



Lora-A Revolutionary Technology for IOT LPWAN

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IoT Connected Device Opportunity



Ericsson

28B

Source: Ericsson. *Ericsson Mobility Report June 2016*

Gartner

21B

Source: Gartner. *Gartner Says 6.4 Billion Connected "Things" Will Be in Use in 2016, Up 30 Percent From 2015, 2015.*

IDC

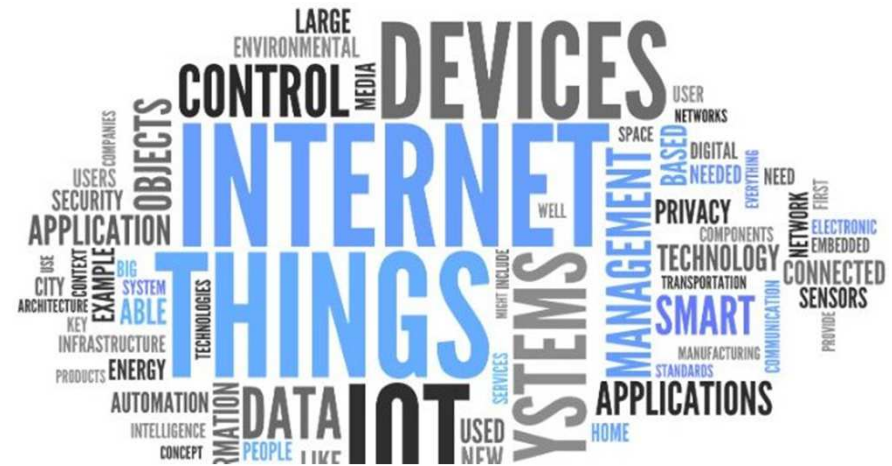
28B

Source: IDC. *Worldwide and Regional Internet of Things (IoT) 2014–2020 Forecast: A Virtuous Circle of Proven Value and Demand Internet of Things, 2014*

IHS

31B

Source: IHS. *Market: IoT Platforms - Enabling the Internet of Things, 2016*



Low Power Wide Area Networks (LPWAN)



Traditional Cellular

Long Range
Higher data rates
Low battery life
High Cost

LPWAN (3-5B in 2022)



Long Range
Low data rates
Long battery life
Low Cost

Local Area Network



Short Range
High data rates
Low battery life
Medium Cost

Personal Area Network



Very Short Range
Low data rates
Good battery life
Low Cost



LoRa® - Brief history

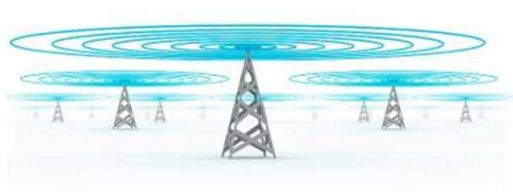


- 2013** • Launch of first LoRa radio by Semtech
- 2014** • First mobile network operator trials
- 2015** • Launch of LoRa Alliance: 130 members in 6 months
 - Multiple sensors, gateways, modules available
 - Public, private, viral network deployments worldwide
- 2016**
 - Over 400 LoRa Alliance members today
 - Over 100 regions with deployments or trials
 - Low power geolocation introduced
 - Comcast announces US LoRaWAN network trial

 LoRa Alliance™



LoRa® Key Features



Long Range

- 15-30 miles outdoor
- Deep indoor coverage

Low Power

- 10-20yr lifetime
- >10x vs cellular M2M

Multi Usage

- Scalable capacity
- Multi-tenant
- Public or private

Low Cost

- Minimal infrastructure
- Low cost end-node
- Open source software

Differentiators & Benefits



True Location

- ❑ Outdoor
- ❑ No Battery Impact



Bidirectional

- ❑ Over the air updates
- ❑ Acknowledgements
- ❑ Security key exchange



LoRaWAN™

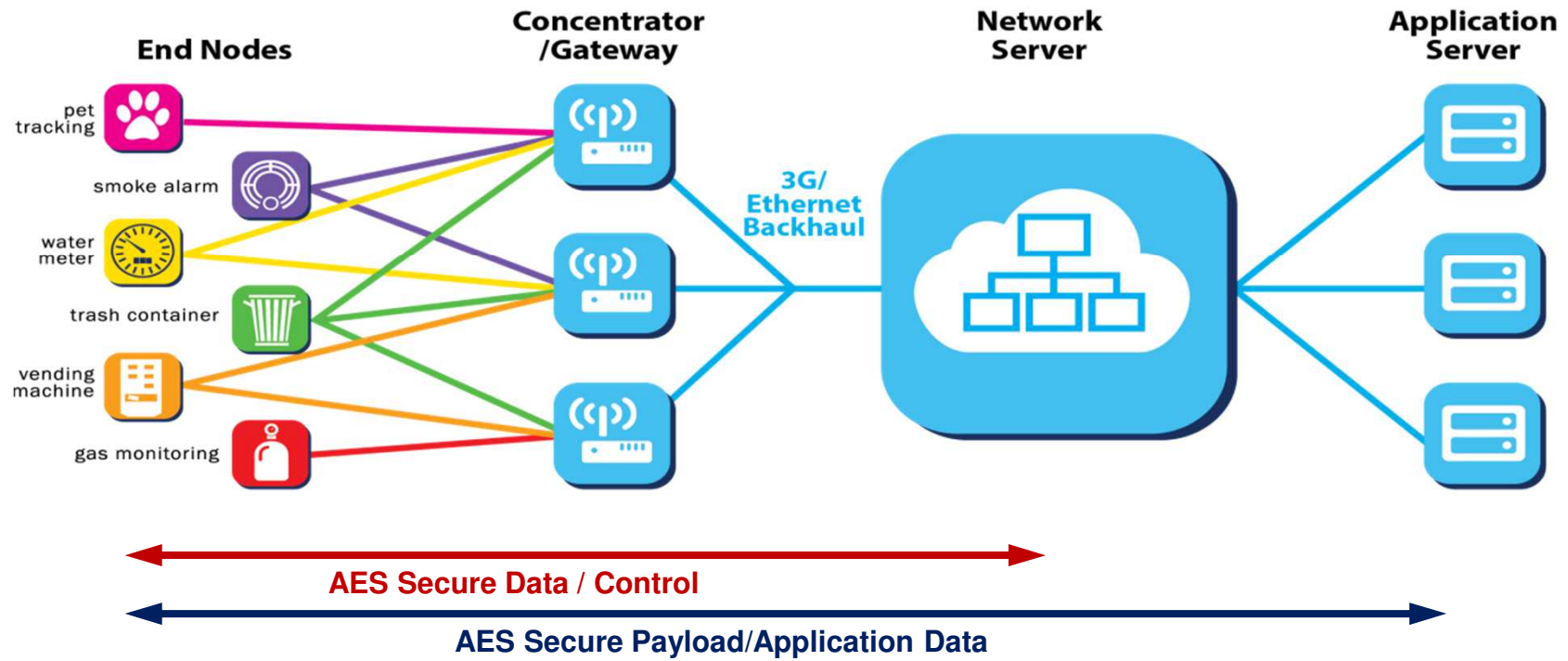
- ❑ Interoperable
- ❑ Global support
- ❑ Roaming



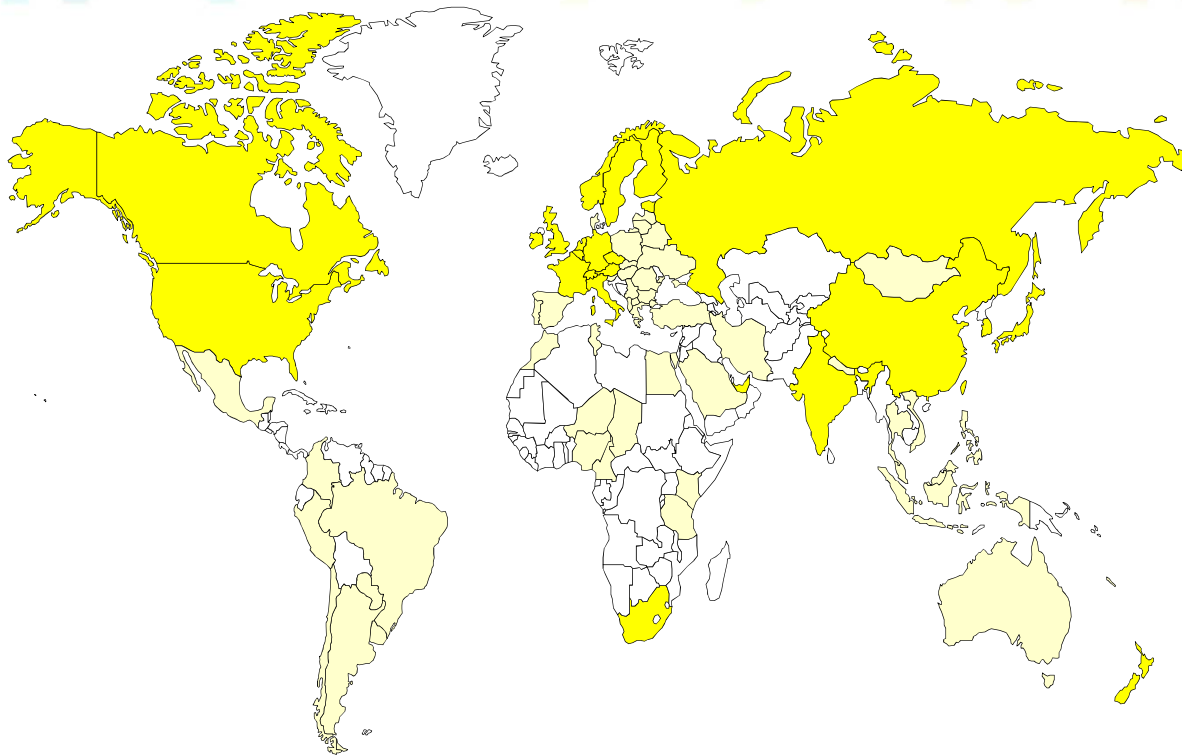
Security

- ❑ End to end encrypted data
- ❑ Secure element ready

LoRaWAN™ Network



Worldwide LoRa® Deployment



- 34 Publicly Announced Operators
- 150+ on-going trials & deployments
- 400+ members in the Alliance

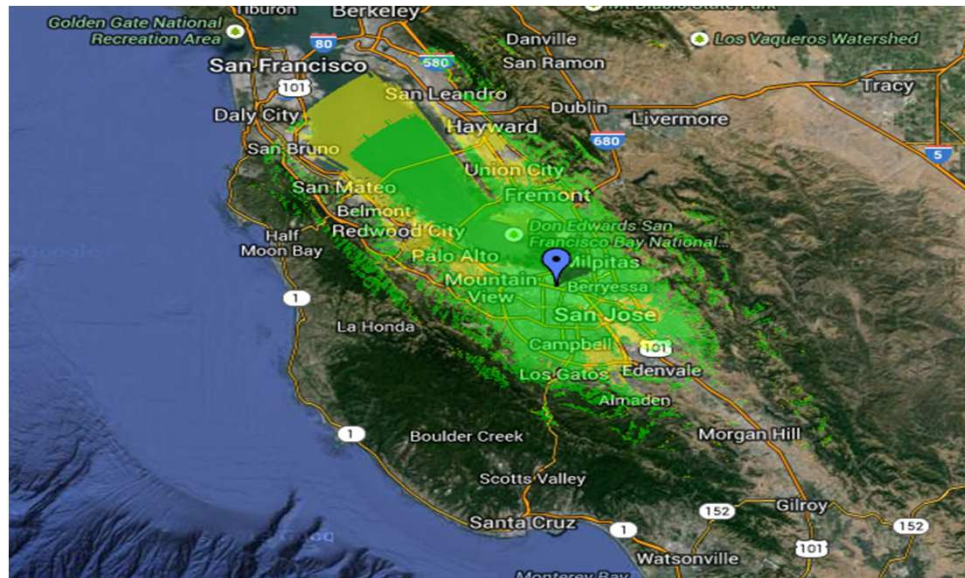
Legend:

- **Publicly Announced**
- **Other deployments**

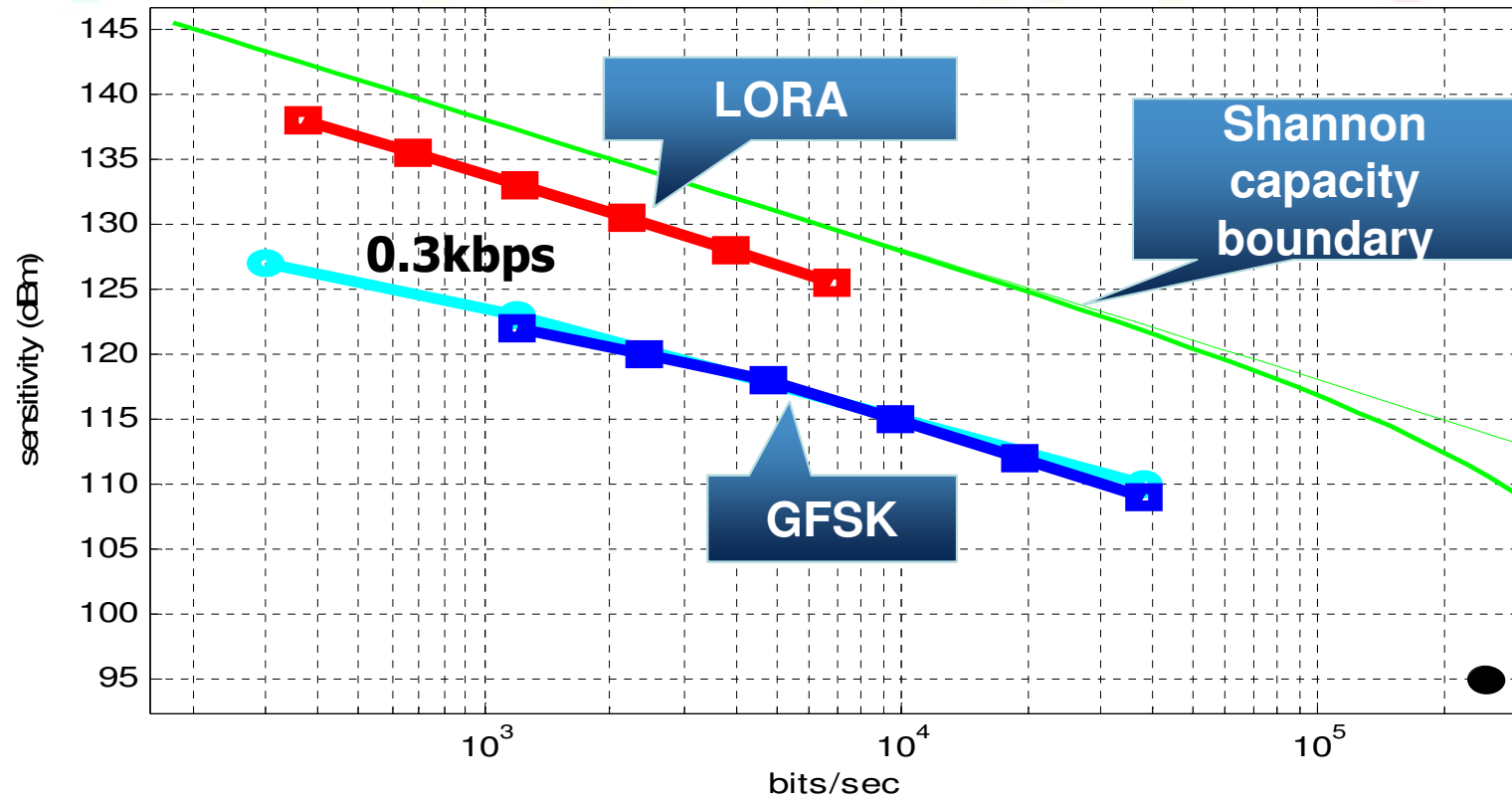
Source: LoRa Alliance

LoRa® Range

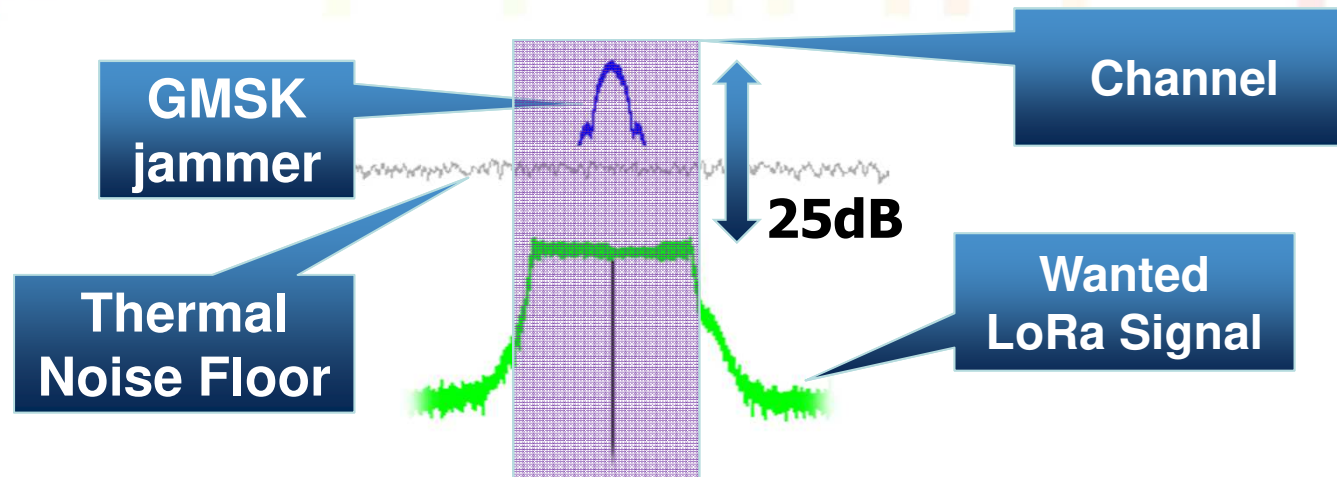
- ❑ Coverage map from a single gateway
- ❑ Cisco Webex building in San Jose
- ❑ >20 miles (32Km) coverage from a single gateway



CMOS State-of-the-Art + LoRa[®]



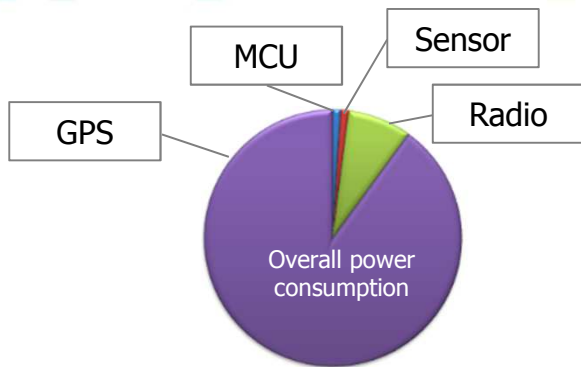
Jammer Resistant



Jammer type	LoRa Co-channel Signal to Interferer ratio	Existing FSK Co-channel Signal to Interferer
CW / FSK / GMSK	-25dB	+8 to 12dB
OFDM / AWGN	-21dB	+10 to 15dB
LoRa at different data rate	-25dB	



Geolocation with LoRaWAN™



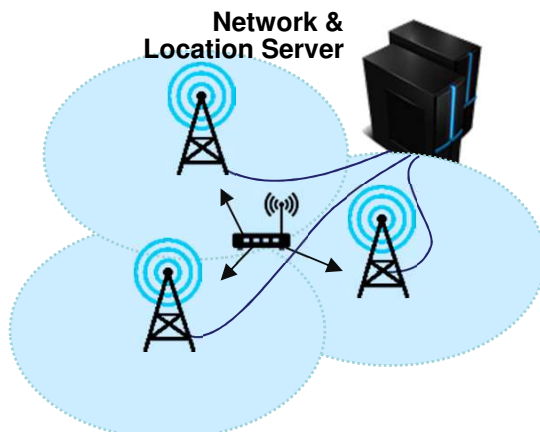
Low Power



GPS free location



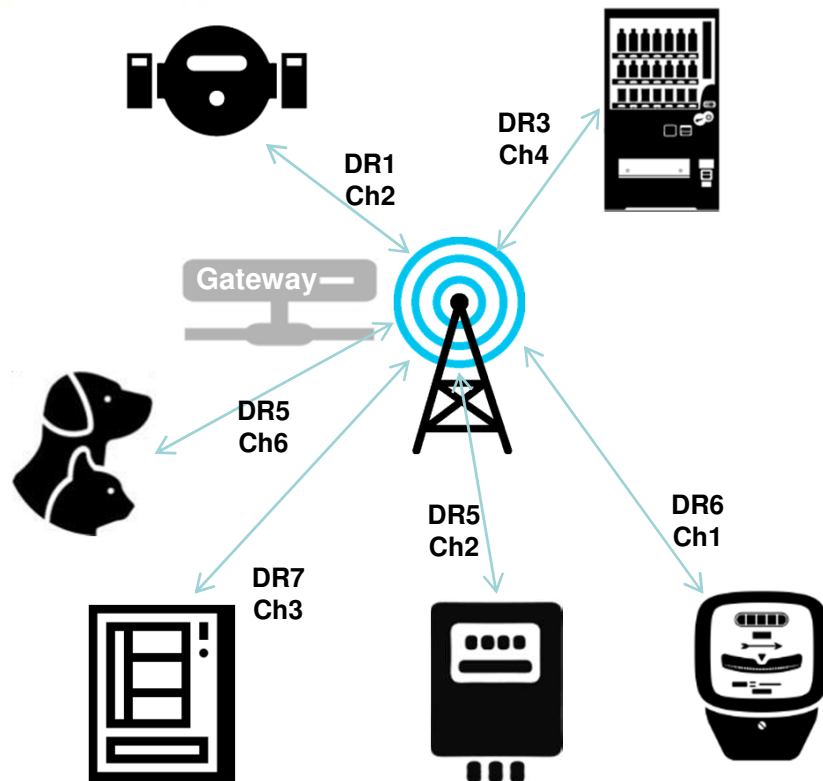
Optimize operations



- All base stations share a common timebase
- A LoRaWAN sensor transmits a packet
- Algorithms compare the time of arrival and other signal parameters



LoRaWAN™ Network



❑ Multi-channel gateway

- Simultaneous reception of messages
- Scalable capacity
- Indoor or outdoor
- Adaptive data rate
- Supports geo-location

❑ Fast time to market

- Commercial products available today
- Reference HW and MAC provided
- Reference design available

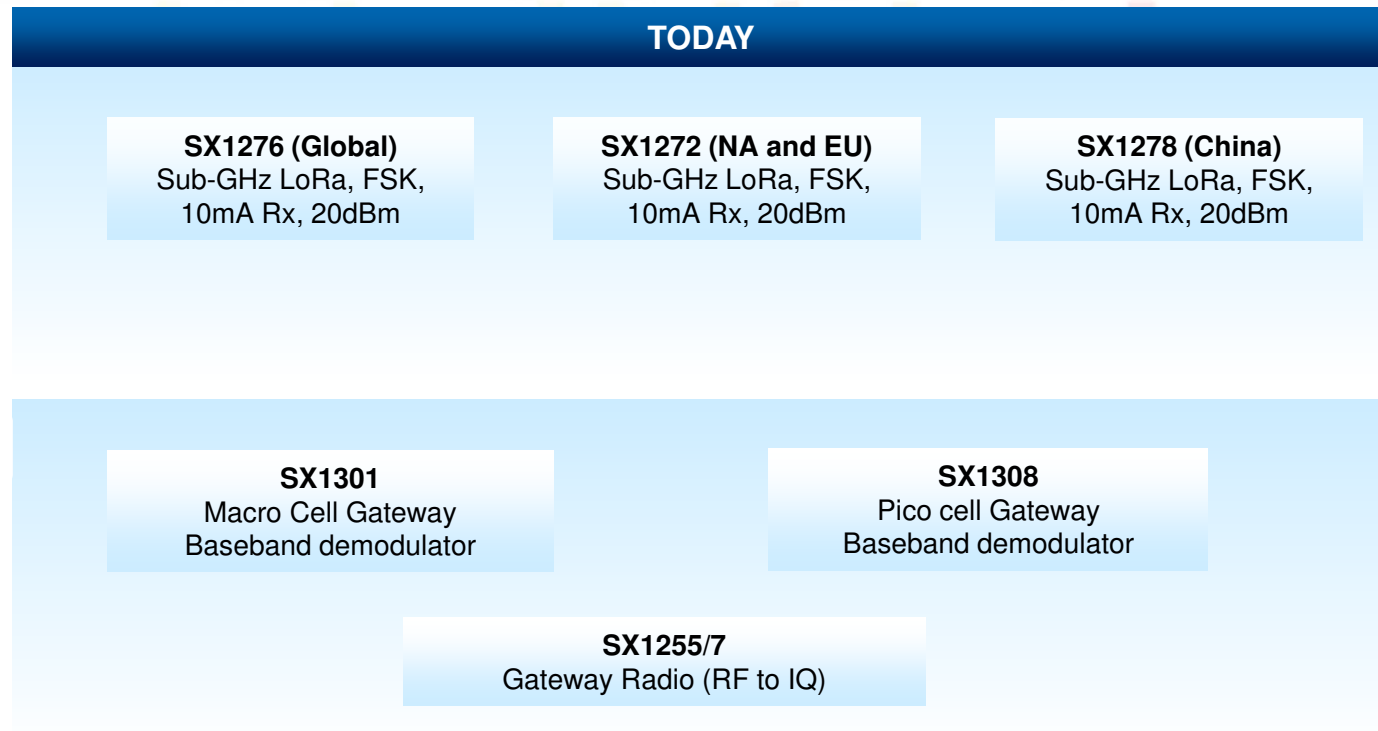
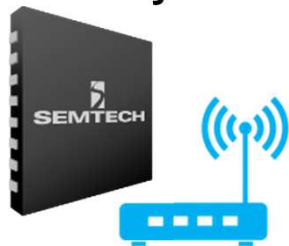
Semtech LoRa[®] IC Products



Sensor Radio IC



Gateway ICs



LoRa Alliance[™] members offer complete LoRaWAN based products and solutions today



End Node Reference Designs



Part	Design	Band	Region	P _{OUT}	Platform
SX1272	SX1272MB1DCS	868MHz	EU	14dBm	Mbed
	SX1272MB2DAS	868MHz/915MHz	EU/US	14dBm	Mbed
	SX1272RF1xAS	868MHz/915MHz	EU/US	20dBm	Eiger, Prototype
SX1276	SX1276MB1JCS	433MHz/868MHz	EU/US	14dBm	Mbed
	SX1276MB1MAS	433MHz/868MHz	EU/US	14dBm	Mbed
	SX1276MB1LAS	433MHz/915MHz	US	14dBm/20dBm	Mbed
	SX1276RF1IAS	169MHz/868MHz	EU	20dBm/14dBm	Eiger, Prototype
	SX1276RF1JAS	433/868/915MHz	EU/US	14dBm/20dBm	Eiger, Prototype
	SX1276RF1KAS	490MHz/915MHz	China/US	20dBm/14dBm	Eiger, Prototype

☐ Design Files are available under Docs & Resources of Semtech's LoRa Product Page

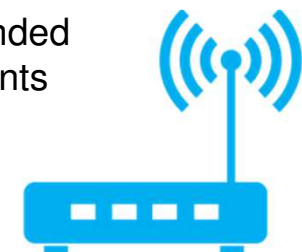


Gateway Reference Designs



	DATA ONLY (V1.X) MACRO & PICO	GEOLOCATION (V2.X)
Baseband IC	SX1301 / SX1308	SX1301
TX Channels	1	2
RX Channels	8	16 to 64
Antennas	1	2
Duplex	Half	Half / Full
Power Output	up to 23dbm	up to 30dbm
ARCHITECTURE		
Modems	1	2 to 8
DSPs	0	2
FPGA	-	1
Radio FE	SX1255/57	SX1255/57

- LoRaWAN gateway products available from multiple suppliers
- Reference design available from Semtech
- Macro cell for outdoor, data and geolocation
- Pico cell design intended for indoor environments



**Base-band extender for GW v2.1*

LoRaWAN™ for sensor nodes



- ❑ LoRaWAN specification defined by the LoRa Alliance
- ❑ Open source stack for ARM Cortex-M MCUs
- ❑ Portable to other MCU or CPU architectures

- ❑ Option 1: GitHub
 - <https://github.com/Lora-net/LoRaMac-node> (Master & develop branches)
 - <http://stackforce.github.io/LoRaMac-doc/> (Documentation)

- ❑ Option 2: ARM mbed
 - <https://developer.mbed.org/teams/Semtech/code/>
 - Many sample applications on mbed™ platform



Device Certification



❑ North America FCC Part 15.247

- Several gateways and sensors are FCC certified today
- Digital Modulation Techniques (DTS)
- Frequency Hopping Spread-Spectrum
- Hybrid Mode
- Semtech provides application notes on FCC compliance

❑ LoRaWAN Compliance Test Houses

- 7Layers
- AT4
- TUV



LoRa Use Cases



Agriculture with LoRa

- Animal health monitoring
- Crop yield
- Water conservation



Asset management with LoRa

- Utilization Of Resources
- Asset tracking and monitoring
- Energy and land use



LoRa Use Cases



Smart City with LoRa

- Energy conservation
- City or neighborhood coverage
- Operational efficiency



Smart Buildings with LoRa

- Deep indoor penetration
- Safety and security
- Operational efficiency



LoRa Community and Microsite



[What is LoRa?](#) | [LoRa Applications](#) | [Join Community](#)

IoT Connects Our World. LoRa Makes It Smart.

Connect Data Intelligently



Connecting virtually all things—sensors, gateways, machines, devices, animals, people—LoRa Technology makes it possible to connect to the Cloud, enabling sound decisions and making people’s lives better.



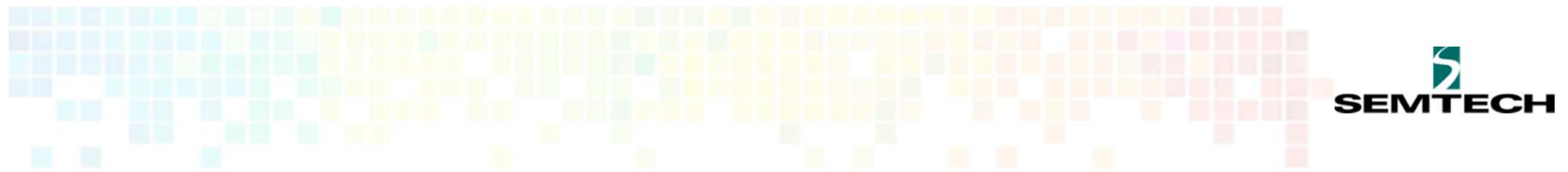
Summary



□ LoRa[®] enables the Internet of Things

- Provides outdoor and deep indoor connectivity
- Very low cost of ownership with private or nationwide networks
- Scalable architecture future proof for capacity & interference
- Strong ecosystem of partners and applications





Thanks !

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