



**MICROCHIP**

**LoRa™ Technology**

[Return to Topics](#)

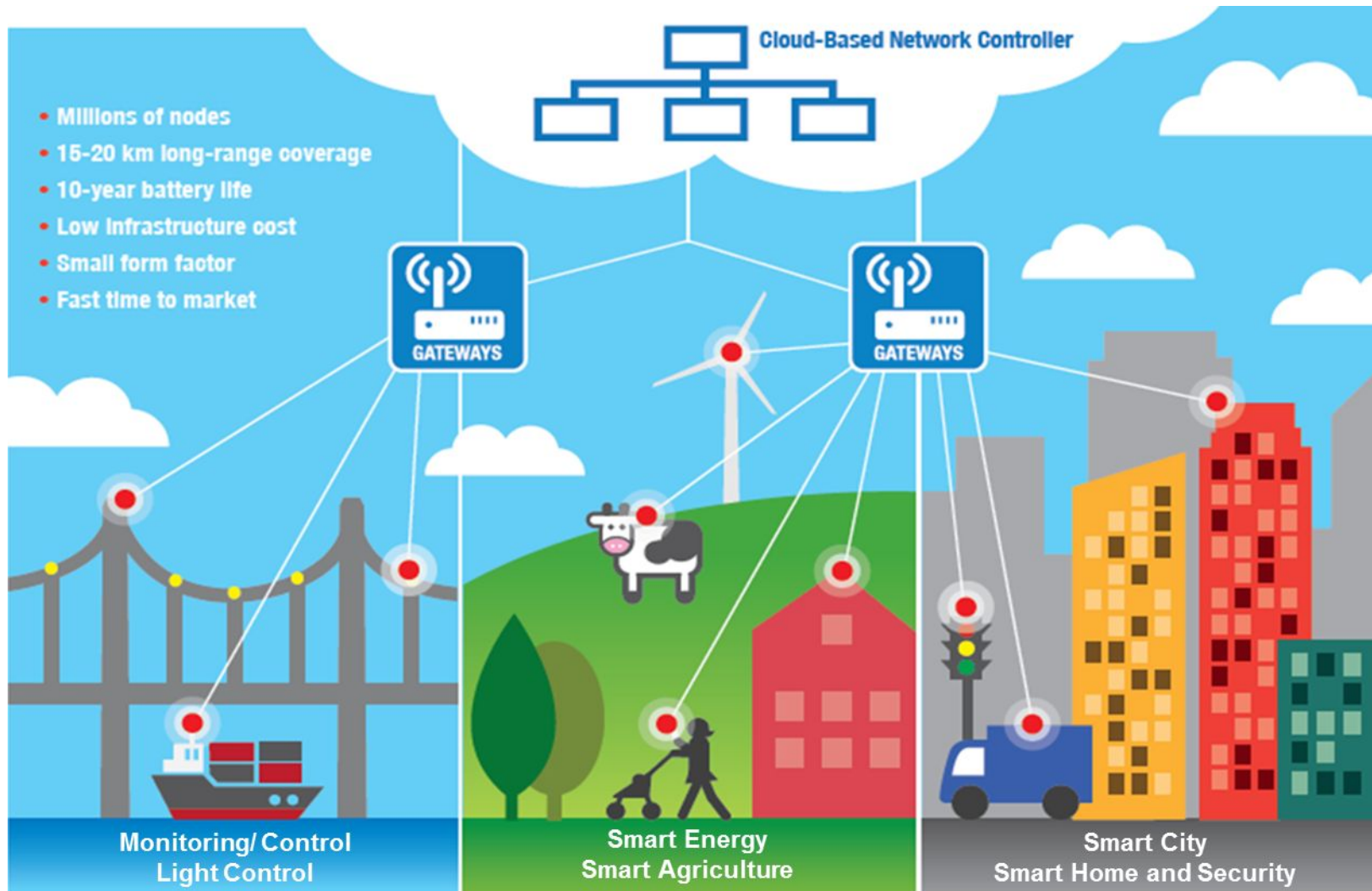
# What is LoRa™ Technology?

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- **Proprietary wireless technology developed by Semtech**
- **Long range and low power consumption**
  - At +14dbm output power, 868MHz:
    - Up to 5km range in urban environment, up to 15km suburban
    - >10 year battery life capability
- **Robust communication**
  - Not susceptible to interference from Wi-Fi, Bluetooth, GSM, LTE, etc
- **Improved network capacity**
  - Connect more nodes, 100k to 300k nodes

# LoRa™ Target Markets :

## Ideal for Internet of “Things”



# Application Examples

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- **Vending machines could alert distributors when a product is sold out or when it requires maintenance**
- **Cities could offer smart metering and apps to help drivers find parking spaces**
- **Animal lovers could track their pets or study migration patterns over longer distances**
- **Logistics providers could track cargo containers on trucks, ships and trains**
- **Home heating oil companies could receive automatic alerts when home oil tanks are running low**



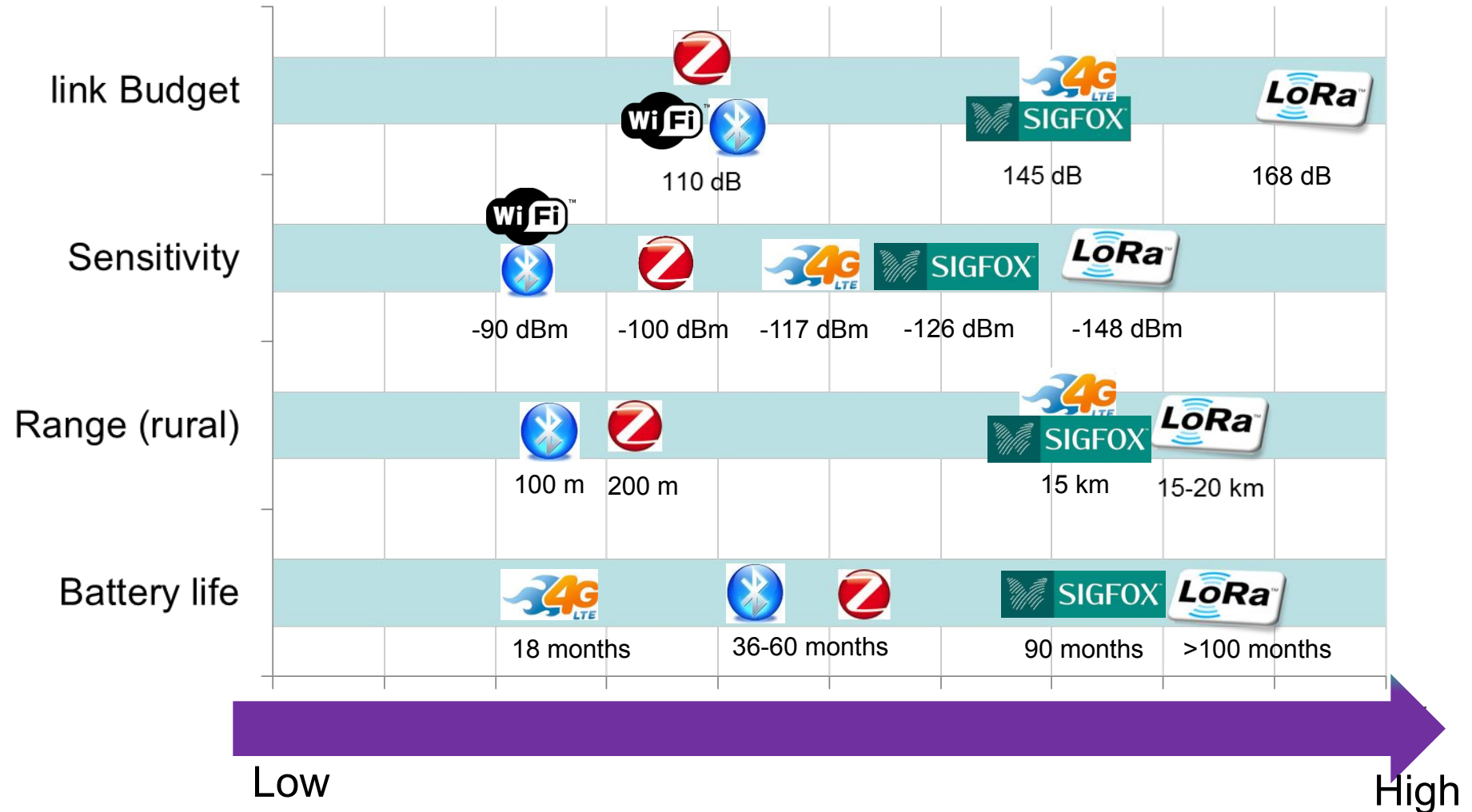
# The LoRa™ Alliance

## A Strong and Active Ecosystem

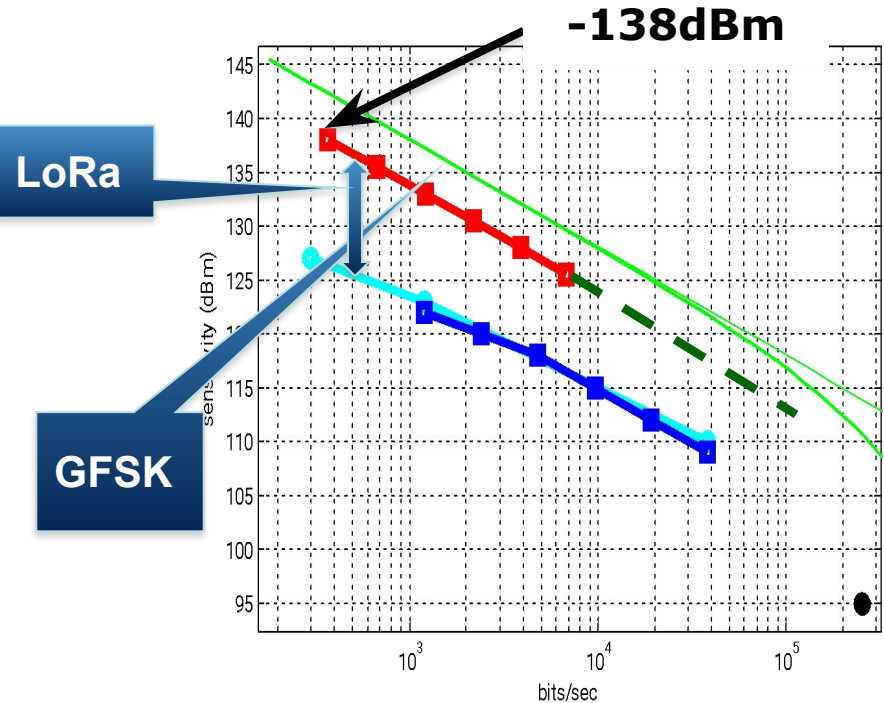
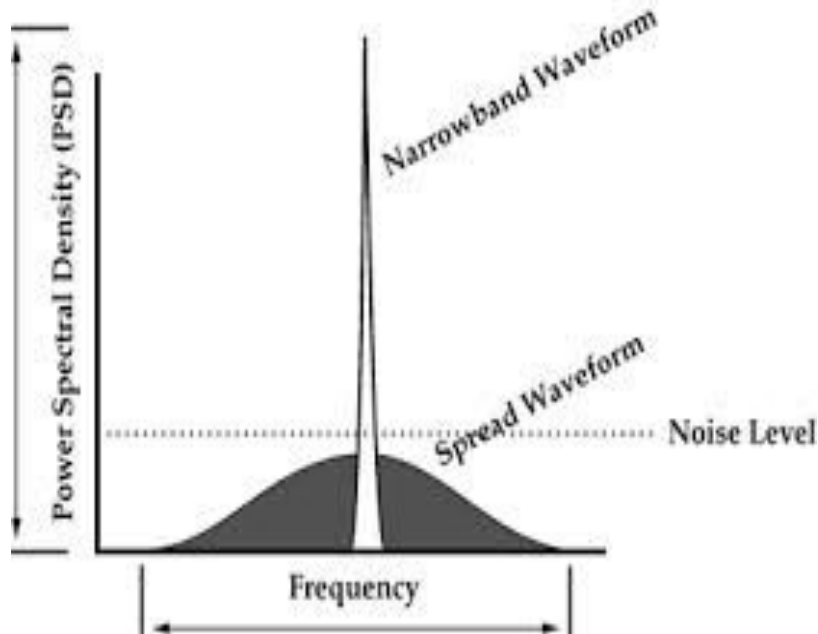
- An open, non-profit association of members that believes the Internet-of-Things era is now
- Already more than 180 companies have joined with over 400 requests for membership
- Mission to standardize Low Power Wide Area Networks (LPWAN) being deployed around the world to enable Internet-of-Things (IoT), Machine-to-Machine (M2M), smart city and industrial applications
- The Alliance members will collaborate to drive the global success of the LoRa™ protocol (LoRaWAN™), by sharing knowledge and experience to guarantee interoperability between operators and devices in one open global standard



# Technology Comparison



# 'Chirp' Spread-Spectrum Modulation



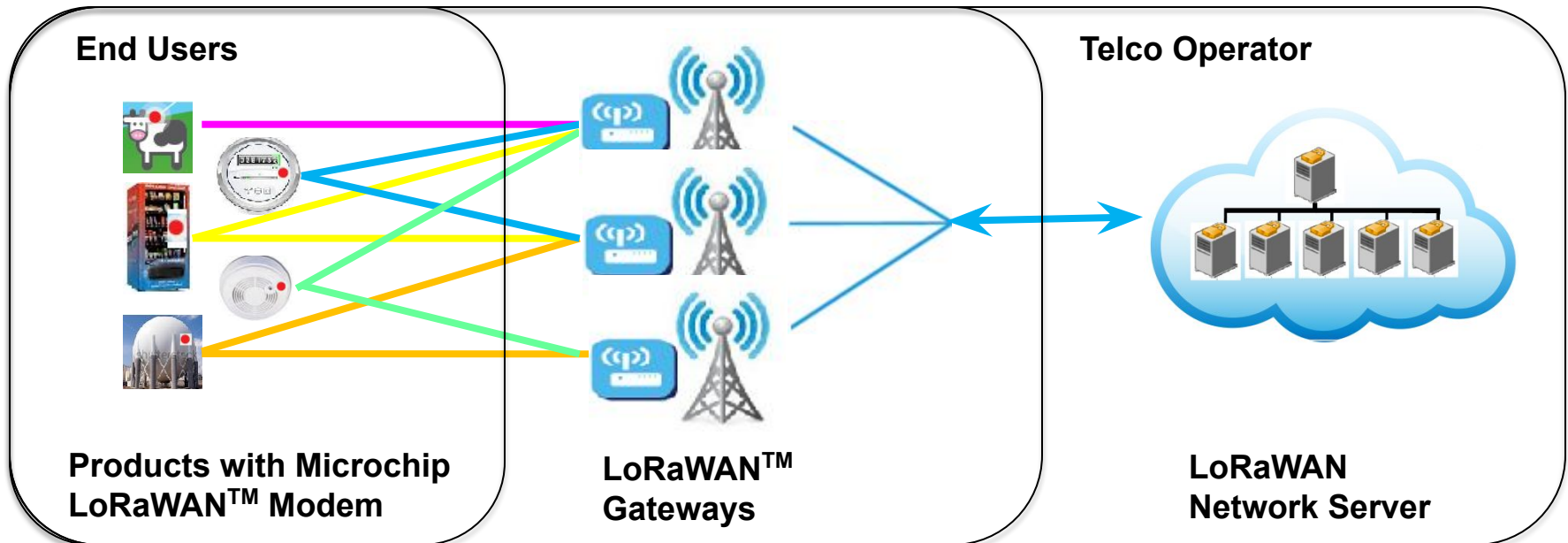
- Innovative & cost sensitive implementation
- Signal demodulation below the noise floor improves sensitivity by ~20dB
- Robust against interference, noise, and jamming
- Multiples signals can occupy the same channel (CDMA)
- Tolerant to frequency offsets (unlike DSSS)



# Supports Private Networks

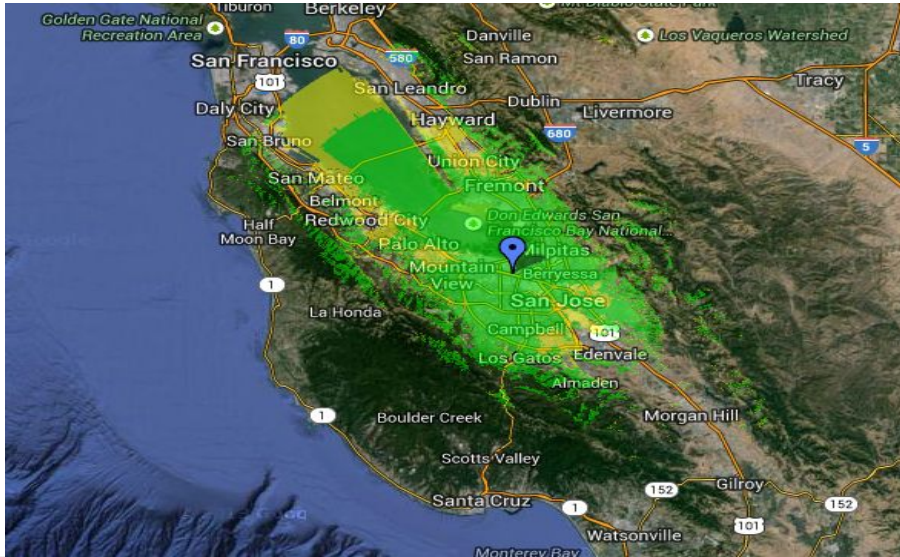
## Scalable & Flexible Architecture Options

- ❑ **Private Network**
  - ❑ Individually managed networks, total end-to-end ownership
- ❑ **Public Network**
  - ❑ Telco operator managed networks, servicing subscriber nodes
- ❑ **Hybrid Network**
  - ❑ Enterprise deployment of Nodes & Gateways, for specific area coverage
  - ❑ Provisioned to a commercial LoRaWAN server product



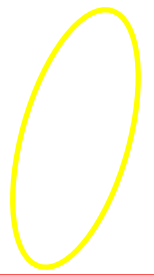
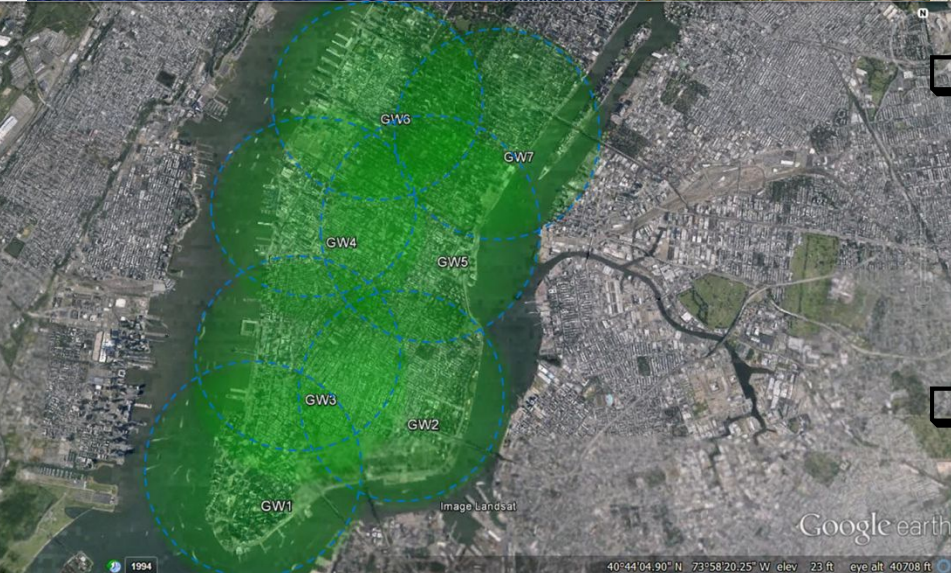


# LoRa™ Coverage Test



## Longest Range Coverage !

- ☐ Coverage map from a single gateway/concentrator located on Cisco Webex building in San Jose
- ☐ >20miles to San Bruno
- ☐ A conservative 1 mile radius allows for in-building penetration even at the edges
- ☐ 7 Gateways cover all of lower Manhattan



# LoRa™ Infrastructure Benefits

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- **Star topology with two-way communications**
  - Minimizes synchronization overhead, saves power consumption from minimum synchronization and hops in mesh network
  - Not constrained to single application (ie, Zigbee)
- **Easily connect millions of nodes to LoRa concentrators**
- **Adaptive data rate feature on Network server**
  - Optimizes the network capacity, battery lifetime and creates a fully scalable system
- **Strong ecosystem established with partners**
- **Support local area network and nationwide deployment**

# LoRa™ Partners

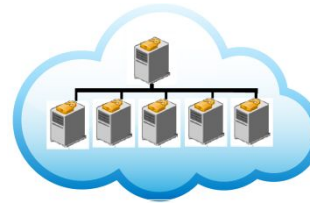
## End Nodes



## Gateway



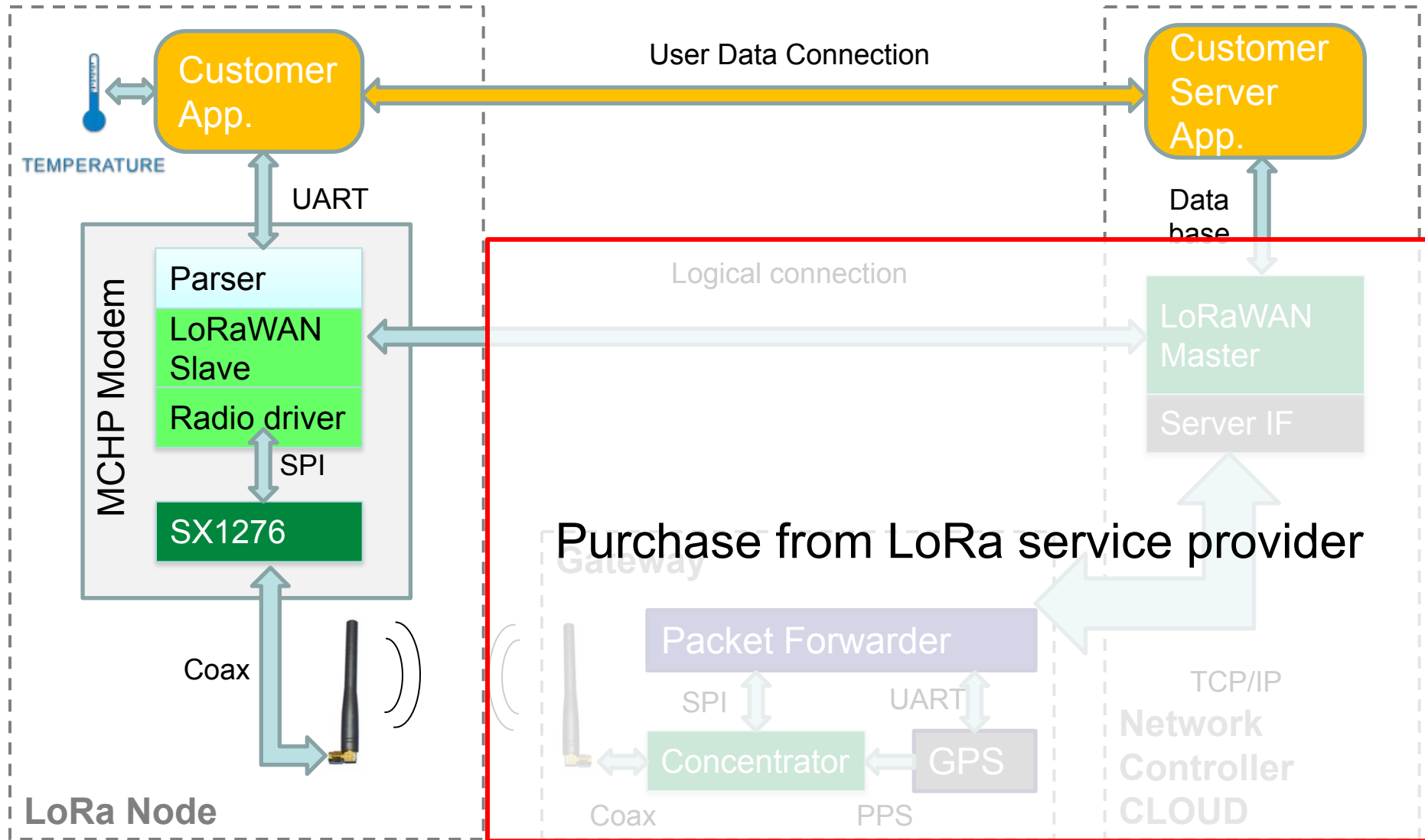
## Network Server



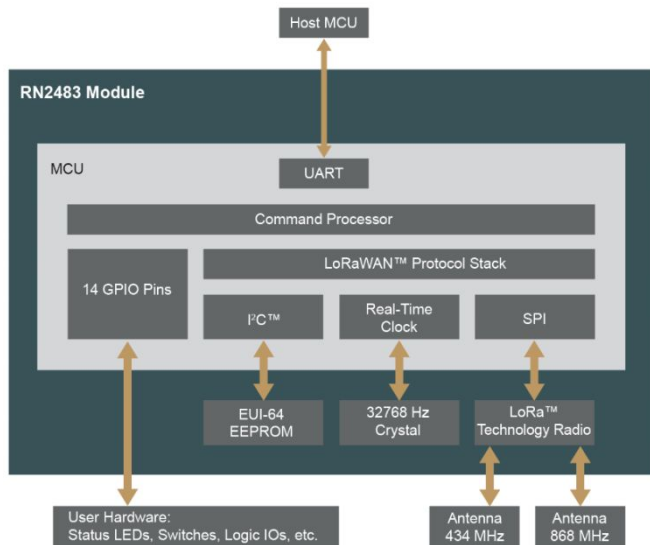
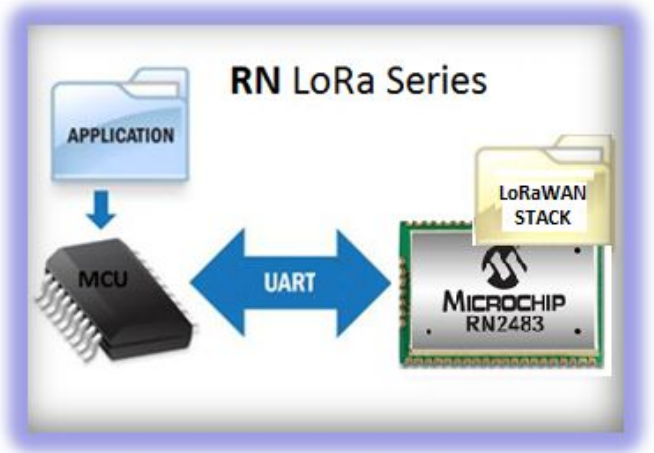
## Public Network Operator



# Public Network



# LoRa™ Modem Features



- Integrates LoRa Radio, PIC MCU & LoRaWAN™ (Class A) stack
- Microchip “RN-Style” Modem
  - Complete Stack on Board
  - Simple ASCII command via UART
  - Easy configuration
  - Quick time to market
  - Fully certified
  - Works with any MCU
- **Supply voltage: 2.1V-3.6V**
- **14x GPIOs**
- **Modem size (same as RN171)**
  - 17.8 x 26.7 x 3 mm



# LoRa™ Modem RF Features

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- **Tx output power:**
  - Up to +18 dBm @ 915 MHz (FCC) - Adjustable
  - +14 dBm @ 868 MHz (ETSI)
  - +10 dBm @ 433 MHz
- **High sensitivity: down to -148 dBm**
- **168 dB maximum link budget**
- **Tx current: 40 mA typ at +14 dBm**
- **Rx current: 14.2 mA typ**
- **Sleep mode/ low power down mode: 1 uA typ**
- **Excellent blocking immunity**
- **FSK and LoRa**
- **Programmable bit rate: 300bps – 5.5kbps (LoRa)**

# RN2xx3 Modem Family

## Key Features

	<b>434 MHz</b>	<b>868 MHz</b>	<b>915 MHz</b>
High Tx OP Power	+10 dBm	+14 dBm	+18.5 dBm
High Sensitivity	-137 dBm	-136 dBm	-132 dBm
Link Budget	147 dB	150 dB	150 dB
Tx Current (Max Power)	33 mA	39 mA	124 mA
Rx Current	14.2 mA		13.5 mA
Sleep Current	1.8 uA ( <i>Errata</i> )		22 uA ( <i>Errata</i> )
Embedded LoRaWAN Features	Complete LoRaWANr1.0 Class-A Functionality (E.g. ABP, OTAA, ADR ...)		
Modulation	LoRa & FSK (Selected automatically by DR)		LoRa
Test Modes	'Radio Mode' for functional test & range trials		





# Introducing RN2903-I/RM FCC LoRaWAN™ Modem



## Complete Solution!

- Integrates LoRa® Radio, PIC MCU & LoRaWAN Stack
- Pre-tested against all major LoRaWAN gateways & servers
- Simple ASCII Command Set
- Optimized for Embedded Designs
- Quick Time-to-Market

## Key Features

- LoRaWANv1.0 Class-A “Golden Unit” Stack
- 915MHz, external antenna
- Integrated filtering and matching circuits
- I/O Expansion: 6x analog, 6x digital, UART, I2C
- Compact size: 27 x 18 x 3.2 mm
- FCC Modular Certification



## Development Tools

- PICtail for Microchip MCU kits
- Mote for portable testing
- Both support USB Interface
- Demo Code available

\$65



\$69.99



**915 MHz SMA Antenna**

**RN2903 Module**

**OLED Display &  
Menu Buttons**

**Sensors** (Light & Temp)

**LED Indicators**

**Battery (reverse)**

**GPIO Test Points**

**ICSP (USB App)**

**USB-UART Bridge**

**USB Port (mini)**



# Introducing RN2483-I/RM EU LoRaWAN™ Modem



## Complete Solution!

- Integrates LoRa™ Radio, PIC MCU & LoRaWAN Stack
- Pre-tested against all major LoRaWAN gateways & servers
- Simple ASCII Command Set
- Optimized for Embedded Designs
- Quick Time-to-Market
- IEEE globally unique address included

## Key Features

- LoRaWANv1.0 Class-A “Golden Unit” Stack
- Dual-band 434 & 868MHz, external antenna
- Integrated filtering and matching circuits
- I/O Expansion: 6x analog, 6x digital, UART, I2C
- Compact size: 27 x 18 x 3 mm
- European R&TTE Certifications



## Development Tools

- PICtail for Microchip MCU kits
- Mote for portable testing
- Both support USB Interface
- Example Code available

\$65



\$69.99



# LoRa Technology Evaluation Kit

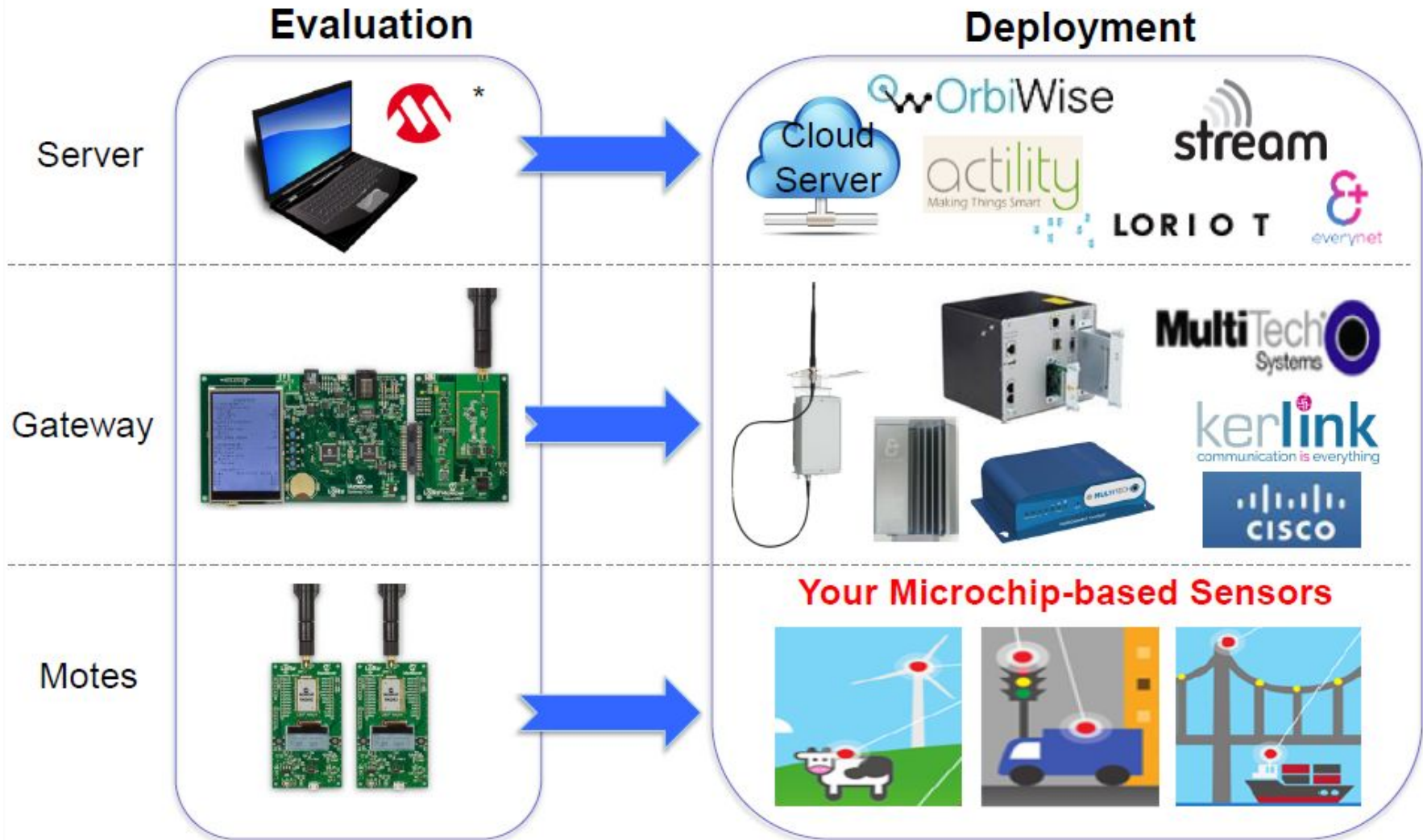
- Everything needed to develop a LoRaWAN™ Network
- 868MHz and 915MHz kits available
- Includes an 8 channel\* gateway and 2 motes
- Local LoRaWAN Network/Application server (docker image)
- GUI for Config & Testing (Windows, Linux and MAC OS)
- DV164140-1 (868 MHz); \$499
- DV146140-2 (915 MHz); \$499
- [www.microchip.com/LoRa](http://www.microchip.com/LoRa)



\* 6 channel for the DV164140-1

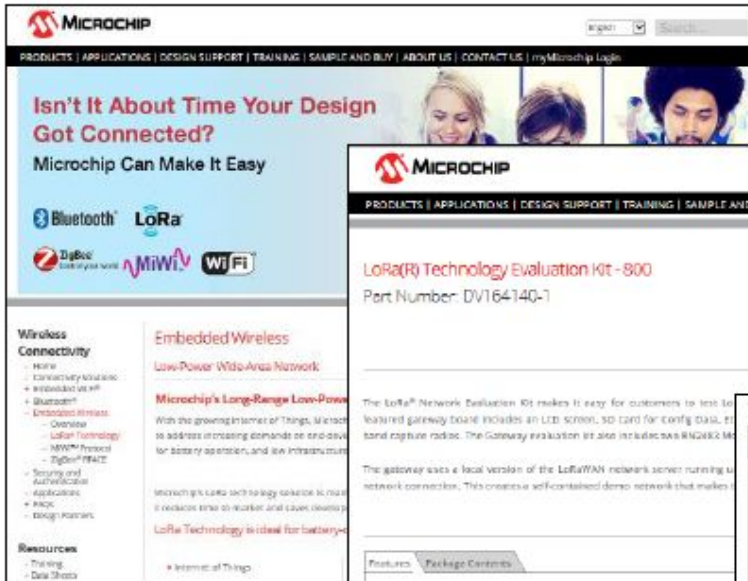


# Getting Beyond the Benchtop



# Get Started Today

- Go To: [www.microchip.com/LoRa](http://www.microchip.com/LoRa)



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**Isn't It About Time Your Design Got Connected?**  
Microchip Can Make It Easy

Bluetooth | LoRa | ZigBee | MiWi | WiFi

**Wireless Connectivity**

- Home Connectivity Solutions
- Embedded in all:
- Bluetooth
- Embedded Wireless
- Over-the-air
- LoRa Technology
- MyWi Personal
- ZigBee® P422
- Security and Authentication Applications
- IPsec
- Design Patterns

**Resources**

- Training
- Data Sheets

**Embedded Wireless**

**Low-Power Wide-Area Network:**

**Microchip's Long-Range Low-Power**

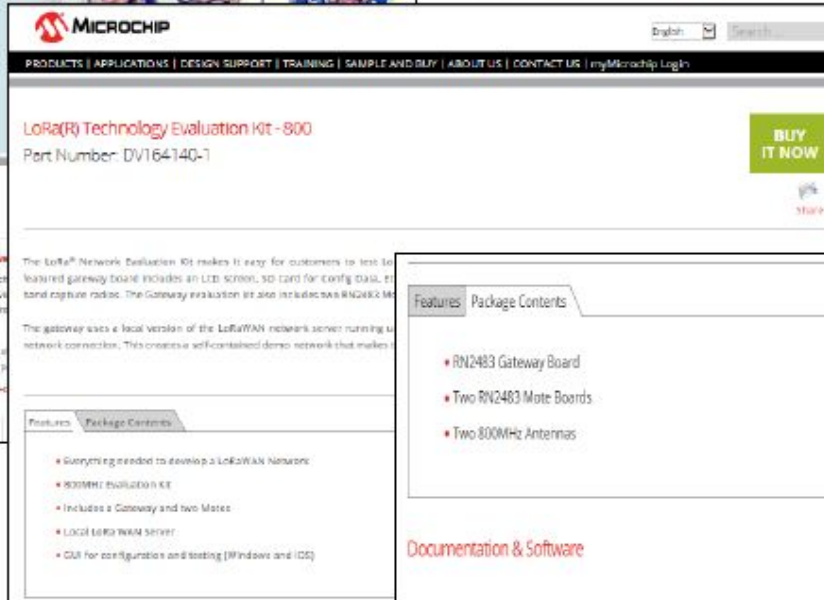
With the growing Internet of Things, Microchip addresses increasing demands on end-devices for battery operation, and low infrastructure.

Microchip's LoRa technology solution is ready to reduce time-to-market and save costs.

**LoRa Technology is ideal for battery-**

- Internet of Things

**Order Your Kit!**



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**LoRa(R) Technology Evaluation Kit - 800**  
Part Number: DV164140-7

**BUY IT NOW**

The LoRa® Network Evaluation Kit makes it easy for customers to test the LoRa network. The LoRa Network Evaluation Kit includes an LCD screen, SD card for configuration, and a band capture radio. The Gateway evaluation kit also includes an RN2483 M.

The gateway uses a local version of the LoRaWAN network server running a network connection. This creates a self-contained demo network that makes it


**Features** | **Package Contents**

- RN2483 Gateway Board
- Two RN2483 Mote Boards
- Two 800MHz Antennas

**Package Contents**




- Everything needed to develop a LoRaWAN Network
- 800MHz Evaluation Kit
- Includes a Gateway and two Motes
- Local LoRaWAN Server
- GUI for configuration and testing (Windows and iOS)

**Download Docs and SW**



**Documentation & Software**

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Documents	Last Updated	Size	
<a href="#">LoRa Technology Evaluation Suite User's Guide</a>	5/18/2016 2:25:13 PM	5MB	
<a href="#">LoRa Development Suite for iOS</a>	5/18/2016 2:24:35 PM	182MB	
<a href="#">LoRa Development Suite for Linux</a>	5/18/2016 2:05:48 PM	165MB	
<a href="#">LoRaWAN Server</a>	5/18/2016 1:44:05 PM	171MB	



# Microchip LoRa™ Products

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## ☐ Microchip LoRa Products – Available NOW

### ☐ [RN2483-I/RM101 EU Module](#)

- ☐ 433MHz/868MHz , European Compliant, R&TTE Certified
- ☐ LoRa Alliance LoRaWAN Certified
- ☐ [DM164138](#) – RN2483 Mote Evaluation Board
- ☐ [RN-2483-PICtail](#) – RN2483 PICtail daughter card

### ☐ [RN2903-I/RM095 NA Module](#)

- ☐ 915MHz , FCC Certified Module
- ☐ LoRa Alliance LoRaWAN Pre-Certified (LoRa Alliance has not completed the certification suite)
- ☐ [DM164139](#) – RN2903 Mote Evaluation Board
- ☐ [RN-2903-PICtail](#) – RN2903 PICtail daughter card

## ☐ In Development

### ☐ LoRa Technology Evaluation Kit

- ☐ LoRa Gateway Core and RF Boards
- ☐ LocalHOST LoRa Network Server
- ☐ (2) LoRa Motes
- ☐ Allows an “Out of the Box” LoRa Network Evaluation Kit
- ☐ Evaluation ONLY! Not Commercial Grade
- ☐ Target Release – FY1Q17



# Getting Started

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- **First □ Choose the correct LoRa™ Technology:**
  - RN2483 Europe: 434MHz and 868MHz; R&TTE Assessed Module
  - RN2903 North America: 915MHz; FCC Certified Module
  - For any other option not available now, please contact Microchip
- **Secondly □ Decide what kind of network customer wants to build:**
  - Private network:
    - Choose gateway from our partner: Kerlink, Multi-Tech, Link Labs, others coming soon
    - Select current available private network service from service provider partner like LoraIoT.io, Actility, or Orbiwise. Others coming soon
  - Public network: Customer contacts the available Public Network operator
    - Regionally specific. Many in Europe, (1) in US (Senet). Others coming soon
    - Public Networks have gateway and network server available.
    - Microchip LoRa™ module are able to communicate to those network controller directly when using the standard LoRaWAN Protocol.
- **Finally, test proper Microchip LoRa™ Technology module or LoRa Technology development tool with the chosen gateway/ network option.**

- **Does LoRa and the LoRa Modules support Point-to-Point Communication?**
  - No, P2P is not supported in the LoRaWAN Protocol spec
- **I just bought two Motes, are they able to talk to each other?**
  - No, The Motes are pre-loaded with the LoRaWAN protocol and it does not support P2P
- **I just bought two Motes. Now what do I do?**
  - Customers will need their own Gateway to set up a LoRa Network or be fortunate enough to be covered by a Public LoRa Network, which means they need to contact the Public LoRa Network Provider
- **I need a couple Motes for my customer, are they available and where can I get them?**
  - The LoRa Modules and Motes are released to production. Please order from mD or a local disty
  - The LoRa Modules are not available for samples
- **My customer wants to test the long range capability of the LoRa Technology. How can they do that?**
  - Customers need a gateway with a high gain antenna and a high vantage point position to get the maximum (10 mile) range from an end device to the gateway. A LoRa Network needs to be set up to test the range
- **Is LoRa a good replacement for BT, BLE, or Wi-Fi?**
  - No, LoRa is a Low-Power Wide Area Network technology. It is not meant to compete with or displace the other PAN/LAN technologies
- **Where can I find more information about LoRa and LoRa Networks?**
  - The LoRa-Alliance.org webpage is a great source of information along with the Microchip.com/lora website
- **Will the LoRa Modules work with the Multi-Tech Gateway?**
  - Yes, We have tested and used the Multi-Tech Gateways in many configurations

# FAQS (cont'd)

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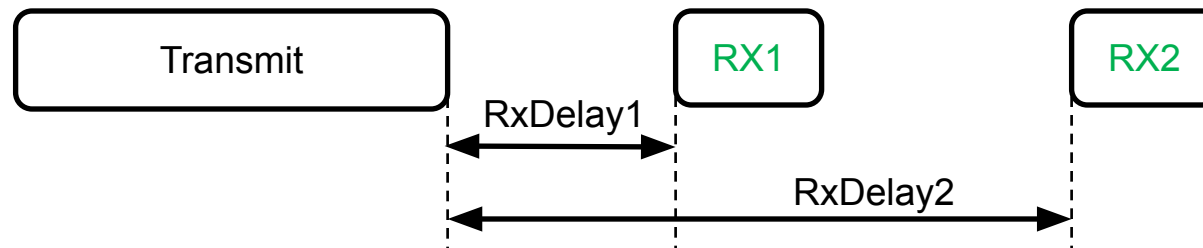
- **Can my customer add their application to the current LoRa Modules?**
  - No, the current Modules do not allow customer application code.
  - They do have an ASCII command set that allows you to customize the module
- **Will the LoRaWAN Stack be available for my customer to use?**
  - Yes, The MCU08 team is working on releasing the LoRaWAN Protocol Stack in a future MCC release
- **Is there a 32-bit version of the LoRa Module available?**
  - The current module is based on a PIC18. A future 32-bit module is in definition. No schedule available
- **How is the LoRa Sub-GHz module different from the MRF89XA or other Sub-GHz solutions?**
  - The LoRa transceiver uses a Chirp-Spread Spectrum modulation where the 89XA and other sub-GHz radios are mostly FSK. The CSS provides better receive sensitivity giving it a better range.
- **Is Microchip going to release a LoRa Gateway?**
  - No, the gateway in its basic form is a packet forwarder. We are developing an RF module for the Gateway to help customers who want to build their own gateway. This will not be released until FY1Q17

## Q2 – Classes A, B & C

---

- **Class A is default for All nodes. ALOHA**
  - Available in nodes, gateways, servers today
  - Provides the core protocol for classes B & C
- **Class C is for Continuous DL (min latency)**
  - Starting to become available
  - Not suitable for battery powered applications
- **Class B is for Beacon Sync'd Downlink**
  - More complex, not well defined today
  - Compromise of downlink latency vs battery life

- **Battery Powered – Class A**
  - Bidirectional communications
  - Unicast messages
  - Small payloads
  - Long intervals
  - End-device initiates communication (uplink)
  - Server communicates with end-device (downlink) during predetermined response windows:



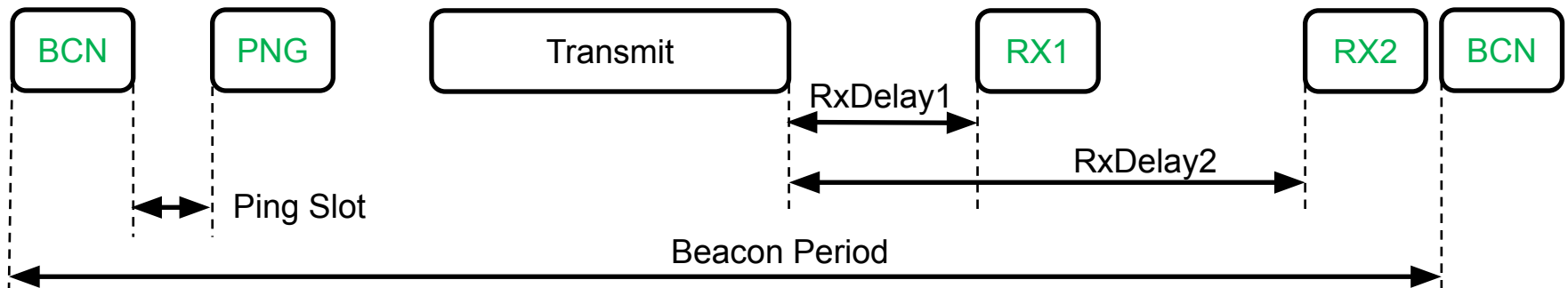


# LoRaWAN™ Network Protocol

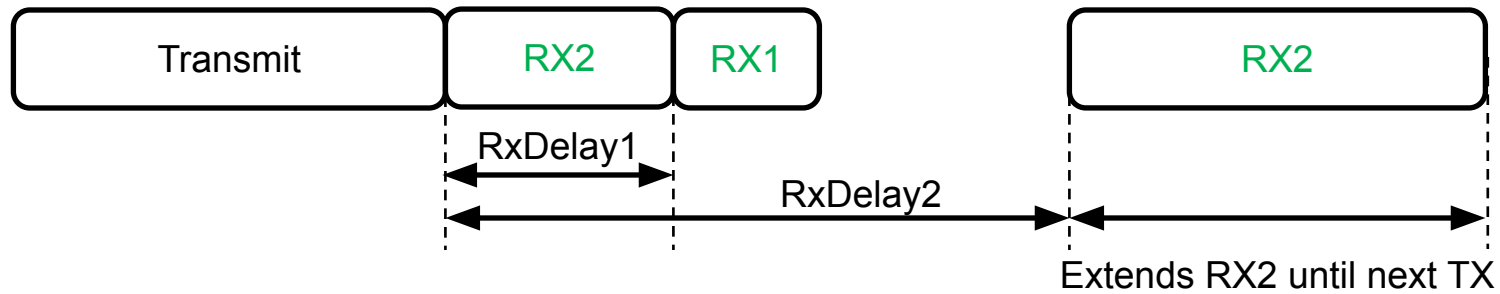
## End-Device Classes

- **Low Latency – Class B**

- Bidirectional with scheduled receive slots
- Unicast and Multicast messages
- Small payloads
- Long intervals
- Periodic beacon from gateway
- Extra receive window (ping slot)
- Server can initiate transmission at fixed intervals



- **No Latency – Class C**
  - Bidirectional communications
  - Unicast and Multicast messages
  - Small payloads
  - Server can initiate transmission at any time
  - End-device is constantly receiving





# Q3 – Protocol Overhead



Figure 5: Radio PHY structure (CRC\* is only available on uplink messages)

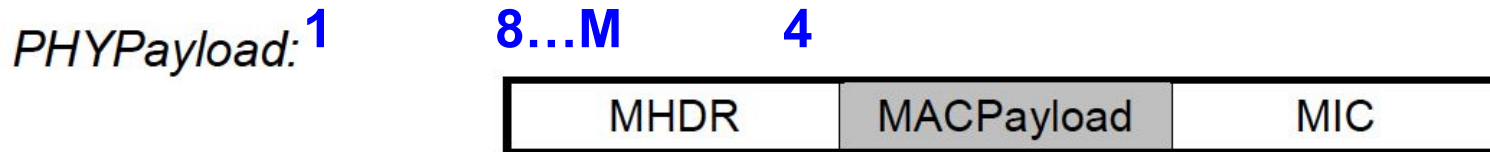


Figure 6: PHY payload structure

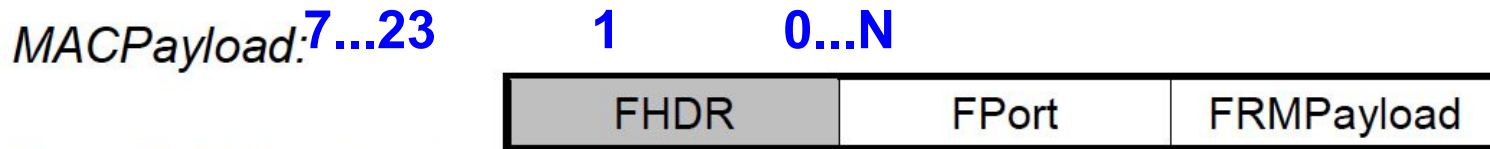


Figure 7: MAC payload structure

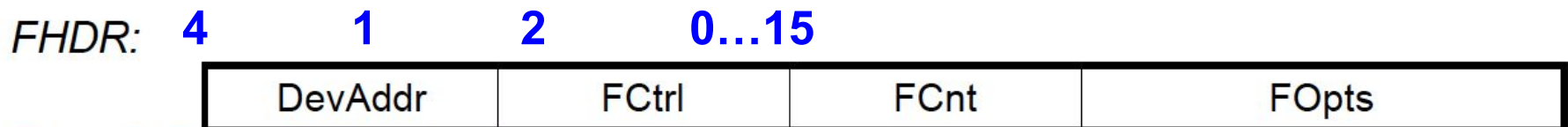
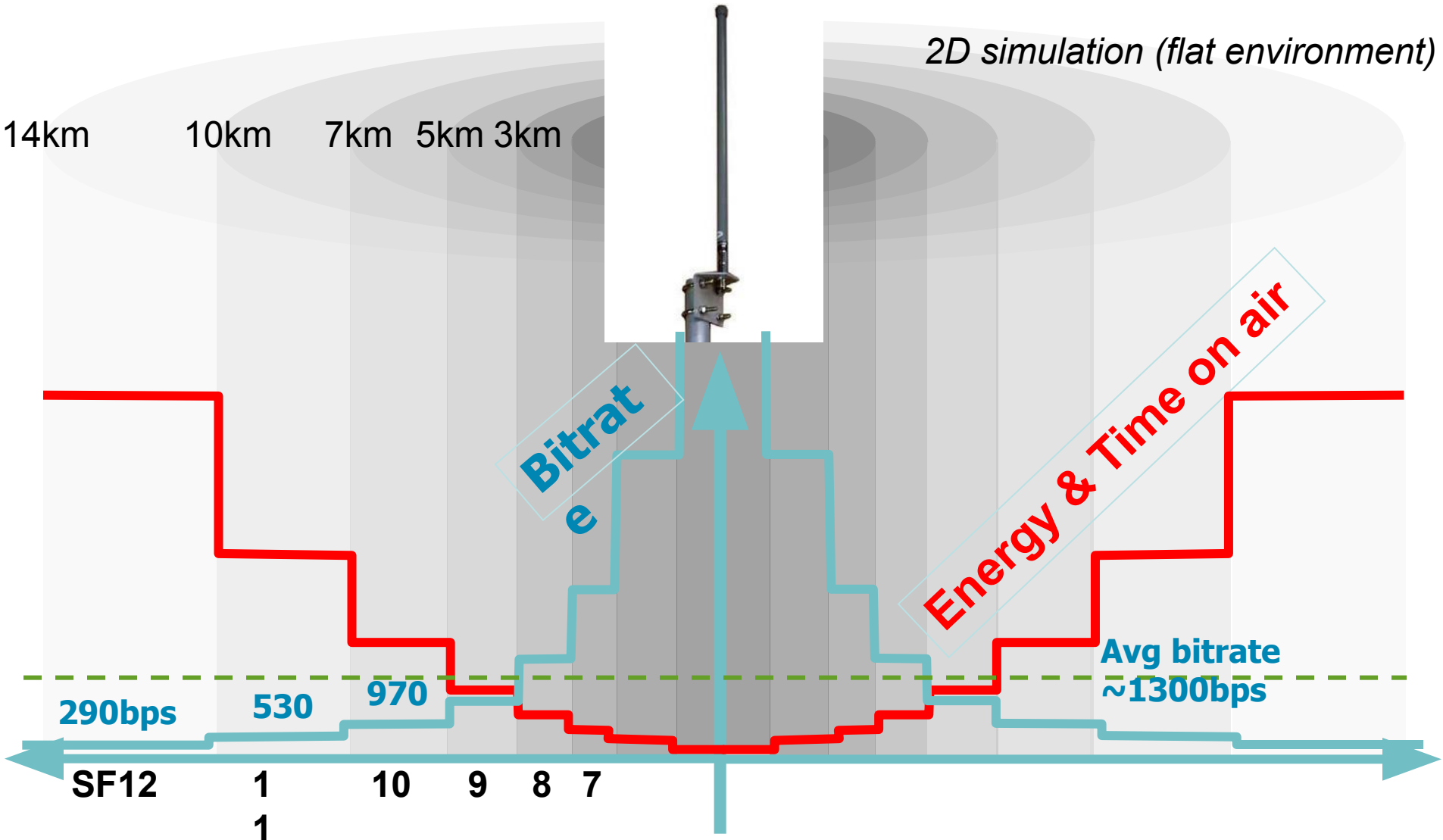


Figure 8: Frame header structure

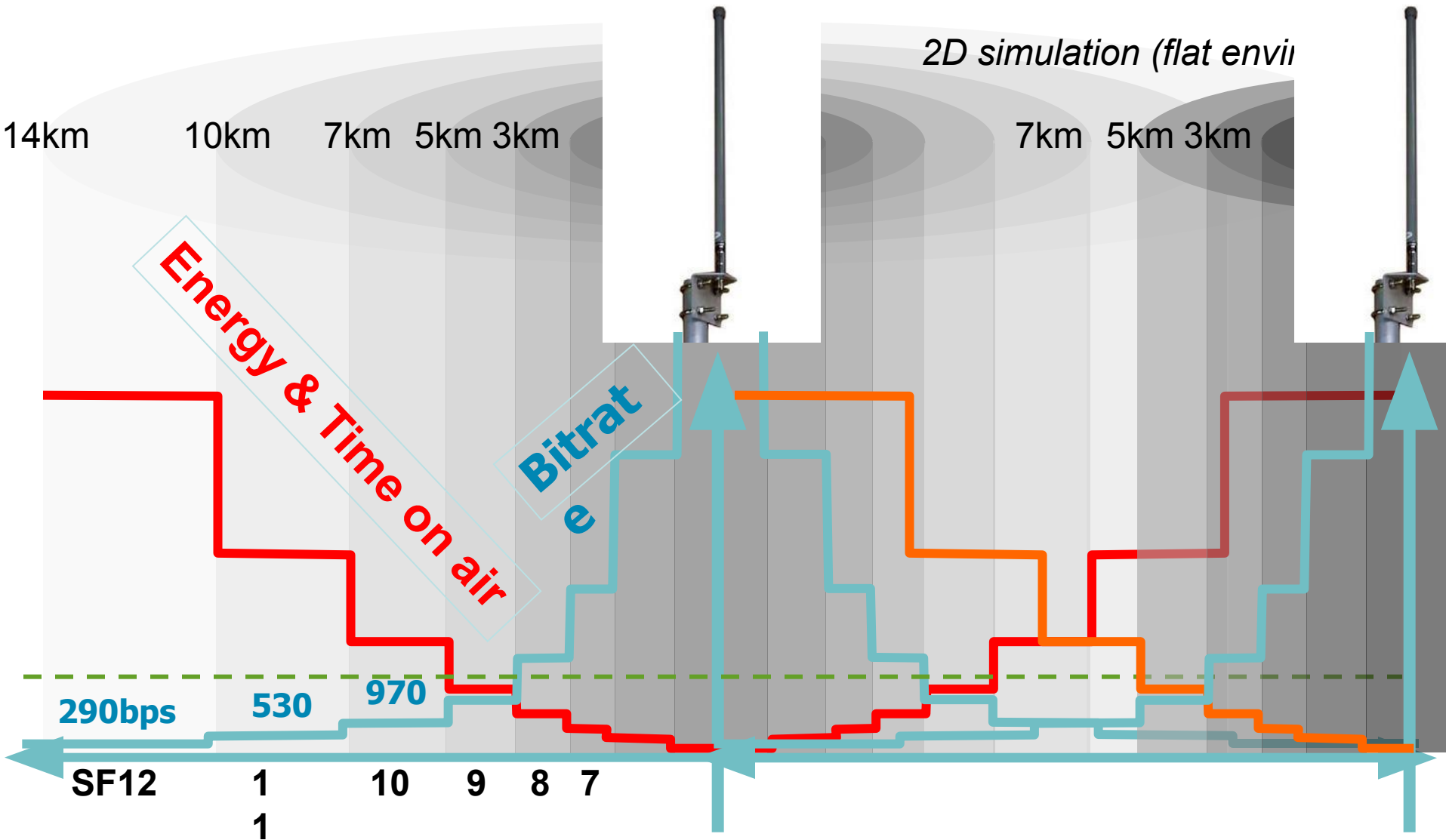
# Q4 – Range & Constraints

## Q5 – Capacity of a Gateway



# Q4 – Range & Constraints

## Q5 – Capacity of a Gateway



# Q6 – Current Consumption

	434 MHz	868 MHz	915 MHz
High Tx OP Power	+10 dBm	+14 dBm	+18.5 dBm
High Sensitivity	-137 dBm	-136 dBm	-132 dBm
Link Budget	147 dB	150 dB	150 dB
Tx Current (Max Power)	33 mA	39 mA	124 mA
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Sleep Current	1.8 uA ( <i>Errata</i> )		22 uA ( <i>Errata</i> )
Embedded LoRaWAN Features	Complete LoRaWANr1.0 Class-A Functionality (E.g. ABP, OTAA, ADR ...)		
Modulation	LoRa & FSK (Selected automatically by DR)		LoRa
Test Modes	'Radio Mode' for functional test & range trials		

# LoRa Market Update

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- **Microchip's RN2483 LoRa® Wireless Module is World's First to Pass the LoRa Alliance's LoRaWAN Certification Program**
- **Senet has over 115,000 sq miles of coverage across the US primarily in the Northeast, Midwest and California**
  - During 2016, network deployment continues on an aggressive pace, including deep coverage in innovation districts of greater Boston and San Francisco Bay area.
- **Mar 1<sup>st</sup>, 2016 – Cisco and Actility will provide LoRa IoT as SaaS model**
  - Both have relationships with tier one mobile operators and are positioning this service as an “available now” alternative to new LTE-based solutions.



# Microchip' LoRa Party Line

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- **Microchip's LoRa product line is focused on supporting LoRaWAN infrastructure**
  - Founder member & Active contributor to LoRa Alliance
- **Point-to-Point comms are NOT supported**
- **Mesh topologies are NOT supported**
- **A gateway & server software is ALWAYS needed**
- **Best engagements will be via Alliance members and their partners / customers**
- **Our key value is integration**
  - Radio, MCU & LoRaWAN in a turnkey solution
  - Proven with eco-system partners



# Summary

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- **Revolutionary & disruptive technology for IoT**
- **LoRa™ enables long range, low power communication**
- **Microchip is a Founding-member of LoRa Alliance**
- **Microchip modems target end-node applications**
- **Microchip LoRa complete “out-of-the-box” solution saves time-to-market**
- **Established LoRa ecosystem and partner relationships makes deployment quick & easy**

[www.microchip.com/LoRa](http://www.microchip.com/LoRa)

# Chip-Down?

Visit the [Wireless Page](#) on the *infoDepot*!

## Low-Power Wireless Solutions



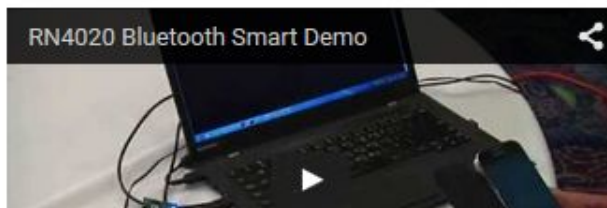
**Do you have a customer insisting on going chip down vs modules for wireless?** Please take a look at the [Wireless Module vs. Chip Down presentation](#). It may reveal a few things of which your customer was unaware. If they still want to do so, please fill out this "[chip down questionnaire](#)" and provide it to your local Microchip sales person or FAE to "qualify" your customer.



[Wireless Products Customer Presentation - June 2015](#) [Download](#)

Document by Erin Hasulak. Modified 6/2/2015 ★★★★★

### How to Demo the RN4020 Bluetooth LE



### Which Wireless Technology?

Erin Hasulak 4/25/2014 ★★★★★

**Which wireless solution do you want to learn about? Not sure, visit the page at the link immediately above.**



**Wireless Newsletters**