

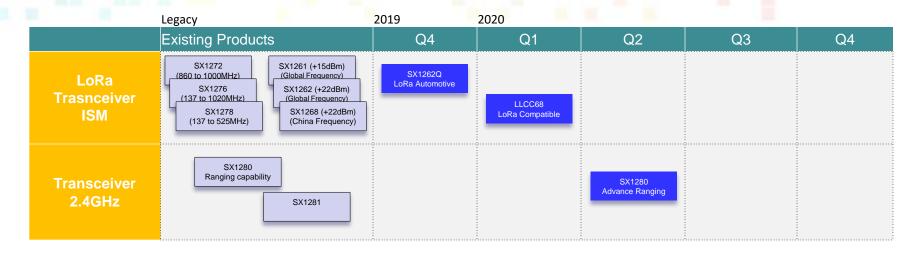
# LoRa TRANSCIEVER ICs ROADMAP STRATEGY

The Information in this presentation contains CONFIDENTIAL SEMTECH INFORMATION.

NOTE: all company non-public information must be kept confidential and should not be disclosed.

#### TRANSCEIVERS ROADMAP





- □ SX1262Q is designed to support AEC-100 grade 3, supported by PPAP level 3 documentation
- LLCC68 is a cost effective LoRa compatible solution
- SX1280 enables advance ranging capabilities offering additional tuning option to improve range accuracy compare to legacy option

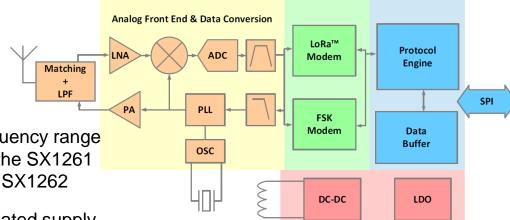




**SX126x** 

# SX1261/62 Key features





#### **Features**

- 150 960 MHz continuous frequency range
- 14/15 dBm max. Tx Power for the SX1261
- 22 dBm max. TX power for the SX1262
  - 160 mW vs 100 mW on SX127x
- LDO/DC-DC combo main regulated supply
  - 4.2 mA vs 9 mA for the sx127x in RX
  - 26 mA for 14dBm on sx1261 in TX
    - sx127x @ 20 dBm = curent sx1262 @ 22 dBm in TX
- Fast switching modes
- TCXO support (integrated LDO with embedded control)
- LoRa® Rx/Tx, BW = 7.8 500 kHz, SF5 to SF12, BR = 0.018 62.5 kb/s
- (G)FSK Rx/Tx, with BR = 0.6 300 kb/s
- Sensitivities down to -139dBm



#### SX126x - Key benefits



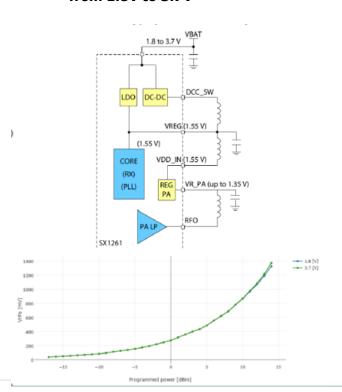
#### Spec comparison with SX127x

- □ ~2x less power in RX
  - 4.2 mA in DC\_DC mode vs 9 mA for the sx127x
- □ ~2x smaller package size
  - Small footprint for small PCB
- □ ~60% higher TX power available (22dBm on sx1262)
  - 160 mW vs 100 mW on SX127x
  - current consumption sx127x @ 20 dBm = current sx1261 @ 22 dBm
- □ ~20% lower power consumption on sx1261
  - 26 mA for 14dBm on sx1261
- No complex register table
  - Simple command set to simplify the SW implementation
- ☐ Full frequency PLL coverage (150-960MHz)
  - World Wide sub-1GHz ISM bands and private bands supported

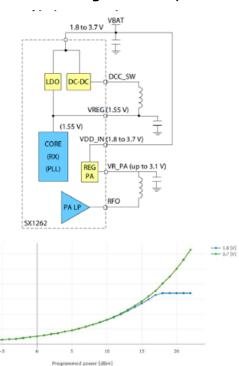
#### SX1261 vs SX1262



## 0.5dB typ. Power accuracy from 1.8V to 3.7V



# Can maintain 20dBm tx power over Vbat range 2.7V to 3,7V



#### **LLCC68: COST-EFFECTIVE LORA SOLUTION**



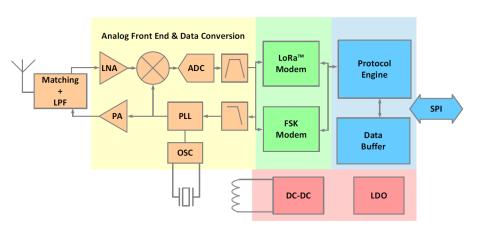


Figure A: LLCC68 Block Diagram

- ☐ LoRa Modulation and LoRaWAN compatible support
- Half Duplex transceiver to support 150 to 960 MHz
- ☐ Trasmit power up +22dBm
  - Modulation options
    - LoRa® Rx/Tx, BW = 125 -250 500 kHz
    - LoRa® SF = 5 6 7 8 9 for BW = 125 kHz
    - LoRa® SF = 5 6 7 8 9 10 for BW = 250 kHz
    - □ LoRa® SF = 5 6 7 8 9 10 11 for BW = 500 kHz
- Power regulation: DC/DC or LDO
- Package 24QFN (4mm x 4mm)
- Operating range:
  - 1.8 to 3.7v
  - -40 to 85°C





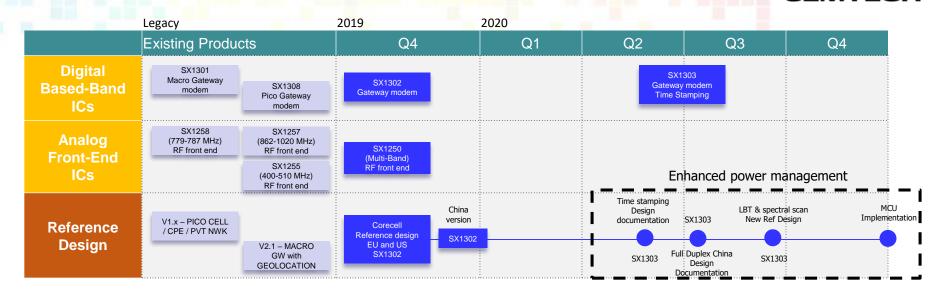
# LoRa GATEWAY ICs ROADMAP STRATEGY

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#### **NEXT-GEN LoRa ICs - GATEWAY APPLICATIONS**





- Next Generation LoRa ICs SX1302, SX1303 and SX1250 are designed from the ground-up to significantly reduce power and BOM cost while increasing performance, enabling optimized small form factor indoor gateway designs
- ☐ Cost-optimized solutions to penetrate Smart-Home, Building and Factory automation applications
- Corecell reference design pre-certified turn-key solution accelerates time to market

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## INTRODUCING SX1302, SX1303 AND SX1250



# LoRa Gateway Baseband SX1302



- LoRaWAN, Class A/B/C, all regions
- 125 kHz LoRa reception with:
  - 8 x 8 channels LoRa® packet detectors
  - 8 x SF5-SF12 LoRa® demodulators
  - 8 x SF5-SF10 LoRa® demodulators125 /250 / 500 kHz LoRa® demodulator
- ☐ (G)FSK demodulator
- ☐ Single 32 MHz clock
- Time Stamping (SX1303)

#### Multi-band Sub-GHz RF Front-End SX1250



- → +22dBm Output power
- ☐ Europe 868 MHz
- ☐ India 866 MHz
- North America 915 MHz
- ☐ APAC 920 MHz
- ☐ Asia 923 MHz
- Lower UHF bands 169 and 433 or 490 MHz

#### **Key Benefits**



#### **Low Power**

- More than 10x Lower power than previous Generations
- · Enable heatsink-less designs

### Higher Integration and more performance

- · Single Oscillator Source
- SF5 and SF6 support
- Handle more traffic with more modulators/demodulators

#### **Smaller Package**

Small Form factor SX1302: 7mmx7mm SX1250: 4mmx4mm

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## **COMPARISION TABLE - BASEDBAND**



Feature	SX1301	SX1308	SX1302/SX1303
Operating Voltage	Dual external power supply $V_{DDIO} = 3.6v$ $V_{DDCORE} = 1.8v$	Dual external power supply $V_{DDIO} = 3.6v$ $V_{DDCORE} = 1.8v$	Dual external power supply V <sub>CCIO</sub> = 3.6v V <sub>CCCORE</sub> = 1.2v
Temperature range	-40 to 85°C	-40 to 70°C	-40 to 85°C
Modulator/ Demodulator	8 x 125KHz LoRa Demodulators 1 x 125/250/500KHz LoRa Demodulators 1 x 500KHz FSK Demodulator 1 x 125/250/500KHz LoRa Modulator (G)FSK demodulator	8 x 125KHz LoRa Demodulators 1 x 125/250/500KHz LoRa Demodulators 1 x 500KHz FSK Demodulator 1 x 125/250/500KHz LoRa Modulator (G)FSK demodulator	125 kHz LoRa reception with:  • 8 x 8 channels LoRa® packet detectors  • 8 x SF5-SF12 LoRa® demodulators  • 8 x SF5-SF10 LoRa® demodulators  125 /250 / 500 kHz LoRa® demodulator  (G)FSK demodulator
Time stamping	Supported	No supported	Supported
Clock Source	Dual clock XTAL32F = 32MHz HSC_F = 133MHz	Dual clock XTAL32F = 32MHz HSC_F = 133MHz	Single clock RADIO_A_CLK_I = 32MHz
Power Consumption	Approx. 1 to 2W <sup>(1)</sup>	Approx. 1 to 2W <sup>(1)</sup>	Approx. 33mW to 102mW <sup>(2)</sup>
RX sensitivity	-142dBm (SX1257)	-139dBm (SX1257)	-141dBm
Package	QFN64 (9mmx9mm)	QFN64 (9mmx9mm)	QFN64 (7mmx7mm)

Calculated based on "Current in full active" – Page 8 SX1301 data sheet Calculated based on "Peak consumption" – Page 13 SX1302 data sheet

(2) Calculated based on Feak Consumption = rage 13 3x1302 data sneet

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# COMPARISION TABLE - ANALOG FRONT-END SEMTECH



Parameter	SX1255/SX1257	SX1250
Frequency Range	400MHz to 510MHz (SX1255) 862MHz to 960MHz (SX1257)	150MHz to 960MHz
Max Transmit Output Power	5dBm	22dBm
Transmit Current VBAT = 3.3V	58mA @ -5dBm	118mA @ 22dBm
Receive Sensitivity @ SF12, 125k	-140dBm	-141dBm
PA Operation	High Linearity	Constant Envelope
Receive Current	20mA	4.2mA
Pin/Package	32 lead MLPQ, 5 x 5mm	24 lead QFN, 4 x 4mm
SPI Interface	Registers	Commands
Operation	Half or Full Duplex	Half Duplex

Benefits of SX1250
Continuous Frequency Coverage
50x Greater Output Power
Better TX Power Saving
Improved Link Budget
Higher Efficiency
5x Lower in RX Current in DC/DC Mode
25% Smaller Footprint
Simpler SW Implementation

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#### CORECELL REFERENCE DESIGN



- ☐ Pre-certified reference design for gateway applications
- ☐ US and EU Performance report available to customers
- ETSI and FCC pre-scan report available to customers
- Complete design files and documentation
  - Gerber files, Schematics, Bill-of-Materials
  - Open SW repository on GitHub
- EU kit part number: SX1302C868GW1
- ☐ US kit part number: SX1302C915GW1



Corecell Reference Design

Corecell Reference Design kit



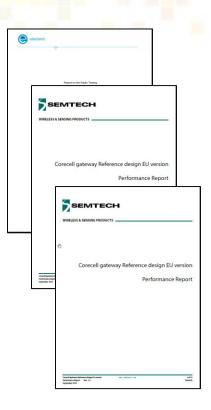
Accelerate time to Market with a complete pre-certified reference design

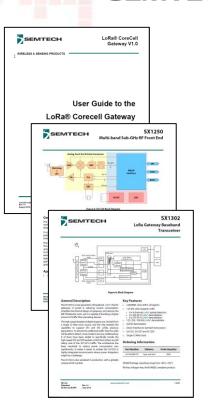
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#### **DOCUMENTATION**



- Application Notes:
  - Corecell Gateway Performance Report for Europe
  - Corecell Gateway Performance Report for US
- Reference Designs
  - Corecell Gateway design and Prod files for Europe
  - Corecell Gateway design and Prod Files for US
- Technical Notes
  - Standards Compliance Report for Europe
  - Standards Compliance Report for US
- Tools and SW
  - https://github.com/Lora-net/sx1302\_hal
- User Guides
  - Corecell Gateway User Guide
- Product data sheets
  - □ SX1302 Data sheet
  - SX1250 Data sheet





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# LoRa @ 2.4GHz SX128x

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## SX1280/SX1281 Overview



#### » LoRa 2.4 GHz

Long Range communication for low data rate in 2.4 GHz

- √ Smart Home
- ✓ Alarm / Security
- ✓ Drone control

#### » FLRC 2.4 GHz

A robust long range modem for high ✓ data rate communication ✓

- √ Video streaming
- Audio streaming

#### SFSK 2.4 GHz

Compatibility asset for migration to FLRC or standard FSK use

- ✓ Traditional application
- √ Backwards compatibility

#### » BLE PHY

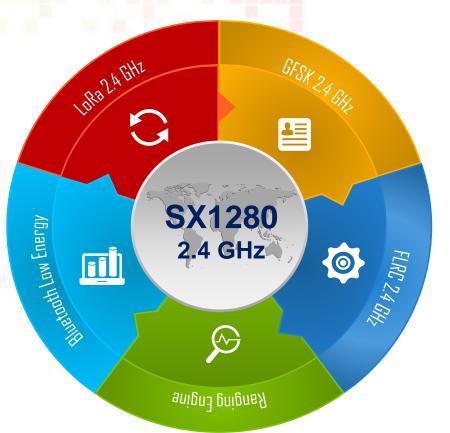
Physical layer compatibility for BLE (PHY layer only)

- Sensor provisioning
- ✓ Wearables
- √ Beacons

#### » Ranging Engine

RF link Security, P2P ranging and positioning solutions

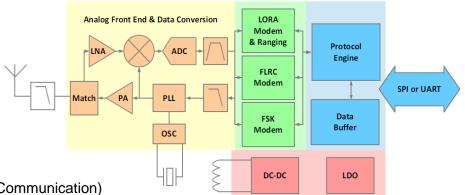
- ✓ Keyless entry
- ✓ Asset tracking
- ✓ Industry 4.0



# **Key Features Overview**

SEMTECH

- □ Long Range
  - High sensitivity down to -132 dBm
  - +12.5 dBm output power with high efficiency PA
  - 144.5 dB maximum link budget
- □ Low Current
  - <5.5 mA RX current (LoRa), 4.8 mA (FSK)</p>
  - 24 mA TX @ +12.5dBm
  - 215 nA sleep mode
- Supported Modulation
  - LoRa 476 bps up to 200 kbps (Long Range)
  - FLRC 260 kbps up to 1.3 Mbps (Fast Long Range Communication)
  - (G)FSK/MSK up to 2 Mbps
  - BLE PHY Layer compatibility
- Ranging Engine
  - Time-of-flight functionality, 1 meter accuracy (LoS)
  - Build-in ranging data filtering
- □ Low System Cost
  - Minimal external BOM/matching
  - Package low foot print, 24-pin 4x4
- ☐ Compliant with 2.4 GHz regulations
  - ETSI EN 300 440, FCC CFR 47 Part 15, ARIB STD-T66





# Low Energy Radio





- ☐ Designed for Coin Cells Battery
- □ Sub-30 mA Current consumption at full Tx Power

□ 4.8 mA Continuous Rx current FSK

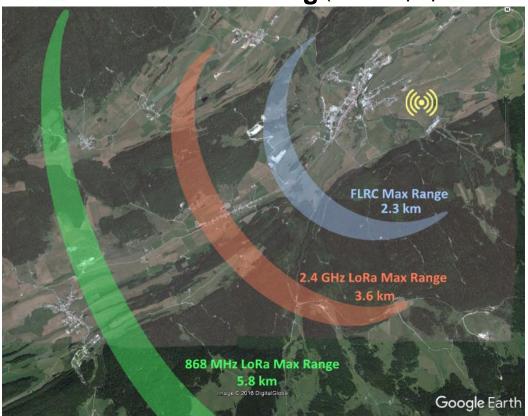
☐ 200 nA Sleep Current



### LoRa 2.4 GHz & FLRC Outdoor



☐ Field Distance Testing (SX1280 output power 12.5 dBm)



- FLRC 2.3 km (SX1280/1)
  - Line-of-Sight
    - 260 kbps
- LoRa 2.4 GHz 3.6 km (SX1280/1)
  - non Line-of-Sight
    - 476 bps (SF12)
- LoRa 868 MHz >5.8 km (SX1272)
  - non Line-of-Sight
  - 292 bps (SF12 135 khz)

# **Coming soon**



- □ 2.4GHz GW
  - prototype of reference Design presented at the TTN conference (3RX + 1TX path)
  - Commercial available from Multitech
- □ Advanced Ranging Feature
  - Spy mode
  - Available on SX1280
- ☐ Protocol stack
  - Global regional parameter in discussion @ the LoRa Alliance
  - Lora Modem will be released soon
  - Williamsen



## LoRa EDGE LR1110

The most affordable and simplified asset management platform

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# LORA LOW-POWER GEOLOCATION SOLUTIONS SEMTECH

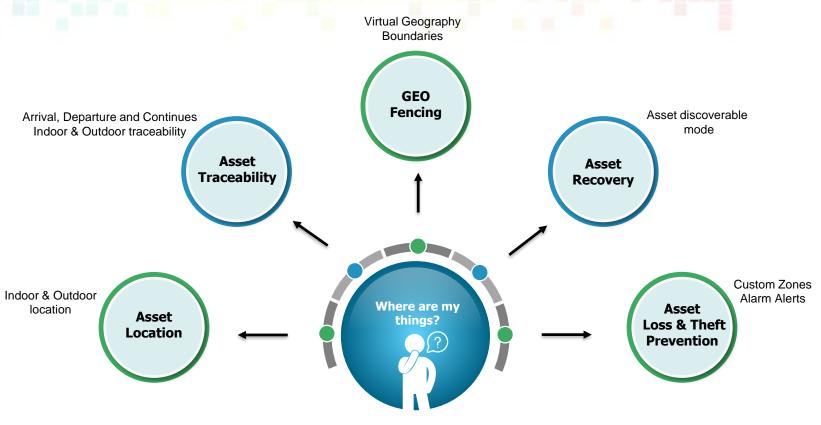


	Q1	Q2	Q3	Q4	2021
Geolocation Solutions (Transceiver)	LR1110 Transceiver				Next Generation
Geolocation Solutions (MODEM)			LR1110 MODEM		Next Generation

- LR1110 MODEM: Lora Cloud-ready solution, preloaded with SW to automatically connect to Lora Cloud services
- LR1110 Transceiver: Barebone silicon, Open to Customers who bring their own cloud infrastructure

## LoRa EDGE: PROBLEM WE SOLVE





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#### **ASSET MGMT. MARKET CHALLENGES**



The National Cargo
Security Council
estimates that the
global financial
impact of cargo loss
exceeds \$50 billion
annually.

30-40% of trackers are lost, battery dies or ownership changes

#### **Challenges**

Existing solutions require to **integrate components from multiple vendors** (GPS, WiFi, Location database, LPWAN) increasing BOM cost, design and procurement complexity

Existing solutions are too **power-hungry**, forcing customers to often replace batteries which is an expensive and complex operation for large deployments

Existing solutions force customers to implement **costly secure manufacturing** process or **additional cost in secure hardware** such as secure elements, increasing cost, power consumption and design complexity

Due to prohibited cost, **outdoor and Indoor management** solutions are typically separate designs, lack of cost effective all in one indoor/outdoor solutions prevent market growth

Asset location is becoming a general requirement for IoT deployments but high **cost** prevents wide adoption

The price of trackers would have to drop down into the \$10-20 range for wide adoption.

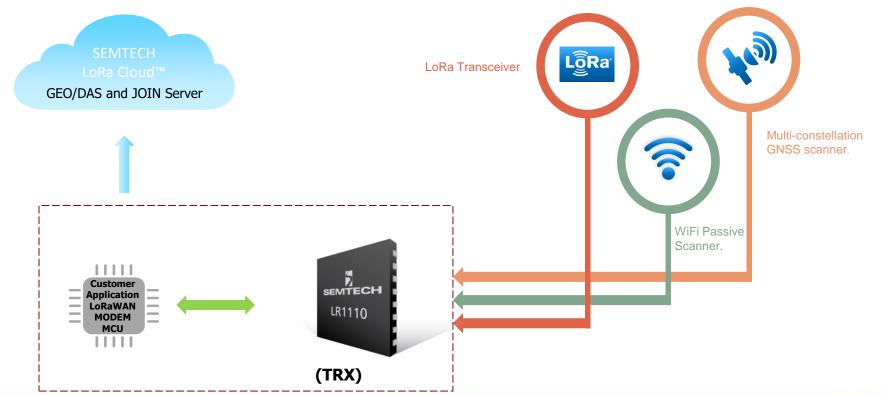
Americans alone lose an average of \$5,591 in assets over their lifetime

Quotes: Mobile experts

## **LR1110 GEOLOCATION TRX SOLUTION**



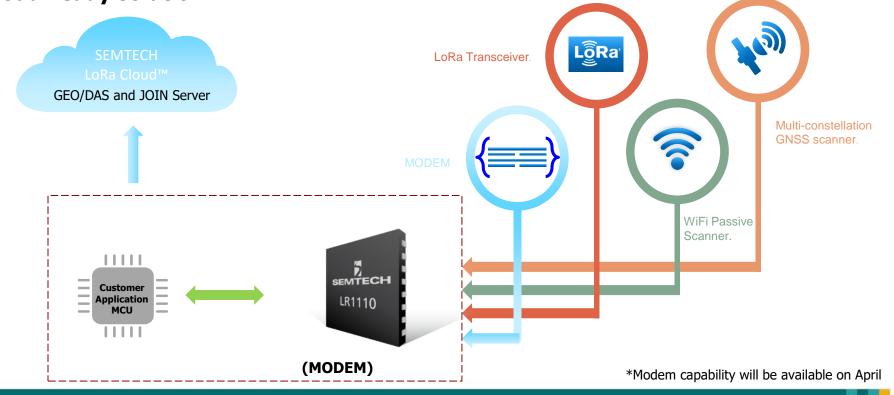
Industry-First low-power, highly integrated multi-technology geolocation solution



# LR1110 GEOLOCATION MODEM SOLUTION SEMTECH

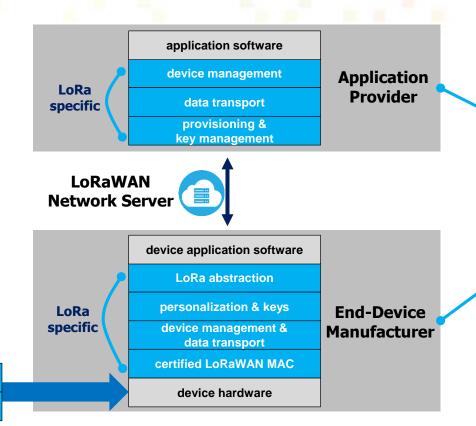


Industry-First low-power, highly integrated multi-technology geolocation, **Cloud-ready solution** 



# Remove Complexity with Modem





Deep LoRa and LoRaWAN knowledge required



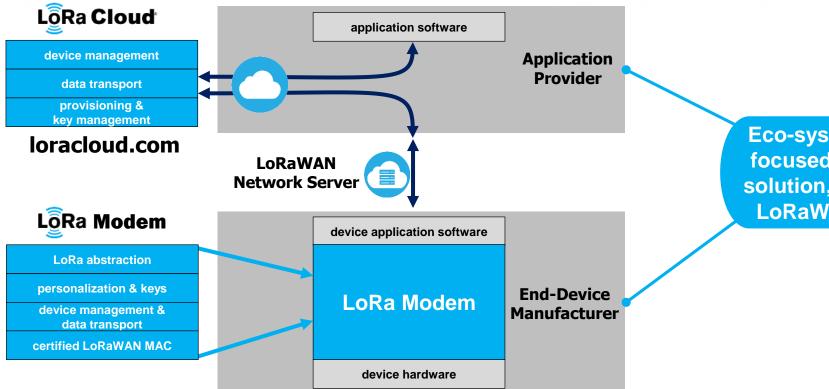
SEMTECH

pre-certified LoRaWAN MAC

LoRa Transceiver

# Modem Approach





**Eco-system** focused on solution, not **LoRaWAN** 



# **Device Management**

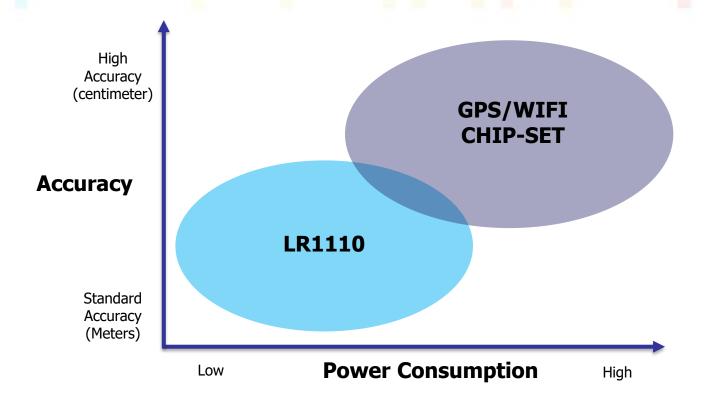


- □ Customer get a set of features accessed via API or Web Interface:
  - Device battery monitoring & temperature
  - Device / Modem reset / reJoin
  - Uplink message streaming (automatic fragmentation, redundancy, error correction)
  - Clock synchronization (all modem come with an RTC synched to the GPS time by the DM service)
  - Uplink file transport service
  - Device application parameters management
  - Sync application events on a group of device (example: simultaneous reading on a group of water meters)
  - Manage the devices keys/ move networks (without accessing the keys themselves)
- □ Detailed functionality are described in the Modem Reference Guide in section 5.2
- When customer purchase the Murata modem module, it does include 5 years of online DM connectivity
  - But it doesn't include connectivity to a network provider



# LoRa EDGE: LR1110 POSITIONING MODEL





#### LORA EDGE: LR1110 PRODUCT SUMARY



#### **Multi-Purpose Radio Front-End**

- ■150 2700 MHz continuous frequency synthesizer range
- □ GPS/ BeiDou scanning
- ■Wi-Fi passive scanning

#### Low-Power LoRa®/(G)FSK RF Transceiver

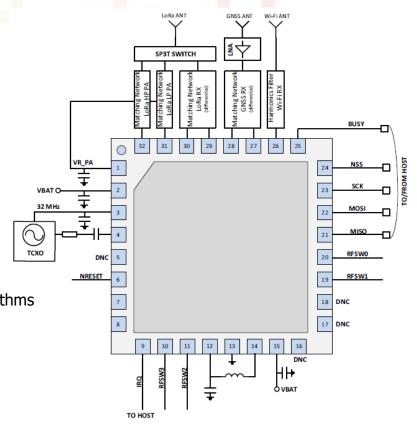
- Worldwide frequency bands support in the range 150 960MHz
- ☐ High power PA path +22 dBm
- ☐ High efficiency PA path +15 dBm
- ☐ Fully compatible with the LoRaWAN® standard

#### **Cryptographic Engine**

- ☐ Hardware support for AES-128 encryption/decryption based algorithms
- ☐ Handling device parameters such as DevEUI and JoinEUI
- ☐ Protects confidential information such as encryption keys
- ☐ Stores NwkKey, AppKey, as defined in the LoRaWAN® standard

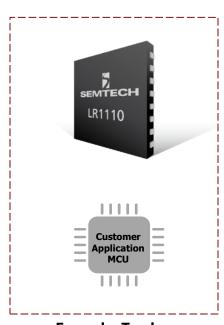
#### **QFN32 5X5mm**

Orderable Part Number: LR1110IMLTRT

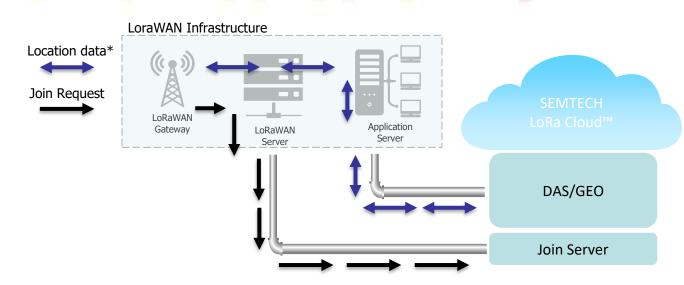


## LORA EDGE: SYSTEM SOLUTION









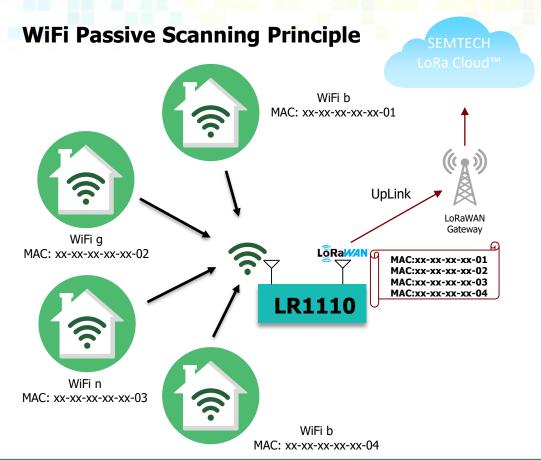
#### Location is solved in Cloud solver:

- WiFi lookup database
- **GNSS Solver**

\*Location data: MAC Addresses GNSS NAV data

#### LORA EDGE: POSITION SOLVER EXPLAINED



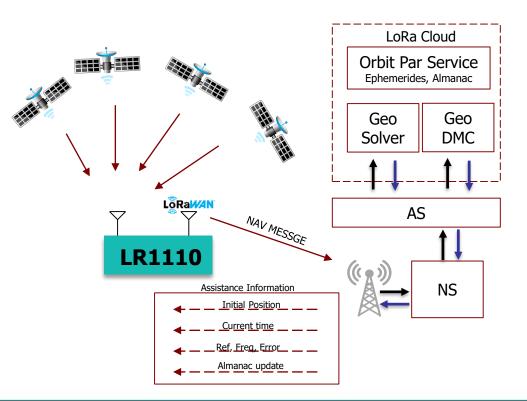


- LR1110 is able to discover the Wi-Fi b/g/n access points
- Extract MAC addresses allowing to geolocate the device
- To save power only a small portion of the Wi-Fi packets containing the MAC address information will be captured and demodulated
- Associated signal level RSSI is also extracted and can be sent optionally
- LR1110 can also extract the country code information
- MAC addresses are sent to a cloud-based Wi-Fi lookup service

#### LORA EDGE: POSITION SOLVER EXPLAINED



#### **GNSS Scanning Principle, Assisted Mode**



- LR1110 captures a short portion of the signal broadcast by the satellite vehicles
- Signals are aggregated into a NAV message and sent to a cloud server
- ☐ GNSS scanner supports the following constellations:
  - ☐ GPS L1 + GPS geostationary SBAS: EGNOS and WAAS
  - ☐ BeiDou B1 + BeiDou geostationary GEO/IGSO
- ☐ Assistance parameters can be provided to the LR1110:
  - Rough estimate of the initial position of the device
  - Current time
  - Frequency reference error to be compensated
  - Recent version of the Almanac
- All assistance information transferred to the LR1110 is tailored for an LPWAN use-case, which mean lowthroughput and low-power.



## Lora EDGE: MODEM OR TRANSCEIVER



	LR1110 MODEM
Limited resources application MCU	<b>✓</b>
Simplified Development	<b>✓</b>
Simplified LoRa Cloud Connection	<b>✓</b>
Custom security process and Key Management	X
Custom Protocol	X

LR1110 TRANSCEIVER
X
X
X
<b>✓</b>
<b>✓</b>

### LoRa EDGE: LR1110 DEVELOPMENT KIT



☐ LR1110 Low Power High Sensitivity Lo	Ra/(G)FSK RF Transceiver with Wi-Fi and
GNSS based geolocation capabilities	

- STM32L476 MCU (80MHz Cortex M4 MCU, 1MB Flash / 128kB RAM )
- 3-axis accelerometer
- ☐ Simple: TFT screen for GUI-based geolocation demo or transceiver evaluation
- ETSI and FCC Pre-scanned

PN	Region
LR1110DVK1BKS	EU
LR1110DVK1CKS	US
LR1110DVK1GKS	CN

#### Kit Content:

- 1xSTM32L476 Nucleo
- 1xTFT screen
- 1xLR1110 LNA shield
- ☐ 1xLR1110 no-LNA shield
- □ 1xLoRa antenna (depending on region)
- 1xWi-Fi antenna
- 1xActive GPS antenna
- 1xPassive GPS antenna
- 1x USB cable

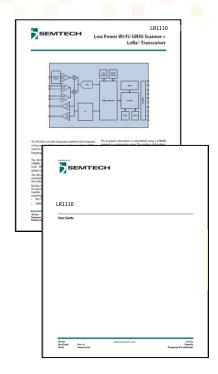


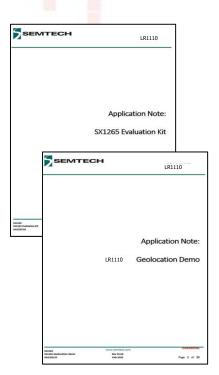
Kit are available in internal stock and it is expected in distribution by June

#### LoRa EDGE: LR1110 DOCUMENTATION



- LR1110 Data sheet
- ☐ LR1110 User Guide
- App Note: LR1110 Evaluation kit
- App Note: Geolocation Demo
- Geolocation Precision







## Lora EDGE SOLUTIONS



#### Challenges

Existing solutions require to integrate components from multiple vendors (GPS, WiFi, Location database, LPWAN) increasing BOM cost, design and procurement complexity

Existing solutions are too power-hungry, forcing customers to often replace batteries which is an expensive and complex operation for large deployments

Existing solutions force customers to implement costly secure manufacturing process or additional cost in secure hardware such as secure elements, increasing cost, power consumption and design complexity

Due to prohibited cost, outdoor and Indoor management solutions are typically separate designs, lack of cost effective all in one indoor/outdoor solutions prevent market growth

Asset location is becoming a general requirement for IoT deployments but high cost prevents wide adoption



#### Solution

LoRa Edge integrates a multi-constellation GNSS Scanner, Wi-Fi passive scanner and low power LoRa transceiver, reducing TCO and design complexity

LoRa Edge and LoRa Cloud geolocation services offer a unique system architecture; High computing, power intensive location computation is performed in the cloud, dramatically reducing power consumption

LoRa Edge is pre-provisioned with security keys using a highly secure Hardware Module; customers do not have to implement costly secure process or additional cost in secure hardware.

LoRa Edge is all in one chipset (GNSS, Wi-Fi and LoRa Transceiver) for indoor and outdoor applications, enabling one single design

LoRa Edge is a very cost effective solution that will enable rapid expansion of location services to IoT deployments



### LR1110 GEO-LOCATION LOCATION ACCURACY



	Conditions	Location Accuracy @50% CDF <sup>(1)</sup>	Success Rate
GNSS (GPS + BeiDou)	Open sky	7 m	~100 %
Single scan capture static position	limited sky view, urban environment	25 - 30 m	>90 %
GNSS (GPS + BeiDou)	Open sky	6 m	~100%
Sync-ed double scan capture Static position	limited sky view, urban environment	20 - 25 m	~100%
Wi-Fi passive scanning	Urban environment	5 - 30 m	look-up database provider dependent AP density dependent
LoRa TDOA		150 m	Network configuration dependent

Note: All data provided using the version of solvers available on LoRa Cloud at the time of product launch (1) Cumulative distribution function

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#### LR1110 GNSS SCANNING POWER CONSUMPTION



	Conditions	Scanning time [s]	Scanning energy [uWh]	Uplink energy [uWh]	Total energy [uWh]
Indoor/ outdoor classification <sup>1</sup>		0.7	4.4	-	4.4
GPS + BeiDou scan	Best assistance <sup>2</sup>	1.34 + 1.82	7.3 + 9.5	2.4	19.2
	Good assistance	1.64 + 1.82	8.7 + 9.5		20.6
	Worse assistance	1.94 + 1.82	10 + 9.5		21.9

- 1 Indoor Classification: this is a very quick (low-energy) way of defining if the device is indoors or outdoors
- 2 The overall GNSS scan time and energy is reduced by keeping the assistance information up-to-date:
  - The LoRa Cloud services are providing the assistance information to allow best device performance.
  - 1x GNSS scan every 30 minutes for more than 5 years on a 500 mAh battery (Best Assistance condition)

#### Notes:

- GNSS scan calculations based on typical open-sky case EU/US, 15 SVs detected [10 GPS (6 strong, 4 weak) + 5 BeiDou (3 strong, 2 weak)]
- 8 strongest (among 15) signal SV transmitted in NAV message to LoRa Cloud (43 Bytes payload)
- Uplink energy given for LoRa SF7, BW = 125 kHz, 14 dBm output power

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#### **LR1110 WI-FI PASSIVE SCANNING**



#### **POWER CONSUMPTION**

	Scanning time	Scanning energy	Uplink energy	Total energy
	[ms]	[uWh]	[uWh]	[uWh]
Wi-Fi b passive scan	65 - 75	0.5 - 0.7	2.1	2.6 – 2.8

LR1110 Wi-Fi passive scanning provides significant reduction in energy consumption compared to GNSS scanning. 1x Wi-Fi b passive scan every 5 minutes for more than 5 years on a 500 mAh battery.

#### Notes:

- Average scanning time/ energy to capture 6 MAC addresses by searching on 3 Wi-Fi channels
- Total Wi-Fi passive scanning time is dependent on the traffic in the scanned channel
- Uplink energy given for LoRa SF7, BW = 125 kHz, 14 dBm output power, packet size 36 Bytes

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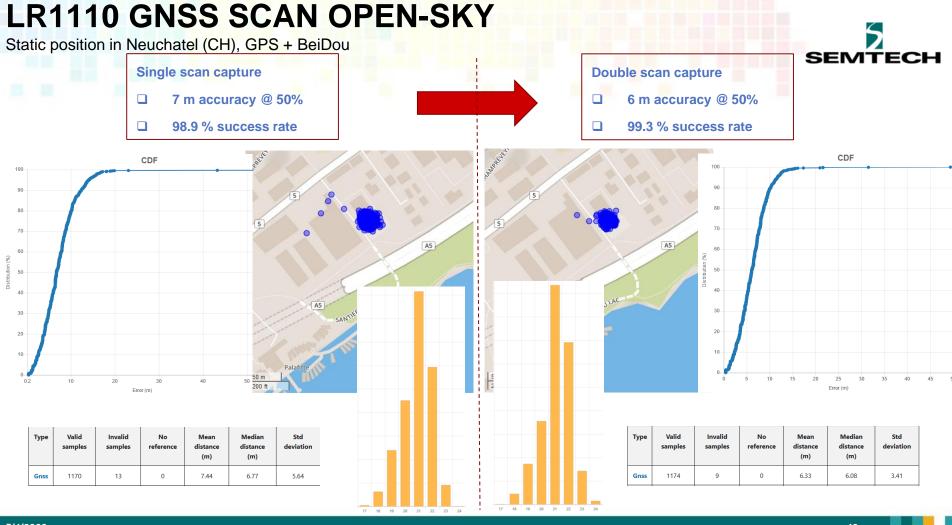
### LR1110 GNSS/ WI-FI SCAN



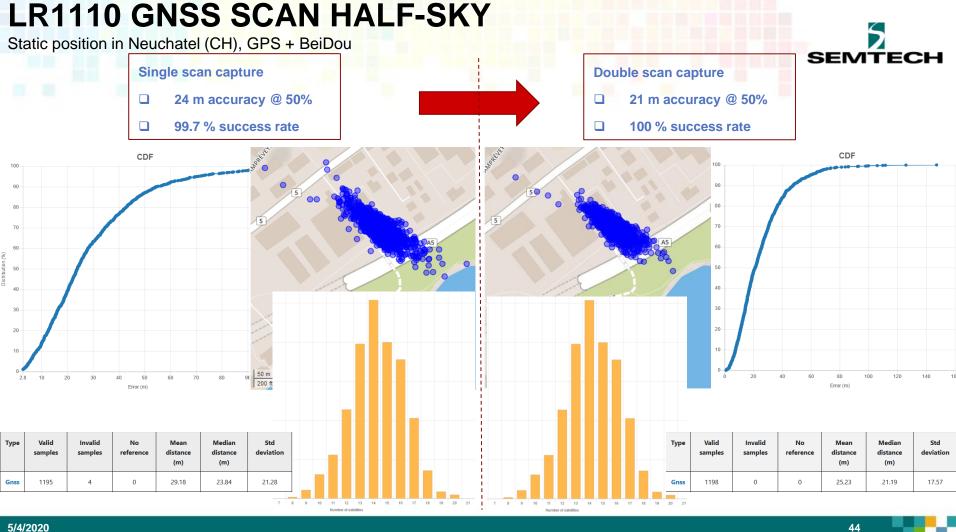
#### **UPLINK/ DOWNLINK MESSAGES**

Message	Size
Uplink with GNSS scan results (NAV message)	43 Bytes for 8 SVs (Space Vehicles)
Uplink with Wi-Fi passive scan results	36 Bytes for 6 Wi-Fi MAC addresses
Assistance downlink from Solver	<ul> <li>Initial assistance position (3 Bytes)</li> <li>Current time (4 Bytes)</li> <li>Freq. ref. error compensation (2 Bytes)**</li> </ul>
Uplink status message to DAS	1 uplink message generated/ day (8 Bytes) + debug & assistance calls messages, if required
Assistance downlink from DAS	1 downlink message/ week (50 Bytes) with delta Almanac updates, when required by device

\*\* Not currently supported



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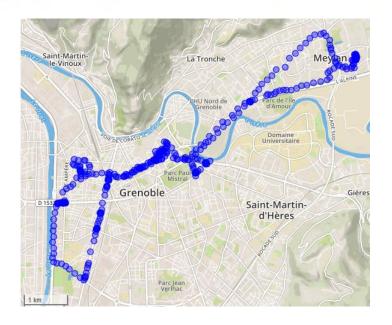
### LR1110 GNSS SCAN URBAN ENVIRONMENT

Drive test in Grenoble (FR), GPS + BeiDou single capture

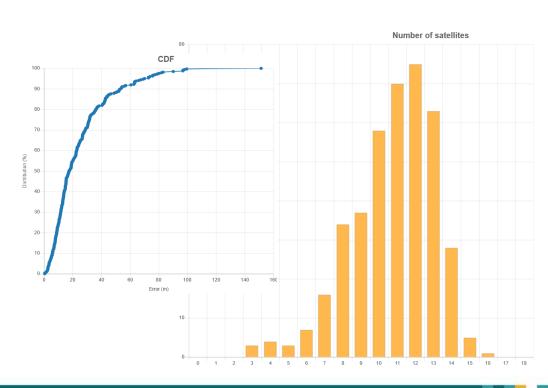


80 % success rate





Туре	Valid samples	Invalid samples	No reference	Mean distance (m)	Median distance (m)	Std deviation
Gnss	323	81	0	24.68	17.68	21.27



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