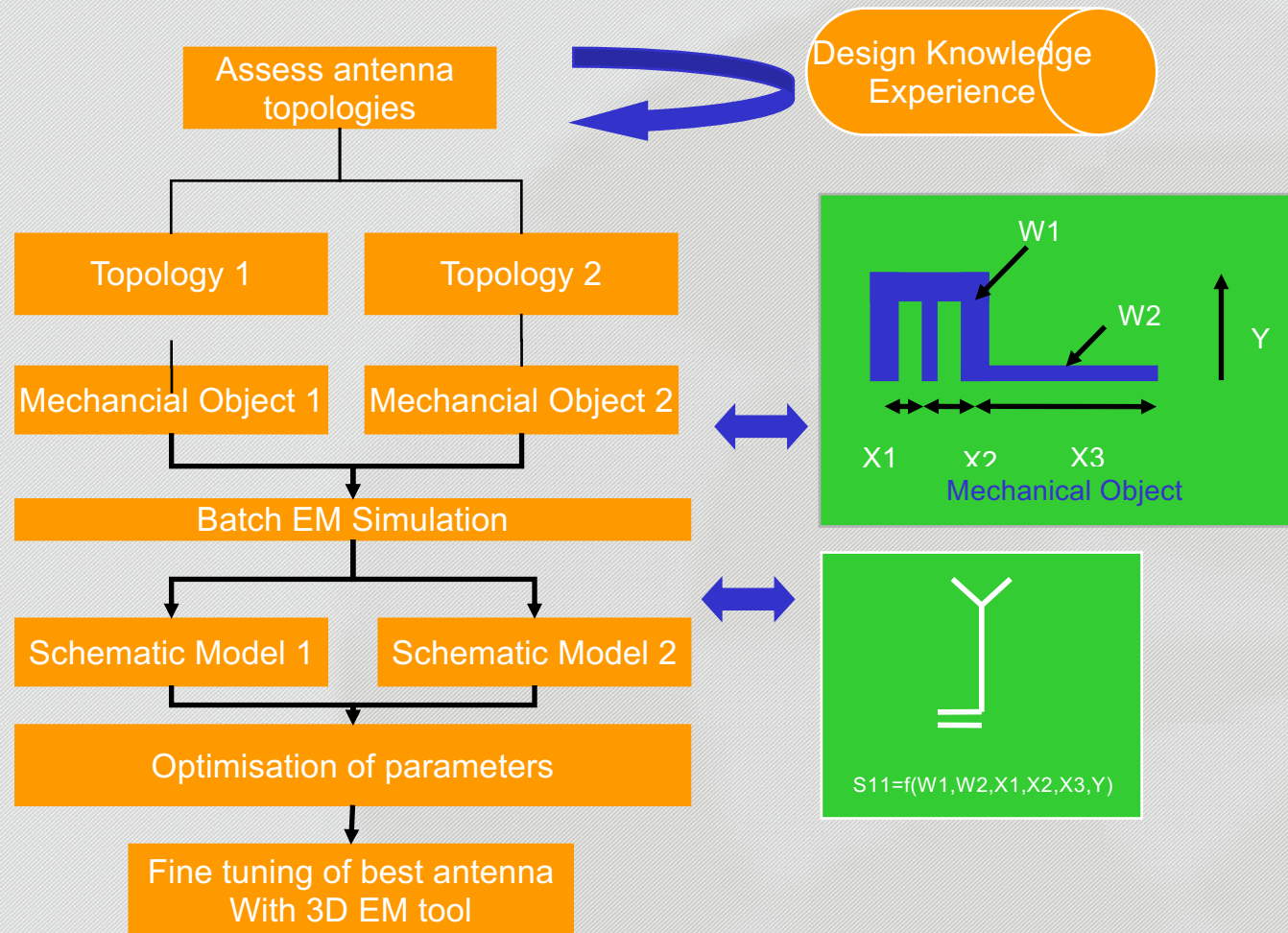
- ✓ Multiple application platforms (ground plane size variations)
- ✓ Standard SiP production tolerances
 - Dimensions
 - Material properties

+ Technical Specifications

- ✓ Return Loss over operating band
- ✓ Radiation Efficiency over operating band
- ✓ Radiation Patterns and Gain



Design Process



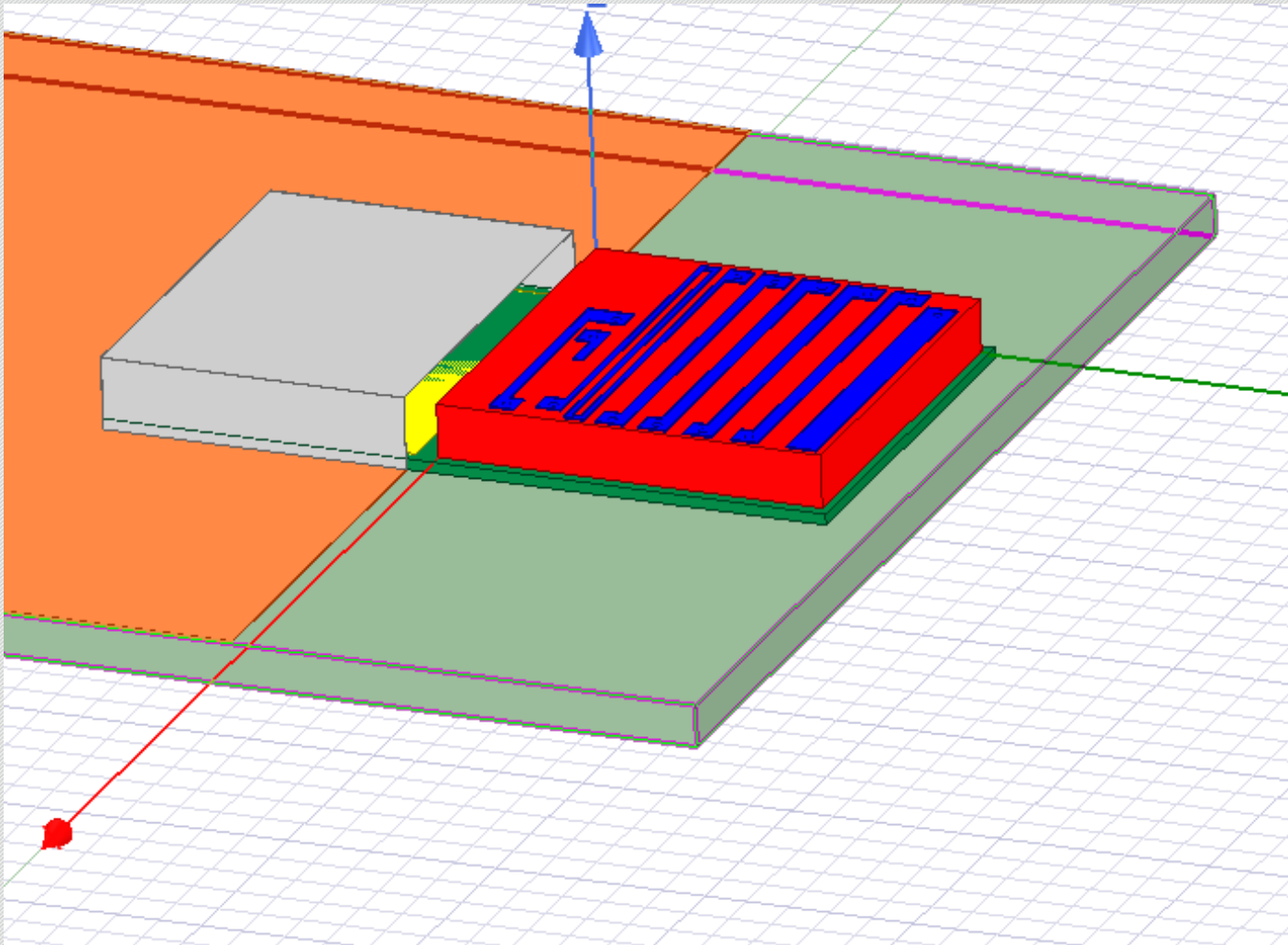


- ✦ **LoRa sub Giga Frequencies**
 - ✦ Wavelength ca 32 cm
 - ✦ $\lambda/4 = 8$ cm
 - ✦ Miniaturization complex
- ✦ **BLE 2.4 GHz ISM band**
 - ✦ Wavelength 12 cm
 - ✦ $\lambda/4 = 3$ cm
- ✦ **Design Options**
 - ✦ 2 antennas
 - ✦ 1 antenna with 2 modes and diplexer
- ✦ **Integration options (in SiP technology)**
 - ✦ Printed in substrate
 - ✦ 3D structure using vertical vias in mold compound
 - ✦ 3D structure as component in mold compound



LoRA BLE ANTENNA

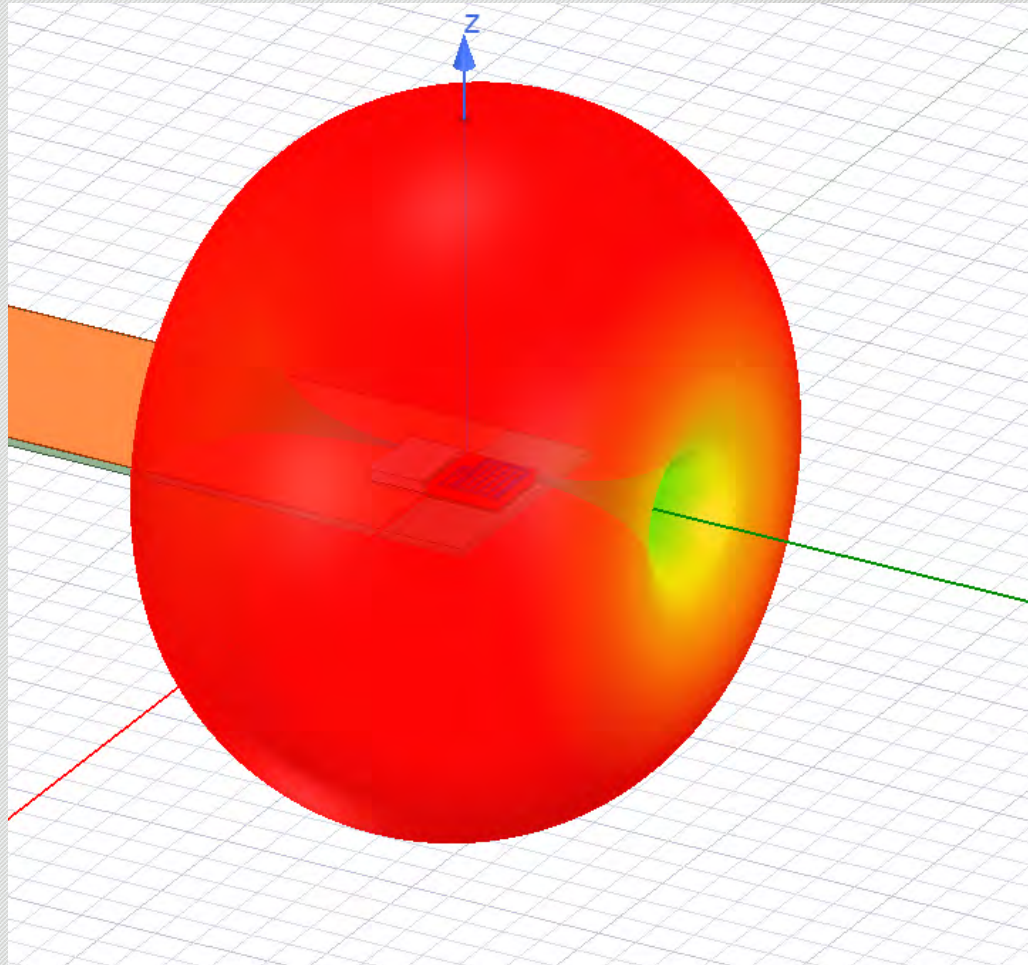
- 3D EM simulation
- ANSYS
- Design Optimized





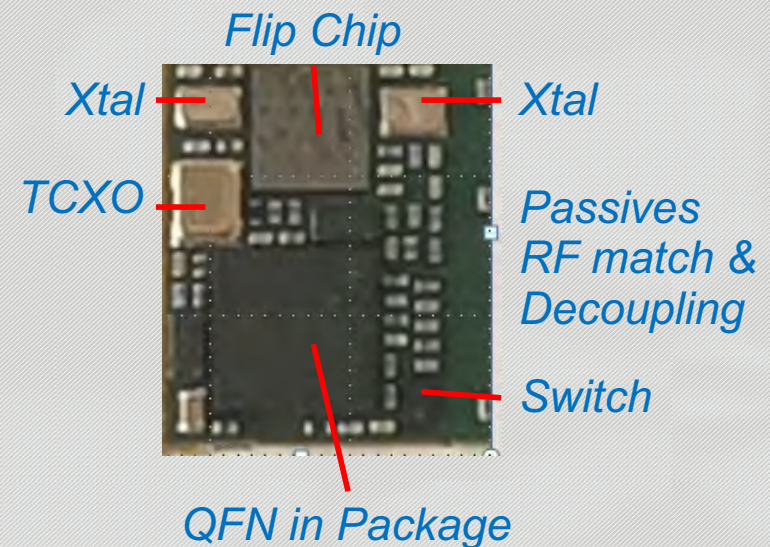
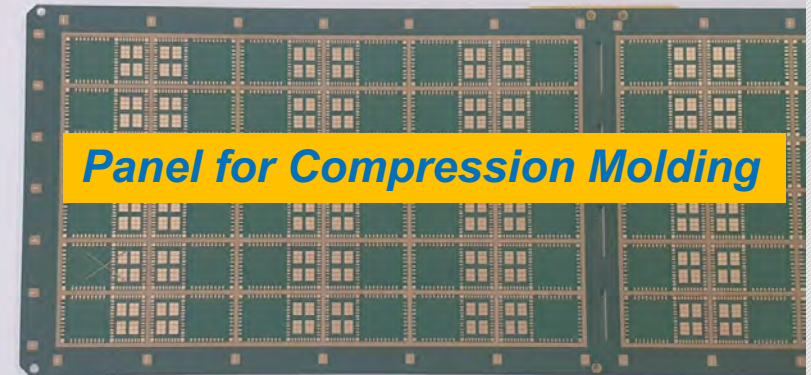
LoRa BLE ANTENNA

+ Donut Radiation Pattern at LoRa



LoRA BLE FABRICATION

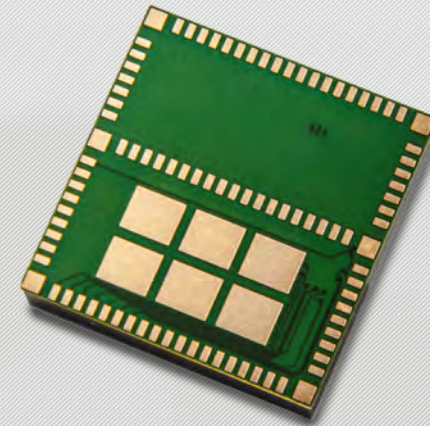
- ✦ Based on large Panel
- ✦ SMT process for all components
- ✦ Compression molding
- ✦ Metallization for shielding
- ✦ Separation
- ✦ Test





UWB BLE MODULE

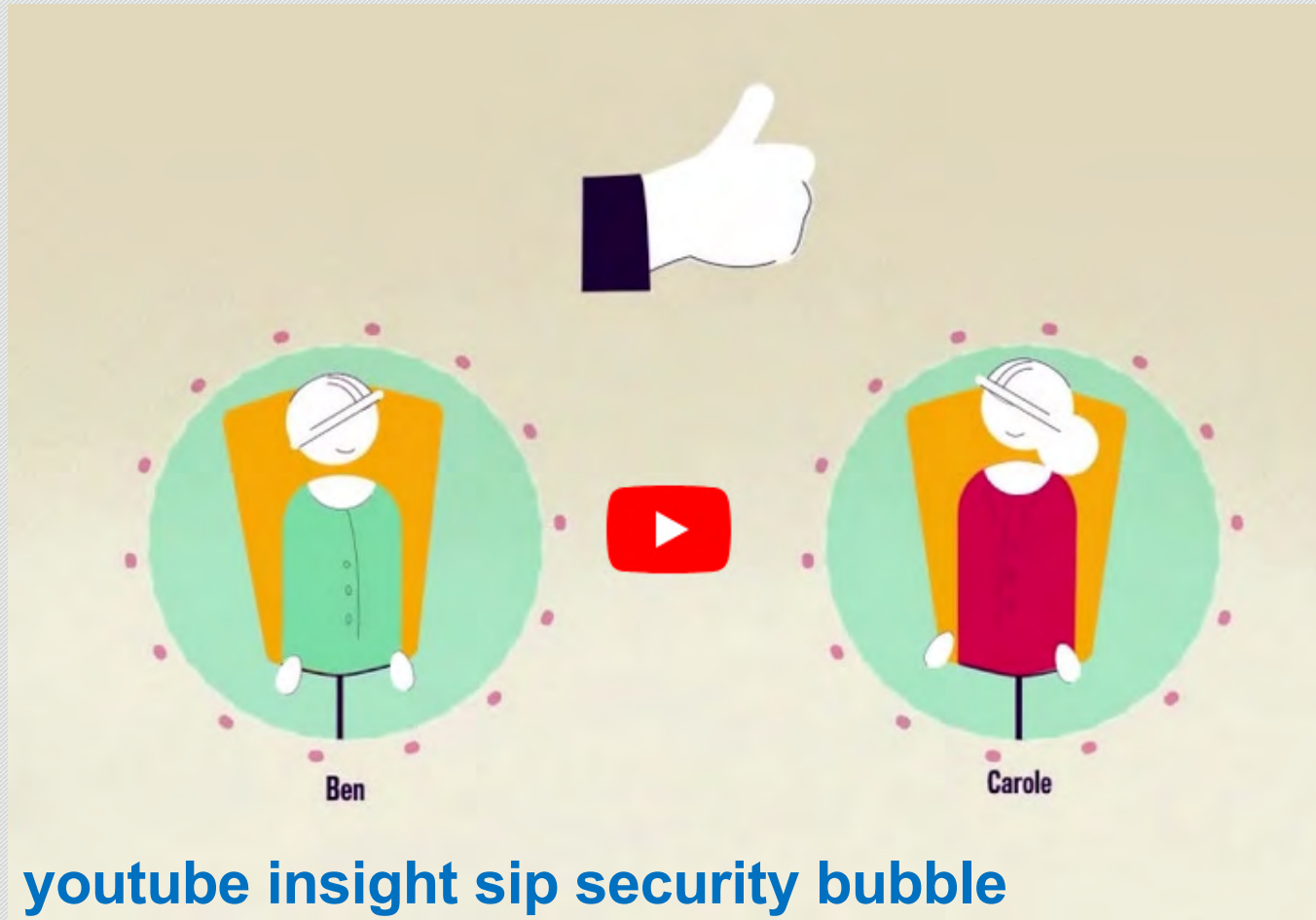
- ✚ Module with 2 antennas
- ✚ BLE (2.4 Ghz) and UWB (6.5 GHz)
- ✚ Based on Decawave DW1000 and nRF52832 (Nordic)
- ✚ Real Time Indoor Localization
- ✚ Social Distancing Solution
 - ✚ Accurate measure of distance (<10cm)
 - ✚ Security Bubble





UWB SECURITY BUBBLE

https://www.youtube.com/watch?v=ltNF83il9RY&feature=emb_logo



youtube insight sip security bubble

THANK YOU

