

# Internet of Things: LoRaWAN

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HAMED VALIPOUR

HAMED NOORI



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## Objectives

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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?



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# 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 to 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/>

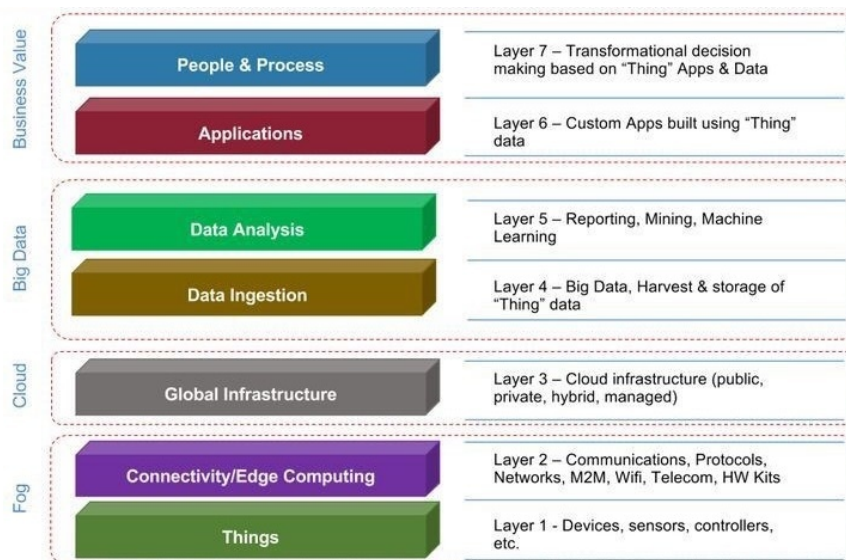


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# Internet of Things



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



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# Low Power Wide Area Network (LPWAN)

Network

Wide Area

Low Power

Paradox: Low Power  $\neq$  Wide Area

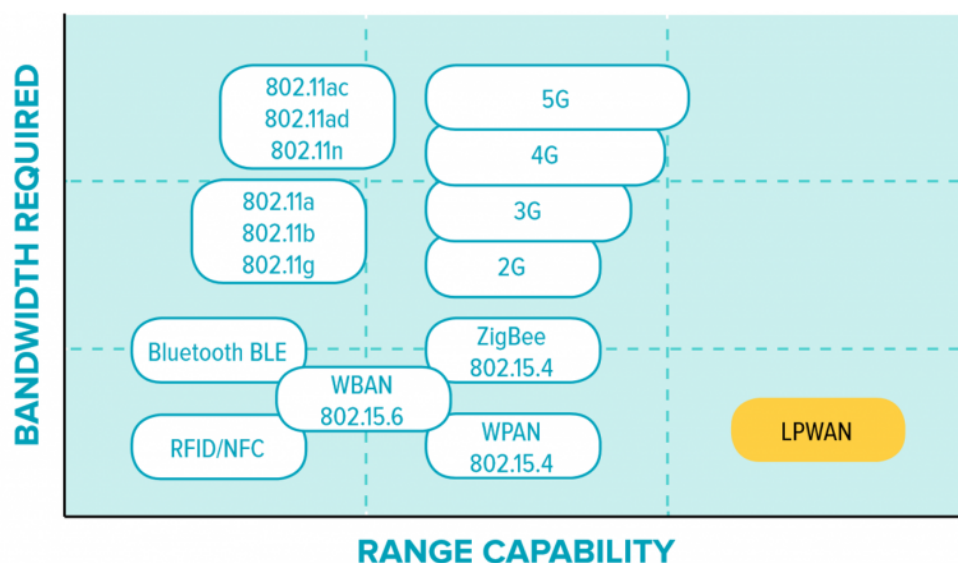


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# Low Power Wide Area Network (LPWAN)










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# Low Power Wide Area Network (LPWAN)

							
	LoRa / LoRaWAN	Sigfox	NB-IoT	LTE-M	RPMA	Weightless-P	Symphony Link
<b>Origin</b>	France	France	USA (Global)	USA (Global)	USA	UK	USA
<b>Proprietary or open</b>	LoRa – proprietary LoRaWAN – open	Net – proprietary Devices – open	Open	Open	Proprietary	Open	Proprietary
<b>Cellular</b>	No	No	Yes	Yes	No	No	No
<b>Spectrum</b>	Unlicensed	Unlicensed	Licensed	Licensed	Unlicensed	Unlicensed	Unlicensed
<b>Range, km</b>	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
<b>Speed, uplink / downlink</b>	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
<b>Power consumption</b>	●●●	●	●	●●●	●●	●	●●
<b>Security</b>	●●	●●	●●●	●●●	●●●	●●●	●●●
<b>Availability of devices</b>	●●	●●●	●●	●	●●	●	●●
<b>Price*</b>	●●	●	●●	●●●	●●●	●	●●
<b>Areas of application</b>	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
<b>Supporting companies</b>	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, uniik, 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**

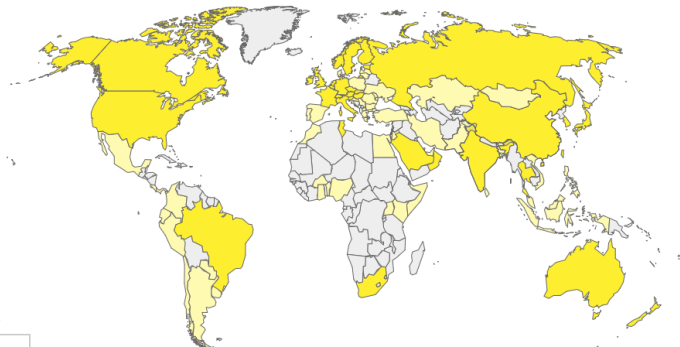
Alliance Member Operators

**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	In definition by Technical Committee	In definition by Technical Committee	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	In definition by Technical Committee	In definition by Technical Committee	In definition by Technical Committee	In definition by Technical Committee
SF Up	7-12	7-10				
Data rate	250bps-50kbps	980bps-21.9kbps				
Link Budget Up	155dB	154dB				
Link Budget Dn	155dB	157dB				

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

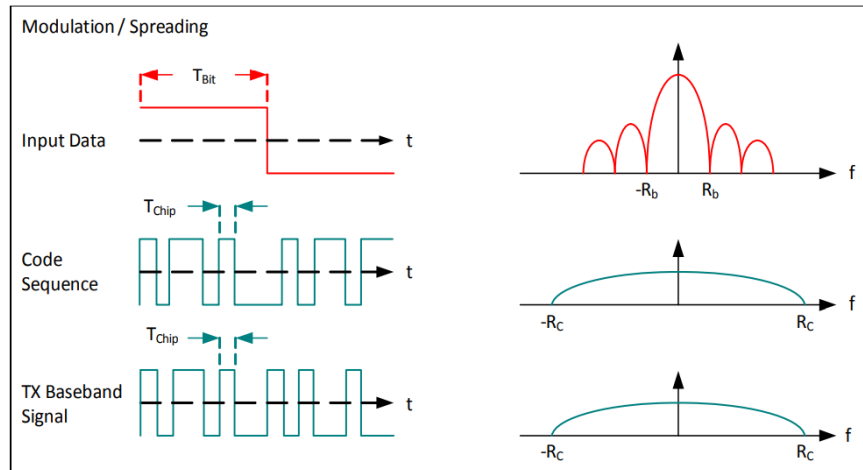


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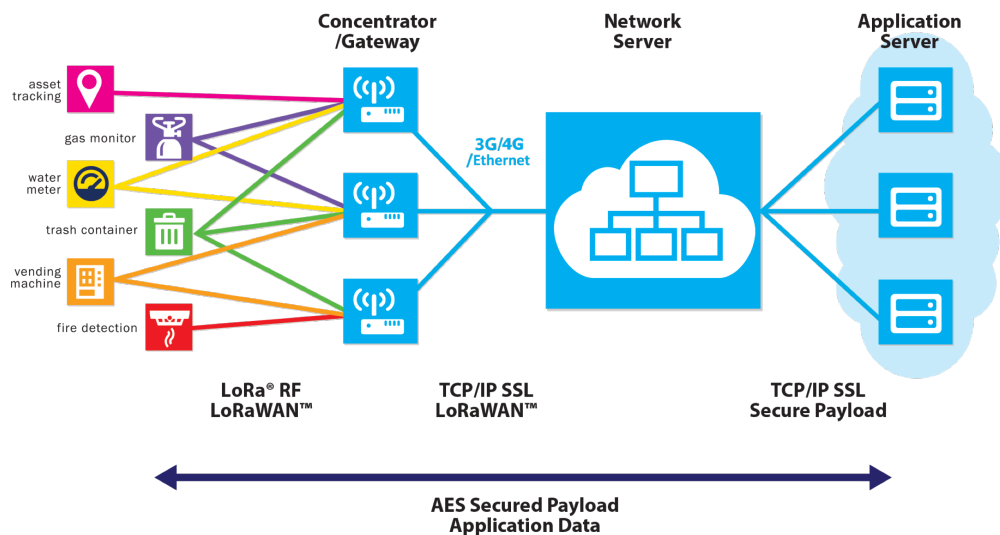
# LoRa Physical Layer



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



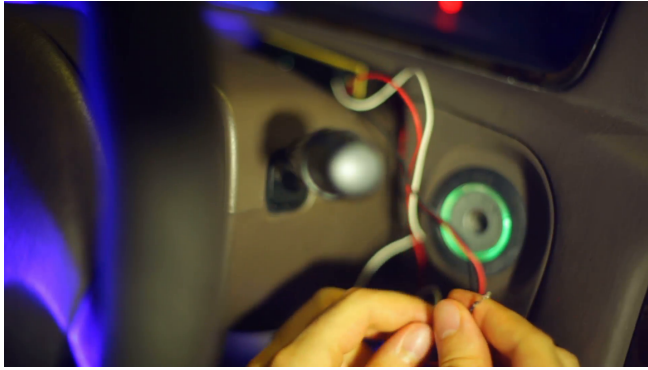
# LoRaWAN (LoRa Wide Area Network)



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



# LoRaWAN Security: AES128 like Immobilizer



[https://www.youtube.com/watch?v=Nu\\_yZelDMZI&feature=player\\_embedded](https://www.youtube.com/watch?v=Nu_yZelDMZI&feature=player_embedded)

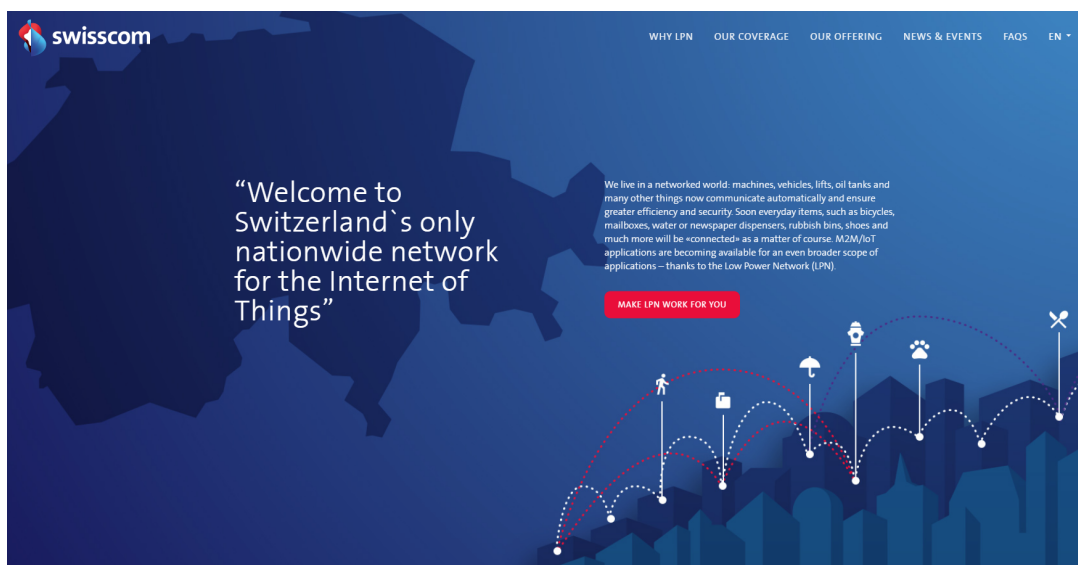


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## Commercial Approach



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# Commercial Approach

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NEWS

## Dutch telco KPN deploys countrywide LoRa network

By Doug Drinkwater - July 1, 2016



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# Community Approach: TheThingsNetwork

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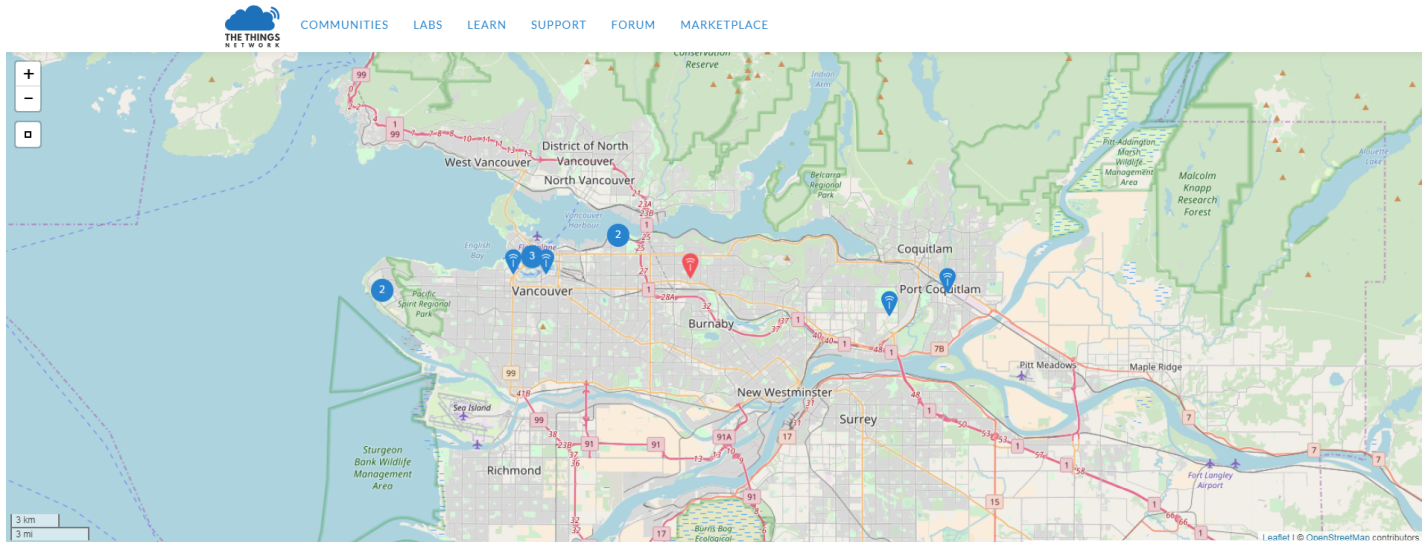
A banner for The Things Network. It features a city skyline (New York City) under a cloudy sky. The logo for The Things Network is at the top center. Below it, the text reads: "BUILDING A GLOBAL INTERNET OF THINGS NETWORK TOGETHER." At the bottom, it says: "BUILDING A FULLY DISTRIBUTED INTERNET OF THINGS DATA INFRASTRUCTURE." There is a "Learn More" button with a right arrow.

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# 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

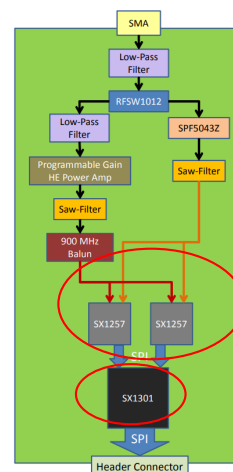
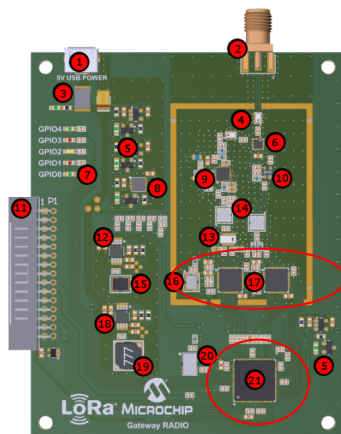


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## Microchip Evaluation Kit: Gateway



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

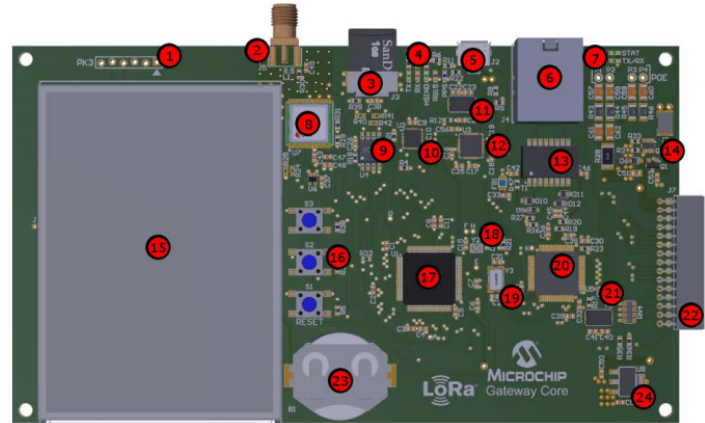
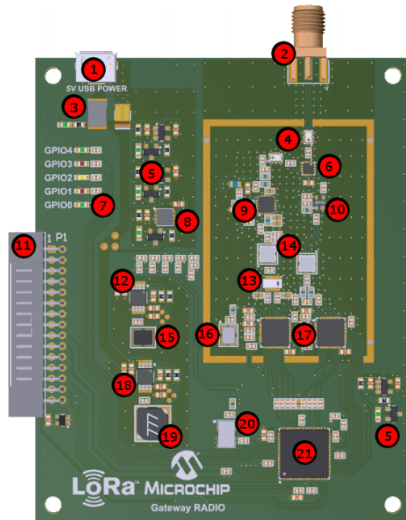


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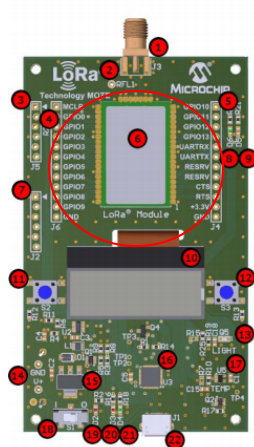
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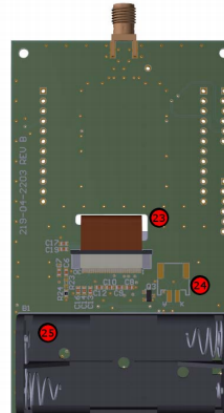
# Microchip Evaluation Kit: Gateway



# Microchip Evaluation Kit: MOTE



Top



Bottom

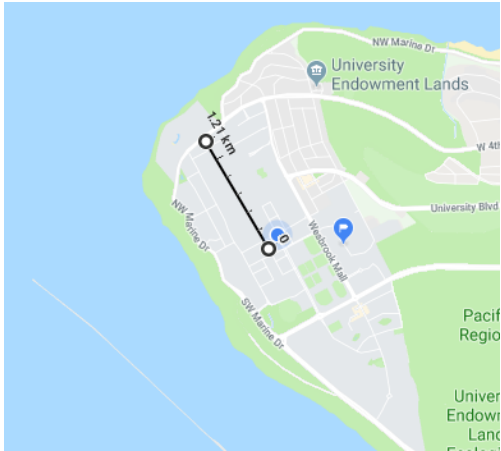


RN2483 - Microchip LoRa® Module, On-Board LoRaWAN™ Protocol Stack

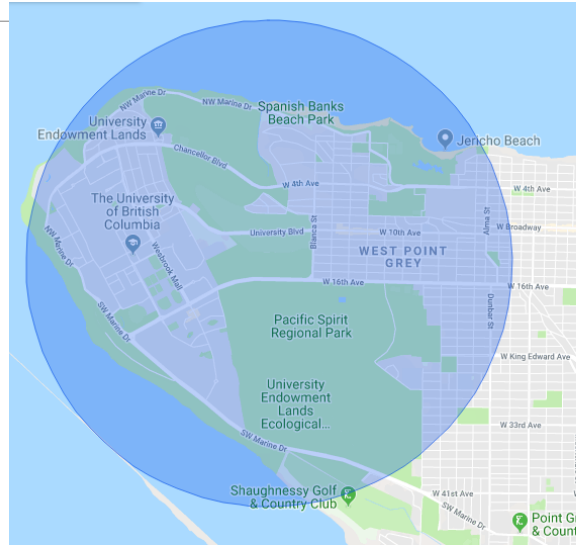




# Microchip Evaluation Kit: Communication Range Evaluation



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:



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## How to Setup the Microchip LoRa Kit:

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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

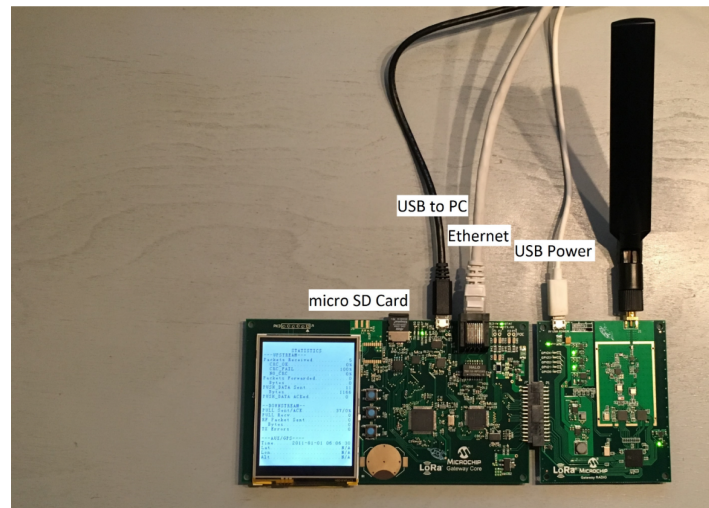


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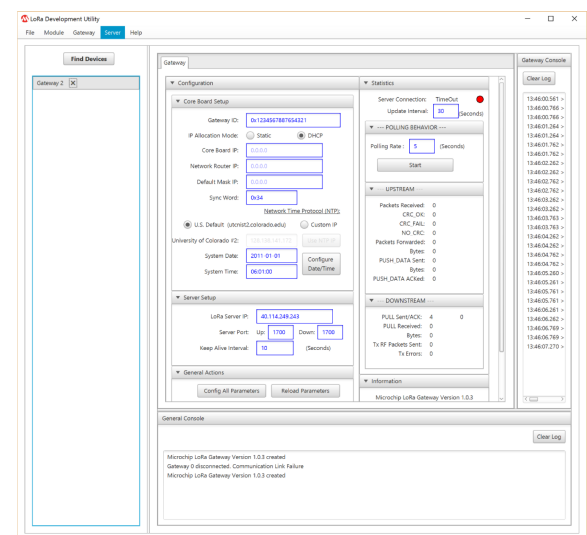


# Setting Up the Gateway:

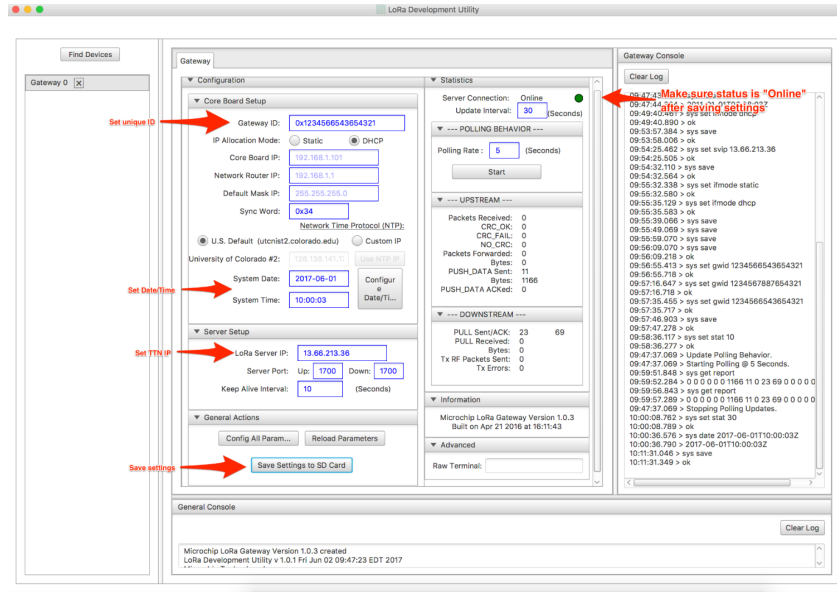


# Setting Up the Gateway:

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



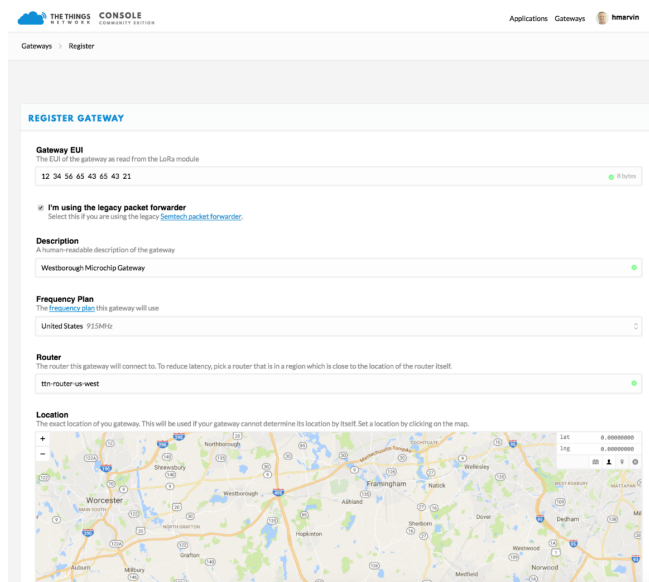
## Setting Up the Gateway:



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## Registering the Gateway with TTN:



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# Connect Microchip's LoRa Technology MOTE to the Gateway:

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



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## Set Up an Application in the TTN Dashboard:

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A screenshot of the 'Add Application' form in the The Things Network (TTN) Console. The form is titled 'ADD APPLICATION' and contains four sections: 'Application ID' with the value 'june17testofttnlab', 'Description' with the value 'June17 Test of TTN Lab', 'Application EUI' with the value 'EUI issued by The Things Network', and 'Handler registration' with the value 'ttn-handler-eu'. At the bottom right, there are 'Cancel' and 'Add application' buttons. The top of the console shows the 'THE THINGS NETWORK' logo, 'CONSOLE' text, and navigation links for 'Applications', 'Gateways', and a user profile 'hmarvin'.

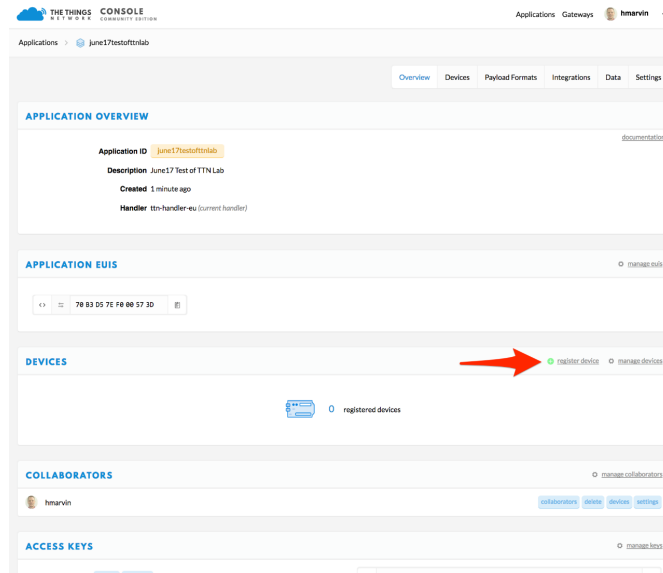
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# Set Up an Application in the TTN Dashboard:

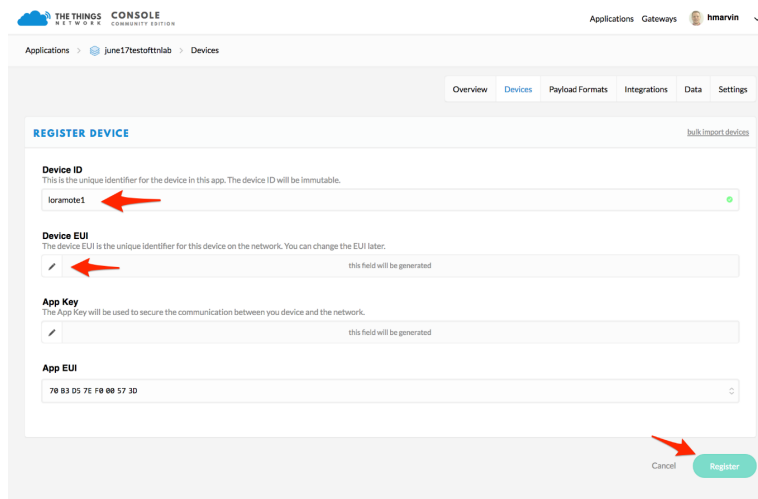


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# Set Up an Application in the TTN Dashboard:

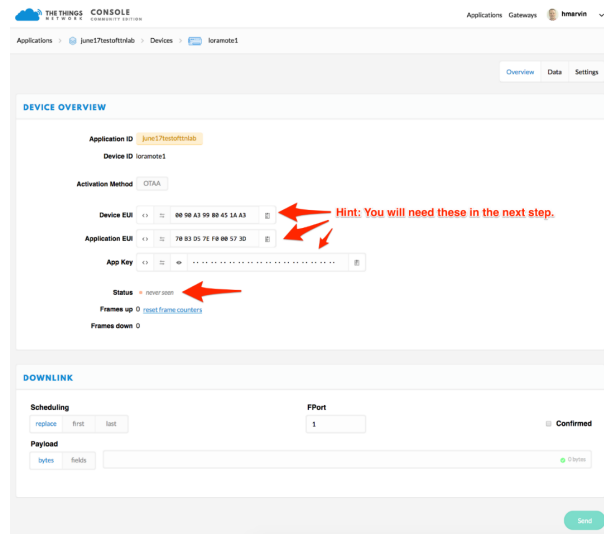


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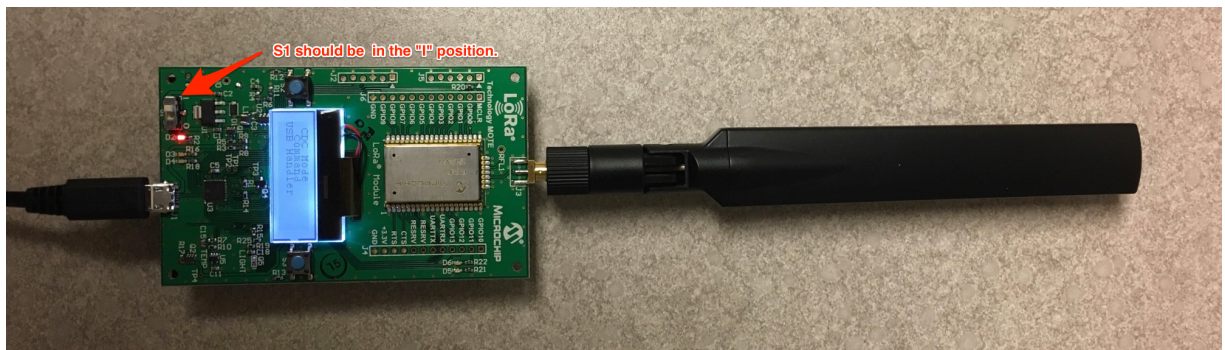
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# Set Up an Application in the TTN Dashboard:

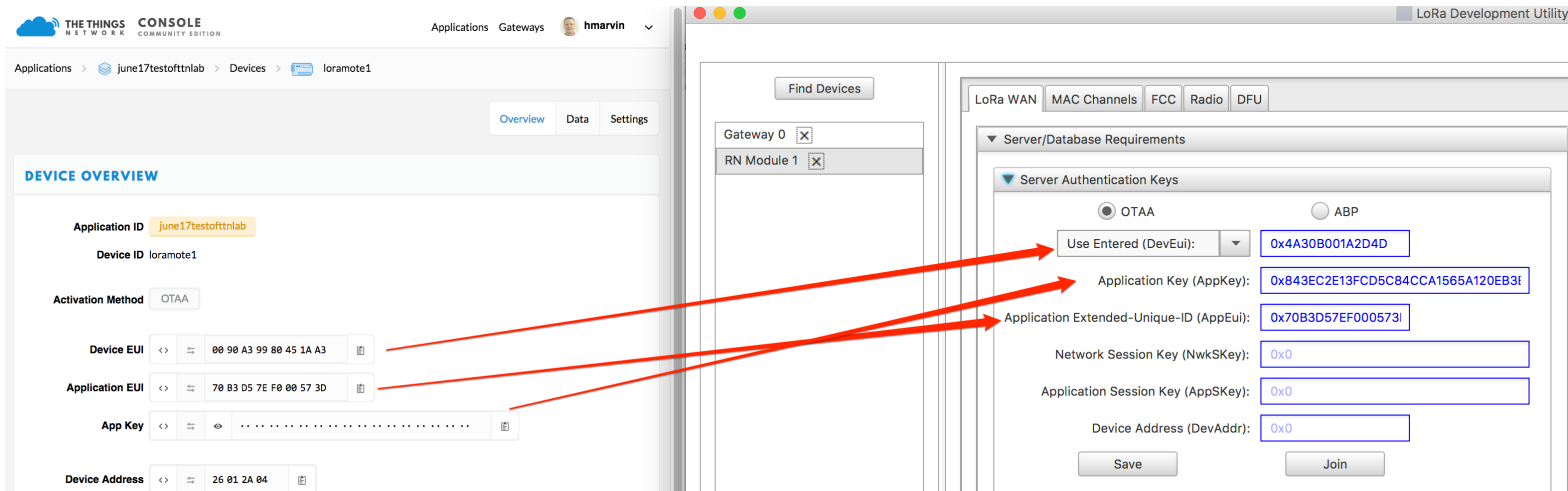


# Connect and Configure Microchip's LoRa Technology MOTE:





# 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



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