SMART MODULES

ROADMAP & PRODUCT RANGE

NOVEMBER 2019
- **Company Overview**
- **Short Range**
- **Wide Area Network**
- **Positioning**
- **Secure IoT**
- **Custom**
Experts in RF System-in-Package (SiP) and Antenna-in-Package (AiP) in response to ultra miniature wireless solution demand

- **Established in 2005**
  - Founded by actual CEO and CTO
  - Core team of PhD and MSc from National Semiconductor
  - Electromagnetic simulation, antenna design and μW & RF circuit theory skills
  - Unique set of design techniques & industrialization expertise
  - 25 people engineering and fabless company

- **Locations**
  - Europe – HQ & Technical team in Sophia-Antipolis
  - North America – Subsidiary in Denver
  - Asia – Sales office in Tokyo
  - Global network of distributors
  - Manufacturing – Taiwan and Philippines
- Modules are manufactured in several plants and partners, in Taiwan and Philippines
  - Production level greater than 1M modules

- Quality standards in production
  - ISO9000 standards and several other equivalent certifications
  - OHSAS18001 – Health and Safety management
  - ISO13485 – Medical requirements
  - AS9100 – Aerospace requirements
  - QS9000 – Automotive requirements

- All modules fully tested before delivery
  - IOs, Radio and Flash/RAM writing
  - Possibility to offer Pre-programming service
SiP approach consists of integrating several different components into a single miniaturized module

- From different semiconductor and passive technologies
  - Organic substrates (BT, FR4...)
  - Multi-layer ceramic substrates (LTCC, HTCC, Thick film...)
  - Thin film IPD on silicon or glass
- Unique ability to embed functions within the package
- RF know-how
- Extremely rapid and low cost development cycles

Insight SiP focus on AiP – Antenna in Package – products with the addition of ultra-miniature antennas in the SiP

- Insight SiP’s long term fundamental research program
- Combining electromagnetic simulations and circuit level optimization
- Based on a user extendable library of physical objects
- R&D work implemented in several Wireless Connectivity products
Technology Benefits

- **Ready to Go**
  - ✓ No need for RF knowledge
  - ✓ Design effort for RF design is very often underestimated
  - ✓ Minimum electronic skills for digital connection
  - ✓ Module is certified, avoiding lengthy and expensive certification process

- **Fast Time to Market**
  - ✓ Time to market reduced by 3 to 6 months

- **Smaller**
  - ✓ Small and integrated solution
  - ✓ Single component replaces many, supply chain simpler

- **Improved performance**
  - ✓ Optimized antenna performance
  - ✓ BLE function concentrated in one single component

- **Application development is focused on customer’s added value**
- Designed by RF specialist with leading chipset manufacturer
- Offers fully embedded connectivity solutions

1. **SoC Inside**
   - WLCSP wireless SoC and multiple analog and digital functions

2. **Both crystals included**
   - Radio & Synchronization
   - Reduced power consumption

3. **Power supply decoupling**
   - For both DC-DC enable or disable operating mode

4. **Antenna matching circuit**

5. **Integrated Antenna**
   - Proprietary integrated antenna
   - Offering best reproducibility and best in class performance
   - Relatively insensitive to environment

6. **Integrated shielding avoiding external metallic covers**
   - Reduces height and size
Insight SiP is addressing a wide area of market segments that require state of the art wireless and IoT solutions.

- Mobile Computing
- Healthcare and Wellness
- Industry 4.0
- Cellular Connectivity
- IoT and M2M
- Defence
- Smart Secure
- Mobility
- Avionics and Space
LOW POWER NETWORKING

- BLE
- BT 5 Long Range & Mesh
- LTE-M & NB-IoT
- LoRa 800/900 MHz & LoRa 2.4 GHz

Very Low Power, Very Low Cost
Moderate Power, Moderate Cost
Low Power, Low Cost
Market & Customers

Positioning

Accuracy (cm)

Range (m)

Signal Strength Technology

LTE-M

BLE

BT 5.1

LoRa 2.4 GHz

Multi-Antenna Angle of Arrival

Time of Flight Technology

UWB
**PRODUCT OFFER**

Insight SiP is the leading provider of Smart, Low Power and Built-in Antenna Connectivity Modules for advanced IoT solutions

- Our portfolio includes a diverse set of solutions to meet different IoT use cases
  - Our modules provide class leading miniaturization
  - Our modules are designed with superb radio performance
## PRODUCT OFFER

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<th>Wide Area Modules</th>
<th>Short Range Modules</th>
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<td>iSP45</td>
<td>iSP09</td>
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<tr>
<td>BT 5.1</td>
<td>LoRa 800/900</td>
<td>BLE 4.0</td>
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<tr>
<td>Direction Finding</td>
<td>Europe Japan USA</td>
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<tr>
<td>Low Cost</td>
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<td>iSP13</td>
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<td>BLE 4.2 ANT+</td>
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<tr>
<td>iSP18</td>
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<td>iSP18</td>
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<tr>
<td>BT 5.0 ANT+ Thread</td>
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<tr>
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<tr>
<td>iSP19</td>
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<td>BT 5.1 ANT+ Thread</td>
<td>BT 5.1</td>
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<tr>
<td>Zigbee</td>
<td>ANT+ Thread</td>
<td>ANT+ Thread</td>
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<td>Low Cost</td>
<td>Long Range</td>
<td>Long Range</td>
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<tr>
<td>iSP30</td>
<td>Long Range UWB</td>
<td>UWB</td>
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<td>iSP19</td>
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<td>High Temp</td>
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<tr>
<td>iSP60</td>
<td>NB-IoT</td>
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</tr>
</tbody>
</table>

2009  | 2018  | 2019 NEW MODULES  | PLAN FOR 2020+ |

Mailto: contact@insightsip.com
Web: www.insightsip.com
Short Range Modules
Bluetooth Low Energy
Insight SiP offers Built-in Antenna BLE Modules with Concentrated Performances for IoT Applications

- **Tiny module size**
  - ✓ SIP package = smallest solution on the market for antenna integrated module

- **Proven available high performance**
  - ✓ Outstanding antenna performance verified by major companies
  - ✓ Hardware support for standard application: Sensor demo, Beacon Demo
  - ✓ Very high quality hardware support from true RF experts: possible RF and range simulation of customer design

- **Based on Nordic Semiconductor chipset**
  - ✓ Established player in BLE for many years
  - ✓ Proven and well supported protocol stack, with huge firmware library

- **Fully certified**
  - ✓ BT SIG, CE, FCC, IC, TELEC
Bluetooth SIG
✓ The Bluetooth Special Interest Group was formed in 1998
✓ This is now a community of over 30000 members

Bluetooth Classic
✓ V2.0   Bluetooth Classic released in 2004
✓ V3.0   Bluetooth High Speed adopted in 2009, dedicated to audio application

Bluetooth Low Energy (BLE)
✓ V4.0   First Bluetooth Low Energy concept adopted in 2010
✓ V4.1   Multirole capabilities : Master & Slave on the same chip
✓ V4.2   Enable IPv6 for Bluetooth : Improve speed, security and privacy
✓ V5.0   Adopted end 2016 : 2X speed, 4X range, 8X throughput
✓ V5.1   Last generation enabling Direction Finding

✓ In parallel, Bluetooth Mesh was introduced as new connectivity capabilities, independent of BLE versions
Insight SiP offers BLE modules from V4.0 up to V5.1
✓ No Bluetooth Classic or Dual Mode available

Bluetooth Low Energy
✓ allows for short bursts of long-range radio connection
✓ doesn’t require continuous connection
✓ depends on long battery life
✓ makes it ideal for Internet of Things (IoT) applications

Bluetooth Classic
✓ establishes a relatively short-range
✓ continuous wireless connection
✓ makes it ideal for use cases such as streaming audio

Dual-Mode
✓ available to support single devices such as smartphones or tablets
✓ need to connect to BR/EDR devices (such as audio headsets)
✓ Also need to connect to LE devices (such as wearables or retail beacons)
Bluetooth Low Energy is designed for Low Power Applications

- Where aim is long battery life
- Months / years off coin cell
- Occasional data exchange

Principle of Bluetooth LE solution

- BLE chip saves power by being in “sleep mode” most of the time
- Power consumption is strongly related to data rate
- Bluetooth low energy is designed to enable connectivity of power-sensitive devices operating on primary cells for long periods of time ranging from months to potentially several years
- One cannot look at peak RX or TX current to assess overall power consumption since the time in low power “sleep” mode dominates overall power consumption
BLE Mesh is a recent extension of Bluetooth technology
✓ It extends the capabilities and potential uses of Bluetooth in many applications
✓ Particularly suited to smart building and home automation applications

BLE Mesh is available from V4.2 Bluetooth version
✓ It uses the same radio and physical transport as existing BLE
✓ It adds a networking layer that allows multiple Bluetooth devices to work together
✓ Messages from one device to another is sent via one or more intermediate nodes
✓ In other words the network or “mesh” allows two devices to communicate that are too far apart to make a direct point to point Bluetooth connection
✓ In practical terms, a direct point to point Bluetooth connection is limited to around 50m (direct line of sight), or 200m for Bluetooth 5 long range.

Ability to extend the effective communication distance

Allows devices to be put into groups and message to be sent to one device or a group of devices
Large Choice of Platforms and Options with Integrated Antenna

- **iSP09 series BLE 4.0**
  - iSP091201-BN
  - iSP1302-BN

- **iSP13 series BLE 4.1**
  - iSP130301-BL
  - iSP130301-BM

- **iSP15 series BLE 4.2 BT5 Ready ANT+**
  - iSP1507-AX

- **iSP18 series BT 5.0 Zigbee Thread**
  - iSP1807-LR

- **iSP19 series BT 5.1 Zigbee Thread Dir. Finding**
  - iSP1907-HT
  - iSP1907-LL

**Performance**
- BLE Connectivity for External MCU
- Integrated MCU Sensor Node
- Integrated MCU Sensor Node & Mesh
- Integrated MCU – Multiprotocol Long Range & Mesh

**Platforms**
- nRF8001 inside
- nRF51 inside
- nRF52 inside
### Comprehensive brand new range of BT 5.0 and BT 5.1 modules based on nRF52 family

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Description</th>
<th>Features</th>
</tr>
</thead>
</table>
| ISP1507-AX  | All-purpose BLE solution for sensor & Mesh connectivity | - Based on nRF52832  
- BT 5.0 Ready  
- 512 kB Flash & 64 kB RAM  
- 30 IOs |
| ISP1507-AL  | Perfect for Mesh Relay nodes and price sensitive solutions | - Based on nRF52810  
- BT 5.0 Ready  
- 192 kB Flash & 24 kB RAM  
- 13 IOs |
| ISP1807-LR  | Home and Building Networks and secure solutions | - Based on nRF52840  
- BT 5.0 Long Range  
- 1 MB Flash & 256 kB RAM  
- ARM Cryptocell  
- 46 IOs + USB |
| ISP1907-HT  | Long Range High Temperature for Smart Home & Lighting | - Based on nRF52833  
- BT 5.1 Long Range & AoA  
- 512 kB Flash & 128 kB RAM  
- 30 IOs + USB |
| ISP1907-LL  | Price Sensitive Home and Building Networks | - Based on nRF52811  
- BT 5.1 Long Range & AoA  
- 192 kB Flash & 24 kB RAM  
- 13 IOs |

**Common features**

- Interchangeable Pin to Pin compatibility
- Form Factor 8 x 8 x 0.95 mm
- BLE, ANT+, BT Mesh
- Built-in Antenna, Cortex M4, DC/DC, Xtals, Balun
- SPI, I2C, UART, ADC interfaces
Low Cost BT5 Ready

iSP1507-AL Perfect for Mesh Relay Node and Price Sensitive Solutions Ultra Low Consumption

Key Features
✓ Based on nRF52810
✓ BT 5 Ready BLE transceiver
✓ Ultra Small LGA 8 x 8 x 1 mm
✓ 32-bit ARM Cortex – M4 CPU
✓ 192K Flash & 24 K SRAM
✓ Suitable for ANT+ Protocol
✓ Complete set of 13 IOs included
✓ Radio 32 MHz & Synchro 32 kHz Xtals
✓ Decoupling and DCDC circuit on board

Applications
✓ Any type of Body Area applications
✓ Industrial Sensors
✓ Home network applications

Market Introduction
✓ Samples, kits available
✓ Full Mass production
✓ Fully Certified
**All Purpose BT5 Ready**

**iSP1507-AX** High Performance Module for BLE / ANT+ / NFC Applications

**Ultra Low Consumption**

### Key Features
- Ultra Small LGA 8 x 8 x 1 mm
- BT 5 Ready nRF52832 BLE transceiver
- 32-bit ARM Cortex – M4 CPU
- 512 K Flash & 64 K SRAM
- NFC-A Tag for OOB pairing
- Suitable for ANT+ Protocol
- Complete IO set included
- Radio 32 MHz & Synchro 32 kHz Xtals
- Decoupling and DCDC circuit on board

### Applications
- Connected sensors
- IoT applications
- Wearable technology

### Market Introduction
- Samples, kits available
- Full Mass production
- Fully Certified
**Long Range Full BT5**

**iSP1807-LR**

Long Range BT5 Module for BLE, ANT+, NFC Applications

**Ultra Low Consumption**

**Key Features**

- Ultra Small LGA 8 x 8 x 1 mm
- BT 5.0 nRF52840 BLE transceiver
- Long Range +8 dBm Tx power
- 32-bit ARM Cortex – M4F CPU
- 1MB Flash & 256 K SRAM
- ARM CryptoCell, NFC pairing
- USB interface
- Suitable for ANT+, Zigbee, Thread
- Complete 46 IOs set included
- Radio 32 MHz & Synchro 32 kHz Xtals
- Decoupling and DCDC circuit on board

**Applications**

- Wearables
- Fitness, Health
- Smart Home
- Industrial sensors
- Remote controls
- Gaming controller

**Market Introduction**

- Samples & Kits available
- Full Mass production
- BT SIG, CE, TELEC, KCC CERTIFIED FCC, IC in progress
LONG RANGE LOW COST 5.1

iSP1907-LL
Long Range & AoA BT 5.1 Module for Price Sensitive Applications

Key Features
✓ Ultra Small LGA 8 x 8 x 1 mm
✓ BT 5.1 nRF52811 BLE transceiver
✓ Long Range +4 dBm Tx power
✓ 32-bit ARM Cortex – M4 CPU
✓ 192 KB Flash & 24 K SRAM
✓ Suitable for ANT+ Protocol
✓ Complete set of 13 IOs included
✓ Radio 32 MHz & Synchro 32 kHz Xtals
✓ Decoupling and DCDC circuit on board

Applications
✓ Body Area
✓ Industrial Sensors
✓ Home network
✓ Logistics and warehousing
✓ Value asset security

Market Introduction
✓ Samples & Kits available
✓ First Production batch in progress
✓ Certification pending
LONG RANGE HIGH TEMP 5.1

iSP1907-HT  Long Range & AoA BT 5.1 Module For High Temperature And Mesh Applications

Key Features
✓ Ultra Small LGA 8 x 8 x 1 mm
✓ BT 5.1 nRF52833 BLE transceiver
✓ Long Range +8 dBm Tx power
✓ 32-bit ARM Cortex – M4F CPU
✓ 512 KB Flash & 128 K SRAM
✓ USB interface
✓ Suitable for ANT+, Zigbee, Thread
✓ 30 IOs included
✓ Radio 32 MHz & Synchro 32 kHz Xtals
✓ Decoupling and DCDC circuit on board
✓ Extended temperature range -40/+105°C

Applications
✓ Lighting Applications
✓ Industrial
✓ Smart Home
✓ Logistics and warehousing
✓ Value asset security

Market Introduction
✓ Samples & Kits schedule Q1-2020 to be confirmed when the chip is available
**iSP15 series**
**iSP18 series**
**iSP19 series**

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**Evaluation Board**

- 1 interface board with J-Link Cortex emulator
- 1 test board

**Test Board**

- Specific test board of required P/N compatible with any Kit
- Test Boards integrate a “Connector Debug In” port compatible with Nordic Dev kits
- All IOs “Test Point” on board
iSP1880 BLE Miniature Multi Sensor Based on iSP1807

Key Features
✓ BT5 nRF52840 transceiver
✓ Long Range +8 dBm Tx power
✓ 32-bit ARM Cortex – M4F CPU
✓ 1MB Flash & 256 K SRAM
✓ ARM CryptoCell
✓ USB interface
✓ Single 2.1 to 5.5 V supply
✓ Decoupling and DCDC circuit on board
✓ Ultra Low Power Consumption on CR2032 Coin cell battery
✓ Overall Size 26 x 32 mm
✓ Temperature -25 to 75 °C
✓ Fully integrated RF matching and Antenna
✓ Radio 32 MHz & Synchro 32 kHz Xtals
✓ Accelero/Gyro / Magneto Sensor
✓ Temperature/Barometer
✓ Humidity Sensor
✓ Programmable controlled mini LED
✓ Sensor Demo available on iTunes and Google Play
**PRODUCT SELECTION GUIDE**

- **Select the RF and Protocol requirements**
  
  ✓ Does the application needs other protocol than pure BLE? What about ANT, Zigbee, Thread?  
  ✓ Is BLE Mesh needed?  
  ✓ Should the radio be Long Range?  
  ✓ Any need for Direction Finding? Tag? Anchor? Both?

<table>
<thead>
<tr>
<th>Module Type</th>
<th>iSP1507-AL</th>
<th>iSP1507-AX</th>
<th>iSP1807-LR</th>
<th>iSP1907-LL</th>
<th>iSP1907-HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi Protocol</td>
<td></td>
<td>OK ANT+</td>
<td>BEST ANT, Thread Zigbee</td>
<td></td>
<td>BEST ANT, Thread Zigbee</td>
</tr>
<tr>
<td>NFC Pairing</td>
<td></td>
<td>OK</td>
<td>OK</td>
<td></td>
<td>OK</td>
</tr>
<tr>
<td>Mesh needed</td>
<td></td>
<td>BEST</td>
<td>BEST</td>
<td></td>
<td>BEST</td>
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<tr>
<td>Long Range needed</td>
<td></td>
<td>BEST</td>
<td>BEST</td>
<td>BEST</td>
<td>BEST</td>
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<tr>
<td>Direction Finding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TAG only</td>
</tr>
</tbody>
</table>
### PRODUCT SELECTION GUIDE

- **Select the adapted CPU performance**

  ✓ Does the application needs an embedded MCU or use an external host ?
  ✓ Does it need many calculation with floating point capability ?
  ✓ What is the requirement in term of memory ?
  ✓ Any additional security required ?

<table>
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<tr>
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<th>iSP1907-HT</th>
</tr>
</thead>
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<tr>
<td>External Host Micro</td>
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<td>BEST</td>
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<td>Embedded floating point computing</td>
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<tr>
<td>Embedded memory requirement</td>
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<tr>
<td>✅</td>
<td>LIGHT 192 / 24 kB</td>
<td>MEDIUM 512 / 64 kB</td>
<td>LARGE 1 MB / 256 kB</td>
<td>LIGHT 192 / 24 kB</td>
<td>MEDIUM 512 / 128 kB</td>
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<td>Embedded Cryptocell security</td>
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<td></td>
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<td></td>
<td></td>
<td>YES</td>
</tr>
</tbody>
</table>
PRODUCT SELECTION GUIDE

### Select the module interfaces

- How many IOs are required?
- Any Analog port?
- Any USB interface?

<table>
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<tr>
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<th>iSP1907-LL</th>
<th>iSP1907-HT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ios including I2C, SPI, UART, PWM, etc.</strong></td>
<td>LIGHT 13</td>
<td>MEDIUM 30</td>
<td>LARGE 46</td>
<td>LIGHT 13</td>
<td>MEDIUM 30</td>
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<tr>
<td><strong>ADCs</strong></td>
<td>LIGHT 3</td>
<td>LARGE 8</td>
<td>LARGE 8</td>
<td>LIGHT 3</td>
<td>LARGE 8</td>
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<tr>
<td><strong>USB</strong></td>
<td></td>
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<td></td>
<td>YES</td>
<td>YES</td>
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</tbody>
</table>
Wide Area Network Modules
LoRa
Insight SiP offers LoRa Low Power solution platform for Longer Range Networking applications

- Insight SiP is LoRa Alliance member since 2018
- LoRa section based on Semtech transceiver
  - Europe: based on Semtech SX1261, 867-869 MHz and +14dBm
  - US: based on Semtech SX1262, 902-928 MHz and +20dBm
  - Japan: based on Semtech SX1261, 920-925 MHz and +14dBm
- BLE section based on Nordic nRF52 chipset
  - Providing over the air configuration of LoRa through smartphone or tablet
  - Also offering low energy rough location indication
- Dual antenna integration
  - New and unique concept developed by Insight SiP with 2 embedded antennas in package
- Certifications
  - BT SIG, CE, FCC, IC, TELEC based on versions
LoRa is a Low-Power Wide Area Network (LPWAN) standard

- Aimed at low data rate – low power applications (like BLE)
- Uses Adaptive Data Rate (ADR) to maximize combination of range/data/rate power
- Thus one cannot quote a max range or data rate like BLE, but the following table (Source: Orange) indicates capability (probably under ideal conditions)
- The following table defines the frequencies used by LoRa in key regions

- LoRa uses unlicensed spectrum

<table>
<thead>
<tr>
<th>Region</th>
<th>Supported</th>
<th>Band [MHz]</th>
<th>Duty cycle</th>
<th>Output power</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU</td>
<td>Y</td>
<td>868</td>
<td>&lt;1 %</td>
<td>+14 dBm</td>
</tr>
<tr>
<td>EU</td>
<td>Y</td>
<td>433</td>
<td>&lt;1 %</td>
<td>+10 dBm</td>
</tr>
<tr>
<td>US</td>
<td>Y</td>
<td>915</td>
<td>&lt;2 % (BW&lt;250 kHz) or &lt;4 % (BW&gt;=250 kHz) Transmission slot &lt; 0.4 s</td>
<td>+20 dBm</td>
</tr>
<tr>
<td>CN</td>
<td>N</td>
<td>779</td>
<td>&lt;0.1 %</td>
<td>+10 dBm</td>
</tr>
</tbody>
</table>
LoRaWAN refers to a standard Network protocol, allowing different LoRa devices to communicate with each other in a standard way:

- A private point to point network could use LoRa technology, but not LoRaWAN (although it could)
- A public network would normally use LoRaWAN

LoRaWAN is defined and maintained by the LoRa Alliance (this roughly corresponds to the BT SIG):

- LoRa Alliance members include chip companies, Network operators, system integrators
- LoRaWAN evolving – currently on 1.0.2, 1.1 coming (roaming protocol)
- Insight SiP module is focused on Class A devices, this is the mode used in most battery driven nodes, as it is the lowest power mode

- There are two types of LoRa node: **Gateway and Device**

- **Gateways** have a different hardware for the radio – thus a device module cannot be used as a Gateway

- **Devices** can be three classes
  - **Class A** – Transmits only when ready - Downlink follows uplink, but there is no way for the Gateway to initiate a downlink
  - **Class B** – Has a regularly scheduled downlink window
  - **Class C** – Is always listening
MULTI BAND COMBO LORa

iSP4520-EU
iSP4520-US
iSP4520-JP

Combo LoRa / BLE module
With Integrated Antenna
EU, US and Japanese Bands

Key Features

✓ LoRa Alliance
✓ BT 5 Ready
✓ NFC-A Tag for OOB pairing
✓ Fully integrated LoRa & BLE Dual Matching and Antenna
✓ Integrated Xtals LoRa 32 MHz, BLE 32 MHz & 32.768 kHz
✓ LoRa based SX126x
✓ BLE based nRF52
✓ Supply 2.8V-3.6V
✓ Temp. -40 to +85 °C
✓ Size 9.8 x 17.2 x 1.7 mm
✓ Externally Controlled or using embedded 32-bit ARM M4 CPU
✓ 512 kB Flash
✓ 64 kB RAM
✓ DC/DC converters
✓ Analog, Digital peripherals
✓ SPI interface

Typical Application

✓ Smart Cities / Smart Retail
✓ Industrial Internet
✓ Big Data / Data science
✓ Energy Engagement / Smart grids
### Multi Band Combo LoRa

**Supported Stacks**

- ✓ S132 BT 5.0 compliant stack concurrent central, observer, peripheral, and broadcaster with up to 20 connections
- ✓ LoRa stack ported from STM32 platform to nRF52 one

**Market Introduction**

- ✓ Samples & Kits available for all versions EU, US and JP
- ✓ First production batch on going
- ✓ Certifications: LoRaWAN, BT SIG and local certification based on different version, targeted Q1-2020

<table>
<thead>
<tr>
<th>Specification</th>
<th>iSP4520-xx (LoRa Section)</th>
<th>iSP4520-xx (BLE Section)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Radio</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EU = 867-869 MHz</td>
<td></td>
<td>2.4 GHz</td>
</tr>
<tr>
<td>US = 902-928 MHz</td>
<td></td>
<td>+ Balun + Antenna</td>
</tr>
<tr>
<td>JP = 920-925 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Balun + Antenna</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NFC</strong></td>
<td>Type 2 NFC-A Tag</td>
<td></td>
</tr>
<tr>
<td><strong>Supply Voltage</strong></td>
<td>2.8 / 3.6 V + DCDC</td>
<td>1.8 / 3.6 V + DCDC</td>
</tr>
<tr>
<td><strong>Peak current Tx</strong></td>
<td>30 mA</td>
<td>5.3 mA @ 0 dBm</td>
</tr>
<tr>
<td><strong>Peak current Rx</strong></td>
<td>12 mA</td>
<td>5.4 mA</td>
</tr>
<tr>
<td><strong>Deep sleep Current</strong></td>
<td>0.1 µA</td>
<td>0.3 µA</td>
</tr>
<tr>
<td><strong>Tx Power</strong></td>
<td>EU &amp; JP = +13 dBm</td>
<td>-20 to +4 dBm</td>
</tr>
<tr>
<td></td>
<td>US = +20 dBm</td>
<td></td>
</tr>
<tr>
<td><strong>Rx sensitivity</strong></td>
<td>-132 dBm</td>
<td>-96 dBm</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>10 km</td>
<td>70 m</td>
</tr>
<tr>
<td><strong>CPU</strong></td>
<td>32-bit ARM Cortex M4F</td>
<td></td>
</tr>
<tr>
<td><strong>Memory</strong></td>
<td>512 kB flash / 64 kB RAM</td>
<td></td>
</tr>
<tr>
<td><strong>Crystal</strong></td>
<td>32 MHz</td>
<td>32 MHz and 32 kHz</td>
</tr>
<tr>
<td><strong>Interfaces</strong></td>
<td>SPI</td>
<td>GPIO, SPI, I2C, UART, ADC</td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>9.8 x 17.2 x 1.7 mm</td>
<td></td>
</tr>
</tbody>
</table>
Development Kit

✓ Offers the perfect solution to start with ISP4520, including ...
✓ 1 x Interface Board with integrated J-Link Emulator
✓ 1 x Tx Test Board / Mote
✓ 1 x Rx Test Board / Gateway
✓ Example firmware codes for both Mote & Gateway demonstrating temperature sensor application
✓ Including LoRaWAN stack ported on nRF52 platform

Tx Test Board / Mote

✓ Consists of a module mounted on a PCB
✓ Includes a connection to the Insight SiP generic Interface Board
✓ Offers test points for all IOs and can be used in conjunction with a Nordic Development kit.

Rx Test Board / Gateway

✓ Consists of a PCB integrating an ISP4520 module and a USB plug for connection to a PC port com
✓ Enables to communicate with a Mote in a point to point connectivity mode through LoRa standards.
LoRa Kits & Demo

iSP4580
LoRa & BLE Multi Sensor Demo Based on iSP4520-EU

Key Features

✓ LoRa Alliance based on SX1261
✓ BT 5 Ready based on nRF52
✓ Fully integrated LoRa & BLE Dual Matching and Antenna
✓ Integrated Xtals LoRa 32 MHz, BLE 32 MHz & 32.768 kHz
✓ Supply 2.8V-3.6V
✓ Temp. -40 to +85 °C
✓ Coin cell battery CR2032
✓ Accelero / Gyro / Magneto Sensor
✓ Temperature / Barometer
✓ Light Sensor
✓ Humidity Sensor
✓ Sensor Transmission with LoRa

BLE Setup
LoRa Sensor Transmission
Cloud Data Transfer
WIDE AREA NETWORK MODULES
NB-IoT
Insight SiP is developing NB-IoT & BLE combo solution with Built-in Antennas

- This small LGA module, 16 x 18 x 1.5 mm, is based on the nRF91 and nRF52 series devices

- Dual processor
  ✓ Cortex M33 Application processor with 1MB Flash and 256 kB RAM
  ✓ Together with a Cortex M4 processor dedicated to Bluetooth activities

- BLE connectivity allows for easy configuration and firmware updates

- Incorporates 2 antennas, one for NB-IoT operation in either Band 3 or Band 20 and a second one for BLE
iSP 60 series

Dual NB-IoT and BLE chips
Built-In antennas
Timeline - end 2020

**Key Features**

- Ultra Low Power Consumption
- Single 3.3 to 5.5 V supply
- Small size 16 x 18 x 1.5 mm
- NB-IoT Functions based on nRF91 series
- Ultra Low Power IoT Modem
- 64MHz ARM Cortex M33 CPU
- 1MB Flash 256 kB RAM
- 20 GPIOs
- BLE Functions based on nRF52 series
- Single Mode BLE V5.0 Compliant
- 2.4GHz low energy RF Transceiver
- 32bit ARM Cortex M4 CPU
- 512 kB Flash
- 64 kB SRAM
- 20 GPIOs including 5 ADC inputs & 1 reference
- Integrated Antennas
Positioning Modules
Bluetooth 5.1
Direction Finding is the main new feature of Bluetooth 5.1
✓ Former BT location systems was based on RSSI only, with poor precision
✓ It will offer enhance location services for Real Time Location Systems (RTLS)

Bluetooth direction finding is using AoA or AoD to detect tag location
✓ Angle of Arrival (AoA) and Angle of Departure (AoD) makes use of the angular phase-shifts that occur between antennas as they receive or transmit RF signals
✓ This full system is made of anchor units positioned in line of sight manner
✓ Antenna arrays at both side of the communication link are providing phase shift data, determining AoA or AoD
✓ Position of tagged items are calculated by triangulation from different anchors

Allows for use of very simple and low cost tags to determine their location
Perfectly suited for asset tracking in warehouses and buildings or ID location of people and staff
**iSP1907-LL**

**AoA BT 5.1**

**Price Sensitive Applications**

**Best Suited for Tags**

---

**Key Features**

- Ultra Small LGA 8 x 8 x 1 mm
- BT 5.1 nRF52811 BLE transceiver
- Long Range +4 dBm Tx power
- 32-bit ARM Cortex – M4 CPU
- 192 MB Flash & 24 K SRAM
- Suitable for ANT+ Protocol
- Complete set of 13 IOs included
- Radio 32 MHz & Synchro 32 kHz Xtals
- Decoupling and DCDC circuit on board

---

**Applications**

- Body Area
- Industrial Sensors
- Home network
- Logistics and warehousing
- Value asset security

---

**Market Introduction**

- Samples & Kits available
- First Production batch in progress
- Certification pending
BLE for Direction Finding

iSP1907-HT AoA BT 5.1 Complete Extended Solution For Tags and Anchors

Key Features
✓ Ultra Small LGA 8 x 8 x 1 mm
✓ BT 5.1 nRF52833 BLE transceiver
✓ Long Range +8 dBm Tx power
✓ 32-bit ARM Cortex – M4F CPU
✓ 512 MB Flash & 128 K SRAM
✓ USB interface
✓ Suitable for ANT+, Zigbee, Thread
✓ 30 IOs included
✓ Radio 32 MHz & Synchro 32 kHz Xtls
✓ Decoupling and DCDC circuit on board
✓ Extended temperature range -40/+105°C

Applications
✓ Lighting Applications
✓ Industrial
✓ Smart Home
✓ Logistics and warehousing
✓ Value asset security

Market Introduction
✓ Samples & Kits schedule Jan 2020 to be confirmed when the chip is available
POSITIONING MODULES
ULTRA WIDE BAND
Insight SiP is also offering new range of innovative IoT Location System based on UWB technology

- **Dual antenna integration**
  - ✓ New and unique concept developed by Insight SiP with 2 embedded antennas

- **Ultra precise Location Systems powered by Decawave DW1000**
  - ✓ Insight SiP decided to improve ISP1510, still using Decawave DW1000, but offering a 50 meters optimal range and an embedded intelligent power supply to operate on coin cell battery
  - ✓ New chipset generation are in progress with much lower power consumption, better sensitivity and longer range

- **BLE section based on Nordic nRF52 chipset**
  - ✓ Providing friendly configuration of UWB through smartphone or tablet
  - ✓ Also offering low energy rough location indication
**Ultra Wide Band in the age**

- UWB is more than 100 Years old technology

- In the 2000’s, WiMedia was intended for short-range multimedia file transfers and was promoted for personal computers, consumer electronics, mobile devices ...

**UWB Impulse Radio (IR-UWB)**

- Finally, UWB spectrum was opened for commercial use in 2005 by the FCC for pulse-based transmission in the 3.1 to 10.6 GHz frequency range targeting sensor data collection, precision locating and tracking applications

- UWB conforms with IEEE 802.15.4 technical standard which defines the operation of low-rate wireless personal area networks (LR-WPANs). It specifies the physical layer and media access control for LR-WPANs which focuses on low-cost, low-speed ubiquitous communication between devices
For applications where precise positioning is necessary, UWB offer the best performances over other technologies

✓ WiFi and Bluetooth using RSSI method, sensitive to Multipath, to Interference, to relative position antenna: offers precision in the 10 meters range
✓ UWB using Time of Flight method, unsensitive to Multipath and Interference offers precision in 10 cm range

Unsensitivity to Noise & Interference of other systems

► RF pulse straight edges give precise determination of arrival time

Unsensitivity to Multi-Path Reflection Interference

► Short pulses avoid combination with reflected signals
2-Way Ranging

- Anchor
- Tag

Listen for poll
Calculate range

Poll
Response
Final
Report optional

Simple measurement of time of flight

Time Difference of Arrival (TDOA)

Location determined by a multi-lateration algorithm

Need to have all Anchors perfectly synchronized

Coverage area
**iSP3010-UX**

High Performance Combo UWB / BLE module With Integrated Antennas

### Key Features
- IEEE802.15.4-2011
- BLE V4.2
- NFC-A Tag for pairing
- Resolution < 10 cm
- Fully integrated UWB & BLE Antennas
- Integrated Xtals UWB 38.4 MHz, BLE 32 MHz & 32.768 kHz
- UWB based DW1000
- BLE based nRF52
- Compact Size 14.0x14.0x1.5 mm
- Temp. -40 to +85 °C
- Supply 2.8V-3.6V
- Externally Controlled or using embedded 32-bit ARM M4 CPU
- 512 kB Flash
- 64 kB RAM
- DC/DC converters
- Analog, Digital peripherals
- SPI interface
- IEEE802.15.4-2011
- BLE V4.2
- NFC
- Resolution < 10 cm
- Fully integrated UWB & BLE Antennas
- Integrated Xtals UWB 38.4 MHz, BLE 32 MHz & 32.768 kHz
- UWB based DW1000
- BLE based nRF52
- Compact Size 14.0x14.0x1.5 mm
- Temp. -40 to +85 °C
- Supply 2.8V-3.6V
- Externally Controlled or using embedded 32-bit ARM M4 CPU
- 512 kB Flash
- 64 kB RAM
- DC/DC converters
- Analog, Digital peripherals
- SPI interface

### Typical Application
- Precision Real Time Location Systems (RTLS)
- Security bubble
- Access control
- Indoor positioning
## Combo UWB & BLE

### Specification

<table>
<thead>
<tr>
<th>Specification</th>
<th>UWB Section</th>
<th>BLE Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio</td>
<td>6.5 GHz (Channel 5) + Balun + Antenna</td>
<td>2.4 GHz + Balun + Antenna</td>
</tr>
<tr>
<td>NFC</td>
<td>-</td>
<td>Type 2 NFC-A Tag</td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>2.8 / 3.6 V + DCDC</td>
<td>1.8 / 3.6 V + DCDC</td>
</tr>
<tr>
<td>Peak current Tx</td>
<td>140 mA</td>
<td>5.3 mA @ 0 dBm</td>
</tr>
<tr>
<td>Peak current Rx</td>
<td>180 mA</td>
<td>5.4 mA</td>
</tr>
<tr>
<td>Deep sleep Current</td>
<td>1 µA</td>
<td>0.3 µA</td>
</tr>
<tr>
<td>Tx Power</td>
<td>-39 dBm / MHz</td>
<td>-20 to +4 dBm</td>
</tr>
<tr>
<td>Rx sensitivity</td>
<td>-93 dBm</td>
<td>-96 dBm</td>
</tr>
<tr>
<td>Range</td>
<td>50 m</td>
<td>70 m</td>
</tr>
<tr>
<td>Spatial Resolution</td>
<td>10 cm</td>
<td>20 m</td>
</tr>
<tr>
<td>CPU</td>
<td>-</td>
<td>32-bit ARM Cortex M4F</td>
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</tr>
<tr>
<td>Size</td>
<td>14 x 14 x 1.5 mm</td>
<td></td>
</tr>
</tbody>
</table>

### Supported BLE Stacks

- S132 BT 5.0 compliant stack: concurrent central, observer, peripheral, and broadcaster with up to 20 connections
- nRF5 SDK for Mesh

### Market Introduction

- Kits and samples available
- Mass production: tbd
- Certifications: tbd
iSP3010

Complete Kit
Test Board
Anchor & Tag

**Development Kit**

- Offers the perfect solution to start with ISP3010, including ...
- 1x Interface Board with integrated J-Link Emulator
- 1x Test Board connected to the Interface Board for testing purpose
- 1x Anchor Board
- 1x Tag Board
- 1x NFC antenna
- A ranging demonstration including the embedded firmware and the Android App

**Test Board**

- Consists of a module mounted on a PCB
- Includes a connection to the Insight SiP generic Interface Board
- Offers test points for all IOs and can be used in conjunction with a Nordic Development kit.

**Anchor & Tag Boards**

- Anchor Board consists of a PCB integrating an ISP3010 module and a USB plug for connection to a PC port
- Tag Board consists of a small PCB integrating an ISP3010 module powered by a coin cell.
**Key Features**

- Range calculation between anchor and tag using UWB and results are sent via BLE
- Anchor board iSP3010-UX-AN
- Tag board iSP3010-UX-TG
- Embedded firmware with Android App
- UWB based on DW1000
- BT 5 Ready based on nRF52
- Fully integrated UWB & BLE Dual Matching and Antenna
- Supply 2.8V-3.6V
- Temp. -40 to +85 °C
- Coin cell battery CR2032
Secure IoT Modules
Insight SiP is developing a BLE with Secure Element solution and integrated antenna

- This ultra-small LGA module, 8 x 8 x 1 mm combines a state of the art BLE 5.0 device together with a Secure Element.

- This combination allows for complete end to end data encryption with secure keys that are held within the highly protected secure element.
  - The private key remains locked in the safe space and is used to code and decode data that passes through the secure element.

- Dual processor
  - Cortex Mxx Application processor
  - Together with a Cortex Mxx processor dedicated to Bluetooth activities.

- Incorporates the antenna for BLE.
iSP70 series

BLE & Secure Element
Built-In antenna
Timeline - end 2020

Key Features

✓ Ultra Low Power Consumption
✓ Single 1.8 to 3.6 V supply
✓ Small size 8 x 8 x 1 mm
✓ Single Mode BLE V5.0 Compliant
✓ 2.4GHz low energy RF Transceiver
✓ 32bit ARM CPU
✓ 512 kB or more Flash
✓ 64 SRAM or more SRAM
✓ Large set of GPIOs
✓ Integrated Antenna
✓ Secure Element
✓ Storage of Private Keys
✓ Storage of Code/encode Apps

Typical Applications

✓ Applications requiring added security
✓ Connected sensors for medical, healthcare, sport, fitness, industrial ...
✓ IoT applications, connected objects, wearable technology
Streamline the success of your IoT application with Insight SiP services & solutions based on your needs

- **DESIGN TO PRODUCTION** fills up our Standard Module and Device offering when looking for Customized Design Service & Consultancy

  ✓ From the pre-feasibility study to the Product launch, we are there to help you with a full-service solution

  ✓ Insight SiP serves the IoT market with turn-key design services and creative packaging solutions to customers who need complex or highly integrated systems to meet wireless and portable devices space requirements

  ✓ **Benefits to our customers: Smaller, Faster, Lower Cost**
CUSTOM SIP

Any Electronic Specification in smallest form factor

Integrated Antenna Technology
Antenna in Package (AiP)

Multiple dies, crystals, MEMS, passives – different assembly techniques, substrates...

Eliminate “trial and error” by in-depth RF and Thermal Simulation

Focus on building on existing IP
“Custom Products” - Greatest Value Add
Example of Glucose Monitoring SIP

- Based on ISP1507-AX
- Wearable device for measuring glucose level for diabetics
- Human body modelling – Custom antenna design for close human body proximity
- Includes custom ASIC
- Single component solution – only power to add
Example of Cycle Pedal Device SIP

- Based on ISP1507-AX
- Device for measuring power in 3 dimensions
- Horrible RF environment – Foot – Pedal – Cleat
- BLE + strain gauges
- Tiny Space
Simulation & Modelling

- Carried out a number of simulations of effect of obstacles to RF
- Human body modelling – example - link budget phone to in ear headphone
- Different scenarios modelled
  - Back/Front pocket
  - Up down orientation
  - Specific phone models
ANY QUESTION

... FEEL FREE TO CONTACT US

contact@insightsip.com