Workshop
Introduction to LoRa Sensor Networking

Hackaday Superconference
Pasadena, November 2, 2018

WHAT YOU WILL LEARN

WHAT IS LORA, AND WHAT MAKES IT DIFFERENT

- Bandwidth, Range, Power
- Network provider: The Things Network

Globalsat LM-110H1 LoRa module

- Manual setup with serial communication
- Useful AT commands
- Joining a local LoRa network
- Transmit data to an application
- Receive data from an application
- Visualize data in MyDevices Cayenne

WHAT IS LORA?

Long range, low energy, wireless communication

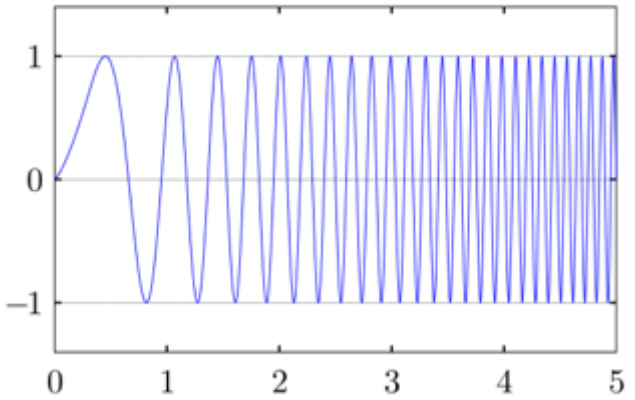
- Typical 5 mile range with line-of sight
- Suitable for battery operated sensors
- Small data packets, 30 seconds/day air time
  ~ every 15 - 30 minutes
- Star network topology
- One gateway can support hundreds of stations

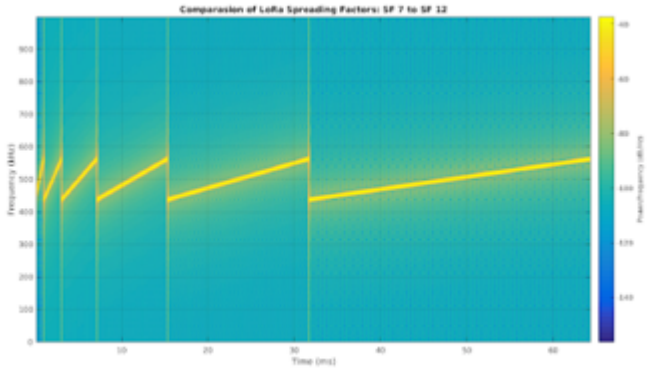
Unlicenced Frequency bands

- USA 902 – 928 MHz, 64 channels
- Europe 863 – 870 MHz, 8 channels

Modulation

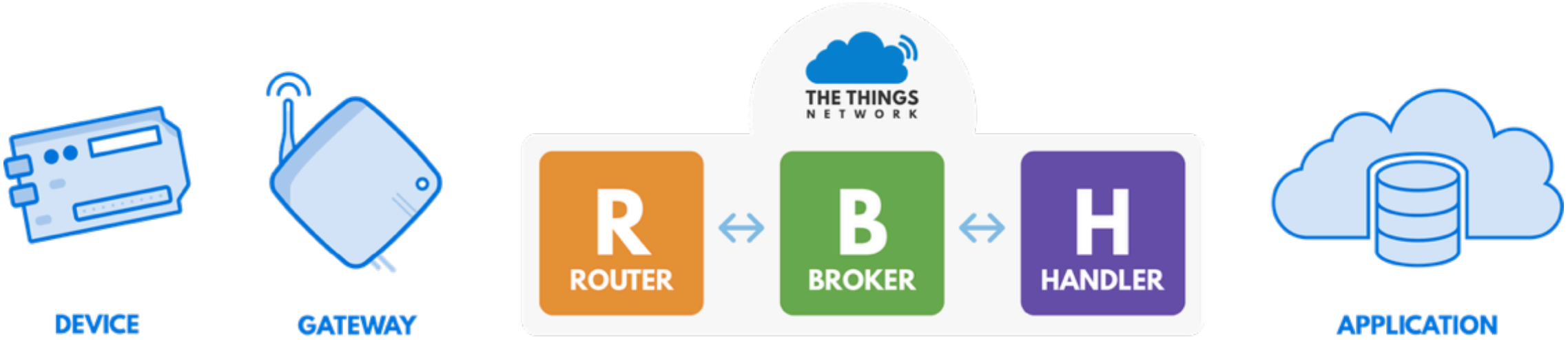
- Chirp spread spectrum, 3 x greater distance than NB FSK
- Data rate depends on bandwidth and spreading factor



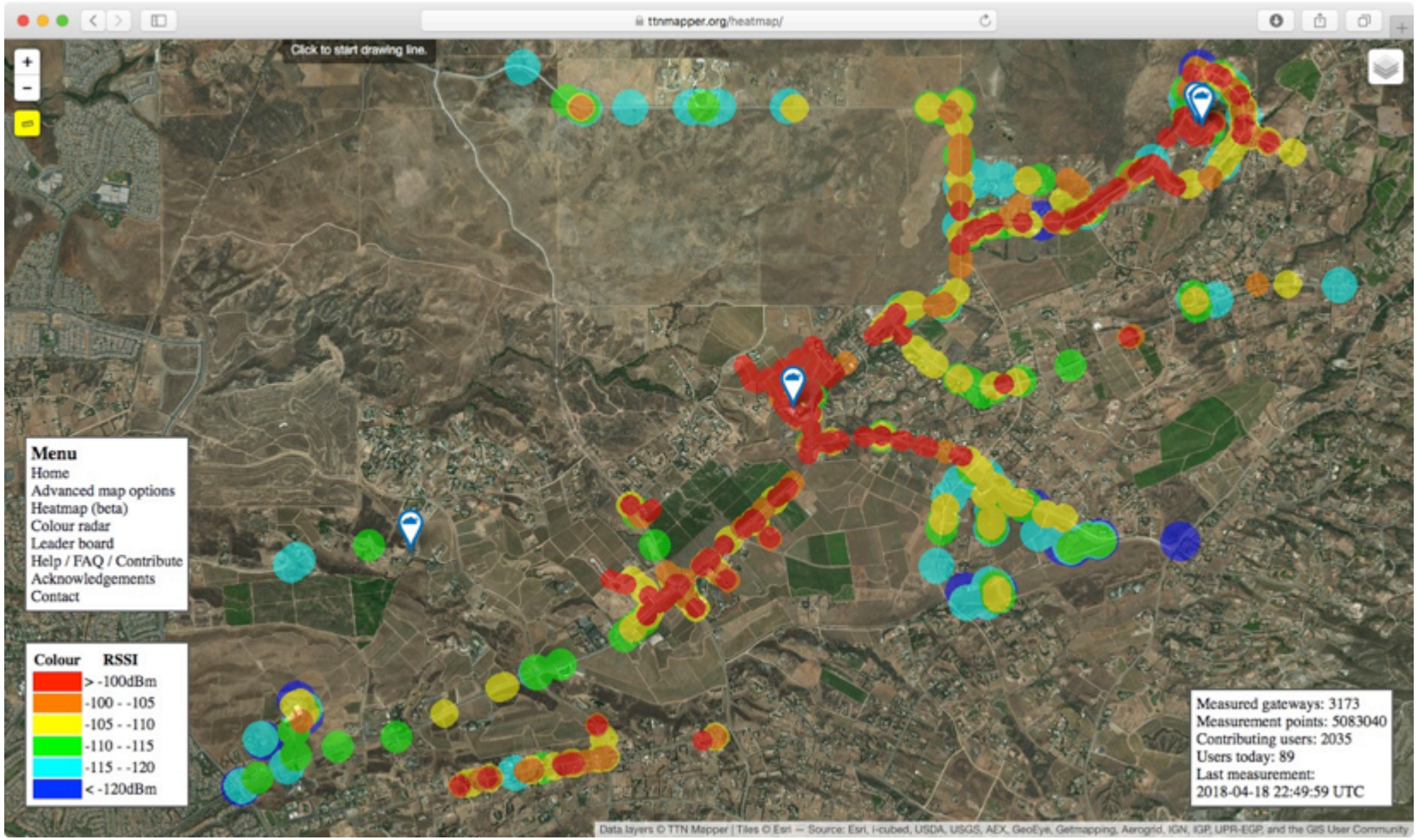


Sakshama Ghoslya

LORA NETWORK ARCHITECTURE



LORA NETWORK IN TEMECULA



ttnmapper.org

WORKSHOP PLAYGROUND

LORAWAN GATEWAY

- MuLtitech Conduit
- Set up for TheThingsNetwork

LORA NETWORK PROVIDER: TTN

- Free to use LoRaWAN networking
- Community owns and deploys the network
- 5,000 communities worldwide

THE THINGS
NETWORK

YOUR WORKSHOP KIT

- Globalsat LM-110H1 LoRa radio module
- NL100 USB-2-Serial adapter
- 915 MHz Antenna

GLOBALSAT LM-110H1

Hardware Specifications	
Chipset	SEMTECH LoRa SX1276
LoRaWAN Class	Class A device, Receives after Tx
Frequency	862-870MHz (Model: LM-110E) 902-928MHz (Model: LM-110H)
Transmission Power	100mW (max.)
UART	Baud Rate : 57600bps Parity: 8N1
Operation Voltage	3.0V~6V
Current Consumption	Receiving: 21 mA (typical) Transmitting: 125 mA (typical) Sleeping: 5 uA (typical)
Transmission Distance	1KM~10KM (0.81Kbps)
Receiving Sensitivity	-132dBm@0.81Kbps

LM-110H1 Pin Definition			
Pin	Signal Name	I/O	Description
1	GND	-	Ground
2	VCC	-	3.0 – 6.0V
3	RXD	Input	3.3V UART input
4	TXD	Output	3.3V UART output
5 -7	-	-	-

BEFORE WE GET STARTED

WIFI

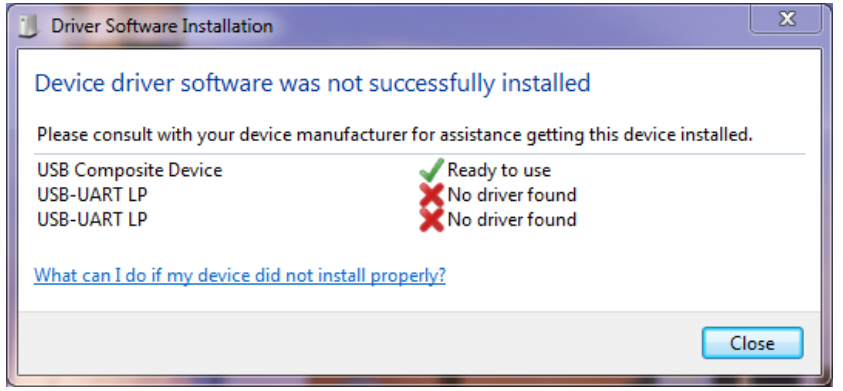
- **SSID:** ……..
- **Pass:** ……..

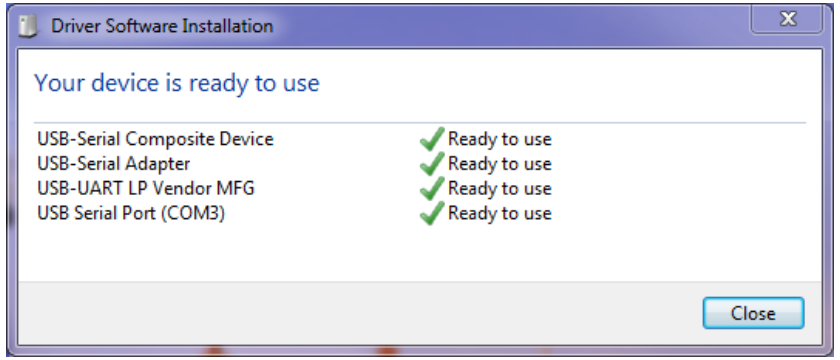
WINDOWS USERS

- **Install Cypress USB serial driver**

Everybody

- **Install CoolTerm serial communications program http://freeware.the-meiers.org**
- **Set up user account at thethingsnetwork.org**
- **Set up user account at mydevices.com**

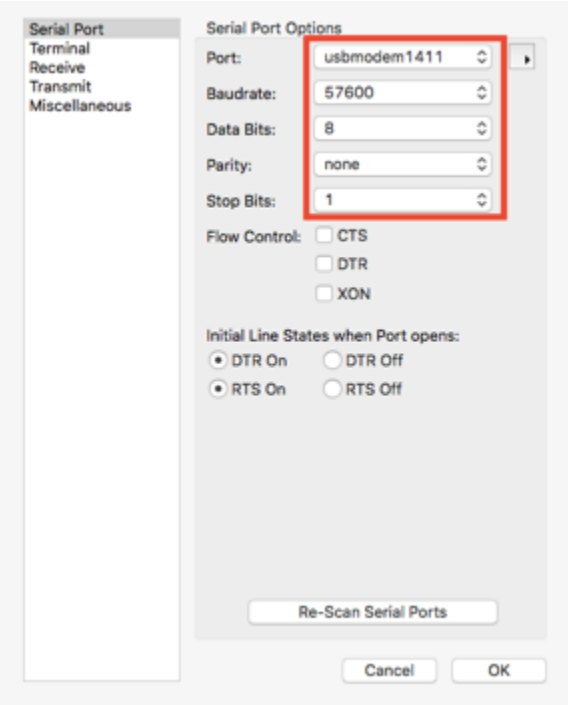


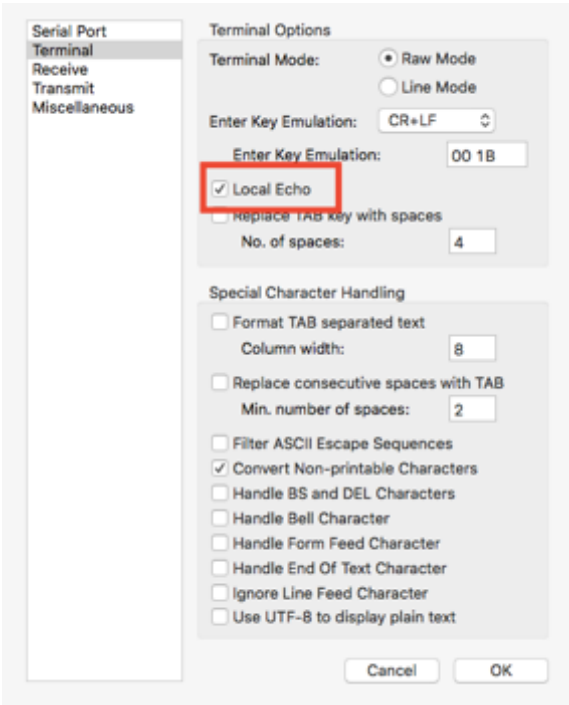


BEFORE WE GET STARTED-2

CoolTerm Settings

- Select correct serial port
- Baudrate:
  57600, 8 bits, no parity, 1 stop bit
- Terminal: Local Echo





The Things Network

- Set up a user account
- https://account.thethingsnetwork.org/register

AT COMMANDS QUICK REFERENCE

Command	Description	Response
AAT1 Reset	Reboot the LM-110H1	OK
AAT1 Save	Save parameters to flash	OK
AAT1 SLEEP	Enter sleep mode	OK
AAT2 JoinMode=1	OTAA activation mode	OK
AAT2 DevEui=?	Device LoRa Mac address	8-byte hex number
AAT2 AppEui= (enter hex here)	Application identifier	OK
AAT2 AppKey= (enter hex here)	Encryption key	OK
AAT2 Tx=2,uncnf,AABBCC (hex payload)	Send data	OK Tx_ok Tx_noACK Tx_no_free_ch Tx_not_joined Rx …

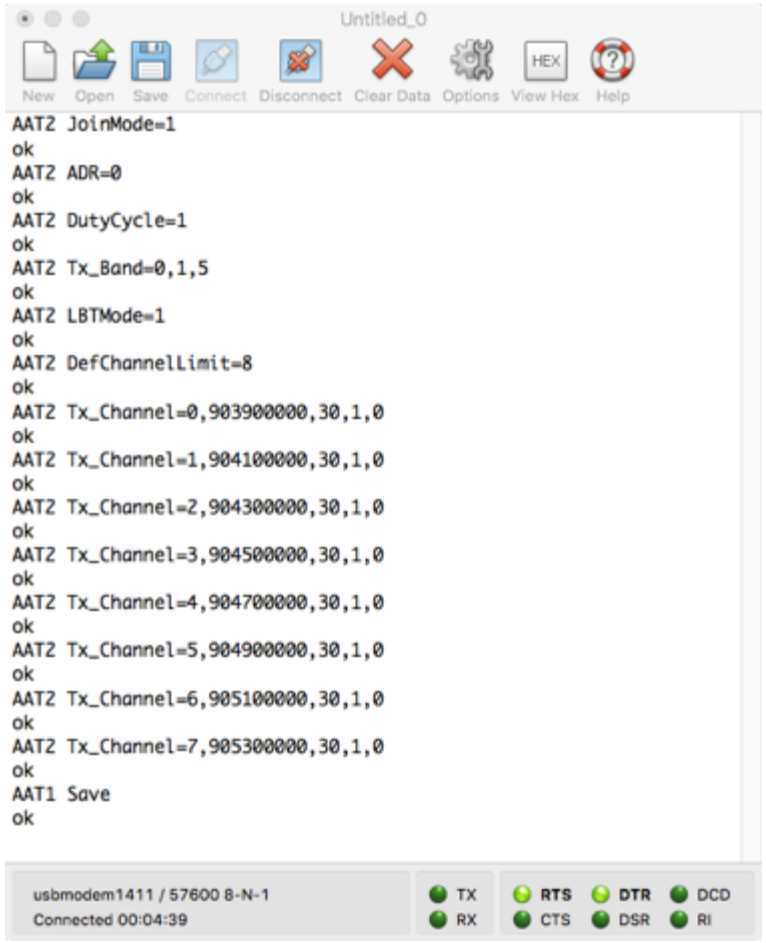
MODULE MANUAL CONFIGURATION

```
AAT2 JoinMode=1
AAT2 ADR=0
AAT2 DutyCycle=1
AAT2 Tx_Band=0,1,5
AAT2 LBTMode=1
AAT2 DefChannelLimit=8
```

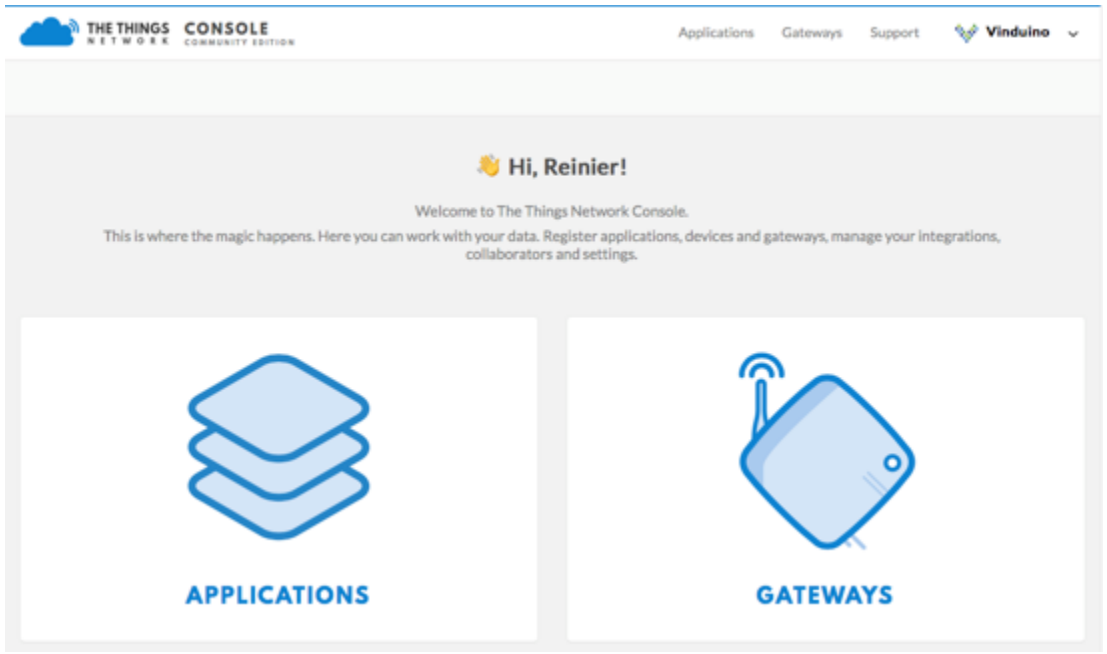
Same for every module setup

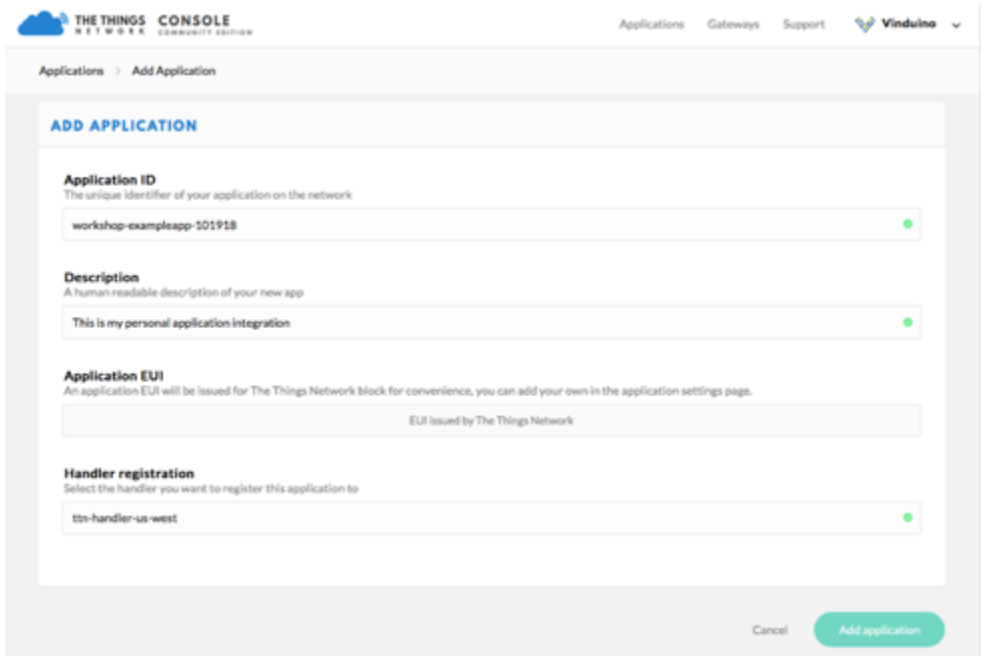
Frequencies can differ per network provider

```
AAT2 Tx_Channel=0,903900000,30,1,0
AAT2 Tx_Channel=1,904100000,30,1,0
AAT2 Tx_Channel=2,904300000,30,1,0
AAT2 Tx_Channel=3,904500000,30,1,0
AAT2 Tx_Channel=4,904700000,30,1,0
AAT2 Tx_Channel=5,904900000,30,1,0
AAT2 Tx_Channel=6,905100000,30,1,0
AAT2 Tx_Channel=7,905300000,30,1,0
AAT1 Save
```



TTN ADD APPLICATION





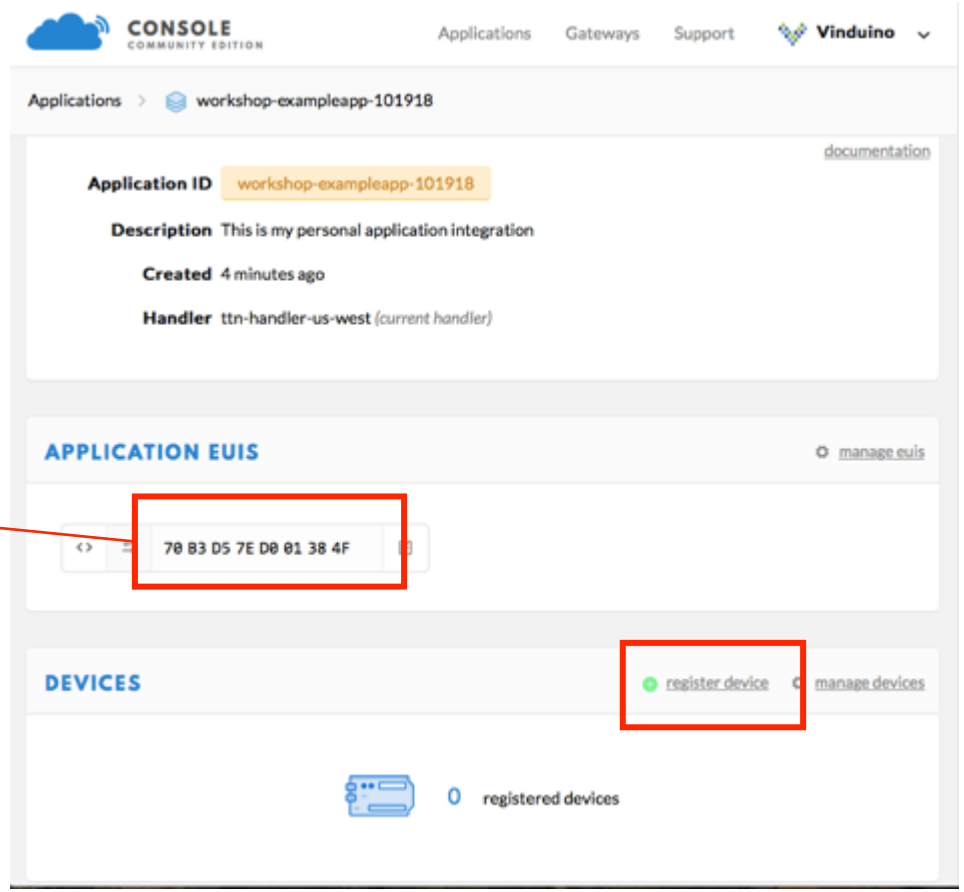
MODULE MANUAL CONFIGURATION-2

AAT2 DevEui=?
000DB53908643681
(should be the same as module marking)

Save DevEUI for TTN registration

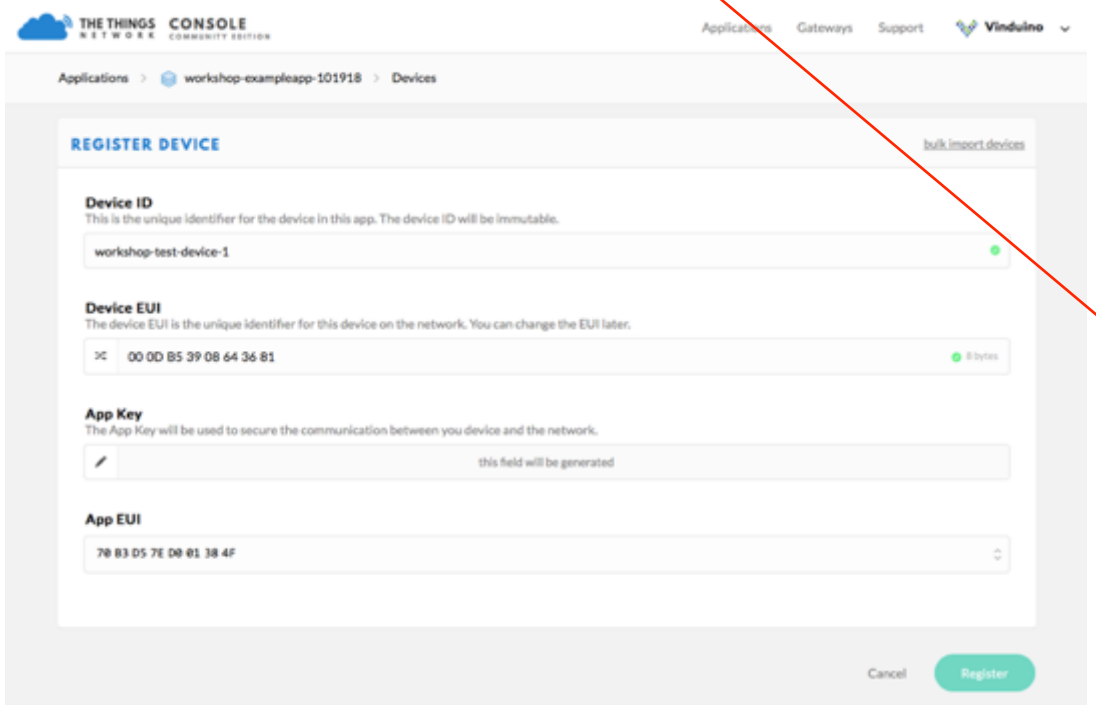
AAT2 AppEui=70B3D57ED001384F
AAT1 Save

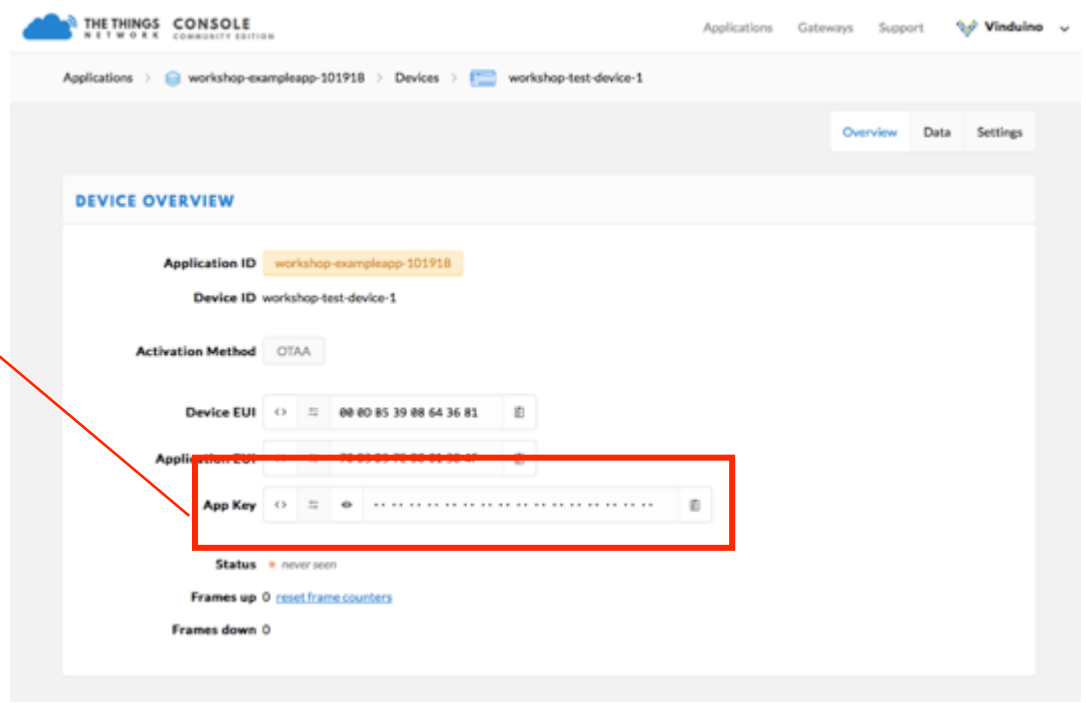
AAT2 AppKey=
AAT1 Save
AAT1 Reset



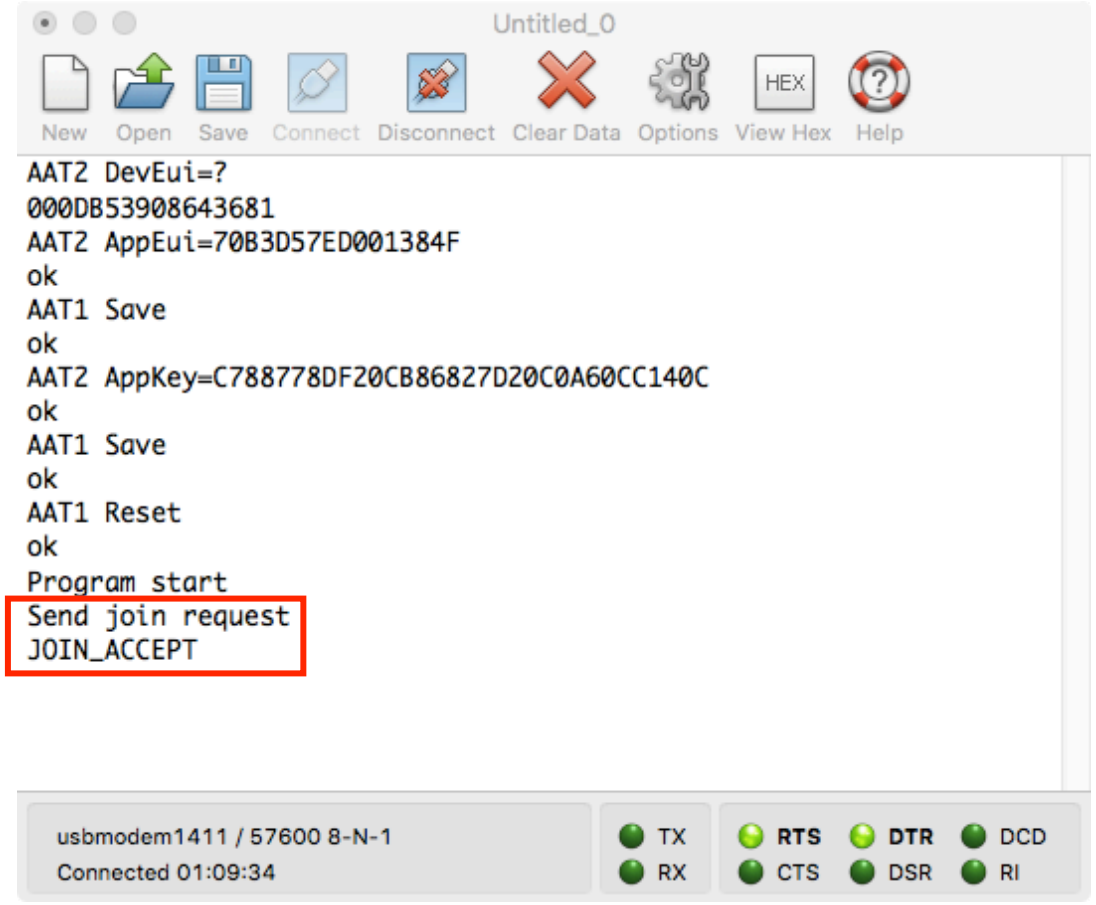
TTN REGISTER DEVICE

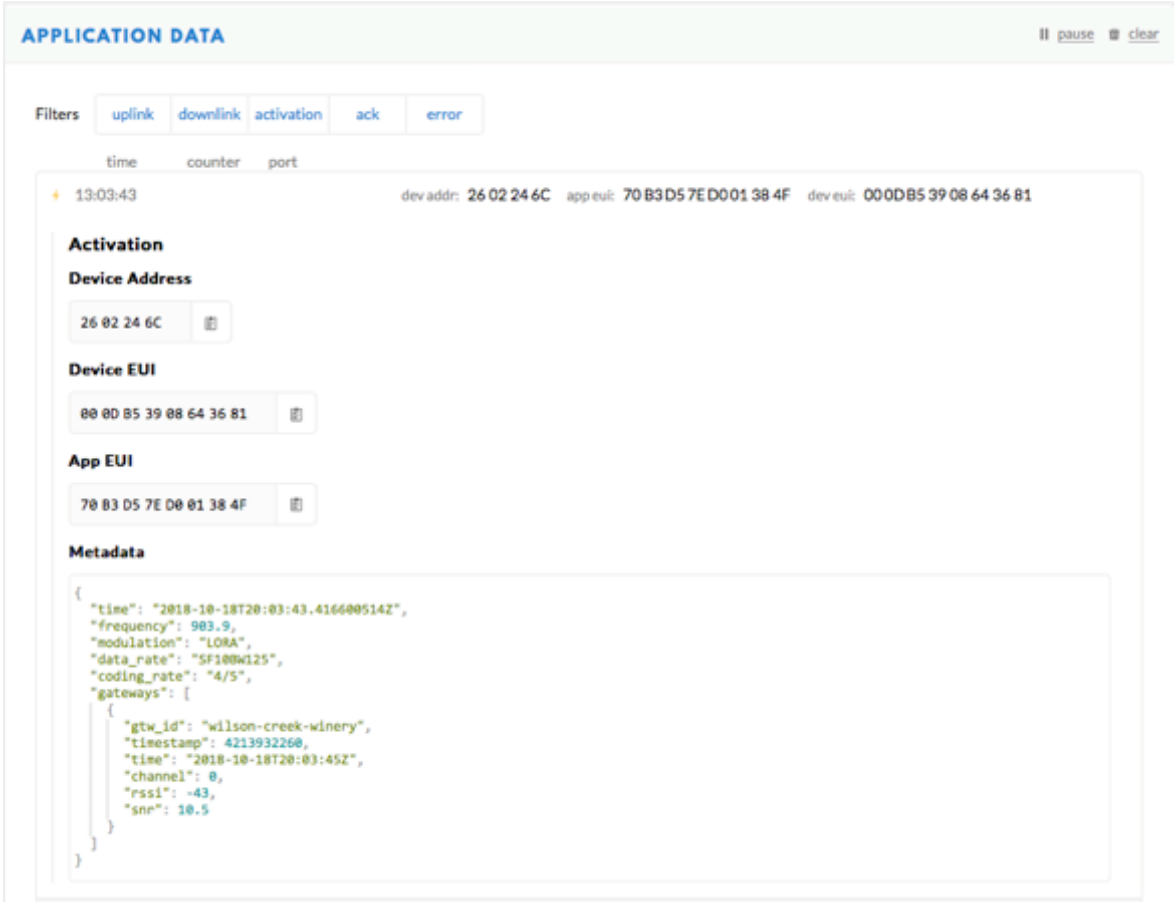
AAT2 AppKey=C788778DF20CB86827D20C0A60CC140C
AAT1 Save
AAT1 Reset



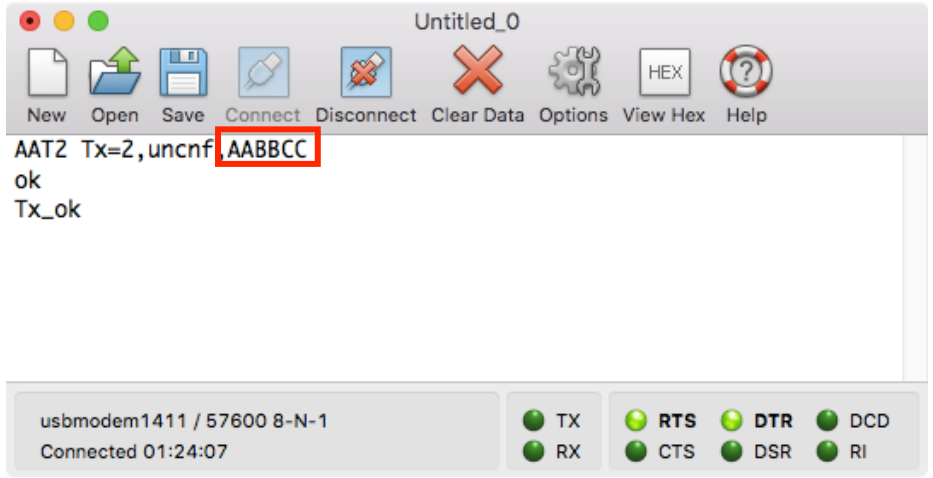


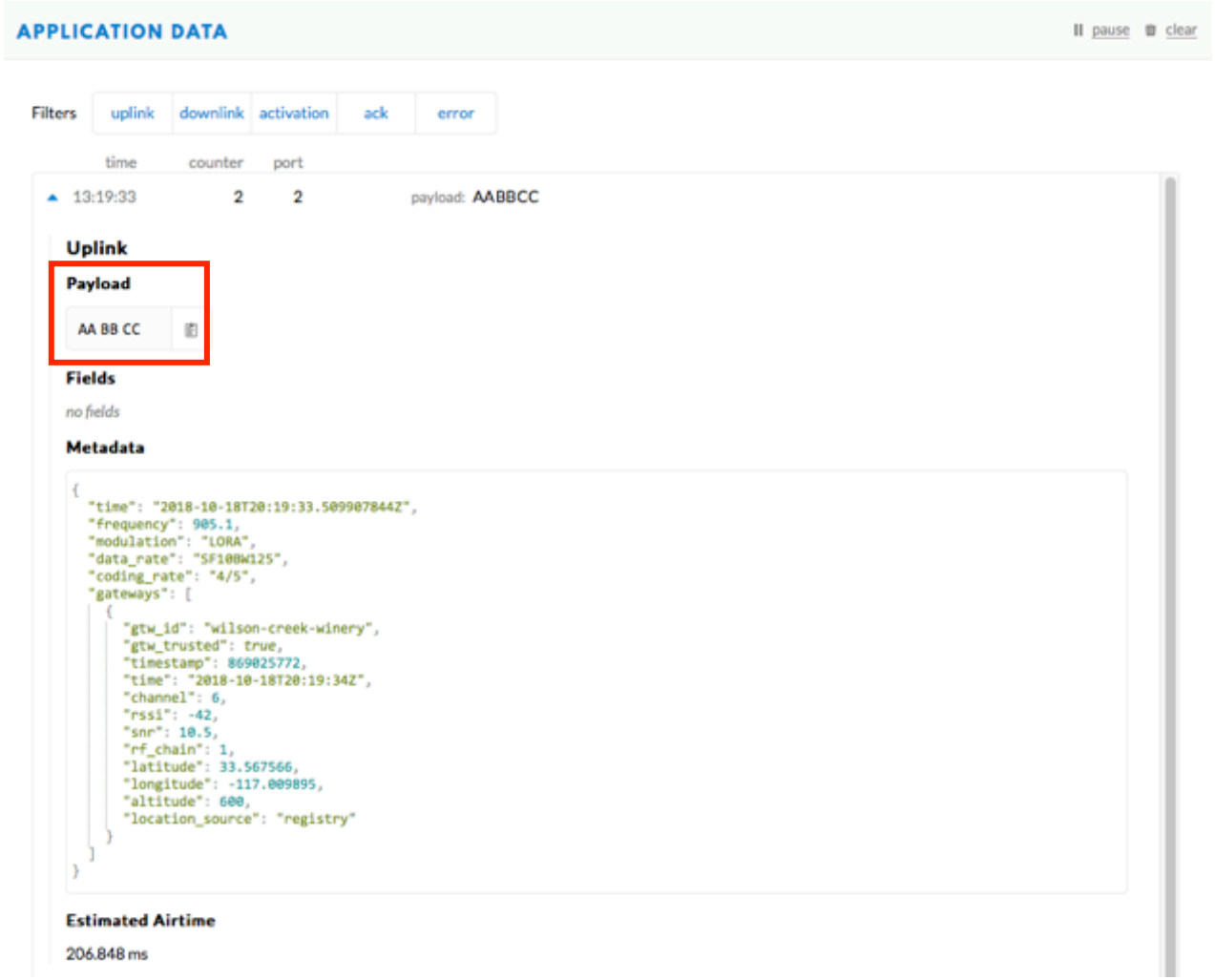
CONNECTED TO THE LORA NETWORK!!



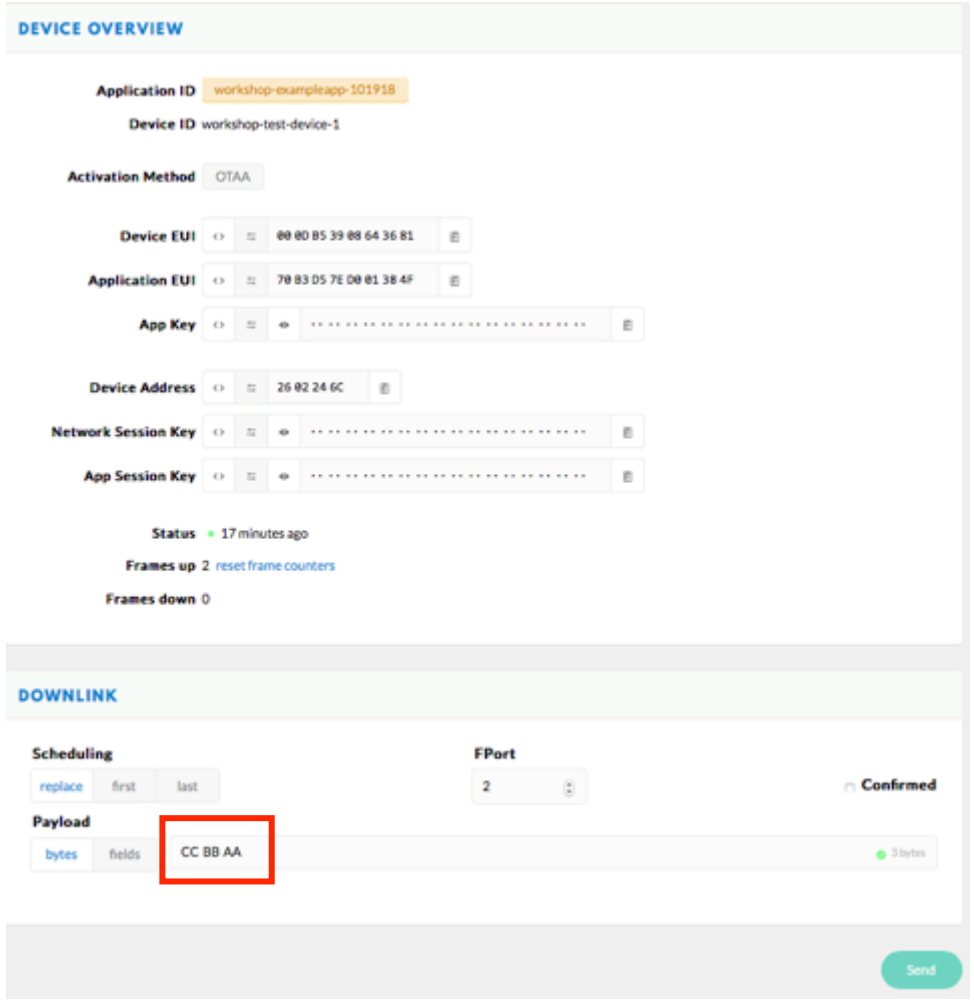


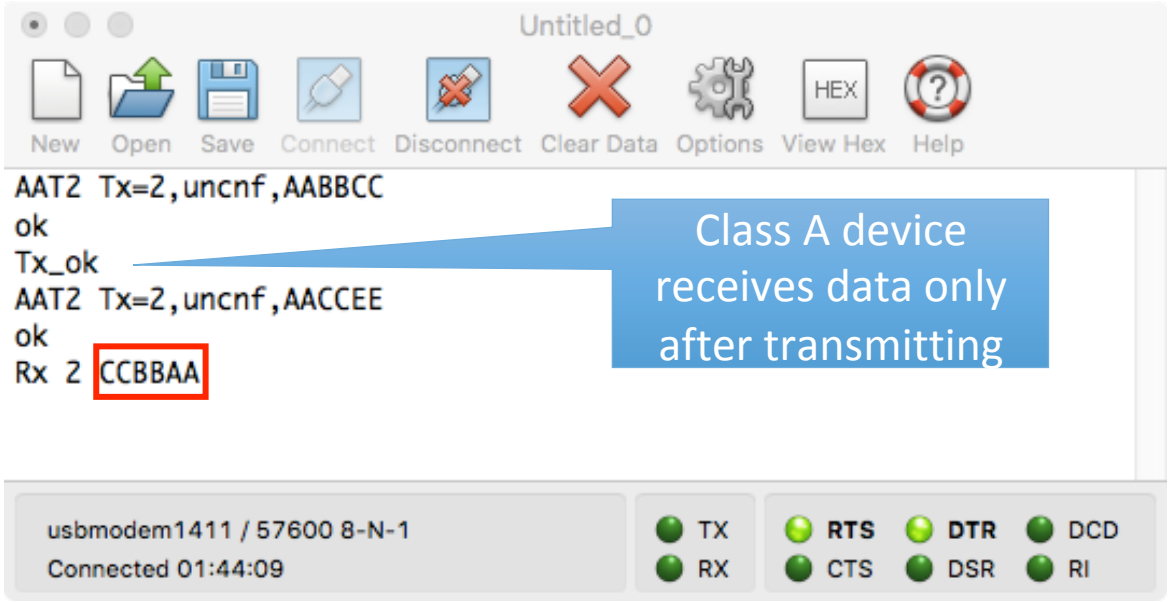
NOW LET'S SEND SOME DATA!!





RECEIVING DATA

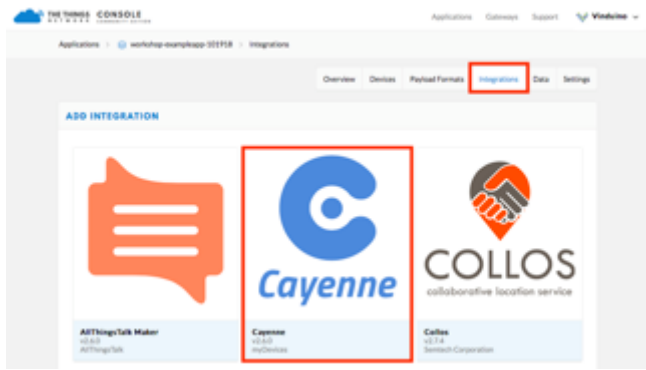


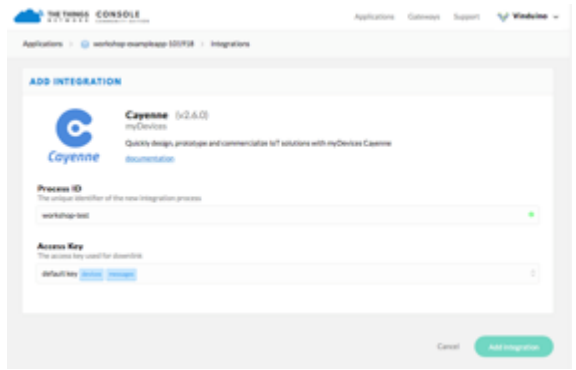


VISUALIZE YOUR SENSOR DATA

ADD CAYENNE INTEGRATION

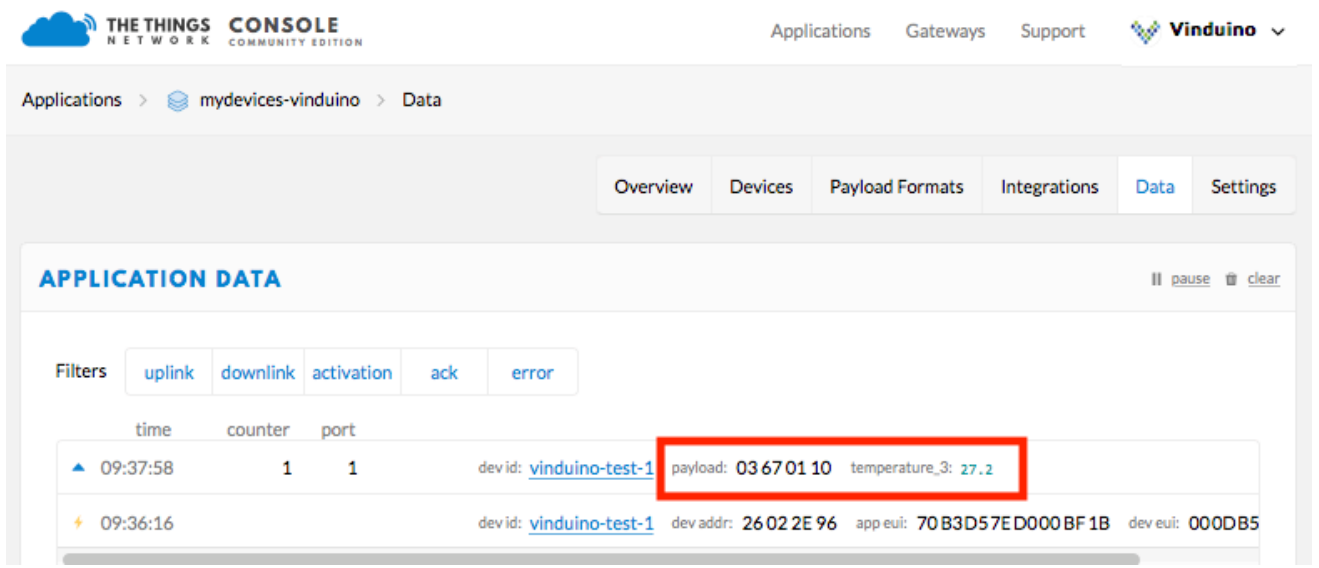
- Process ID : any unique name
- Access Key: use default key





TEST INTEGRATION

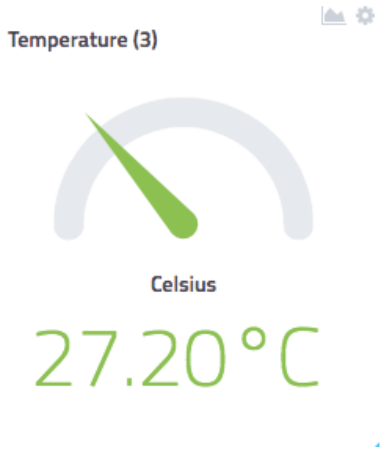
- AAT2 Tx=1,uncnf,03670110
- 03=data channel
- 67= data type, Temperature
- 0110= Value = 272 =>27.2C

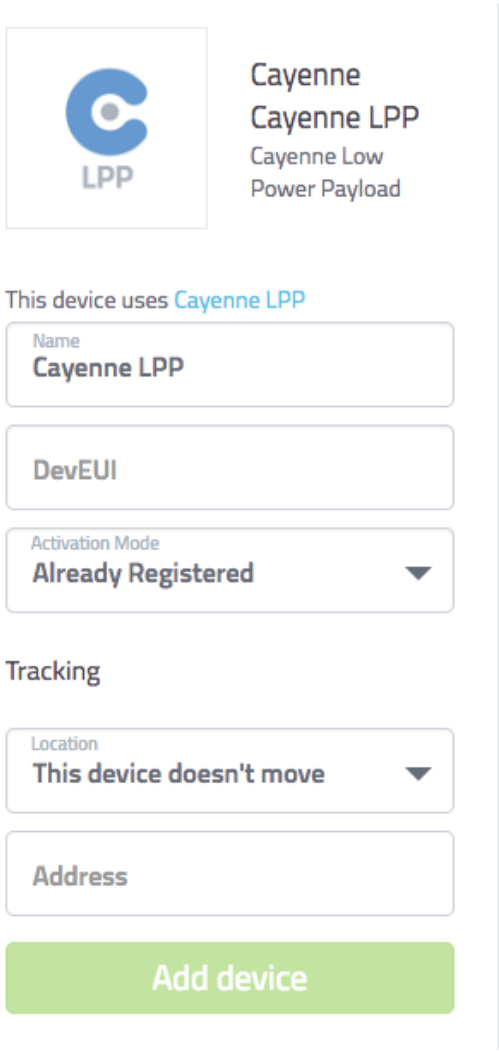


USING CAYENNE

SET UP DEVICE IN CAYENNE

- Add new … Devices & Widgets
- Select LoRa / TheThingsNetwork
- In devices list: select Cayenne LPP
- Enter DevEUI:
- AAT2 Tx=1,uncnf,03670110

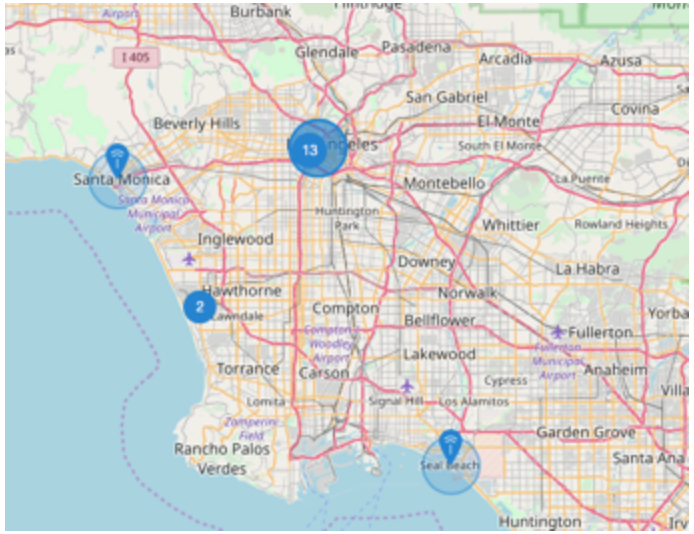




CONGRATULATIONS

USEFUL LINKS

www.thethingsnetwork.org/community/losangeles/
https://www.thethingsnetwork.org
www.usglobalsat.com
www.vinduino.com
www.tindie.com
lora-alliance.org




THANK YOU