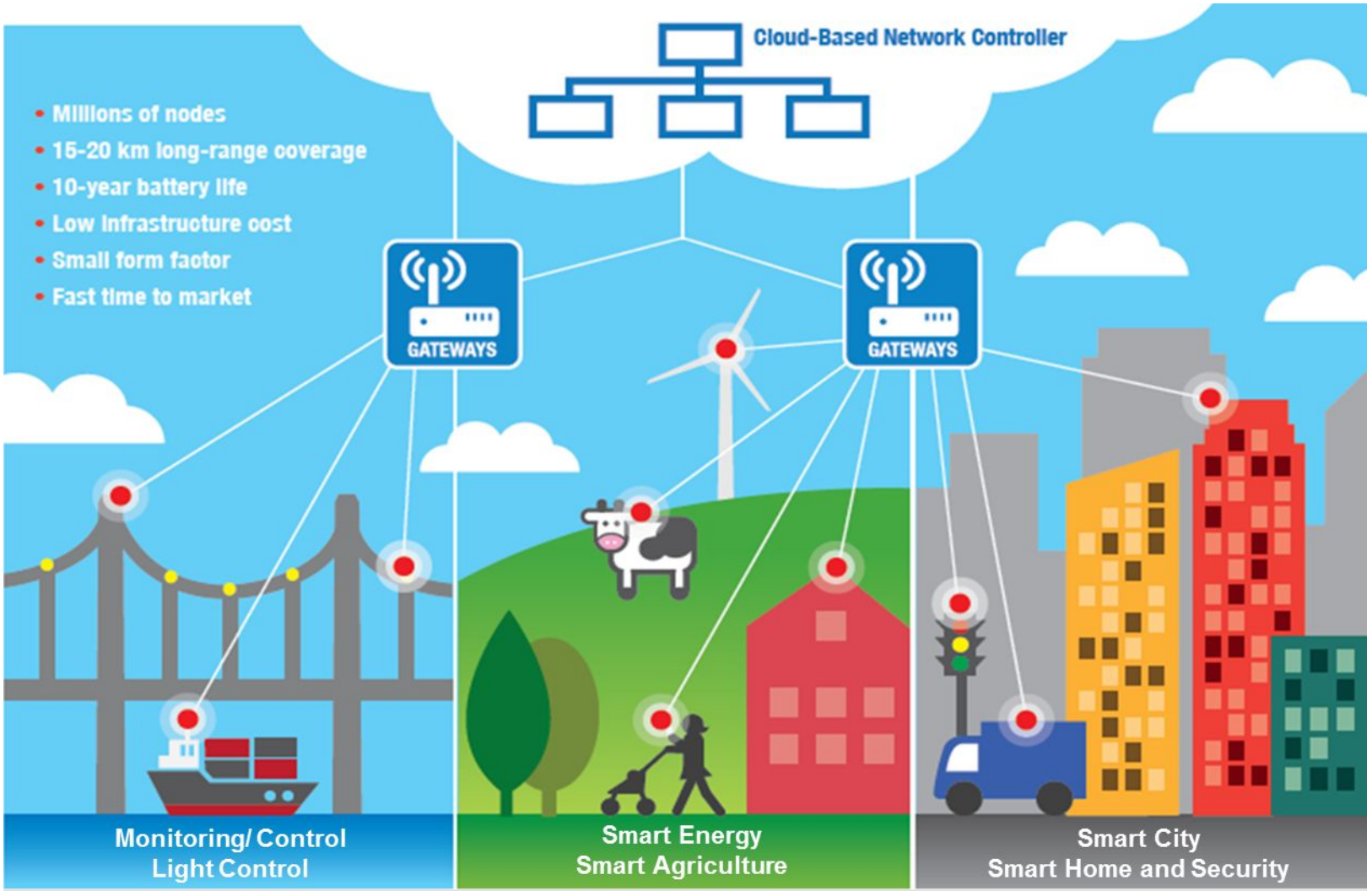
LoRa™ Technology

Return to Topics

What is LoRa™ Technology?

- **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

- 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

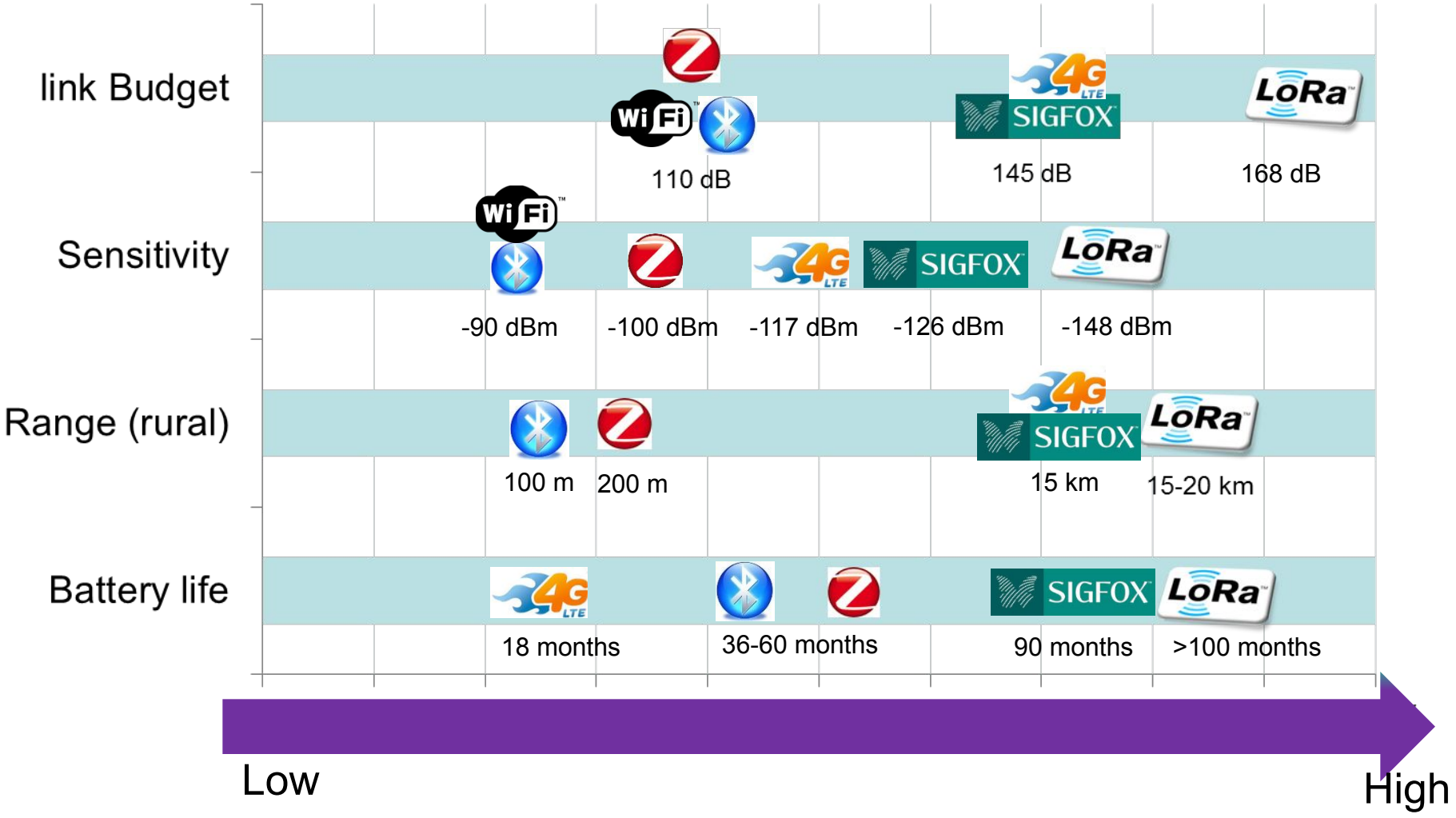
The LoRa™ Alliance
A Strong and Active Ecosystem

- 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

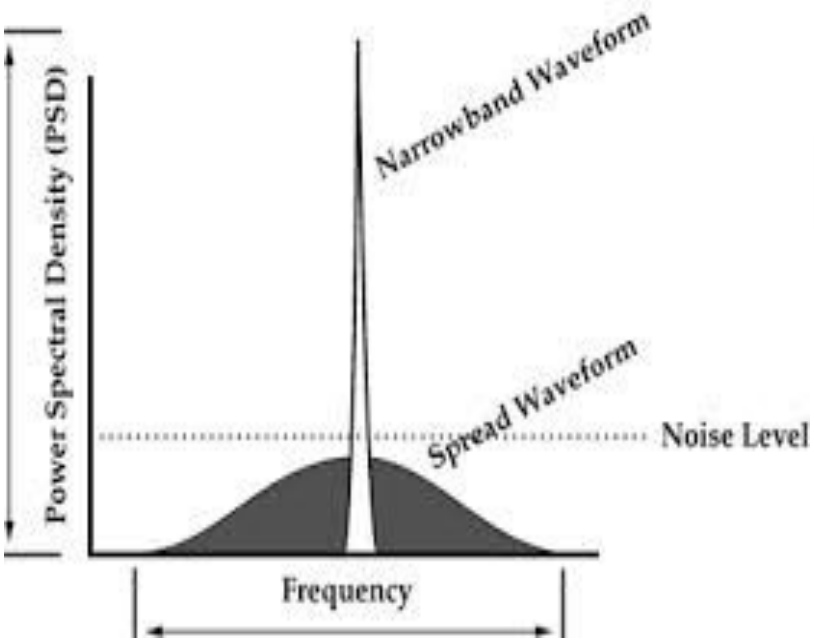
Bouygues Telecom, kerlink, Gemtek, SingTel, swisscom, FastNet, Microchip, imst, kpn, IBM, Mueller Systems, MultiTech Systems, actility, TELKOMSEL by Telkom Indonesia, SEMTECH, OrbiWise, CISCO

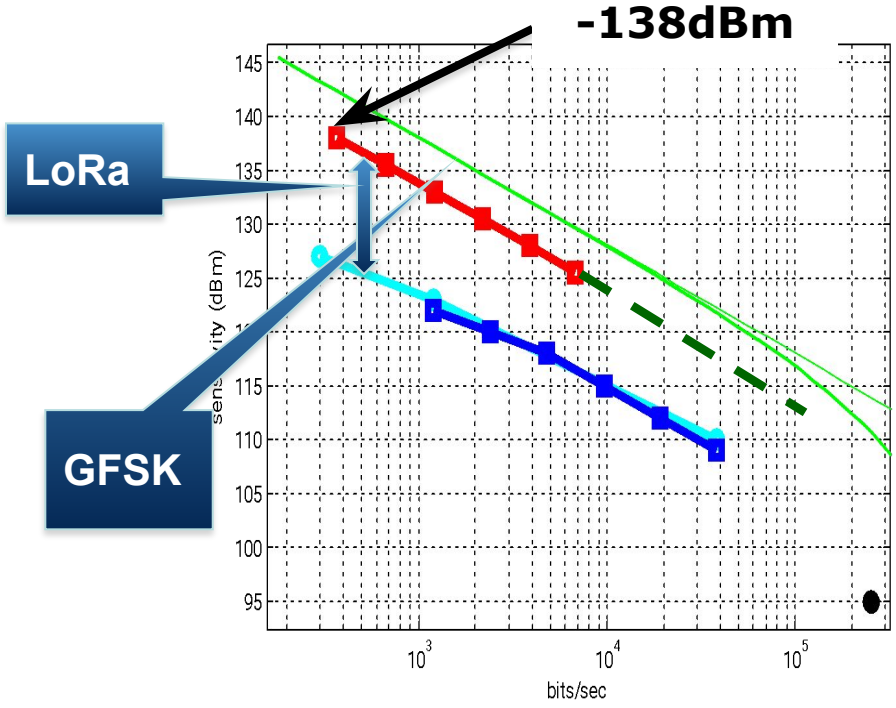
www.LoRa-Alliance.org

Technology Comparison



‘Chirp’ Spread-Spectrum Modulation

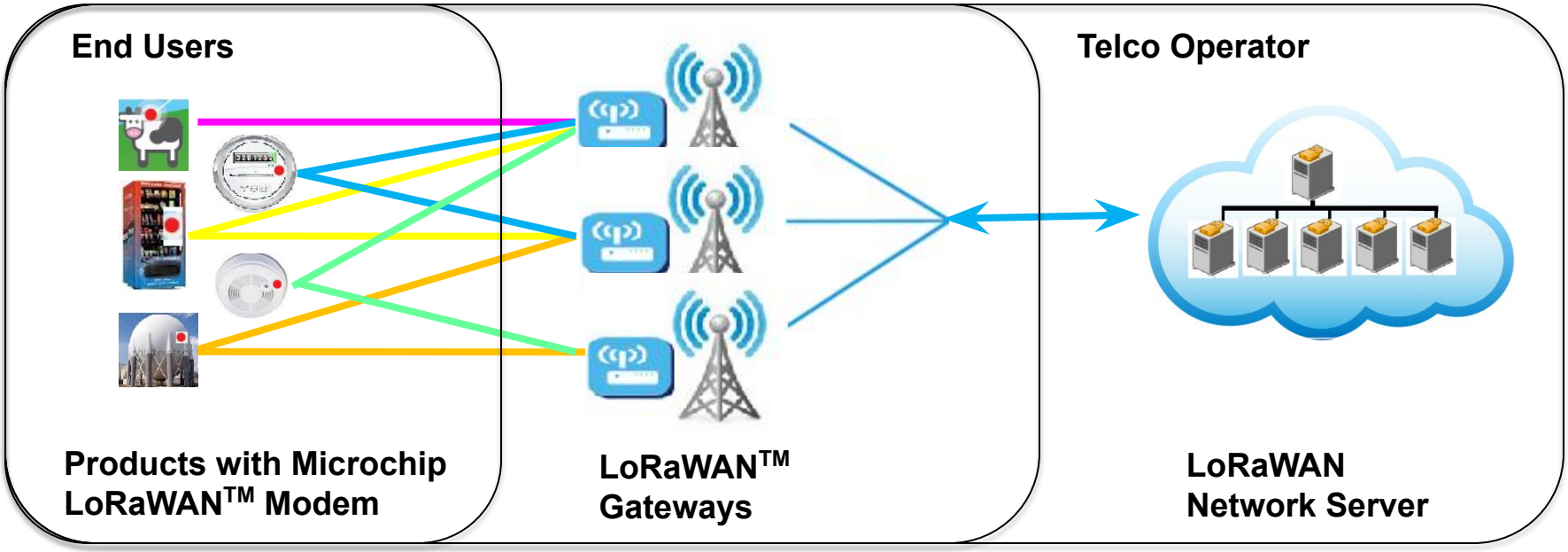




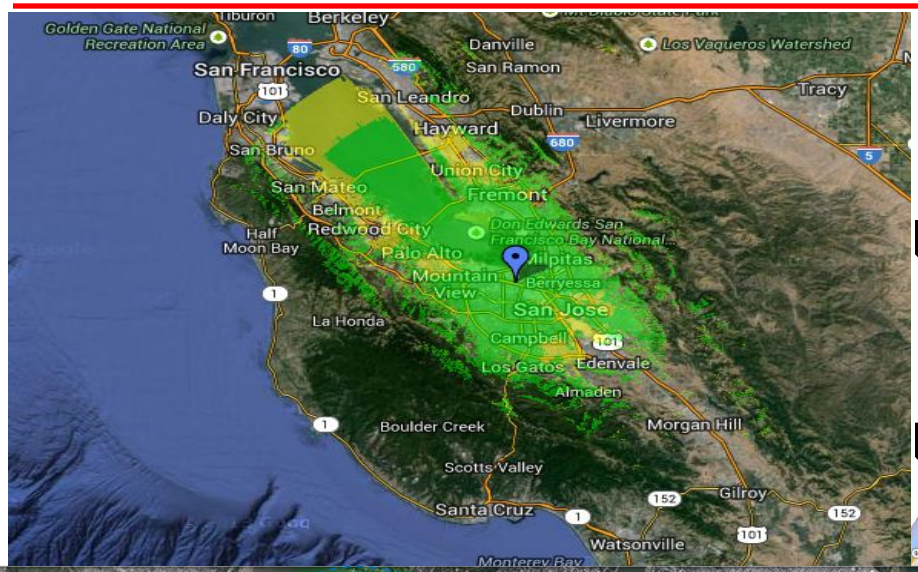
- Innovative & cost sensitive implementation
- Signal demodulation below the noise floor improves sensitivity by ~20dB
- Robust against interference, noise, and jamming
- Multiples signals can occupy the same channel (CDMA)
- Tolerant to frequency offsets (unlike DSSS)

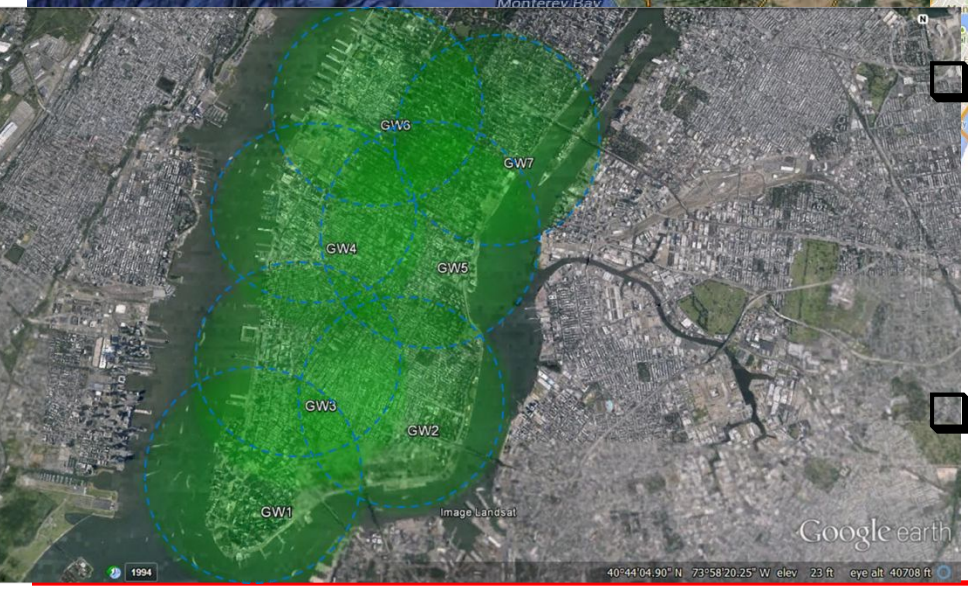
Supports Private Networks
Scalable & Flexible Architecture Options

- **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

- **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

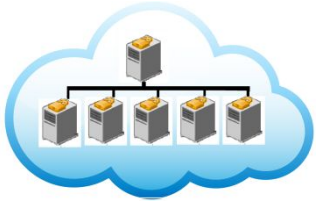
End Nodes

- Microchip

Gateway

- Cisco
- MultiTech Systems
- kerlink

Network Server

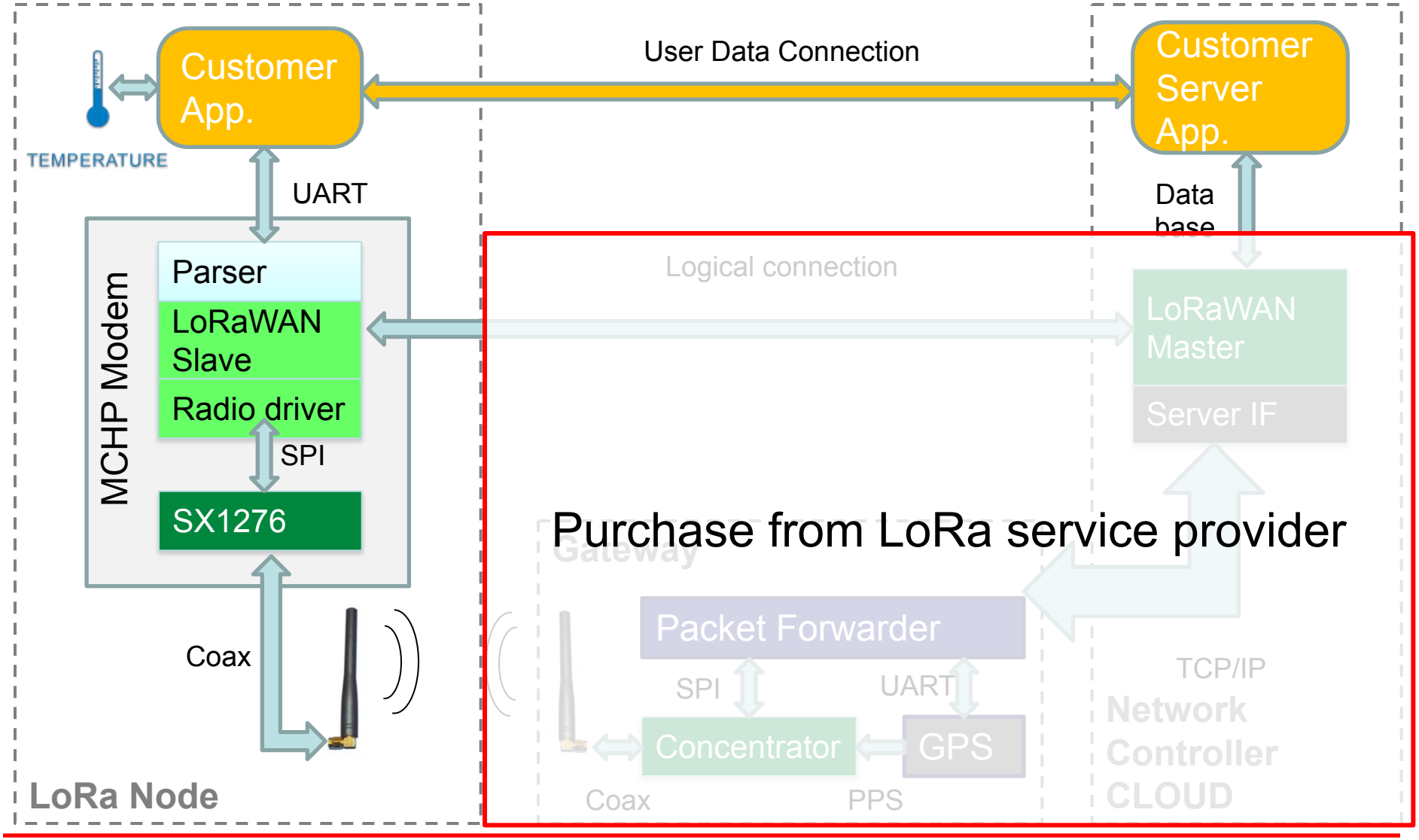


- IBM
- actility (Making Things Smart)
- FastNet
- OrbiWise

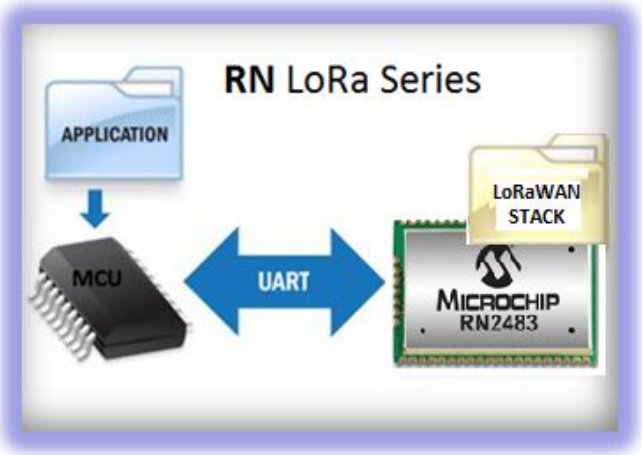
Public Network Operator

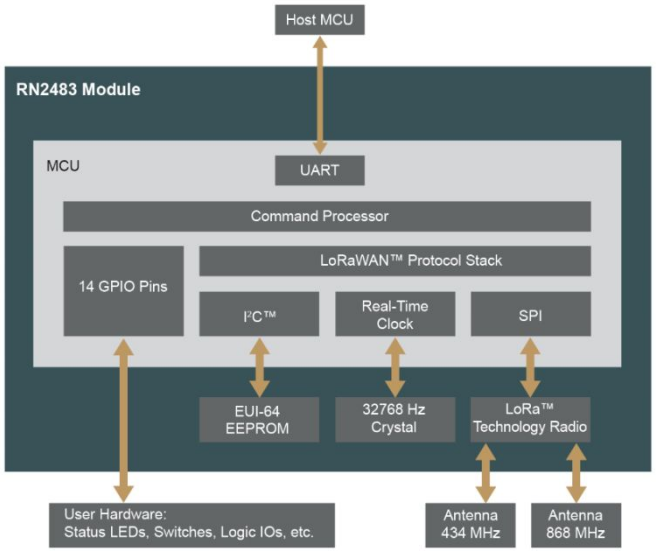
- Bouygues Telecom
- kpn
- vodafone
- SingTel
- swisscom
- senet (the sensible network company)

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

- **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

	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
Rx Current	14.2 mA		13.5 mA
Sleep Current	1.8 uA (*Errata*)		22 uA (*Errata*)
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

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

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

Development Tools

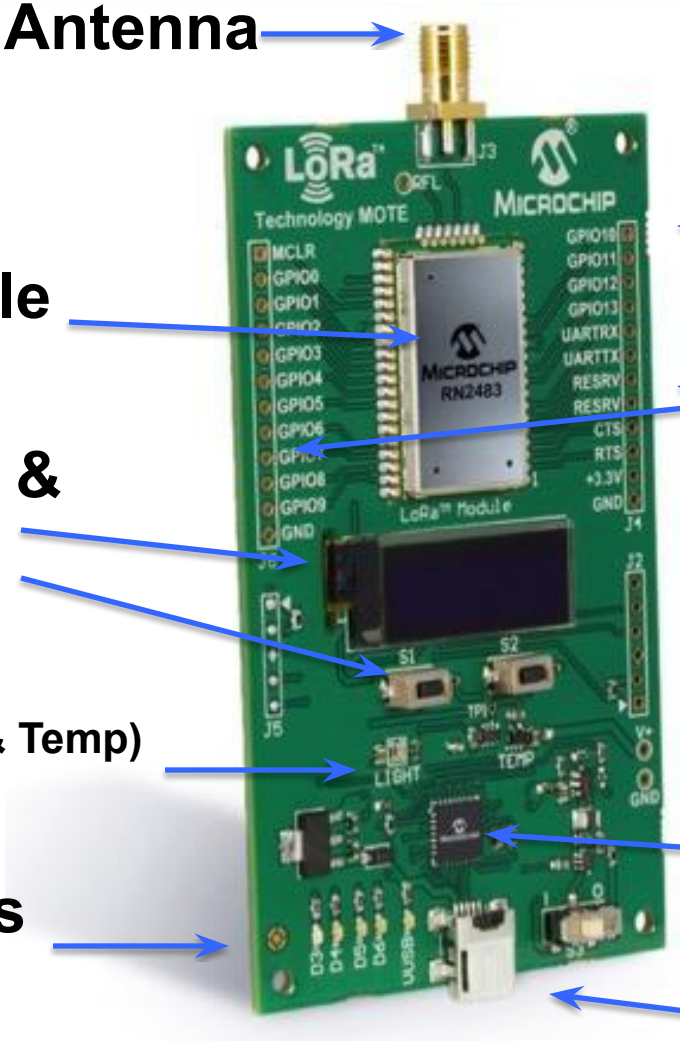
- PICtail for Microchip MCU kits
- Mote for portable testing
- Both support USB Interface
- Demo Code available

$65

$69.99

RN-2903-MOTE Kit (DM164139)

See www.microchip.com/RN2903



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

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

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

Development Tools

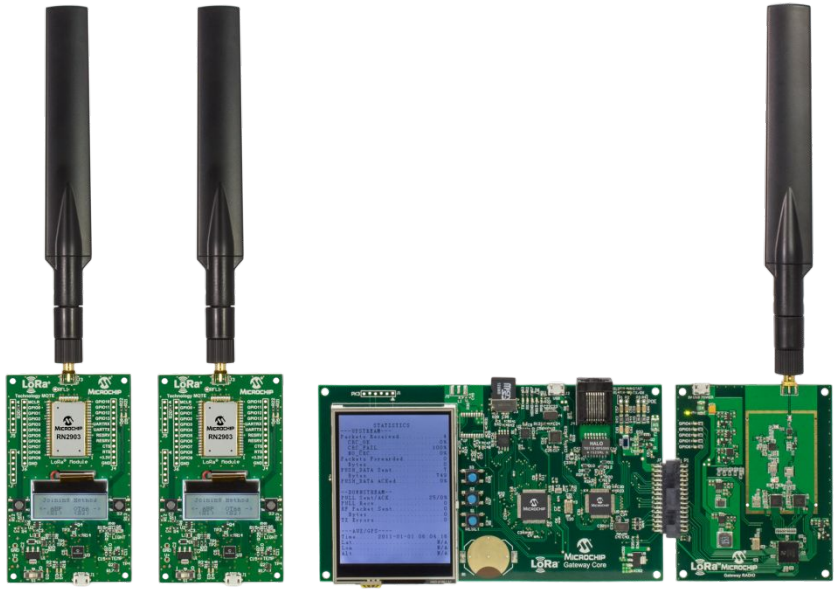
- PICtail for Microchip MCU kits
- Mote for portable testing
- Both support USB Interface
- Example Code available

$65

$69.99

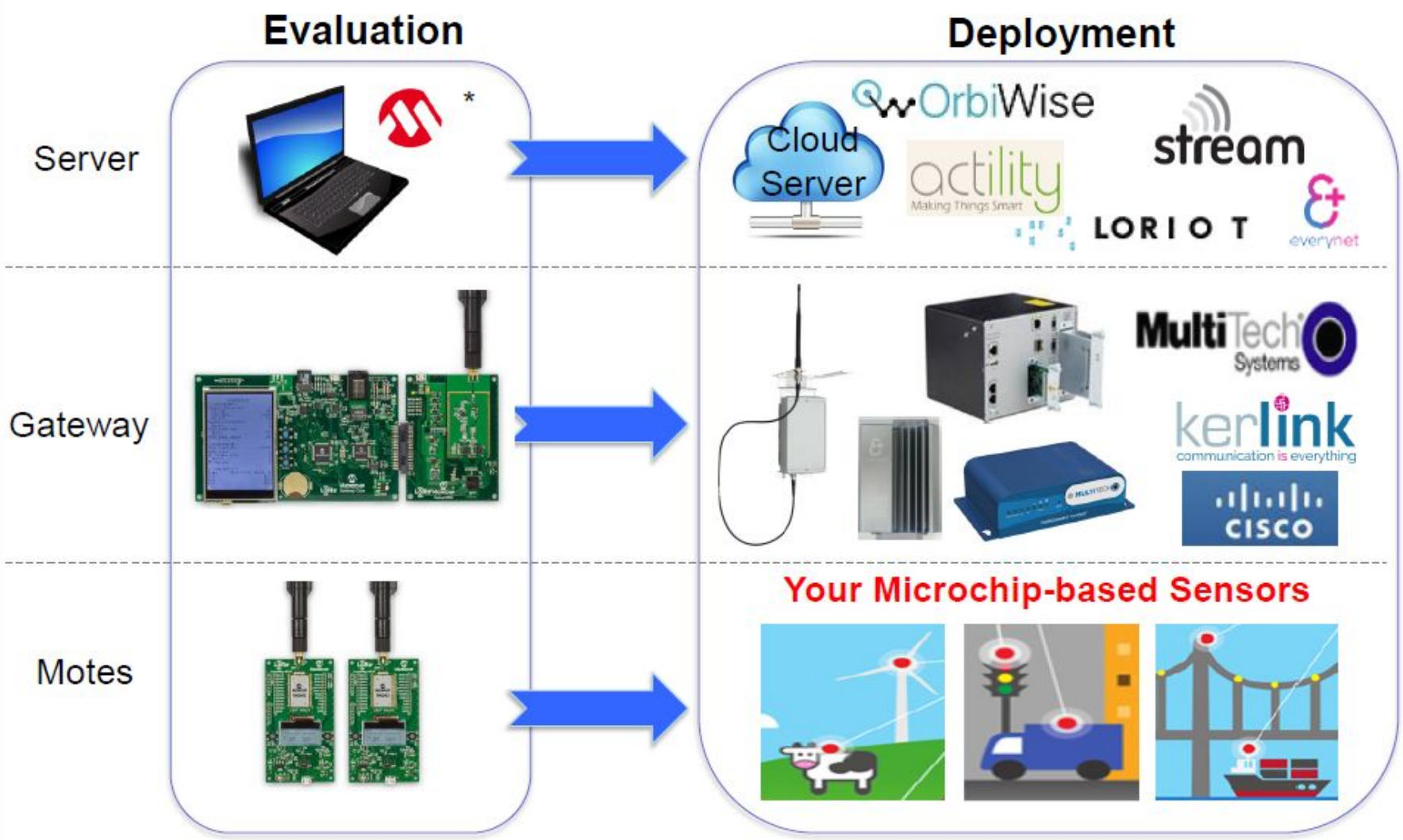
LoRa Technology Evaluation Kit

- 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



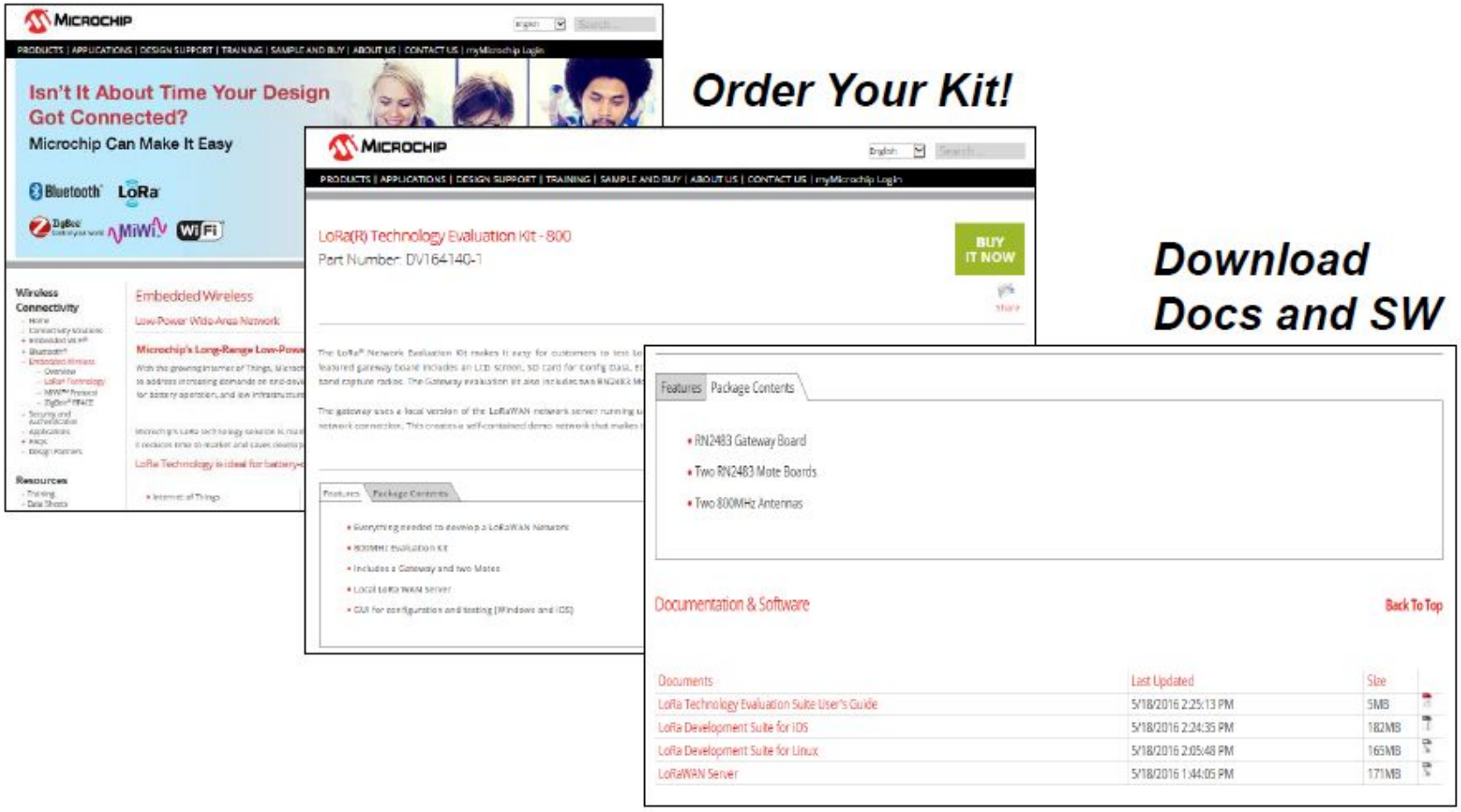
* 6 channel for the DV164140-1

Getting Beyond the Benchtop



Get Started Today

- Go To: www.microchip.com/LoRa



Microchip LoRa™ Products

- **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

- **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 Loriot.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.**

FAQs

- **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 there 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 of 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 Micorchip.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)

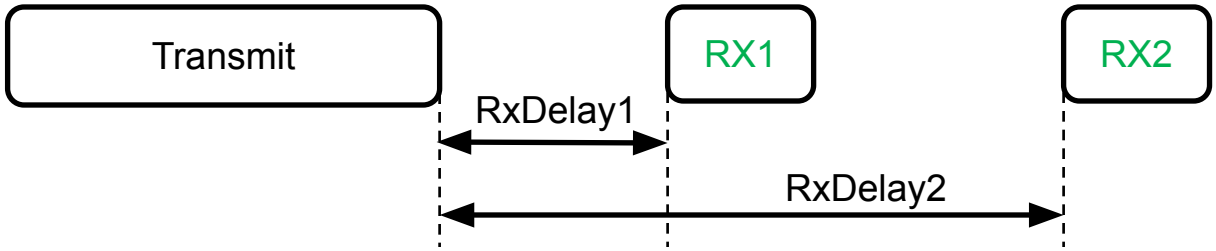
- **Can my customer add their application to the current LoRa Modules?**
  - No, the current Modules do not allow customer application code.
  - They do have an ASCII command set that allows you to customize the module
- **Will the LoRaWAN Stack be available for my customer to use?**
  - Yes, The MCU08 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

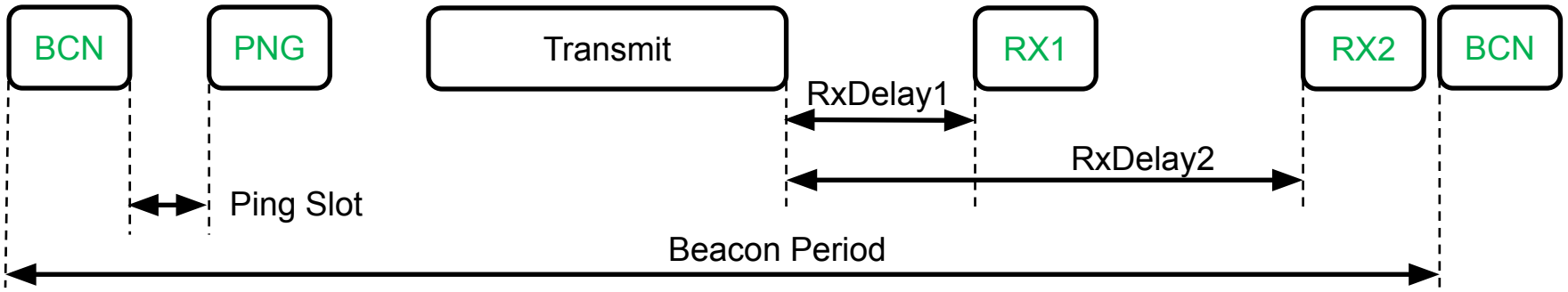
LoRaWAN™ Network Protocol End-Device Classes

- **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:



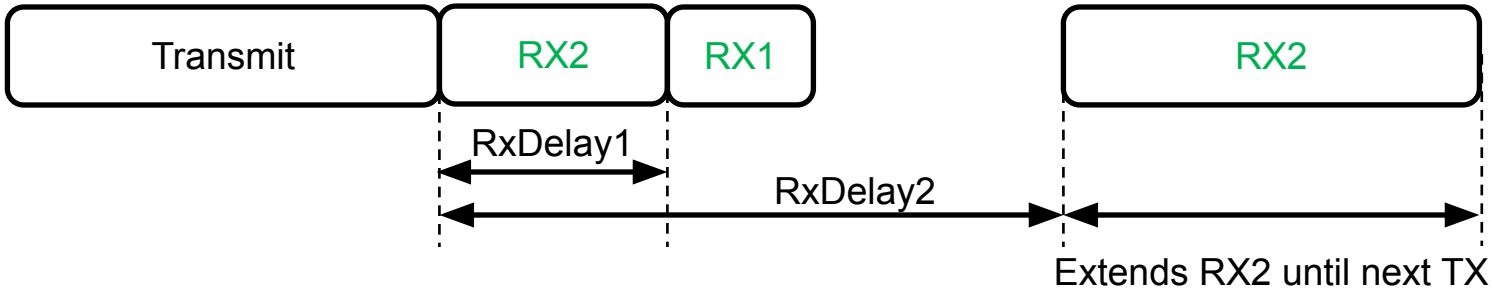
LoRaWAN™ Network Protocol End-Device Classes

- **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



LoRaWAN™ Network Protocol
End-Device Classes

- **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

Radio PHY layer:

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

PHYPayload:

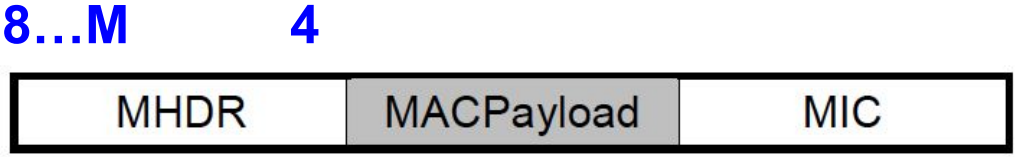


Figure 6: PHY payload structure

MACPayload:

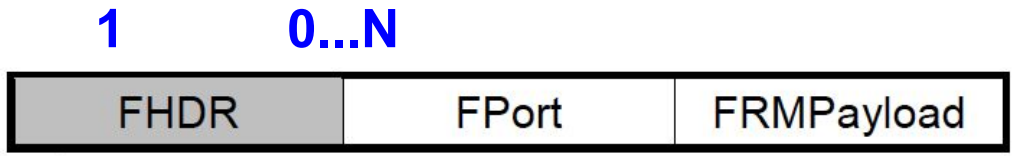


Figure 7: MAC payload structure

FHDR:

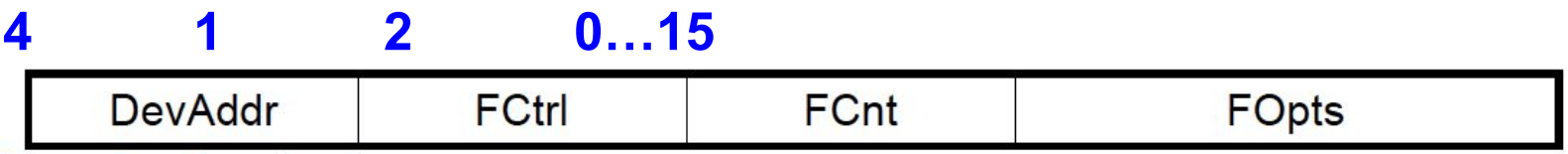
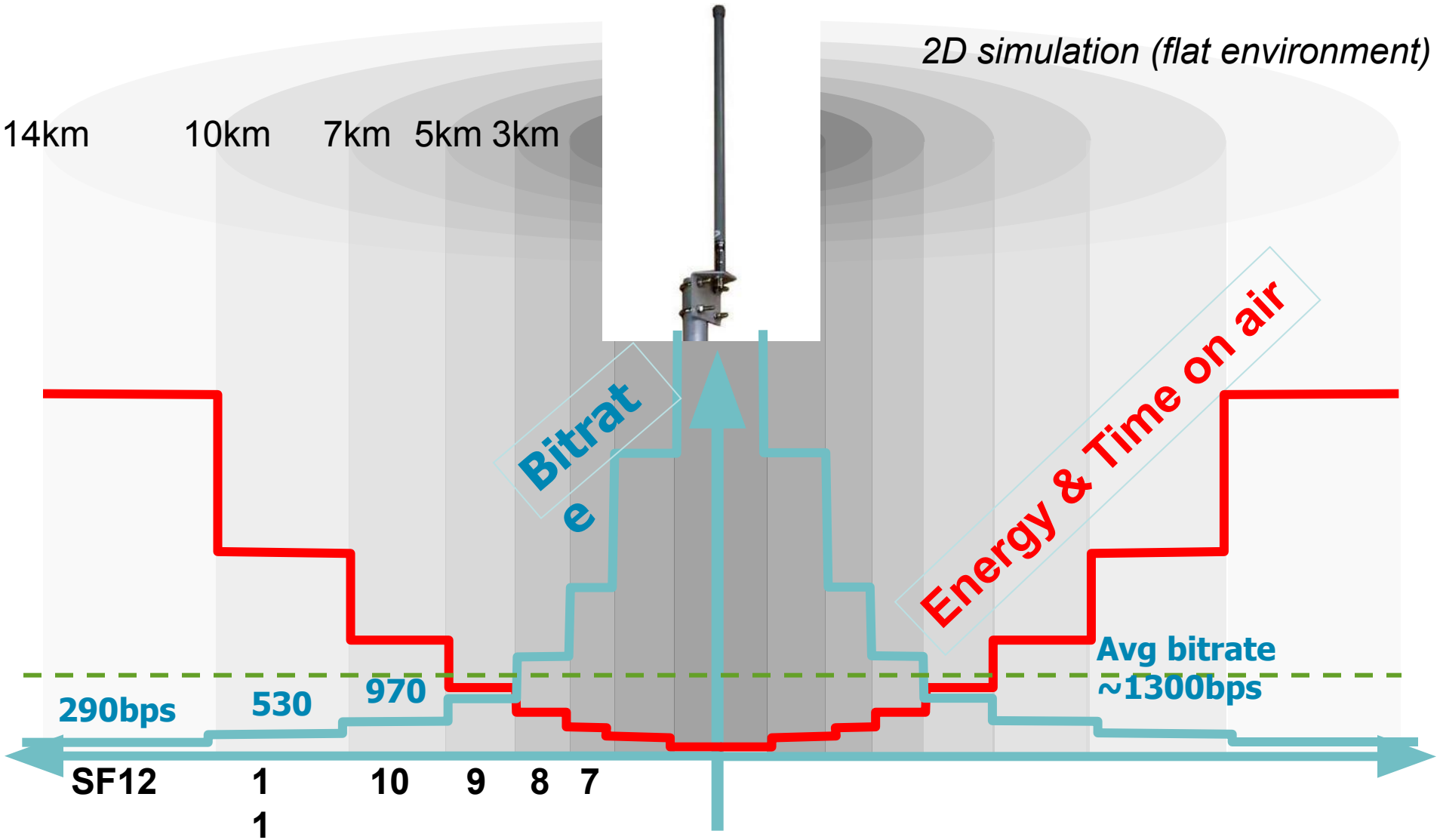


Figure 8: Frame header structure

Q4 – Range & Constraints
Q5 – Capacity of a Gateway



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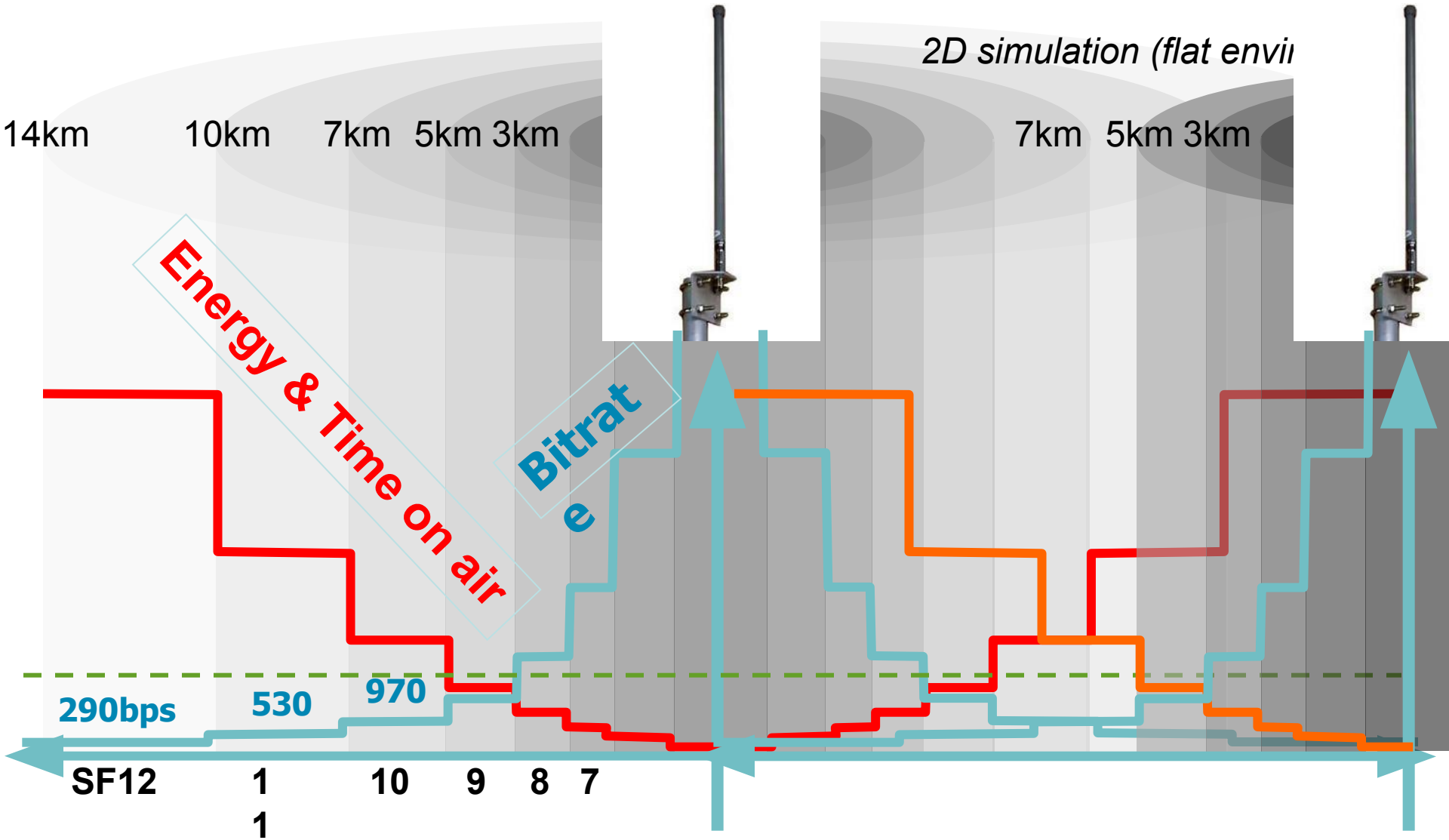

Q6 – Current Consumption

	434 MHz	868 MHz	915 MHz
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High Sensitivity	-137 dBm	-136 dBm	-132 dBm
Link Budget	147 dB	150 dB	150 dB
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Modulation	LoRa & FSK (Selected automatically by DR)		LoRa
Test Modes	'Radio Mode' for functional test & range trials		

LoRa Market Update

- **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 1st, 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

- **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

- 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

Chip-Down?

Visit the Wireless Page on the infoDepot!

Low-Power Wireless Solutions MICROCHIP

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

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.

Wi Fi™ Bluetooth®

How to Demo the RN4020 Bluetooth LE

MiWi™ ZigBee® LoRa™

Wireless Newsletters