

Internet of Things: LoRaWAN

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Objectives

What does “Internet of Things” mean?

What are the communication methods in IoT? Low Power AND long range?!

What is LoRa protocol? What is LoRaWAN?

How to setup a simple LoRa kit? How to connect it to the application server?



Content

Internet of Things

- History
- Layers

Low Power Wide Area Network (LPWAN)

- Low power AND long range

LoRa

- Physical Layer
- LoRaWAN

Microchip Evaluation Kit, TheThingsNetwork

IoT Applications



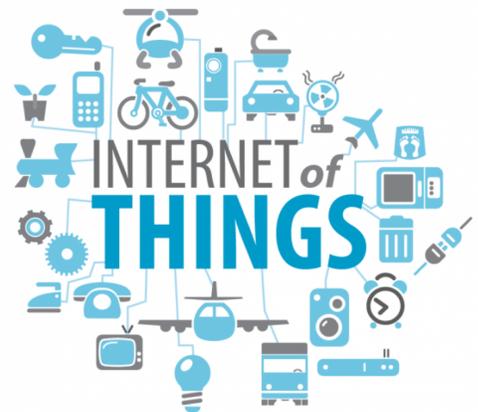
Internet of Things

Kevin Ashton coined the term “the Internet of Things” in 1999

20th century: computers were brains without senses

Nowadays: GPS, Self-driving cars, etc.

Connecting all of the “things” to the internet



Internet of Things

Connecting all of the sensors to the internet

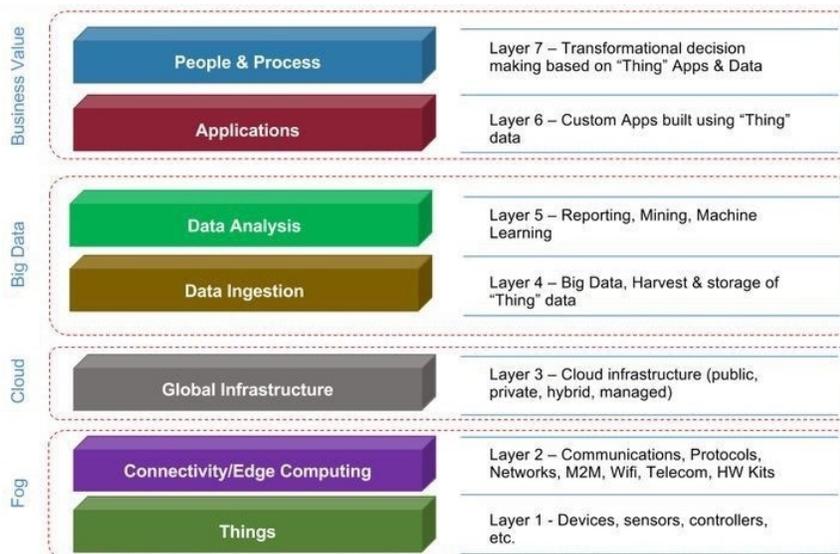
Kevin Ashton:

“tell me what it means for my toaster’. But there’s so much more to the world than freaking kitchen appliances, you know? And I’m sure there’s something interesting you might do with a kitchen appliance, but I can’t really think of it. And I don’t see why I have to.”

<https://www.smartcompany.com.au/technology/kevin-ashton-on-why-the-internet-of-things-is-much-more-than-talking-toasters-and-coding-is-yesterday-s-skill/>



Internet of Things



<https://www.quora.com/What-are-the-different-layers-of-IoT-model>



Low Power Wide Area Network (LPWAN)

Network

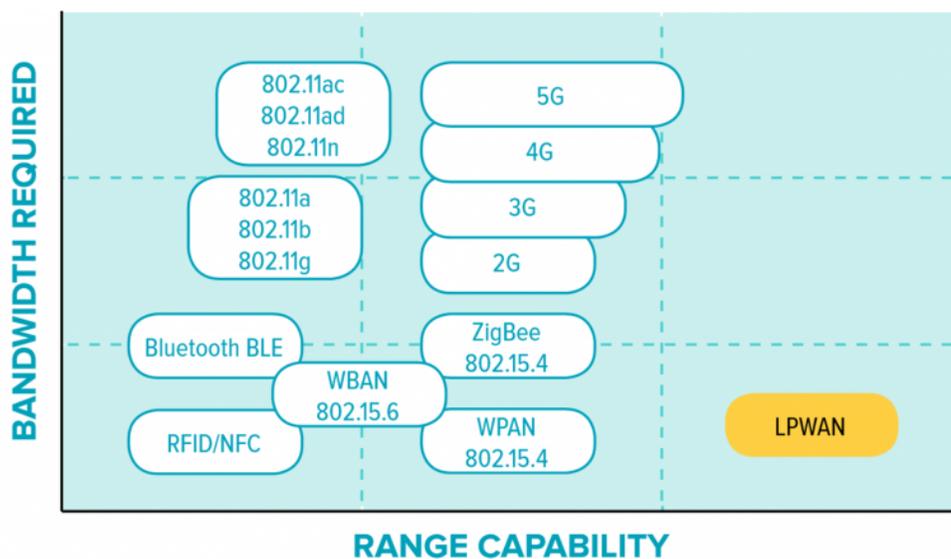
Wide Area

Low Power

Paradox: Low Power \neq Wide Area



Low Power Wide Area Network (LPWAN)



Low Power Wide Area Network (LPWAN)

	 LoRa	 sigfox	 NB-IoT	 LTE	 INGENU	 WEIGHTLESS-P	 LinkLabs
	LoRa / LoRaWAN	Sigfox	NB-IoT	LTE-M	RPMA	Weightless-P	Symphony Link
Origin	France	France	USA (Global)	USA (Global)	USA	UK	USA
Proprietary or open	LoRa – proprietary LoRaWAN – open	Net – proprietary Devices – open	Open	Open	Proprietary	Open	Proprietary
Cellular	No	No	Yes	Yes	No	No	No
Spectrum	Unlicensed	Unlicensed	Licensed	Licensed	Unlicensed	Unlicensed	Unlicensed
Range, km	urban: 2-5 rural: 15	urban: 3-10 rural: 30-50	urban: 1-5 rural: 10-15	urban: 2-5	urban: 1-3 rural: 25-50	urban: 2	urban: 2-5 rural: 15
Speed, uplink / downlink	50 kbps / 50 kbps	300 bps / –	250 kbps / 250 kbps	1 Mbps / 1 Mbps	634 kbps / 156 kbps	100 kbps / 100 kbps	100 kbps / 100 kbps
Power consumption	●●●	●	●	●●●	●●	●	●●
Security	●●	●●	●●●	●●●	●●●	●●●	●●●
Availability of devices	●●	●●●	●●	●	●●	●	●●
Price*	●●	●	●●	●●●	●●●	●	●●
Areas of application	Precision farming, manufacturing automation, pipeline monitoring	Predictive maintenance, capacity planning, demand forecasting	Electric metering, manufacturing automation, retail PoS	tracking objects, wearables, energy management, utility metering, city infrastructure	Digital oilfield, connected cities, usage-based insurance, agriculture	Smart grid, healthcare, automotive, smart cities, asset tracking	Industrial control systems, lighting control, alarm systems
Supporting companies	IBM, Semtech, Cisco, HP, Orange, Kerlink, Actility	STMicroelectronics, Texas Instruments, Atmel, Silicon Labs	Huawei, Ericsson, Qualcomm, Vodafone	Verizon, AT&T, Nokia	Ingenu	Accenture, Sony Europe, unik, ARM, Telensa	Link Labs



LoRa (Long Range)

Developed by Cycleo of Grenoble, France, and acquired by Semtech in 2012

Uses unlicensed spectrum below 1GHz (915 MHz for North America)

Very-long-range transmissions (more than 10 km in rural areas) with low power consumption (3 ~ 5 years with battery)

Two parts:

- LoRa, the physical layer
- LoRaWAN, the upper layers



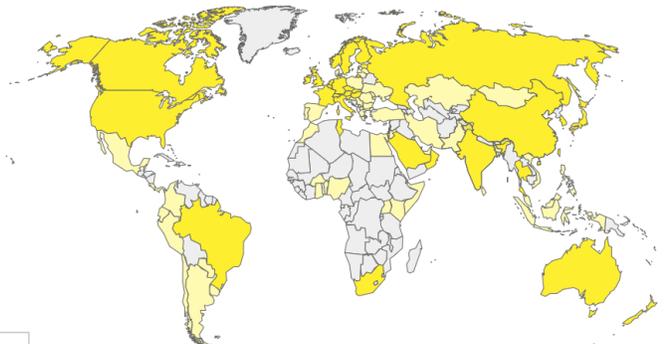
LoRa Alliance

Coverage & Operator Map



Click on the coverage map to find details of Network Operators by individual country. The extent of LoRaWAN network coverage globally is significant and expanding on a monthly basis. The dark yellow represents LoRa Alliance Member Operators, many of which have extensive network deployments. Light yellow defines smaller scale LoRaWAN activity or networks by Operators who are not yet members. Please contact the LoRa Alliance Operator members for specific information about their networks.

- 83**
Network Operators
- 57**
Alliance Member Operators
- 49**
Countries operating in
- 95**
Countries with LoRaWAN Deployments



- Alliance Member Public Networks
- Other LoRaWAN Deployment



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LoRa Physical Layer

	Europe	North America	China	Korea	Japan	India
Frequency band	867-869MHz	902-928MHz	470-510MHz	920-925MHz	920-925MHz	865-867MHz
Channels	10	64 + 8 + 8	In definition by Technical Committee			
Channel BW Up	125/250kHz	125/500kHz				
Channel BW Dn	125kHz	500kHz				
TX Power Up	+14dBm	+20dBm typ (+30dBm allowed)				
TX Power Dn	+14dBm	+27dBm				
SF Up	7-12	7-10				
Data rate	250bps- 50kbps	980bps-21.9kpbs				
Link Budget Up	155dB	154dB				
Link Budget Dn	155dB	157dB				

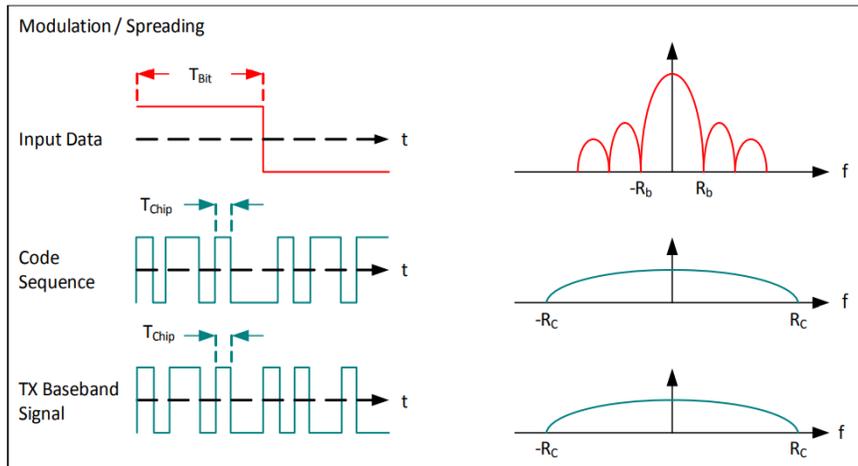
<http://www.3glteinfo.com/lora/lorawan-frequency-bands/>



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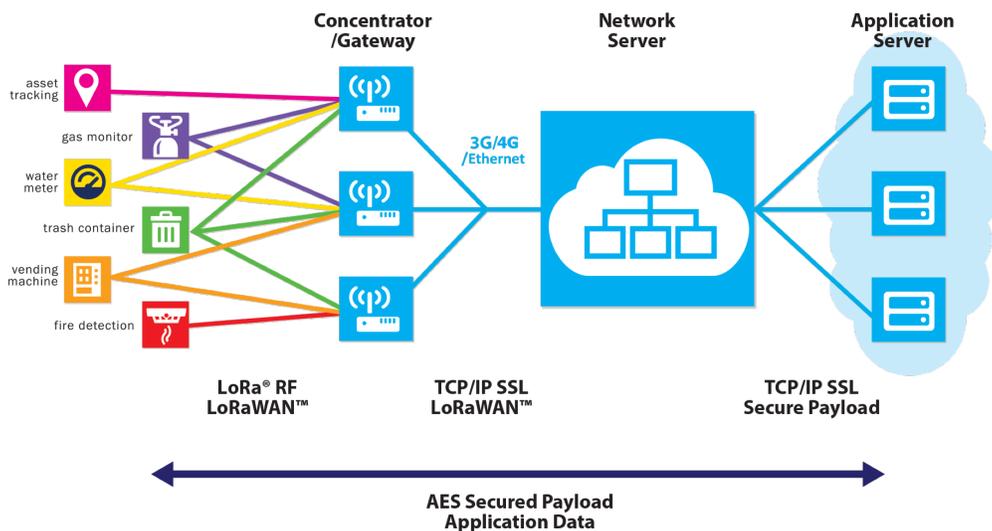
LoRa Physical Layer



<https://www.semtech.com/uploads/documents/an1200.22.pdf>



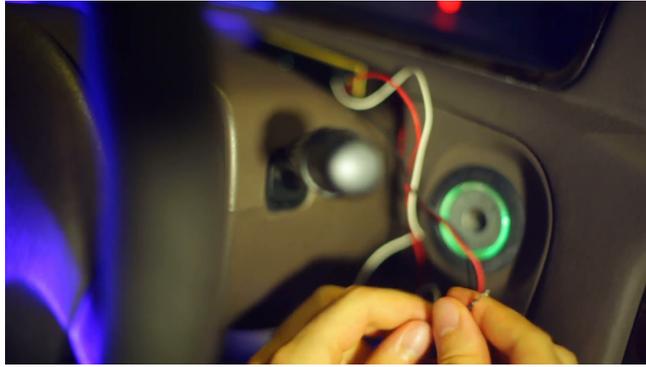
LoRaWAN (LoRa Wide Area Network)



<https://www.resiot.io/en/what-is-lorawan/>



LoRaWAN Security: AES128 like Immobilizer



https://www.youtube.com/watch?v=Nu_yZelDMZI&feature=player_embedded



Commercial Approach

The image shows a screenshot of the Swisscom website banner for the Low Power Network (LPN). The banner features a dark blue background with a map of Switzerland on the left. The text reads: "Welcome to Switzerland's only nationwide network for the Internet of Things". Below this, there is a paragraph: "We live in a networked world: machines, vehicles, lifts, oil tanks and many other things now communicate automatically and ensure greater efficiency and security. Soon everyday items, such as bicycles, mailboxes, water or newspaper dispensers, rubbish bins, shoes and much more will be «connected» as a matter of course. M2M/IoT applications are becoming available for an even broader scope of applications—thanks to the Low Power Network (LPN)." A red button with the text "MAKE LPN WORK FOR YOU" is positioned below the paragraph. At the bottom of the banner, there is a graphic of a city skyline with various icons (a person, a car, a house, a lightbulb, a paw print, a cross) connected by dotted lines, representing the Internet of Things.



Commercial Approach



NEWS

Dutch telco KPN deploys countrywide LoRa network

By Doug Drinkwater - July 1, 2016

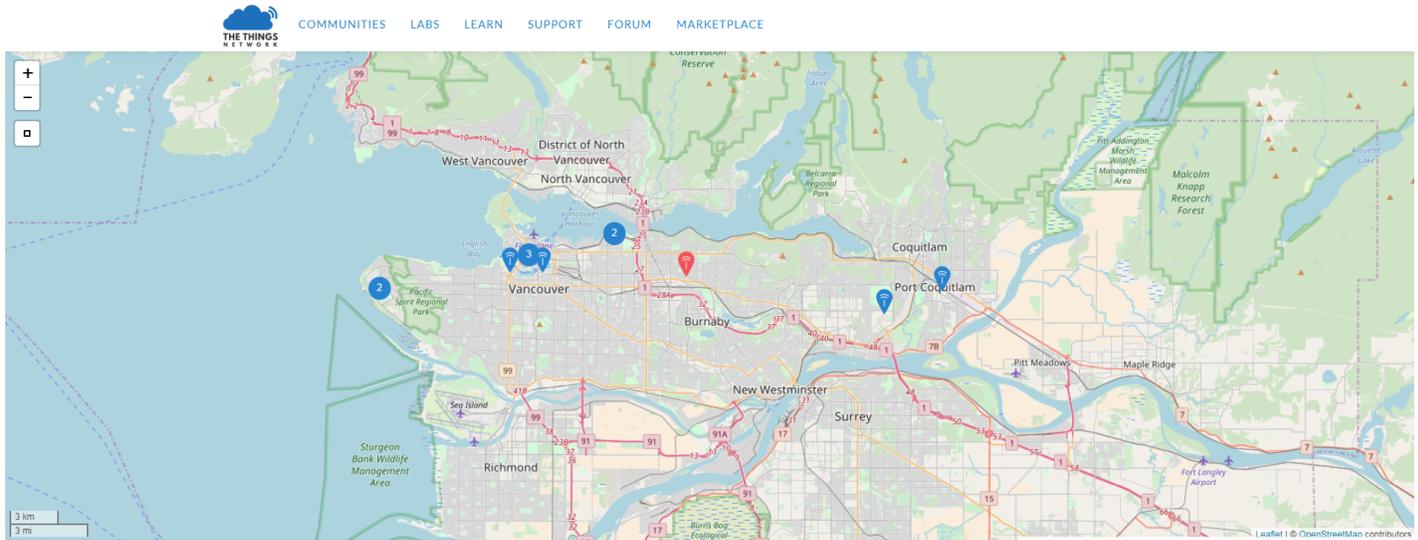


Community Approach: TheThingsNetwork

A promotional banner for The Things Network. The background is a city skyline under a cloudy sky. At the top center is the logo for 'THE THINGS NETWORK', which consists of a blue cloud with a signal icon and the text 'THE THINGS NETWORK' below it. Below the logo, the text 'BUILDING A GLOBAL INTERNET OF THINGS NETWORK TOGETHER.' is displayed in blue. Underneath this text is a blue button with the text 'Learn More' and a right-pointing arrow. At the bottom of the banner, the text 'BUILDING A FULLY DISTRIBUTED INTERNET OF THINGS DATA INFRASTRUCTURE.' is displayed in blue.



Community Approach: TheThingsNetwork



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Microchip Evaluation Kit:

An 8-channel Gateway and

Two Motes

A Local LoRaWAN Network/Application Server

A GUI for configuration and testing (Windows, Linux and Mac OS)



MICROCHIP

LoRa(R) Technology Evaluation Kit - 800 ☆

Part Number: dv164140-1

Summary:

The LoRa® Network Evaluation Kit makes it easy for customers to test LoRa technology, range and data rate. The full-featured gateway board includes an LCD screen, SD Card for Config Data, Ethernet connection, 868 MHz antenna, and full-band capture radios. The Gateway evaluation kit also includes two RN2483 Mote boards (Part #

[View More](#)



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Microchip Evaluation Kit:

An 8-channel Gateway

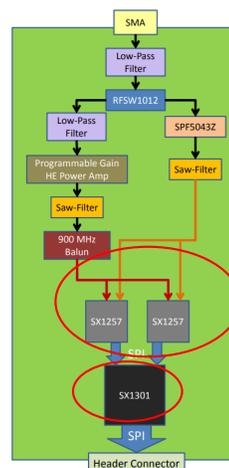
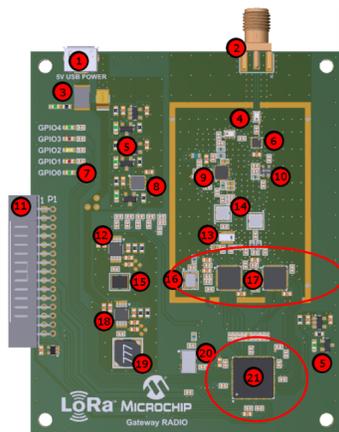
8 Parallel Channels = 8 Devices

However, at 50% duty cycle = 16 Devices

And at 1% duty cycle = 800 Devices



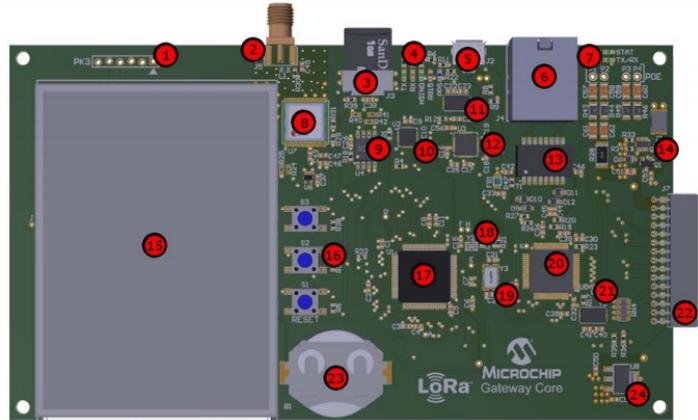
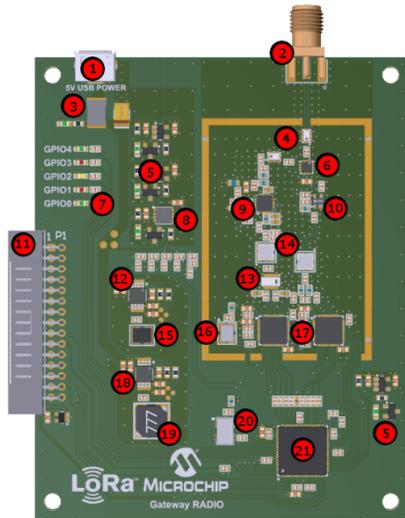
Microchip Evaluation Kit: Gateway



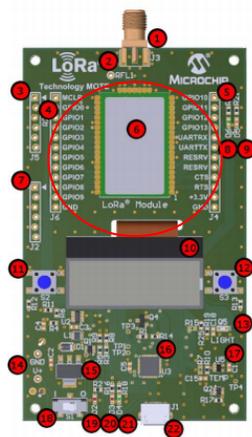
17. (2) SX1257 – 862 – 960 MHz RF to Digital FE Transceiver
21. SX1301 – Base Band Processor and Data Concentrator



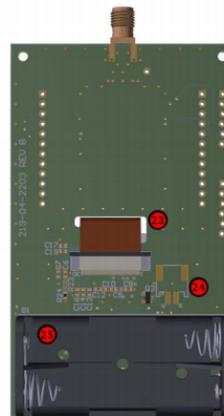
Microchip Evaluation Kit: Gateway



Microchip Evaluation Kit: MOTE



Top



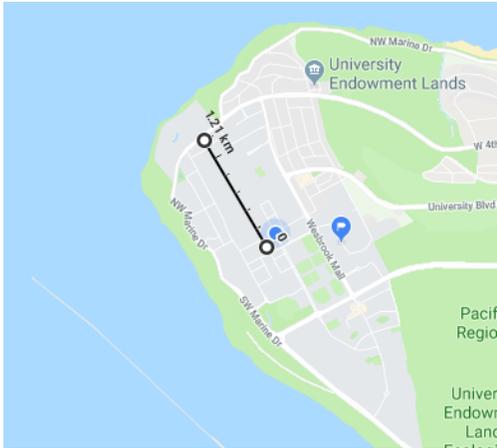
Bottom



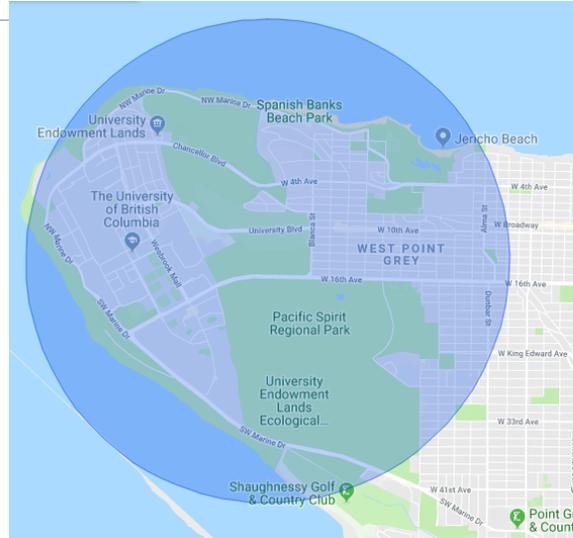
RN2483 - Microchip LoRa® Module, On-Board LoRaWAN™ Protocol Stack



Microchip Evaluation Kit: Communication Range Evaluation



Sample Measurement



Sample Approximate Communication Range (~3Km)

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5038744/>

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LORA Applications: Smart Lighting



NEWS

Baltic Sea marina uses LoRaWAN to benefit from smart street lighting

By Sooraj Shah - January 12, 2018

<https://blog.semtech.com/cities-get-smarter-with-lora-technology>

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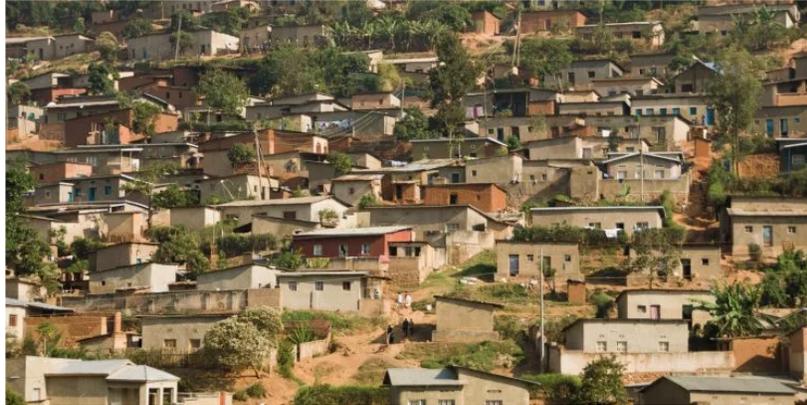


LORA Applications: Smart Cities

Leveraging LoRaWAN for a smart city initiative in Africa

Juan Pedro Tomás • May 18, 2017 •

Share | 1



<https://blog.semtech.com/cities-get-smarter-with-lora-technology>

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LORA Applications: Smart Parking

Parking spots of the future being tested in Stratford, Ont.

City embeds 78 sensors under parking spaces near city hall

CBC News · Posted: Feb 21, 2018 1:55 PM ET | Last Updated: February 21



<https://blog.semtech.com/cities-get-smarter-with-lora-technology>

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Setting Up the Microchip LoRa Evaluation Kit:



How to Setup the Microchip LoRa Kit:

THE THINGS NETWORK COMMUNITIES LABS LEARN SUPPORT FORUM MARKETPLACE SIGN UP LOGIN

SETTING UP YOUR OWN GATEWAY AND ENDPOINT WITH MICROCHIP'S LORA TECHNOLOGY EVALUATION KIT

by Heath Marvin

ABOUT THIS STORY

Posted on July 19, 2016

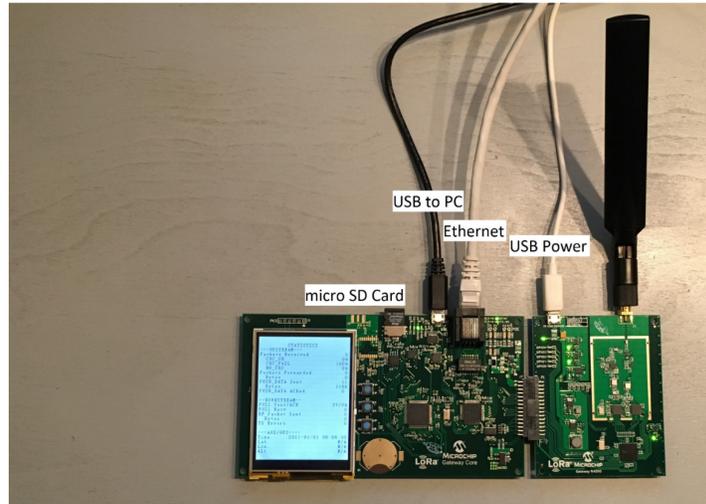
#Gateway

Intermediate

10 people like this

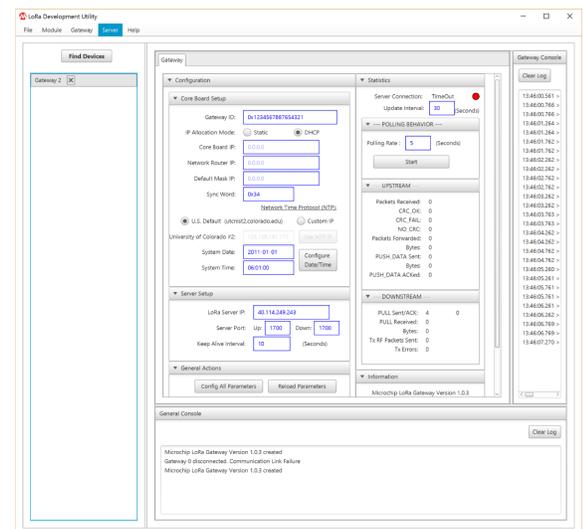


Setting Up the Gateway:

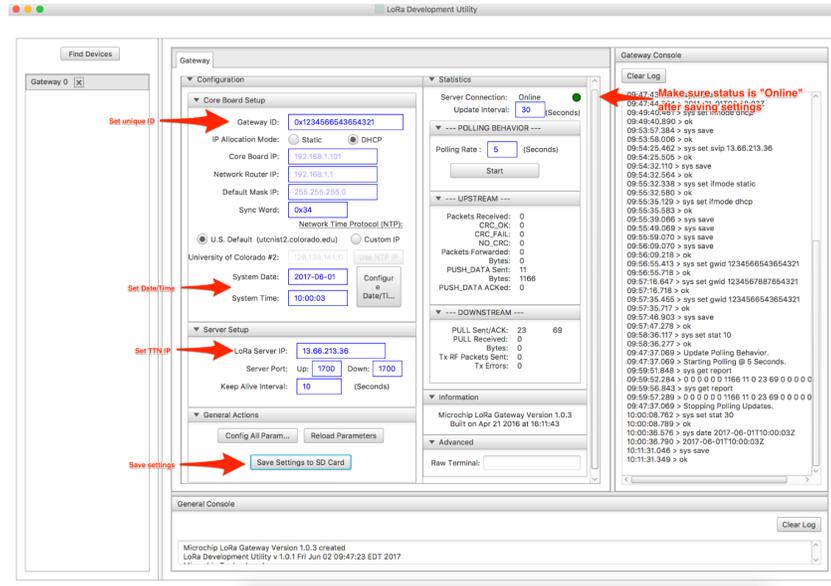


Setting Up the Gateway:

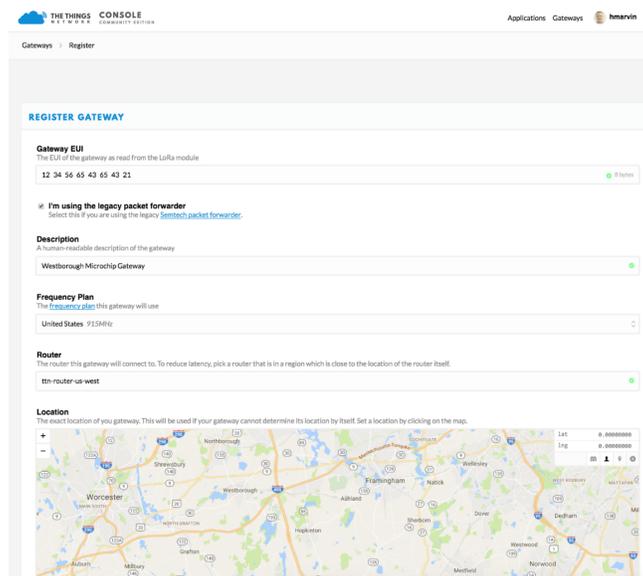
LoRa Development Utility GUI for Mac OS., Windows, and Linux



Setting Up the Gateway:



Registering the Gateway with TTN:

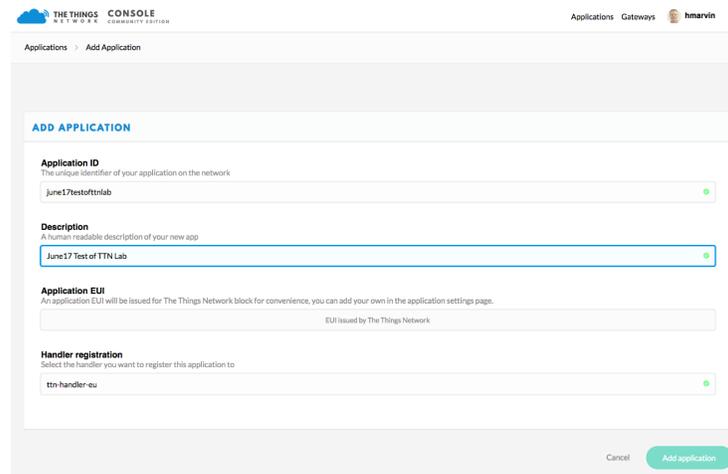


Connect Microchip's LoRa Technology MOTE to the Gateway:

1. Set up an application in the TTN Dashboard.
2. Connect and configure Microchip's LoRa Technology MOTE.



Set Up an Application in the TTN Dashboard:



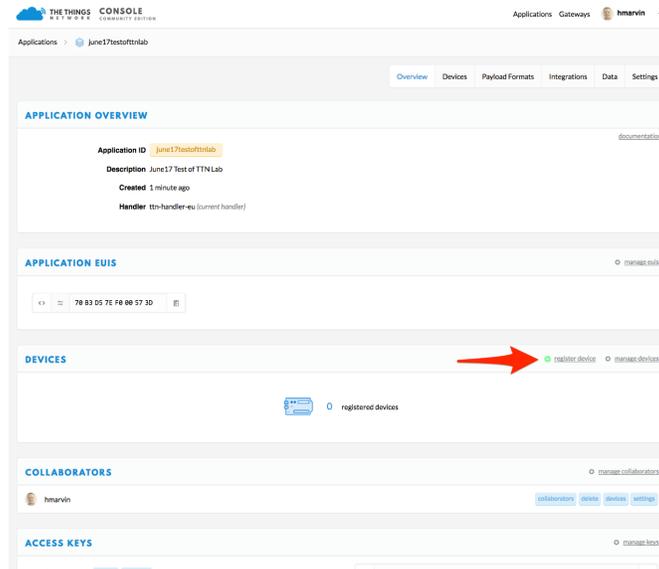
The screenshot shows the 'ADD APPLICATION' form in the TTN Console. The form includes the following fields:

- Application ID:** A text input field containing 'june17testoftnlab'.
- Description:** A text input field containing 'June17 Test of TTN Lab'.
- Application EUI:** A text input field containing 'EUI issued by The Things Network'.
- Handler registration:** A dropdown menu with 'ttn-handler-eu' selected.

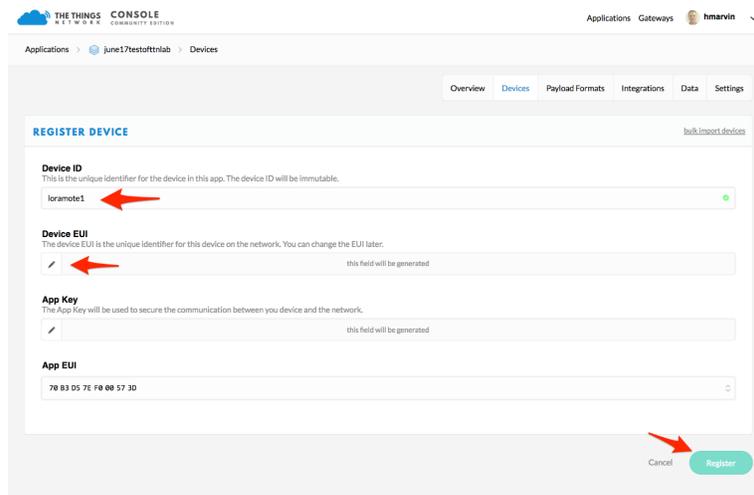
At the bottom right of the form, there are two buttons: 'Cancel' and 'Add application'.



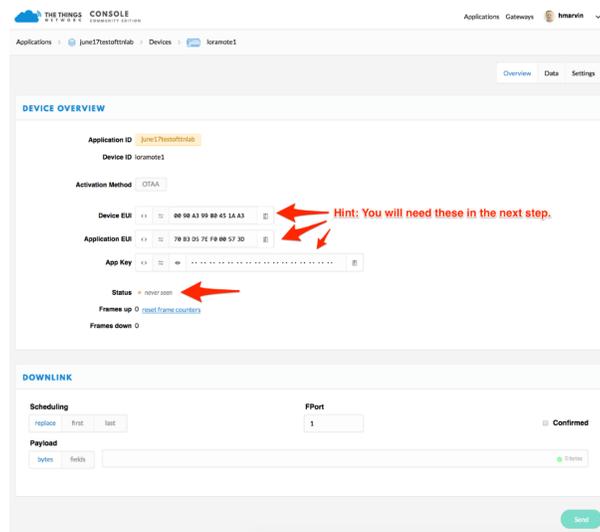
Set Up an Application in the TTN Dashboard:



Set Up an Application in the TTN Dashboard:



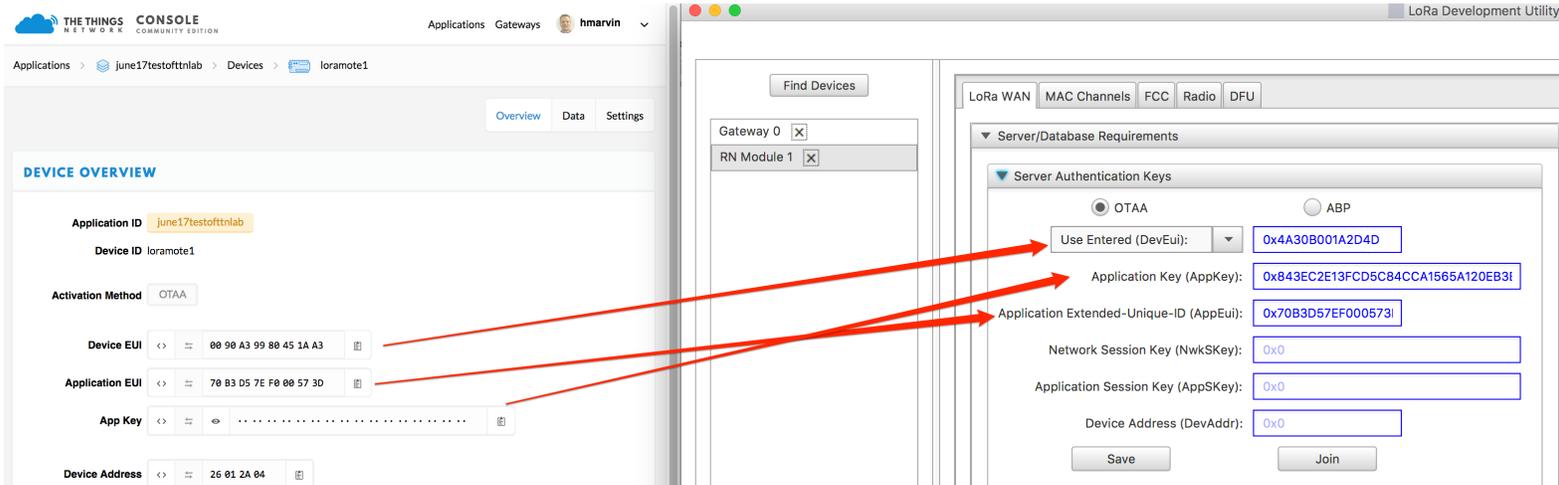
Set Up an Application in the TTN Dashboard:



Connect and Configure Microchip's LoRa Technology MOTE:



Connect and Configure Microchip's LoRa Technology MOTE:



Connect and Configure Microchip's LoRa Technology MOTE:

Click on Join to send the Join Request to the Gateway

After nearly one second, Join Accept is received from the Gateway

Now We can send Uplink messages to the Server

