Esempio LoRaWAN per monitoraggio ambientale

Monitor flooding from Small Watercourses, ditches and culverts

Mobilise residents and staff before a crisis develops

Small, low cost device

See what's working, what needs attention

- Threshold crossings
- Device health, battery
- Links to analytics
- Recalibrate & set thresholds

They are powered by battery and can connect wirelessly to a gateway which instantly sends the data to show on your map.

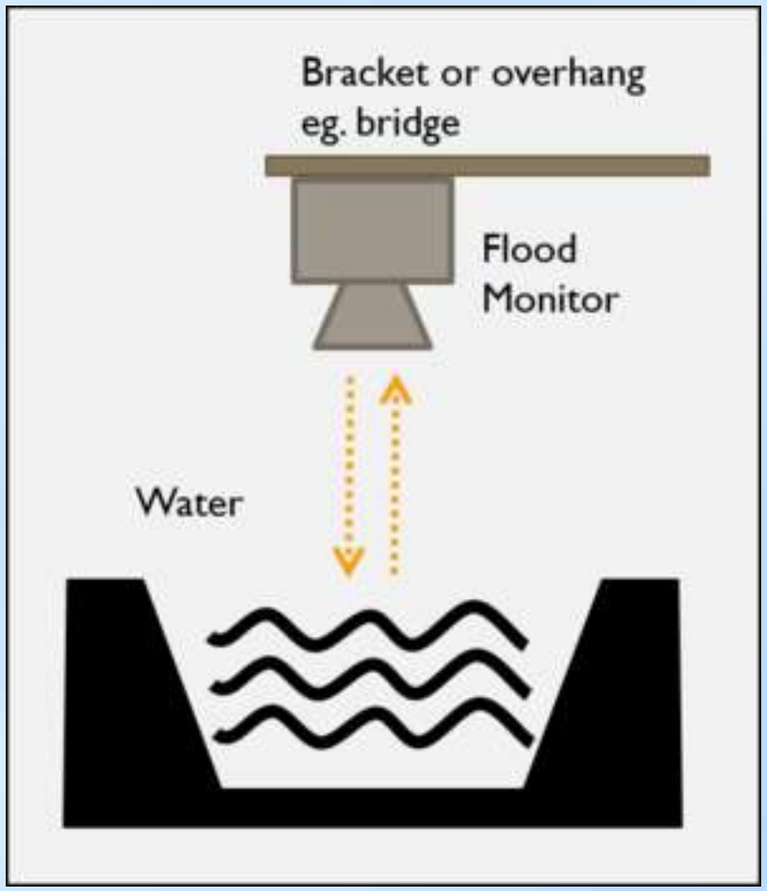
- Battery life > 1 year
- Reading interval: 15 minutes
- Max sensor range: 3m (enquire for 6m)
- Min sensor range: 20cm
- Acoustic detection pattern: 7 degrees
- CE Approved

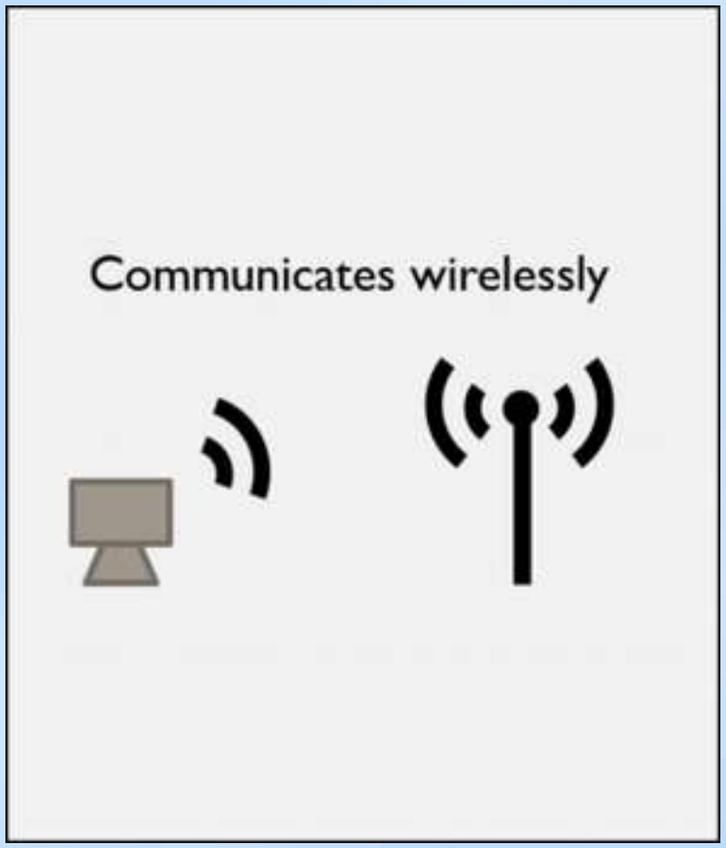
Flood Monitor

+ 1 Year Subscription

£418.00

Flood Network





E noi cosa facciamo?

Abbiamo RMAP e Stima

Trasporti

In pratica i trasporti "passivi" permettono di eseguire procedure remote codificate in formato json specifiche dell'implementazione Stima; quelli attivi permettono la pubblicazione su server (broker) dei messaggi aderenti allo standard R-MAP.

Trasporti Passivi:

- Seriale
- TCP/IP
- Bluetooth (serial port profile)
- NRF24

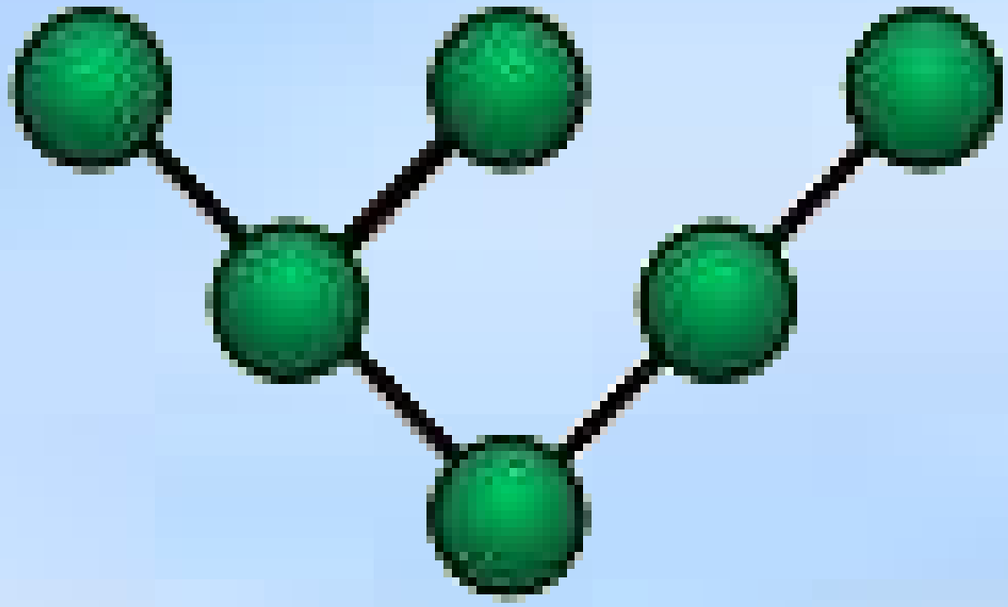
Trasporti

Trasporti attivi:

- MQTT
- AMQP
- LoraWan

Migrazione da RF24Network

- Trasporto **RF24Network**
  - OSI Network Layer using nRF24L01(+) radios 2.4GHz ISM
  - 50/150m in aria libera
  - Host Addressing. Each node has a logical address on the local network.
  - Message Forwarding. Messages can be sent from one node to any other, and this layer will get them there no matter how many hops it takes.
  - Ad-hoc Joining. A node can join a network without any changes to any existing nodes.



Tree

A RadioHead

Full-featured library provides an object-oriented interface for sending and receiving packetized data messages with a range of radio and other transports

RadioHead consists of 2 main sets of classes:

- Drivers provide low level access to a range of different packet radios and other packetized message transports.

- Managers provide high level message sending and receiving facilities for a range of different requirements.

RadioHead drivers

- Hope-RF **RF22B** and **RF23B** based transceivers, **RFM22B RF23BP**
- Silicon Labs **Si4460/4461/4463/4464** family of transceivers chip, HopeRF **RF24/26/27**, HopeRF **RFM24W/26W/27W**
- Hope-RF **RF69B** based radio modules, such as the **RFM69** module, **RFM69W, RFM69HW, RFM69CW, RFM69HCW** (Semtech **SX1231, SX1231H**)
- Nordic **nRF24** based 2.4GHz radio modules, such as **nRF24L01** and others, **Hope-RF RFM73,BK2423**
- Nordic **nRF905** based 433/868/915 MHz radio modules.
- Nordic **nRF51** compatible 2.4 GHz SoC/devices such as the **nRF51822**, Sparkfun **nRF52832**
- **Semtech SX1276/77/78/79, Modtronix inAir4 and inAir9, and HopeRF RFM95/96/97/98 and other similar LoRa capable radios. Supports Long Range (LoRa) with spread spectrum frequency hopping, large payloads etc.**
- Microchip **MRF89XA** and compatible transceivers. and modules such as **MRF89XAM9A**.
- Texas Instruments **CC110L** transceivers and compatible modules such as **Anaren AIR BoosterPack 430BOOST-CC110L**
- **EBYTE E32-TTL-1W** serial radio transceivers
- ASK (amplitude shift keying) RF transceivers such as **RX-B1 TX-C1** transmitter and **DR3100** transceiver; **FS1000A/XY-MK-5V** transceiver; **HopeRF RFM83C / RFM85**
- **RS232, RS422, RS485, RS488** and other point-to-point and multidropped serial connections, or with TTL serial UARTs

RadioHead Managers

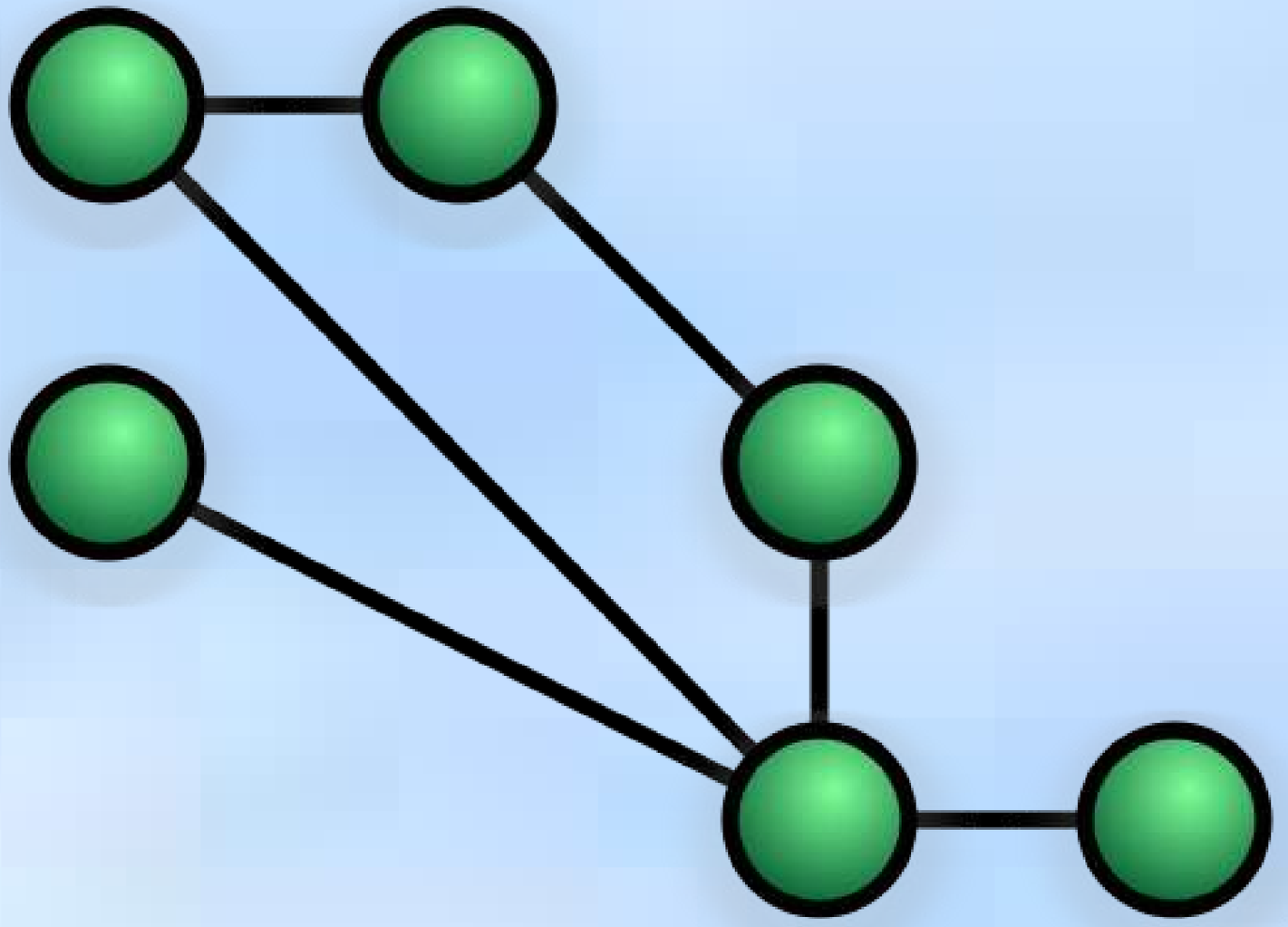
The following Managers are provided:

- **RHDatagram**: Addressed, unreliable variable length messages, with optional broadcast facilities.
- **RHReliableDatagram**: Addressed, reliable, retransmitted, acknowledged variable length messages.
- **RHRouter**: Multi-hop delivery of RHReliableDatagrams from source node to destination node via 0 or more intermediate nodes, with manual routing.
- **RHMesh**: Multi-hop delivery of RHReliableDatagrams with automatic route discovery and rediscovery.

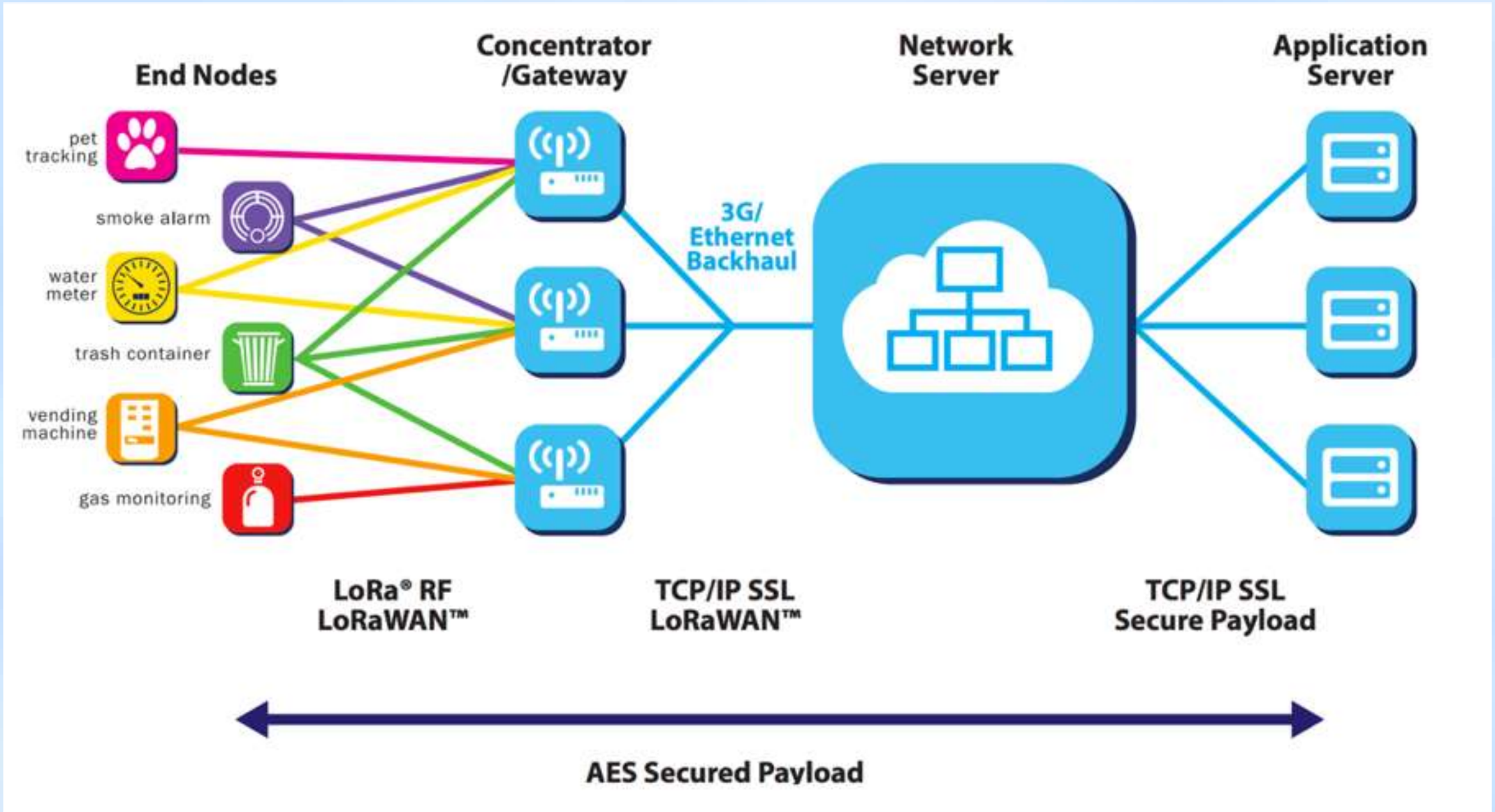
Any Manager may be used with any Driver.

Rete mesh

- Trasporto **Lora**
  Rete radio basso consumo, lunghe distanze



Gateway LoraWan



What is the difference between a “single-channel gateway”and a “real gateway”?

- A real gateway is able to listen on 8 channels and all spreading factors at the same time. Single-channel gateways are fixed to one channel and spreading factor, so they will only receive about 2% of the messages unless you specifically configure your nodes to send at the exact same configuration as your single-channel gateway.

- As LoRaWAN is a spread-spectrum radio protocol, single-channel gateways are not LoRaWAN-compatible.

- You can use a single channel gateway on the TTN network but you miss a lot of messages, if you use your own node you can match your gateway channel with that of the node and don’t miss messages because the channels are 'locked.

LoraNode Single Channel Gateway

https://github.com/things4u/ESP-1ch-Gateway-v5.0

LoRaWan - Gateways

- List of commercial gateways:

  https://www.thethingsnetwork.org/docs/gateways/start/list.htm

  - Kerlink
  - Laird – RG1xx
  - Multitech
  - Lorrier
  - Lorank
  - AAEON AIOT-ILRA01
  - Gemtek
  - Adaptive Modules
  - Tektelic
  - Link Labs
  - Cisco

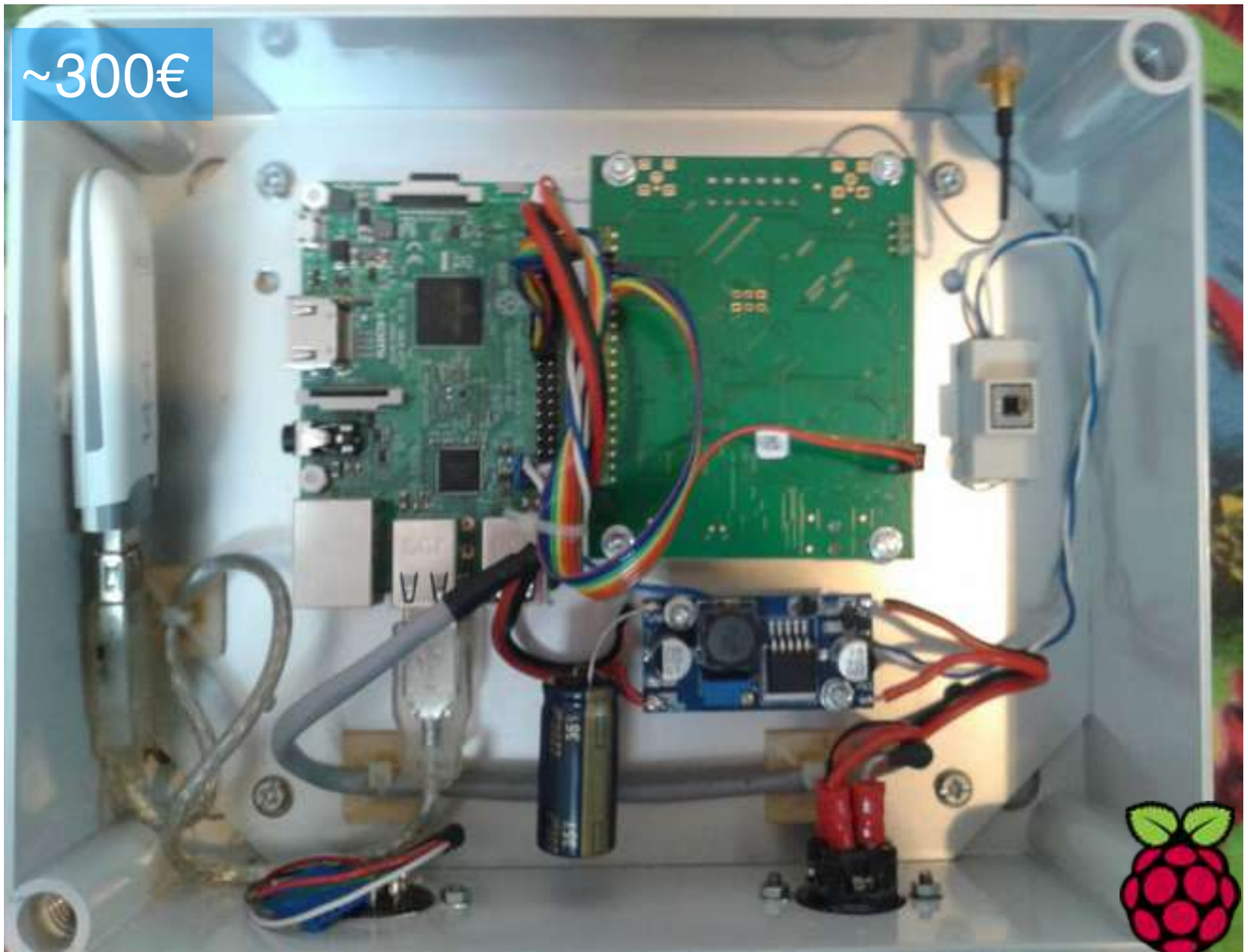
The Things Gateway

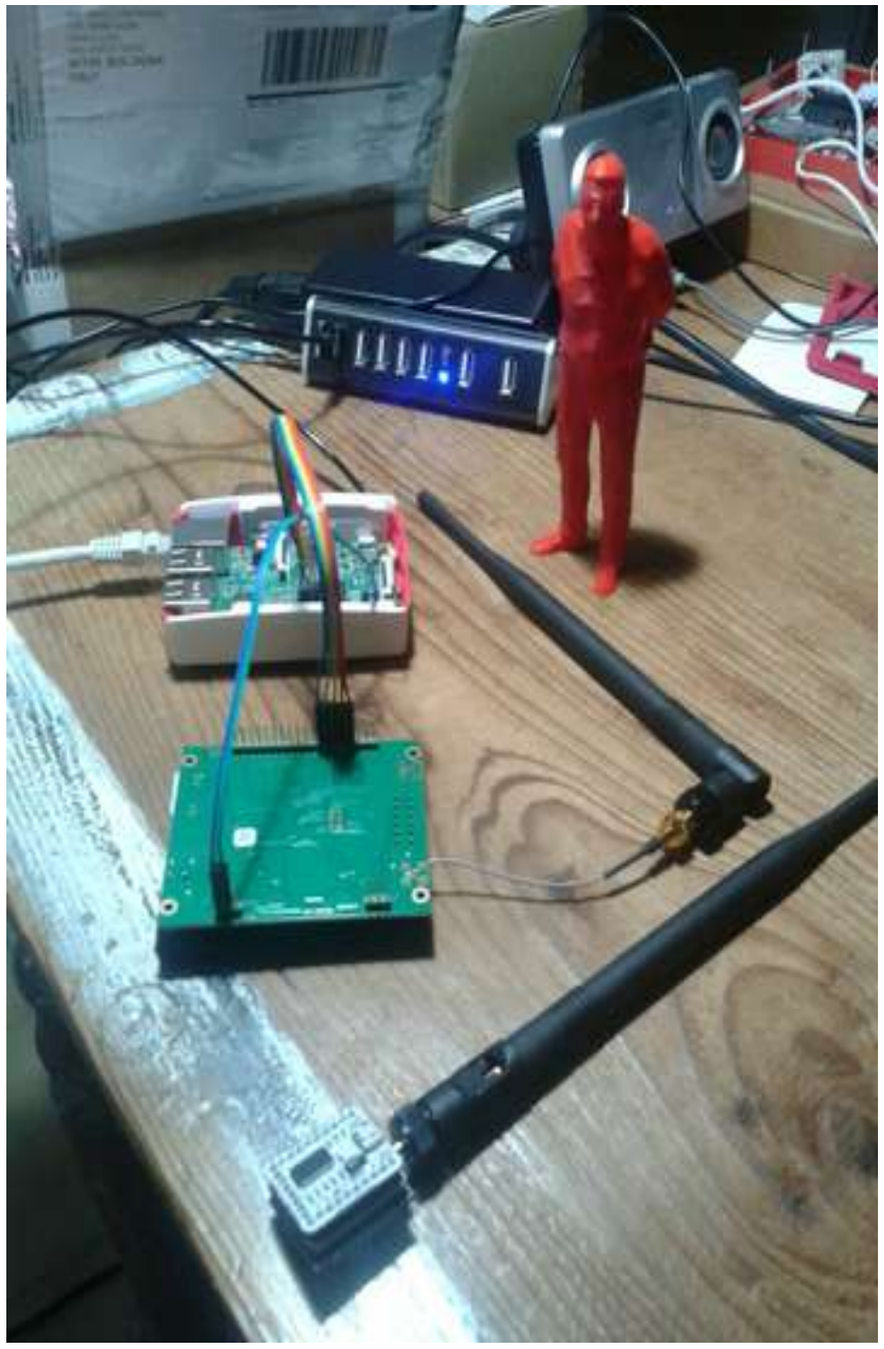
Following a successful Kickstarter TTN LoRa Gateway is now available world-wide. At a price of just under €300 and its easy, web-based setup.

Build your own gateway

http://www.raspibo.org/wiki/index.php?title=Gruppo_Meteo/HowTo/LorawanGateway

- A LoRa concentrator board, to receive LoRaWAN packets.
- An antenna, to amplify the signal.
- A computer, to process incoming and outcoming LoRaWAN packets, and to exchange them back and forth with the concentrator board.



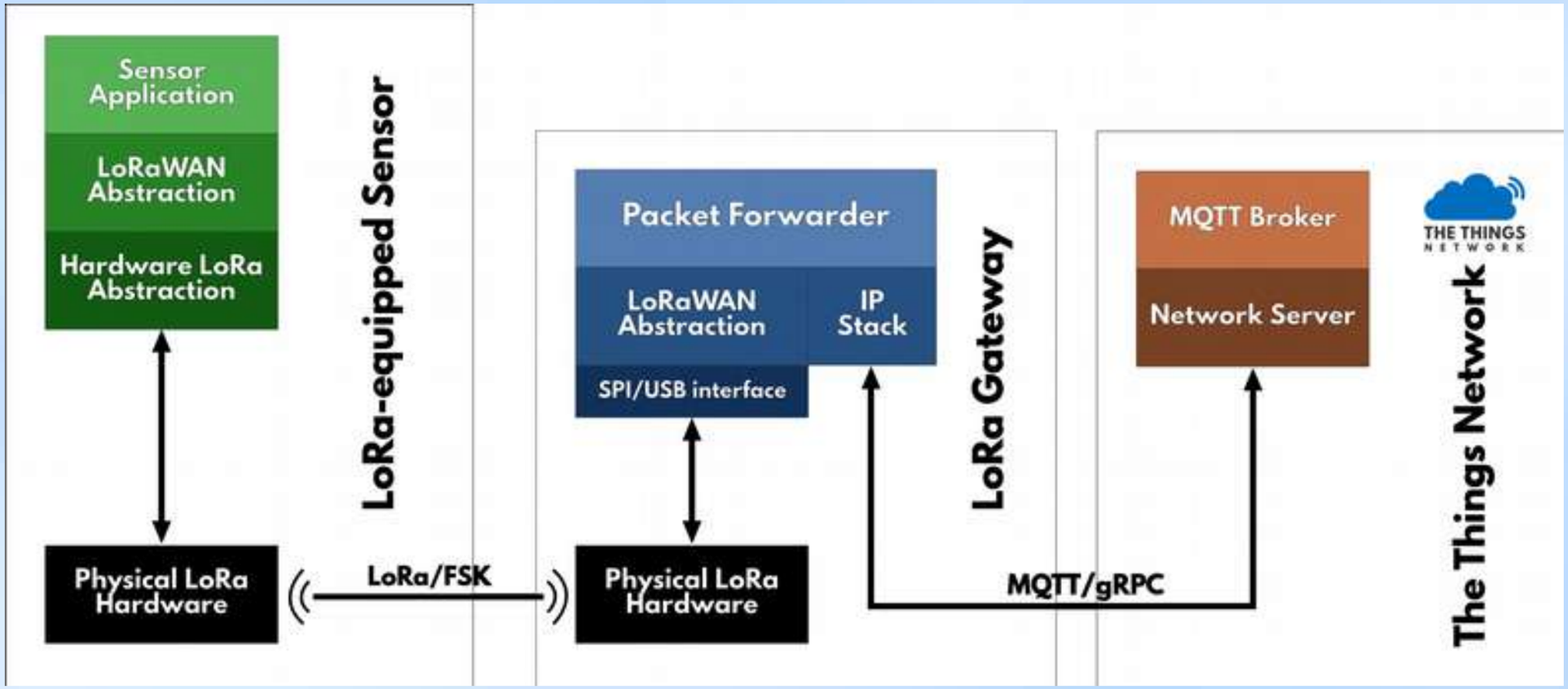


Penultimo prototipo di gateway

Packet Forwarders

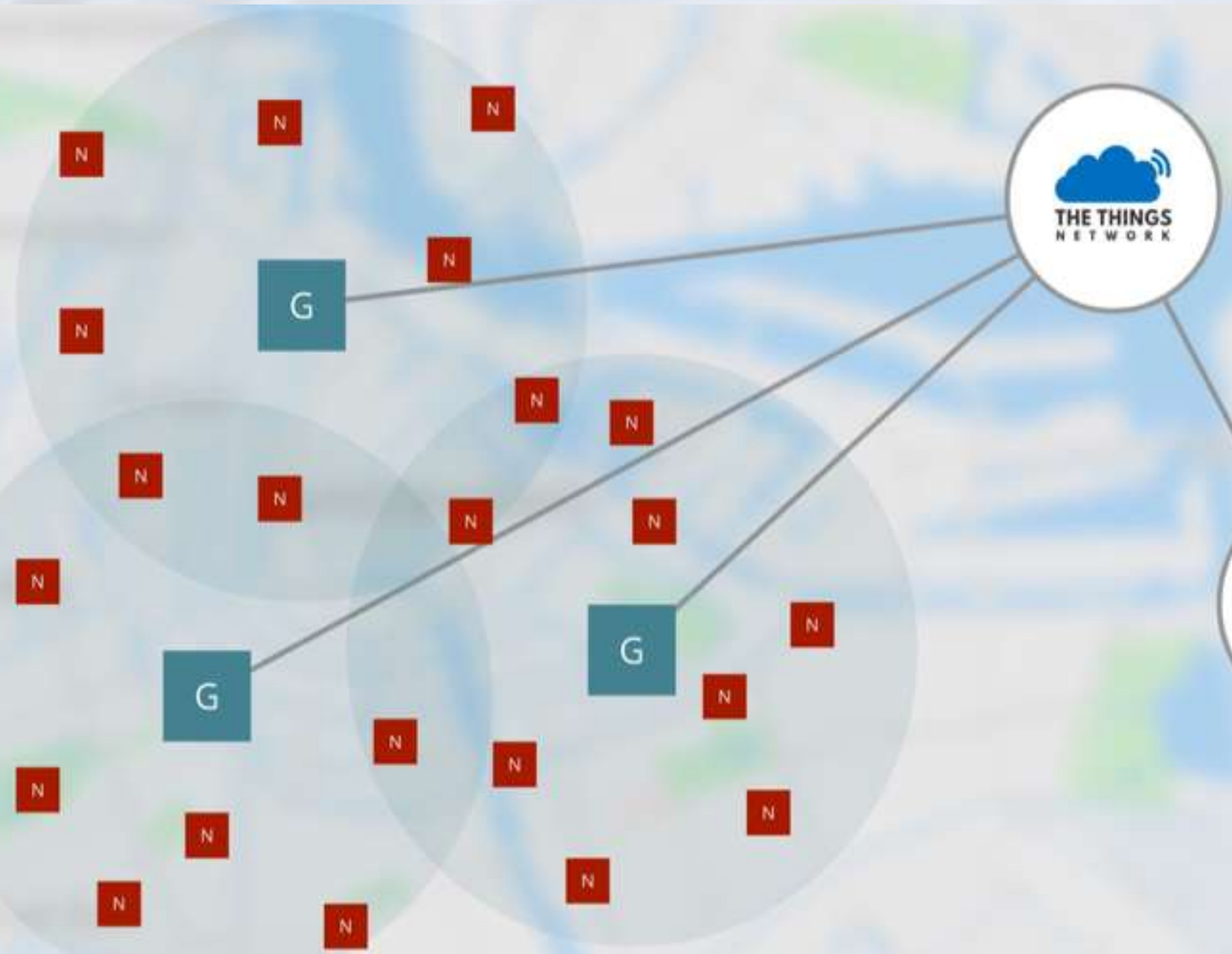
A Packet Forwarder is a program running on a gateway, that interacts:

- with the LoRa chip, to receive and transmits LoRa packets ;
- with the network, to transmit them for applications.



The Things Network

https://www.thethingsnetwork.org/



TTN fair usage per day:

- 30s uplink
- 10s downlink

1000 messaggi (SF7)
36 messaggi (SF12)

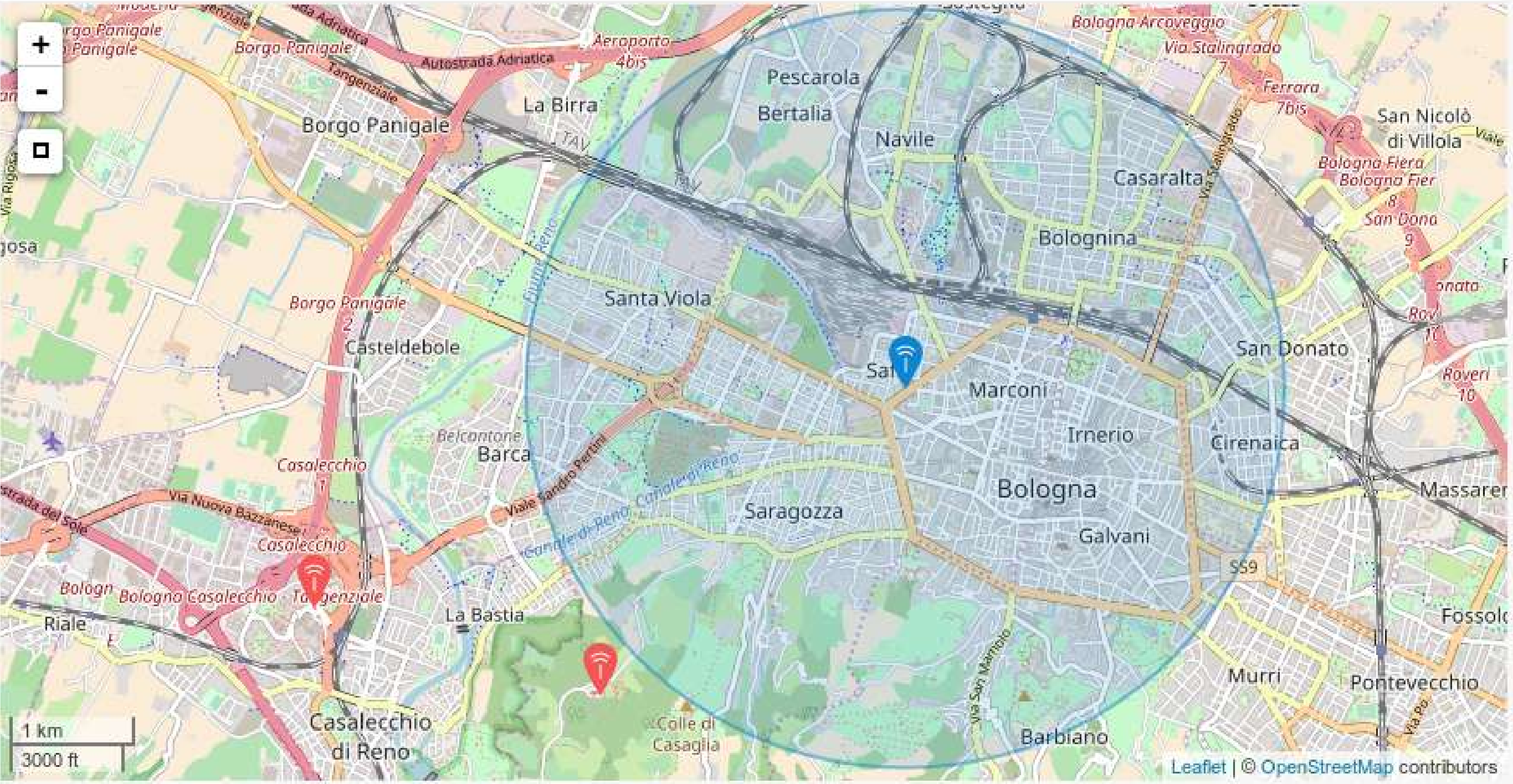
Assomiglia molto alla copertura cellulare

The Things Network - Bologna

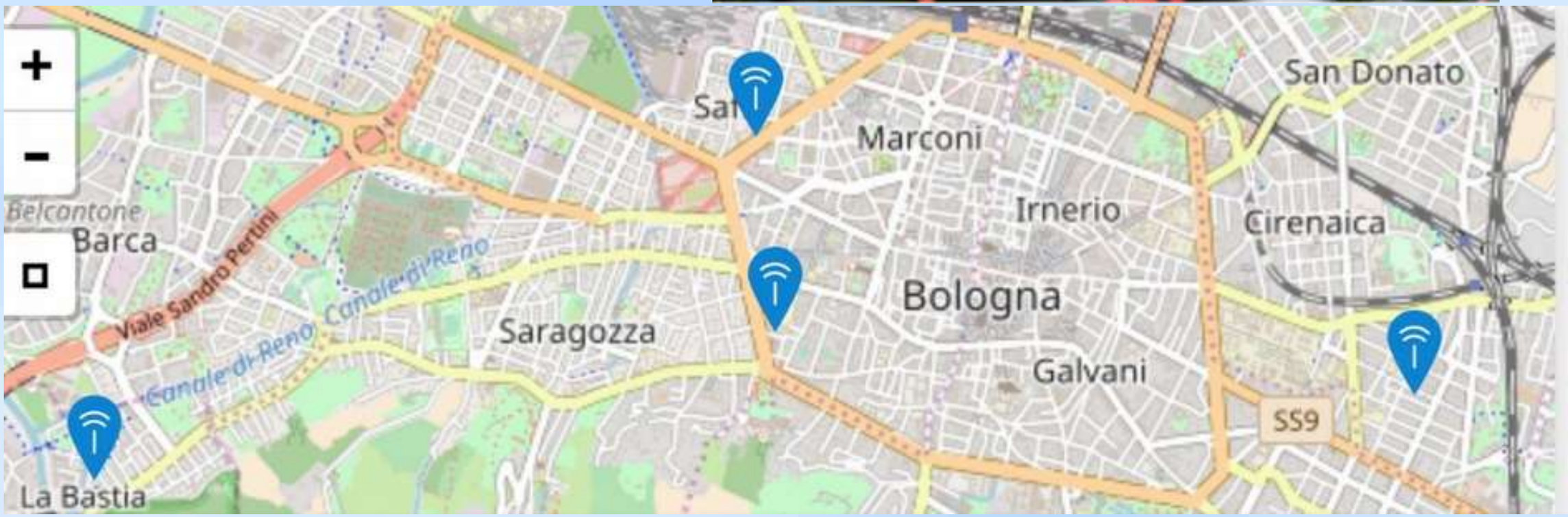
https://www.thethingsnetwork.org/community/bologna/
https://www.thethingsnetwork.org/community/emilia-romagna/

GATEWAYS

Add a gateway

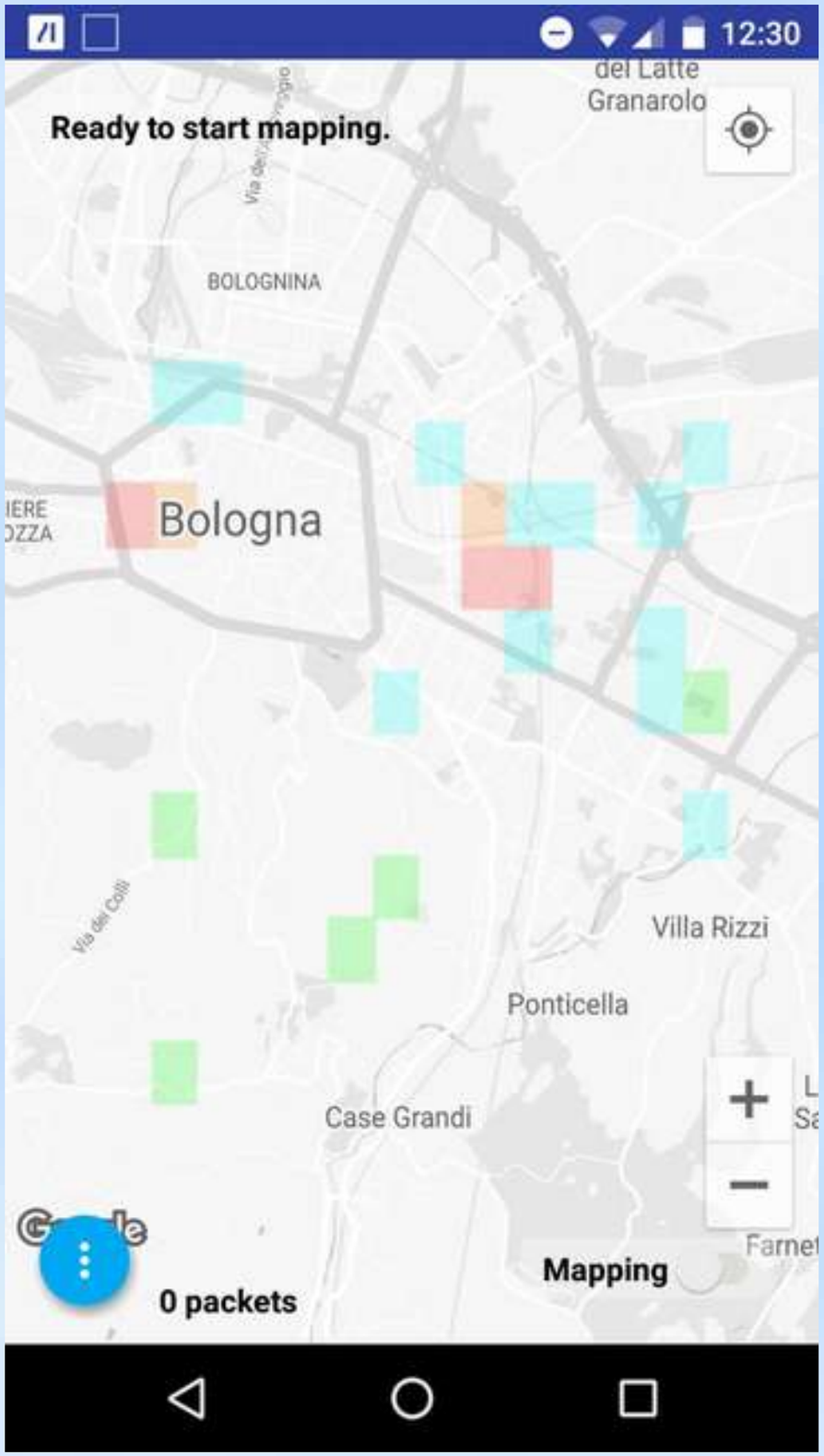


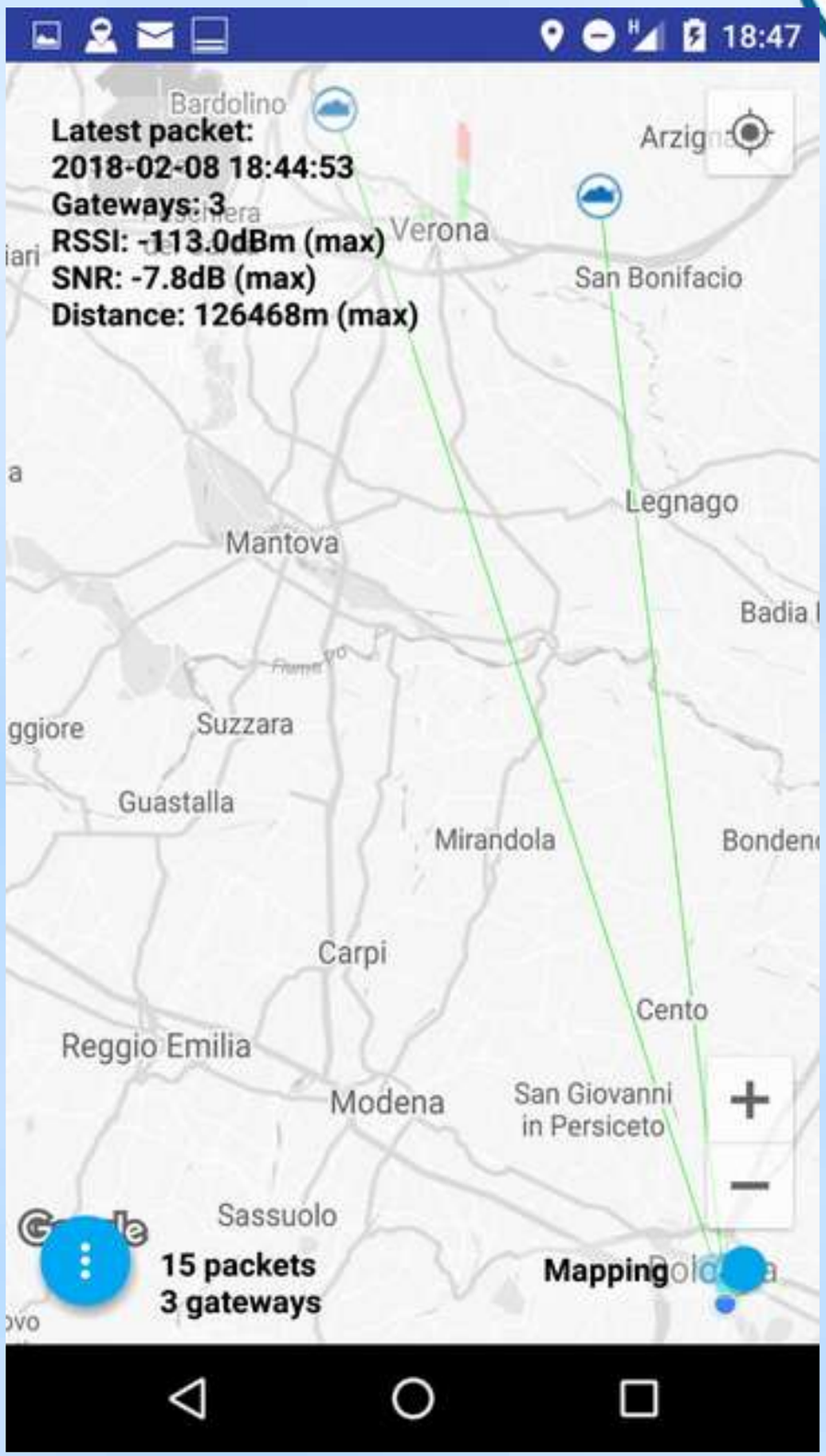
Installazioni “urbane”



La LoraWan-mobile

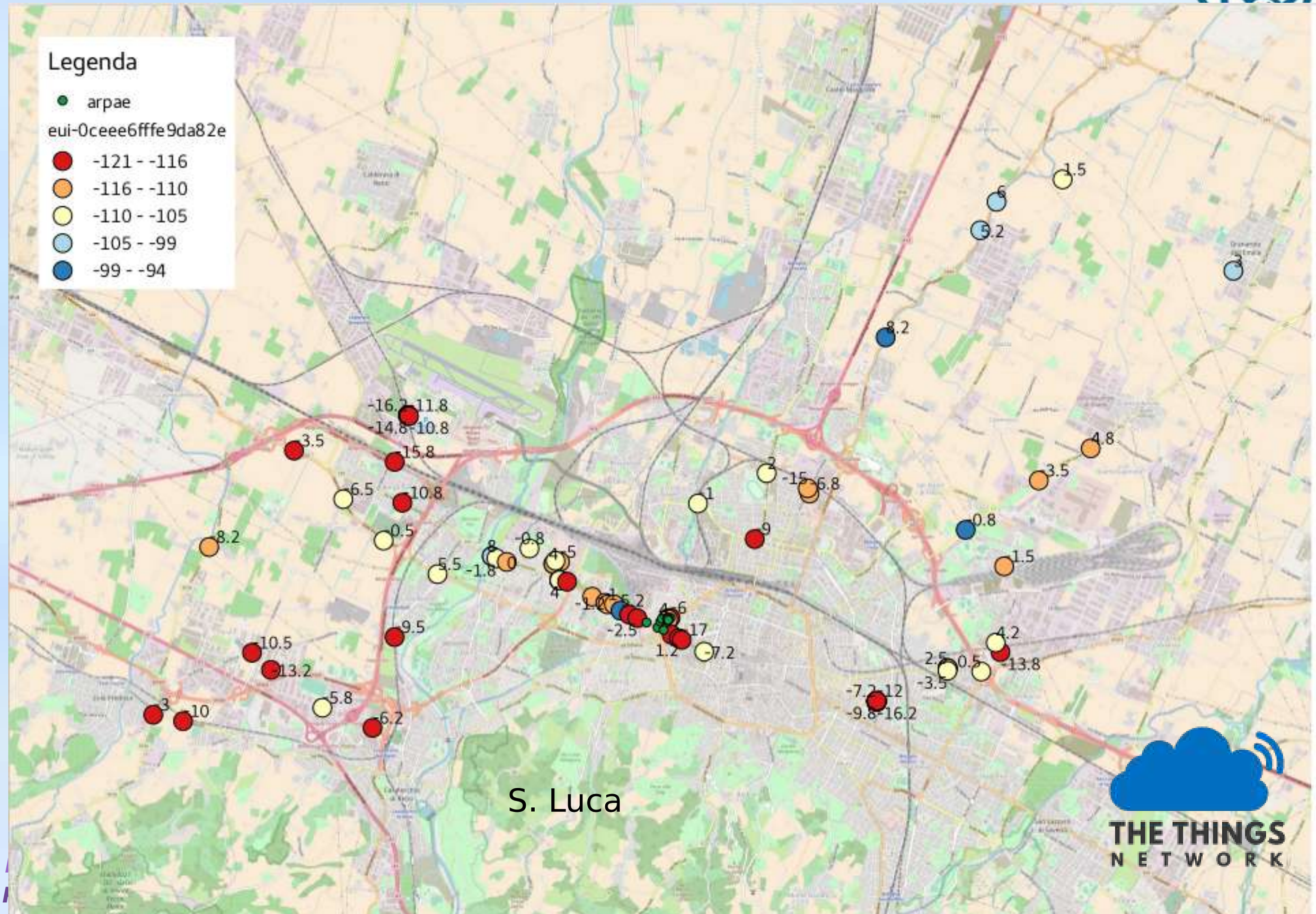
Copertura con gateway in “urbani”



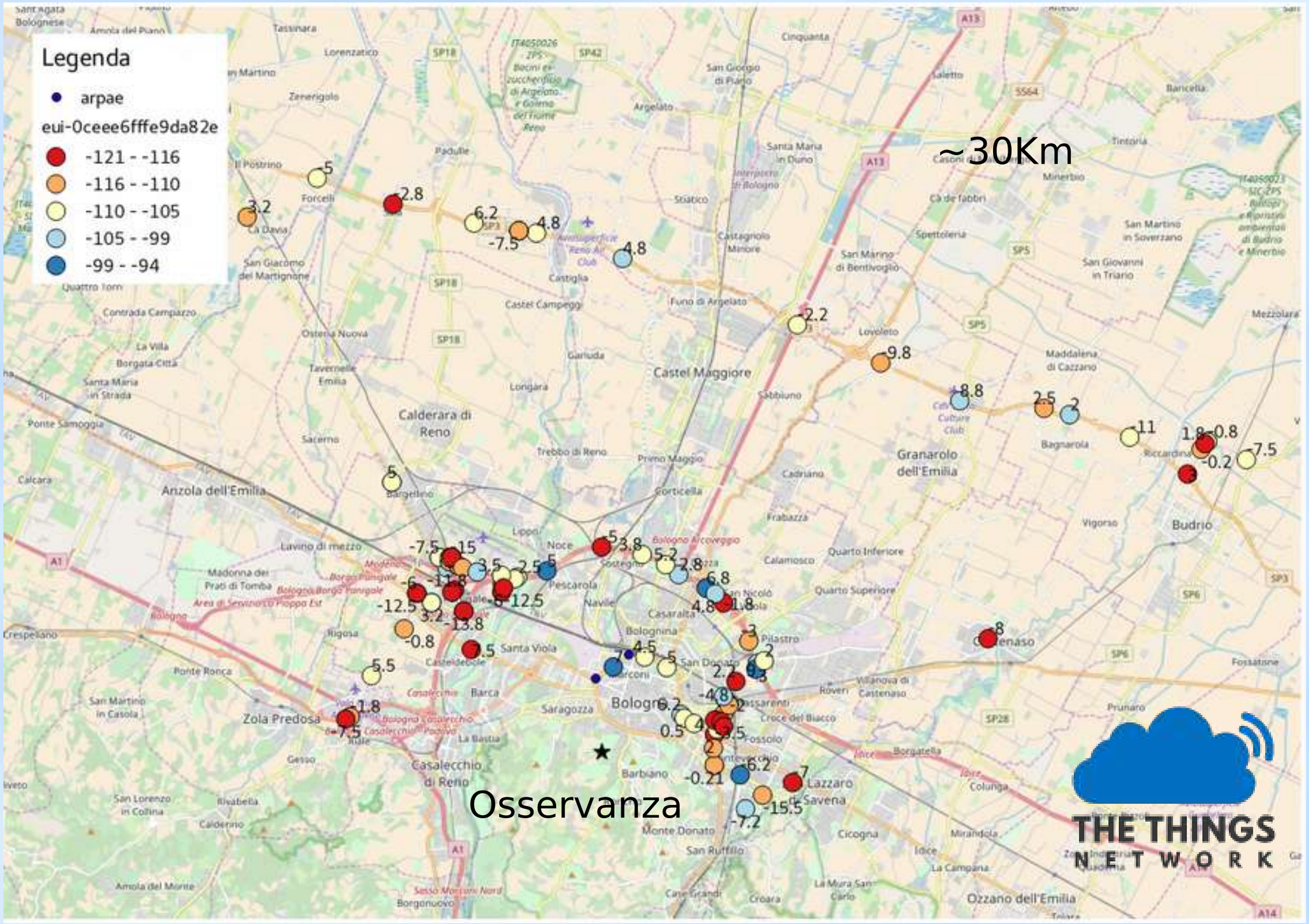


Installazioni “collinari”

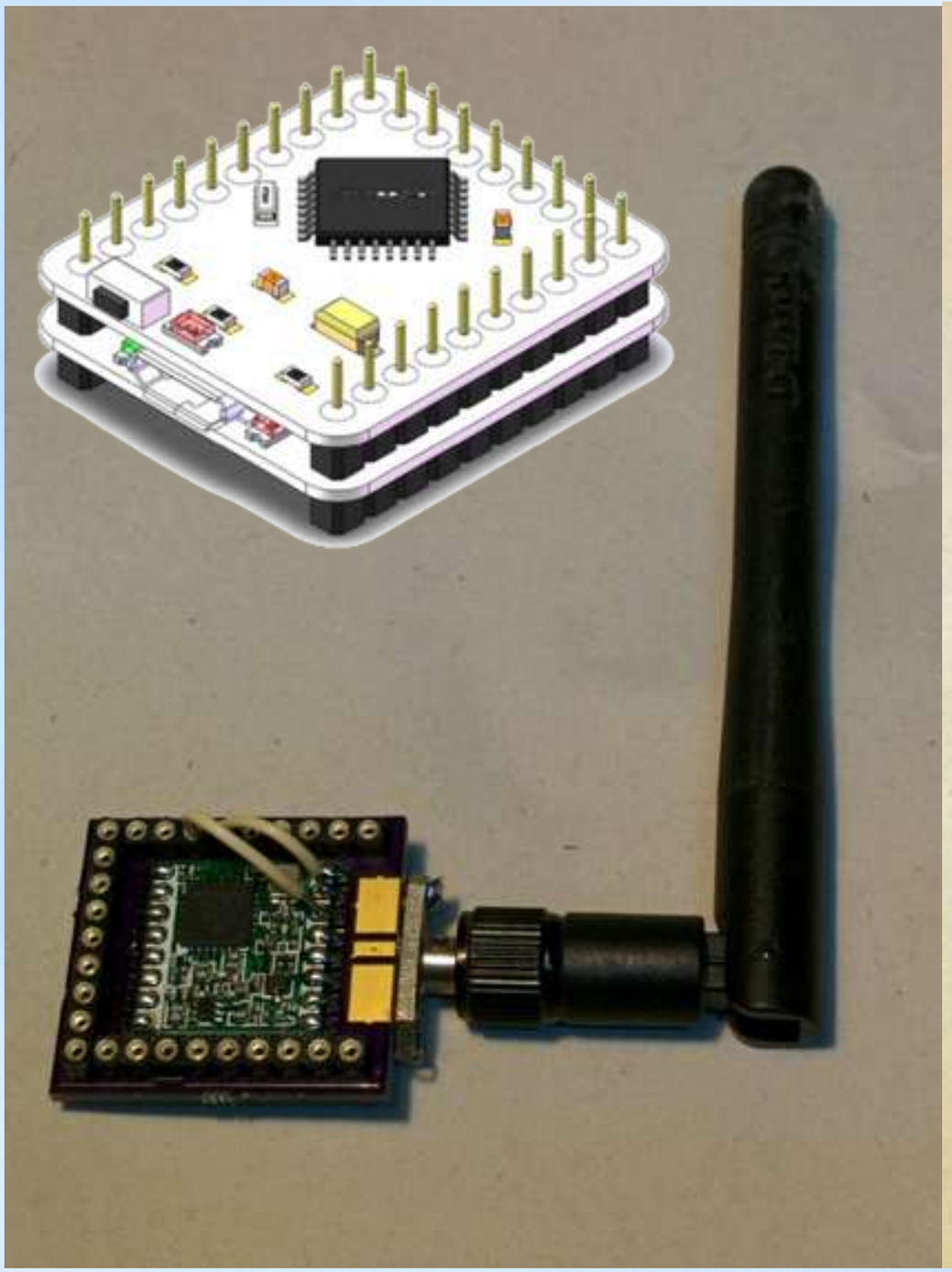
The Things Network - Bologna



The Things Network - Bologna

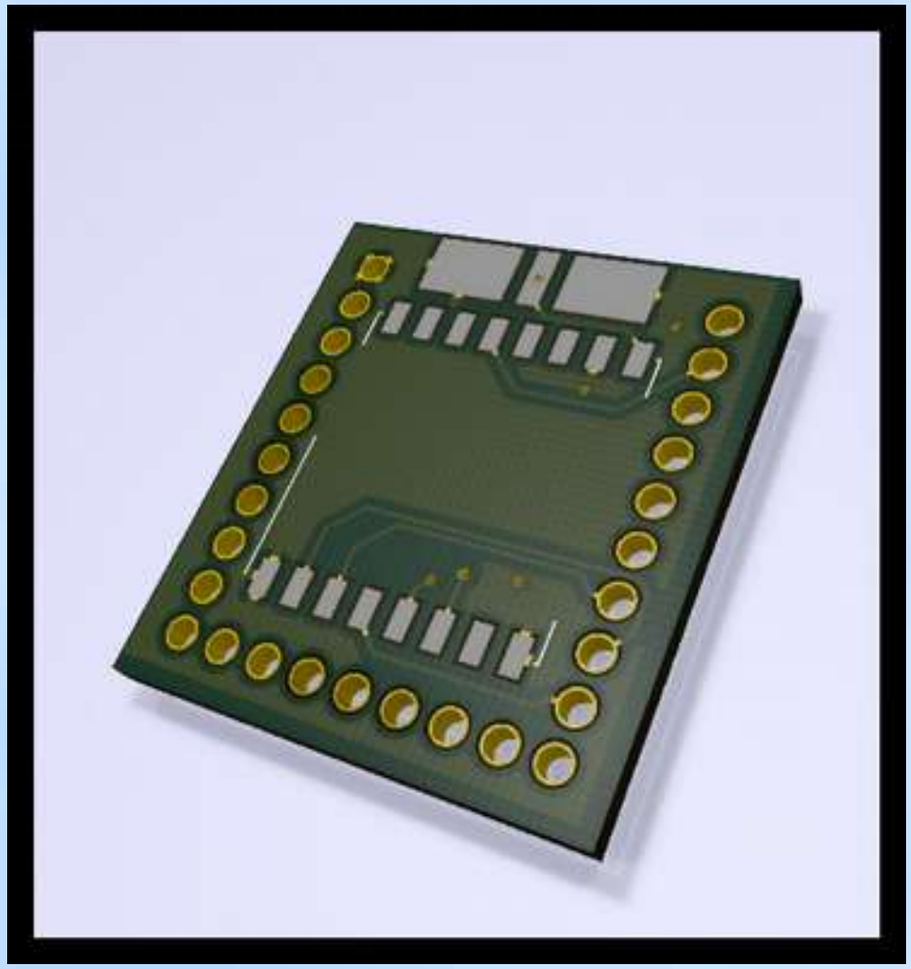


Stima-TTN



Hardware

- HOPERRF RFM95W
- Modulo adattatore Upin27
- Antenne stilo 2dB
- Atmega 644p 3.3V 8Mhz



Software

- Porting di LMIC (IBM) a Arduino
  https://github.com/matthijskooijman/arduino-lmic
- Usa libreria SensorDriver
- Configurazione tramite Jsonrpc
- Configurazione sensori tramite template
- Join OTAA
- Riconnessione tramite parametri salvati di sessione ABP
- Configurazione comunicazioni per postazione fissa o mobile
- Configurazione SF-BW (di partenza)
- Attivazione ACK
- Rispetta duty cycle di legge

Batterie

~3€

- Bassa autoscarica
- Evitare il regolatore di tensione
- Ricaricabili

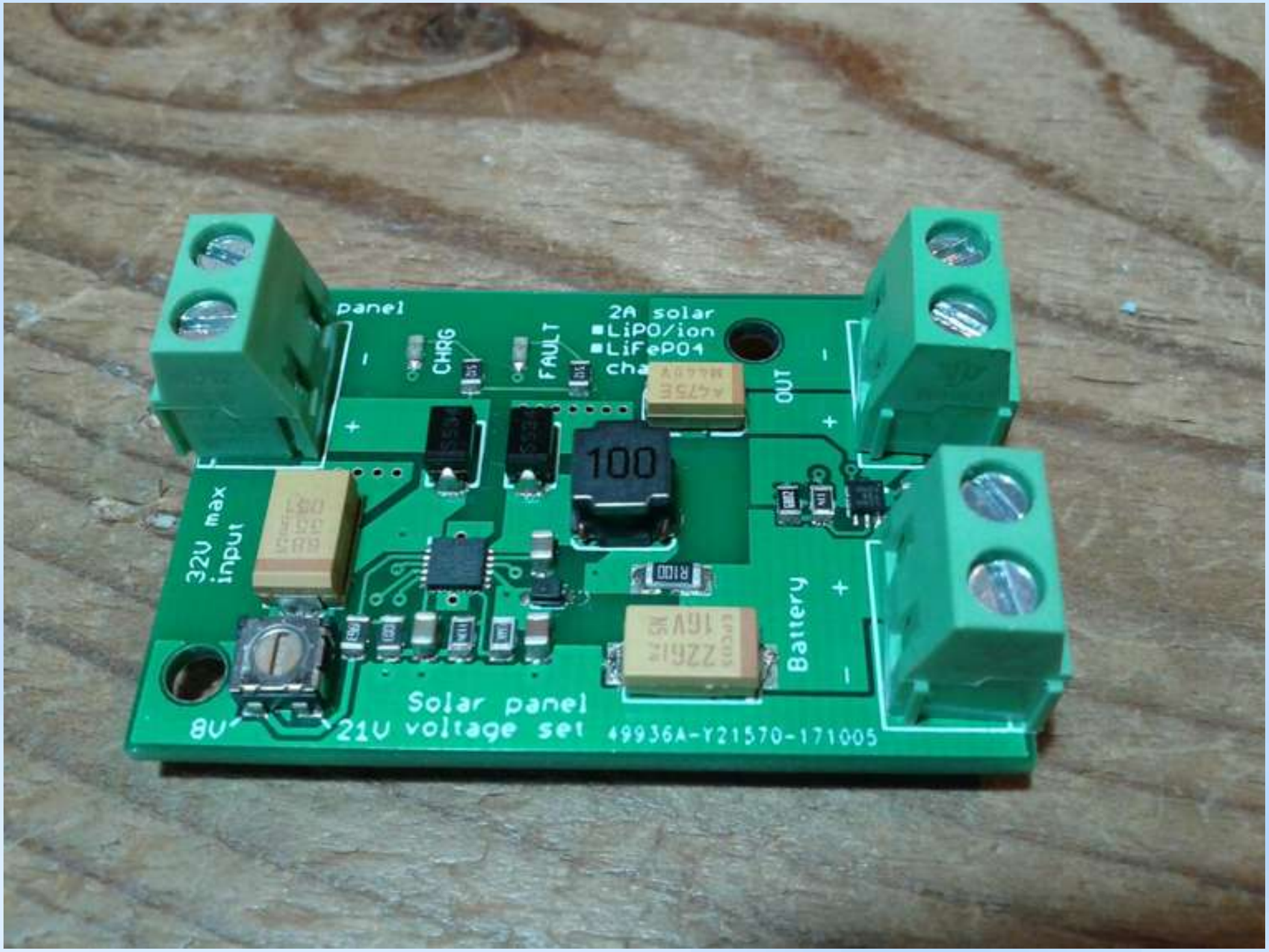
$LiFePO_4$

https://it.wikipedia.org/wiki/Accumulatore_litio-ferro-fosfato

~3€

- Autoscarica mensile 0,8%
- Tensione nominale 3.2V
- Facili da caricare con solare

Regolatore di carica per pannello solare MPPT



Dati inviati stile template BUFR (WMO)

- Un byte definisce la sequenza dei dati definendone anche tutti i metadati
- I dati sono un stream di bit impacchettati

Payload (4 byte):

011F2762

01 template number

1F2762 stream di bit contenente temperatura e umidità

Template 01:

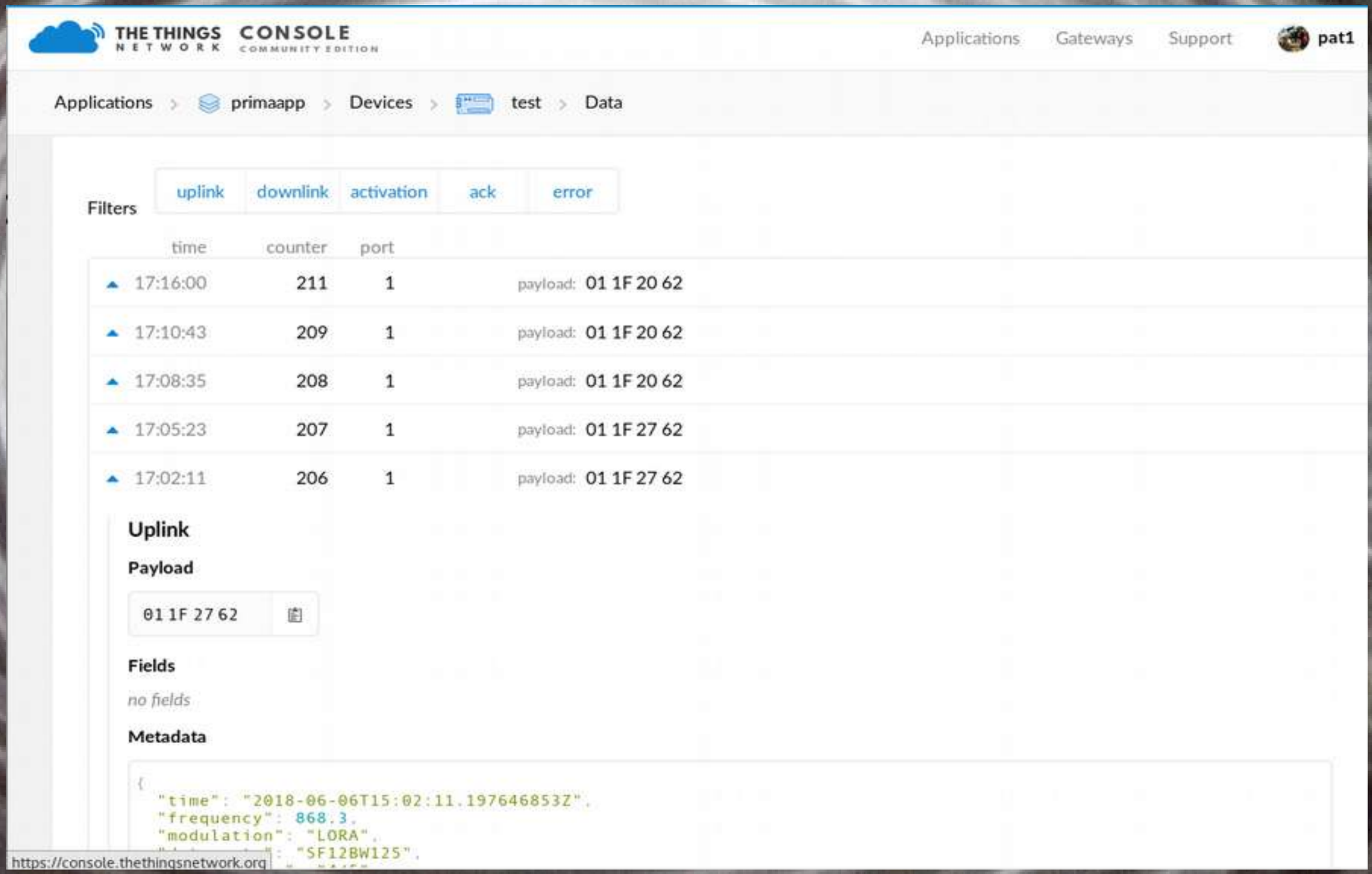
B12101 {"nbit":16,"offset":22315,"scale":100,"timerange":"254,0,0","level":"103,2000,-,-"}

B13003 {"nbit":7,"offset":0,"scale":1,"timerange":"254,0,0","level":"103,2000,-,-"}

Per ottenere i valori fisici si moltiplica per fattore di scala e si somma offset

LoRaWan - Dati Applicazione

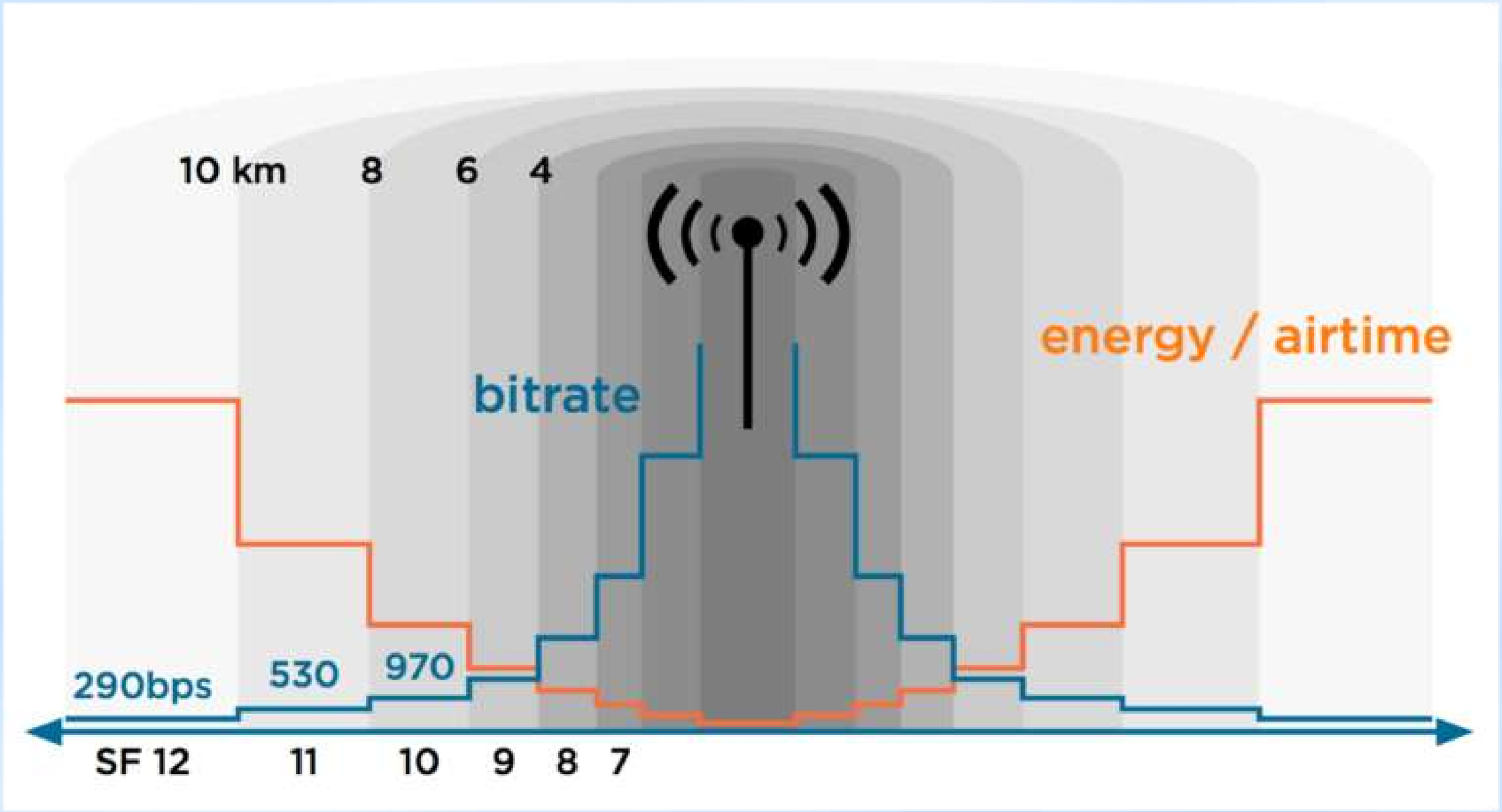
https://console.thethingsnetwork.org/



Metadata


```
{
  "time": "2018-06-06T15:02:11.197646853Z",
  "frequency": 868.3,
  "modulation": "LORA",
  "data_rate": "SF12BW125",
  "coding_rate": "4/5",
  "gateways": [
    {
      "gtw_id": "eui-0ceee6fffe9da82e",
      "timestamp": 1661816284,
      "time": "",
      "channel": 1,
      "rssi": -107,
      "snr": -16.2,
      "rf_chain": 1,
      "latitude": 44.48125,
      "longitude": 11.329837,
      "location_source": "registry"
    }
  ]
}
```

The spreading factor



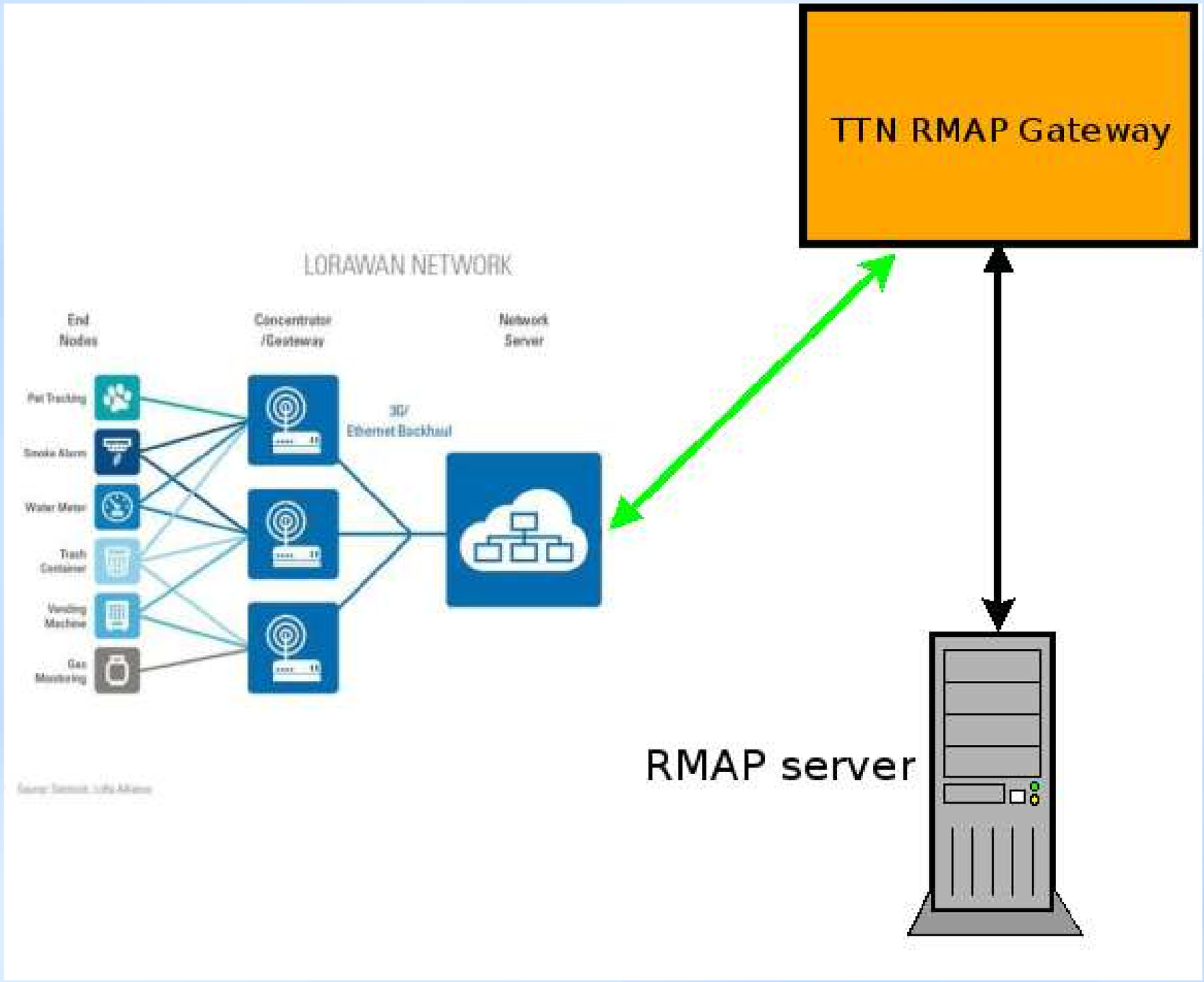
Caratteristiche funzionamento

- Funzionamento con batteria 3000mAh: 5 settimane con report ogni 3 minuti (due anni con report orari)
- Frequenza dei report: 15minuti / una ora
- Possibilità di avere converma di ricevuto

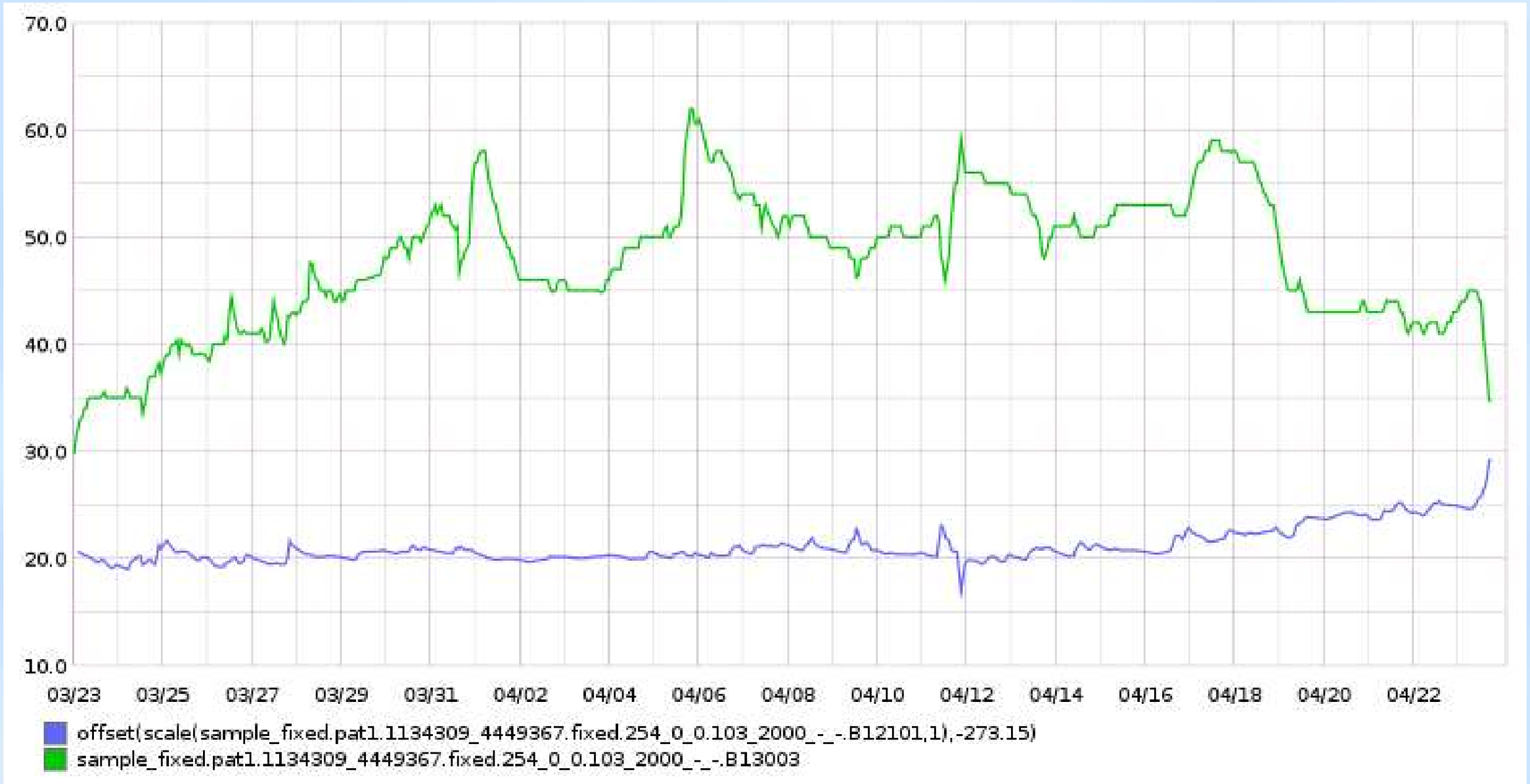
Da fare:

- Adeguamento a LoRaWAN 1.1
  - Timestamp
  - Georeferenziazione
  - Invio parametri di funzionamento (batteria)
  - Salvataggio dati in locale (scheda SD)
  - Fair use di TTN

TTN-RMAP Gateway



http://rmapv.rmap.cc/stations/pat1/ttn/



Venite a trovarci al Makerspace

- Iscrivetevi alla mailing list
- Clonate
- Forkate
- Pull requestate

- http://rmap.cc
- http://raspibo.org