



WINDOW IS OPEN

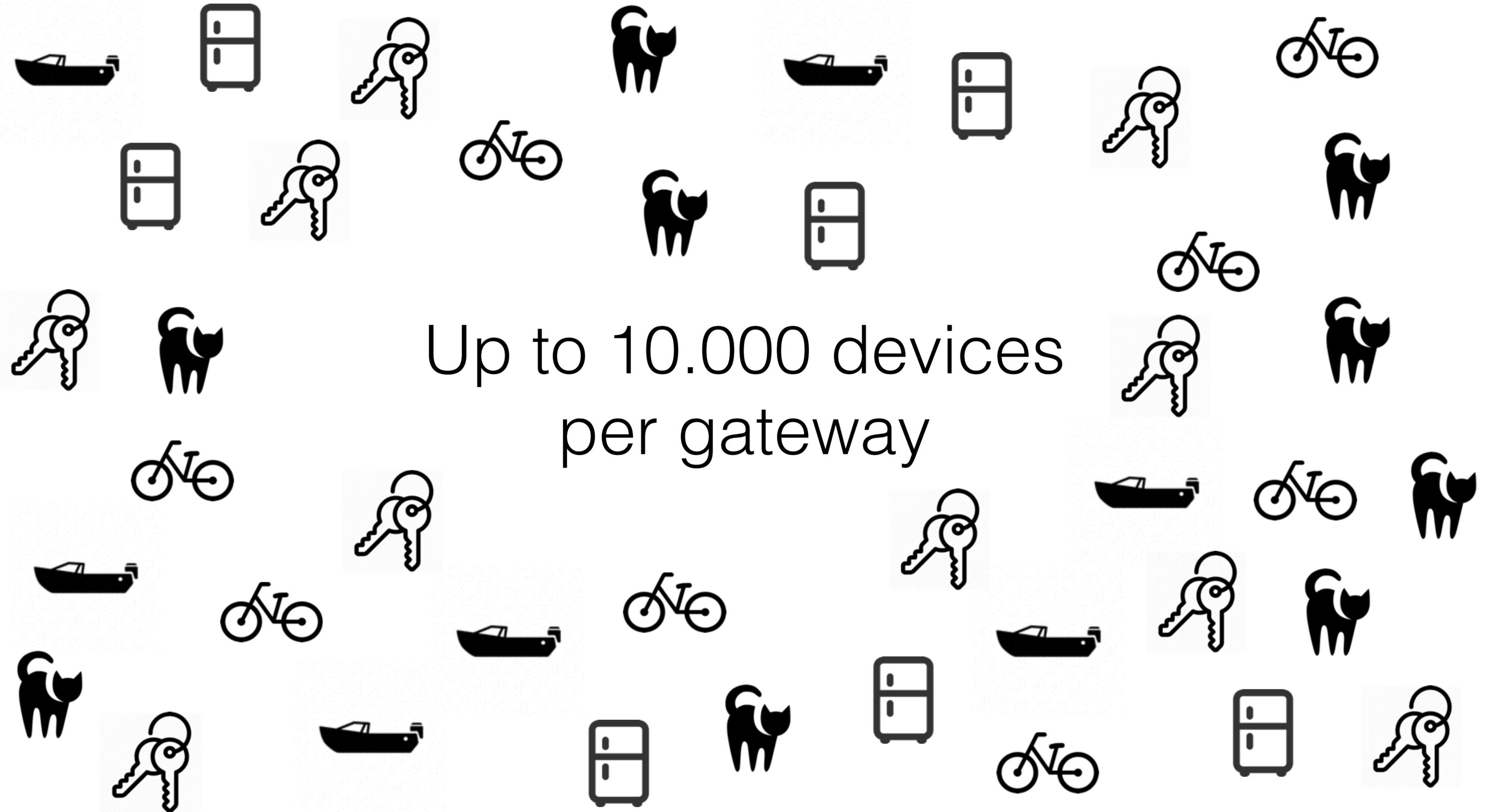


**THE THINGS**  
**N E T W O R K**

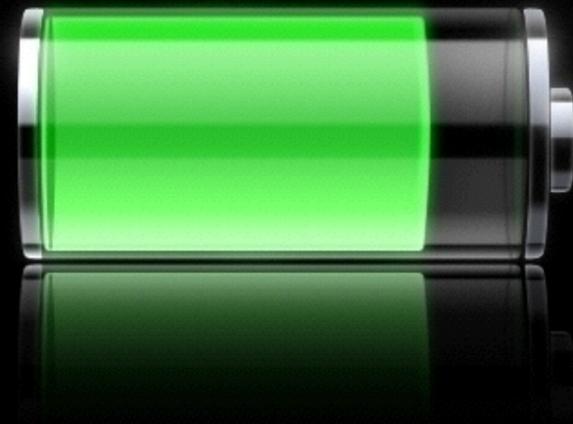
@johanstokking @thethingsntwrk



Up to 10.000 devices  
per gateway



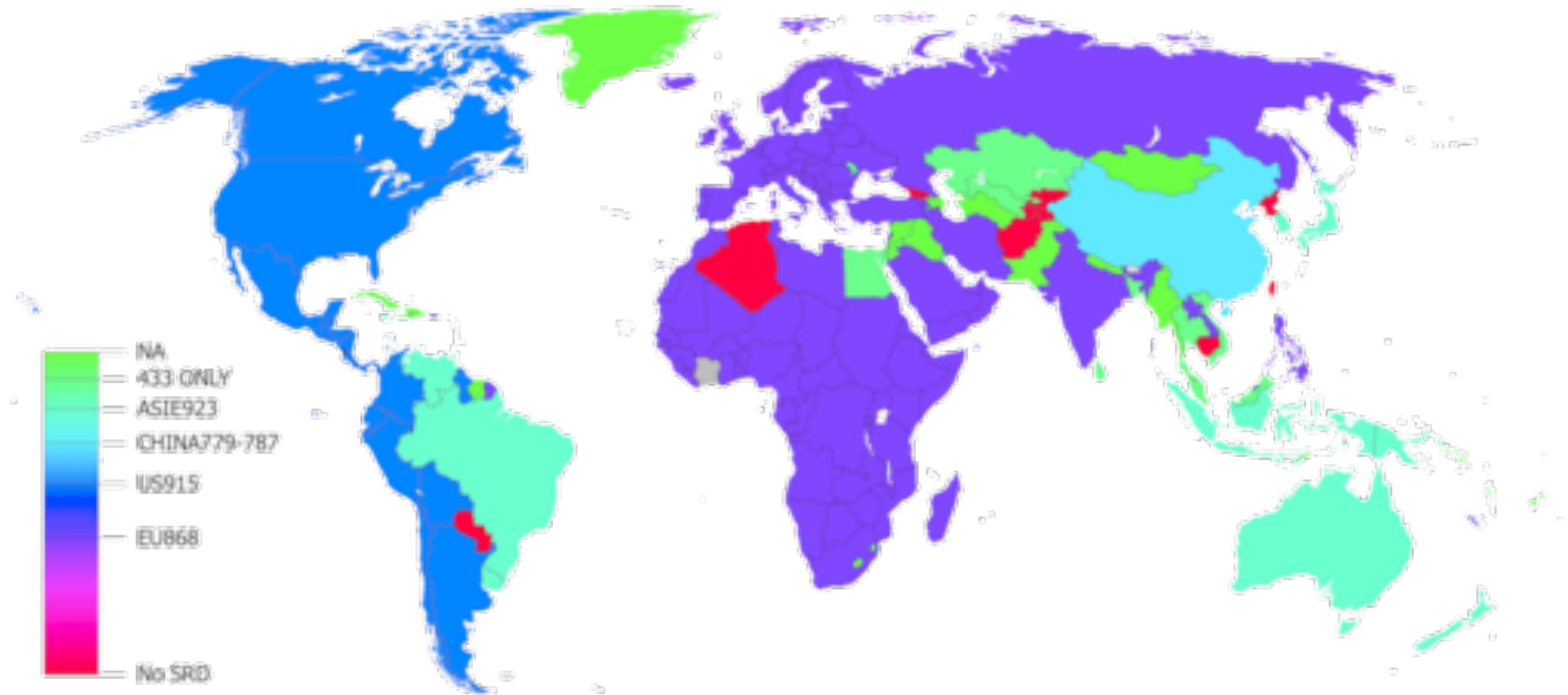
Low power and small messages



so devices can run on solar panels  
or months to years on batteries

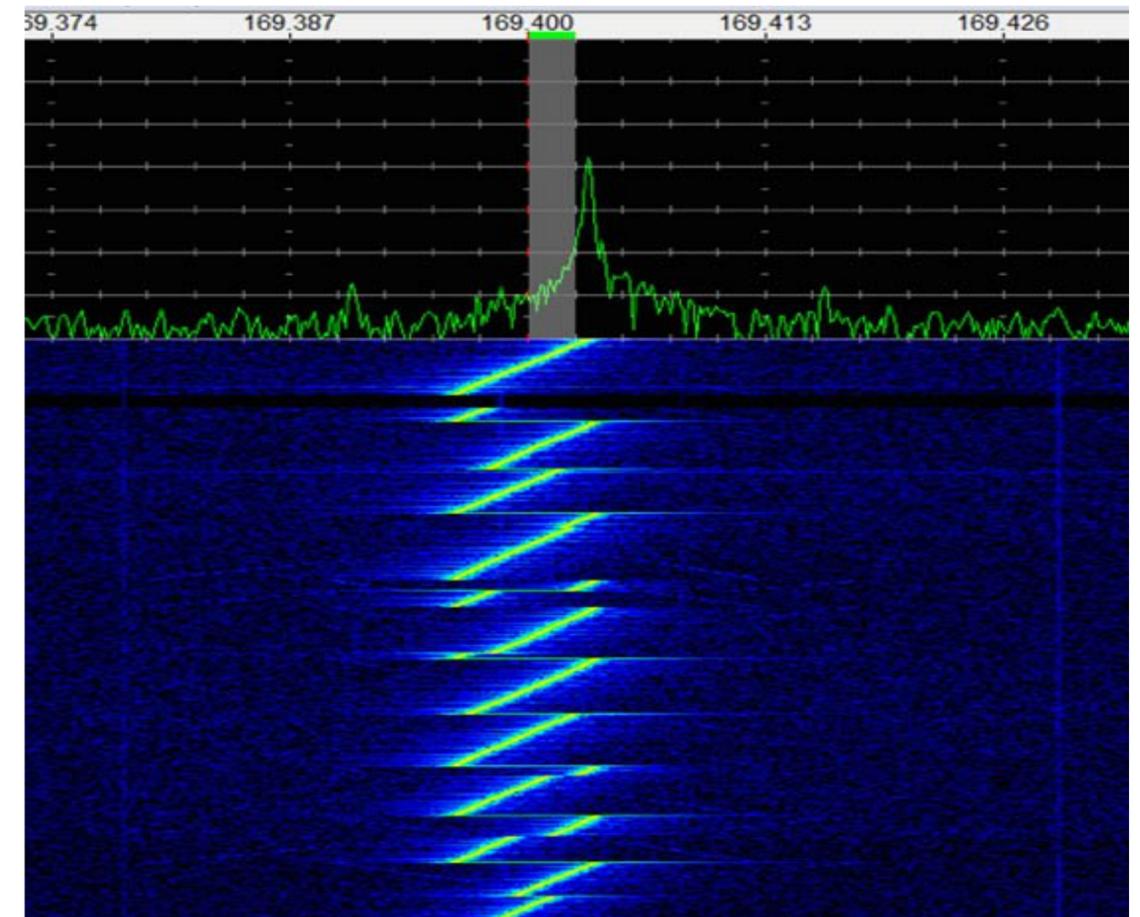
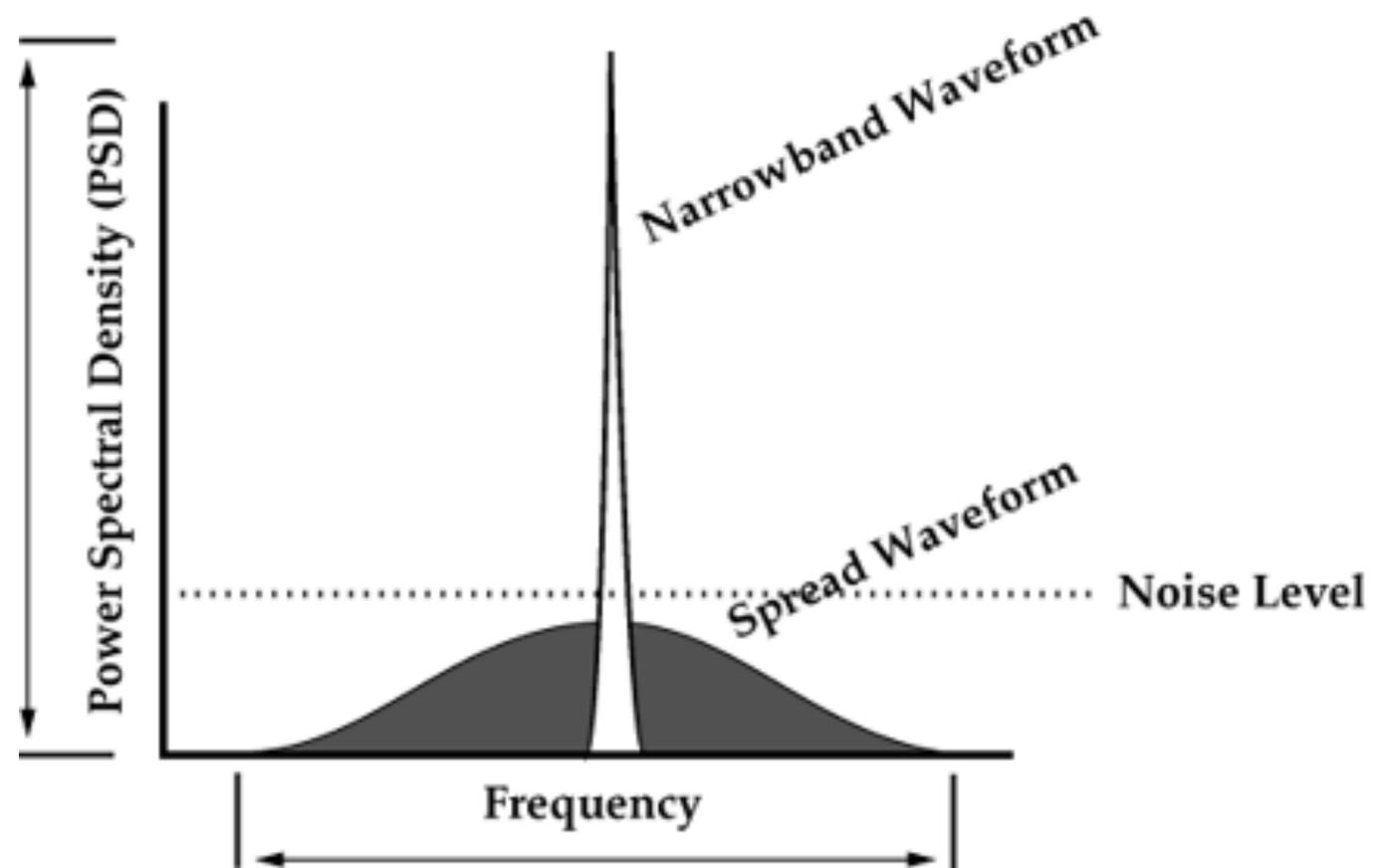
# Unlicensed spectrum

US 915, EU 433/868, CN 470/779, AU 925



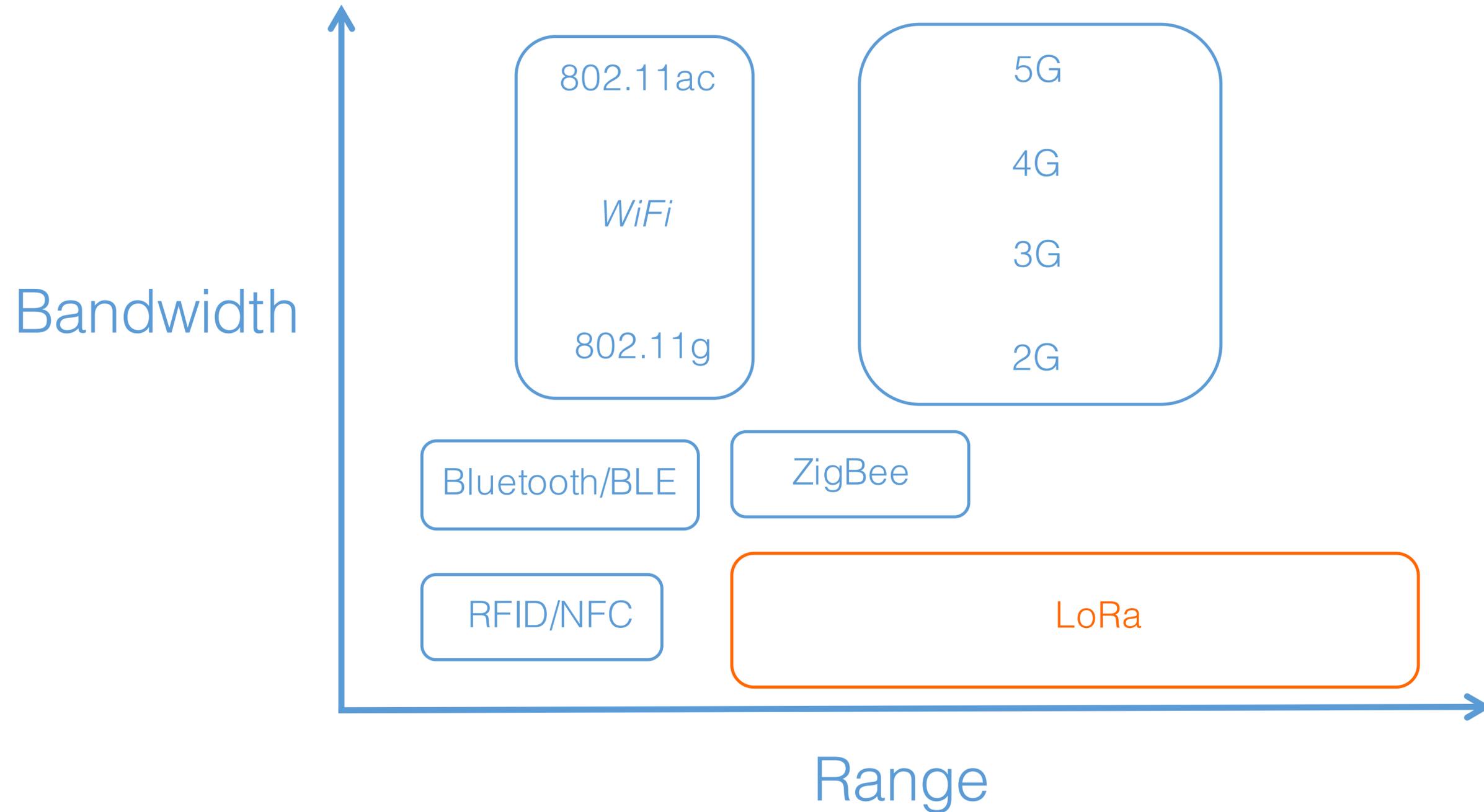
# LoRa

Spread-spectrum; robust to interference, multipath and fading



# LoRa

Long range, low bandwidth



Our **mission**  
is to build  
a **decentralized,**  
**open** and  
**crowd sourced**  
IoT data network

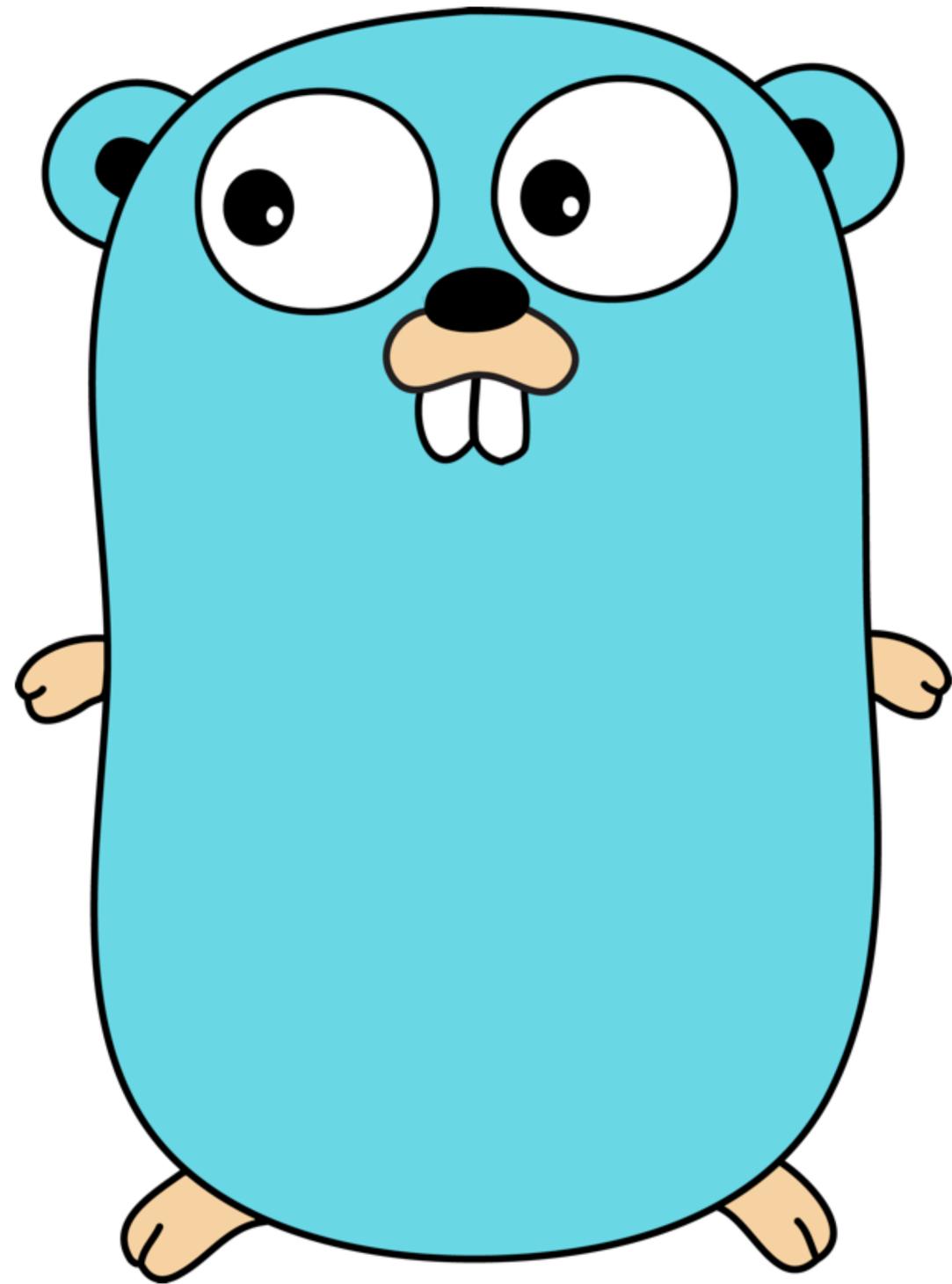
Owned and operated by its users



Our **mission**  
is to build  
a **decentralized**  
**open** and  
**crowd sourced**  
IoT data network

Owned and operated by it's users





croft\_1

| 2016/06/08 07:52:17 Croft is ALIVE



23:41

donderdag 20 augustus



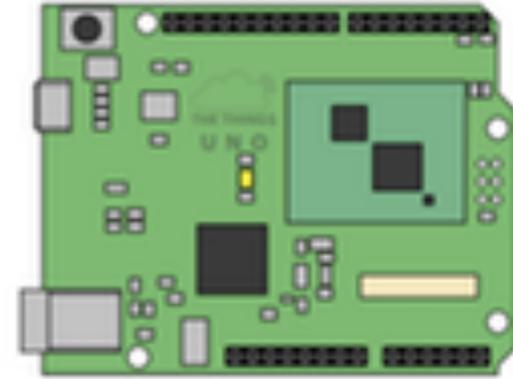
**TTN** nu

Uw boot staat onder water!

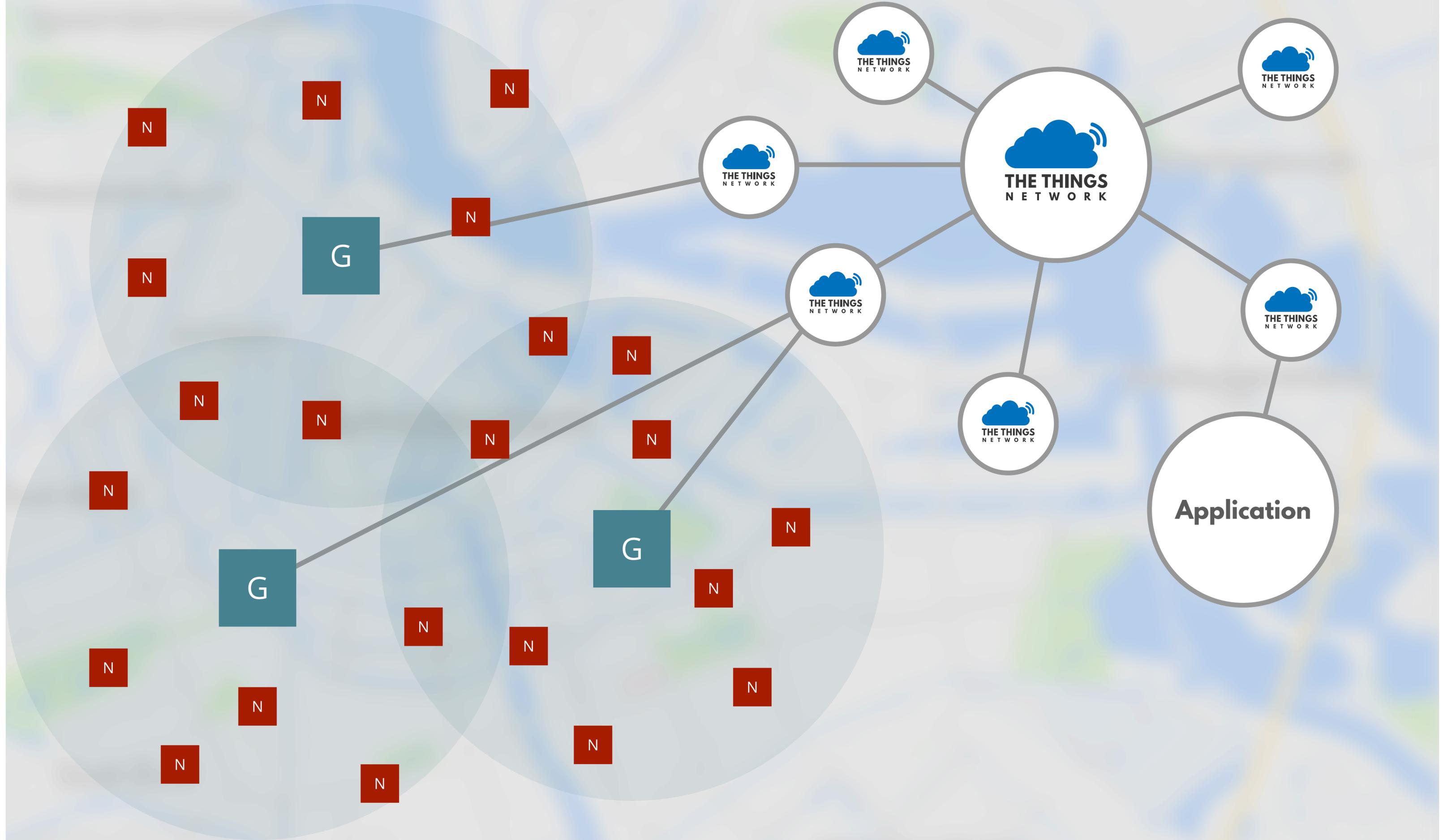
schuif om te antwoorden



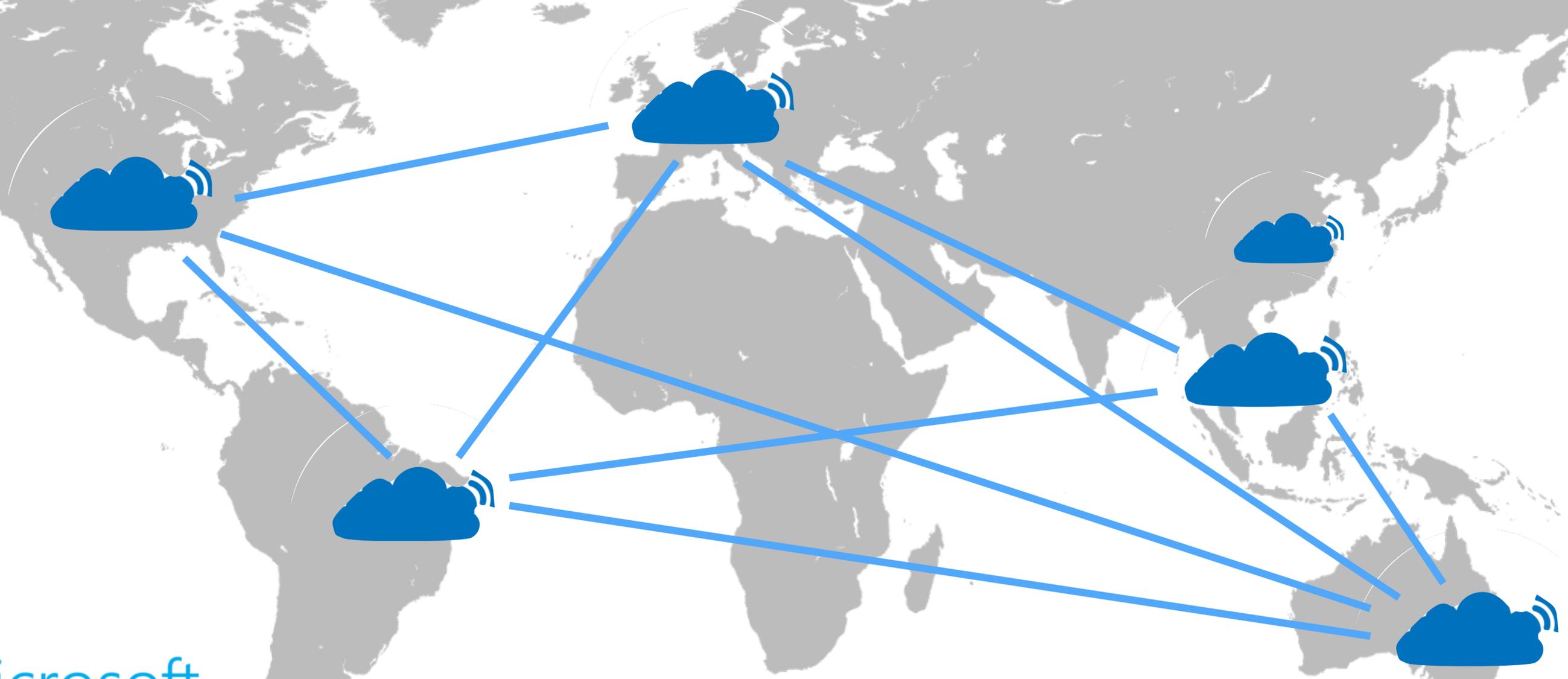
**KICK  
STARTER**



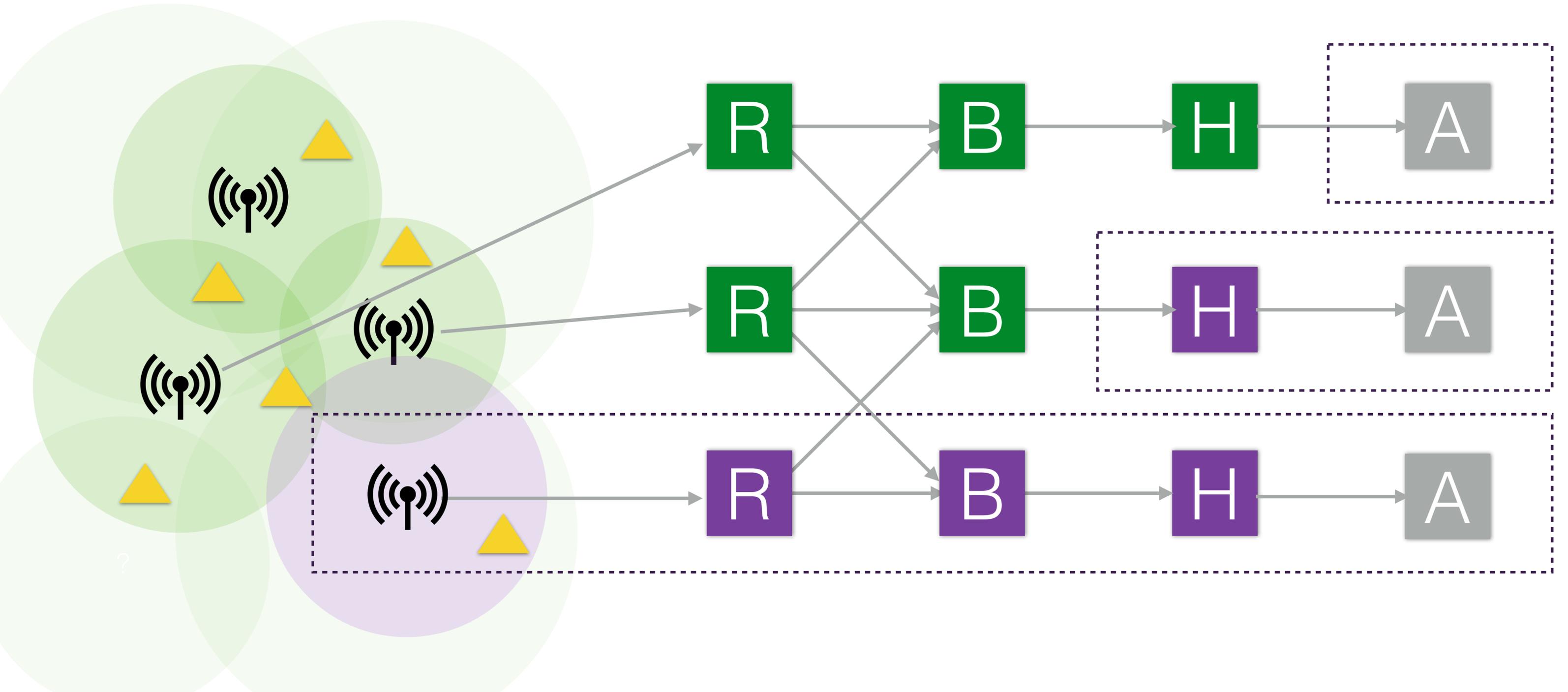




# Deployment



# Architecture



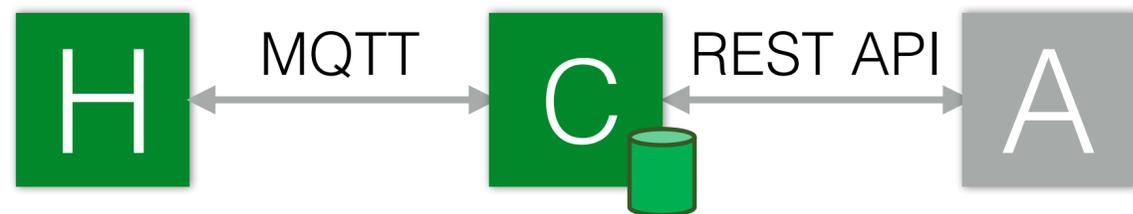
# Connecting Applications



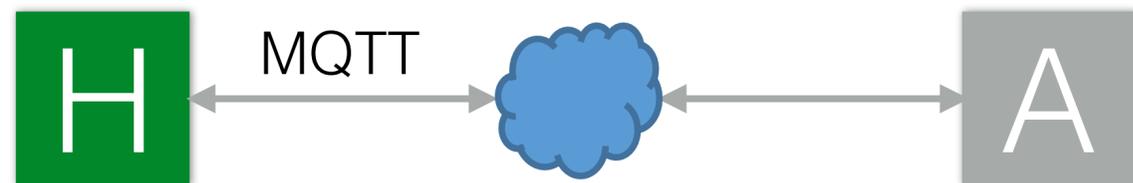
1. Get data directly from MQTT broker



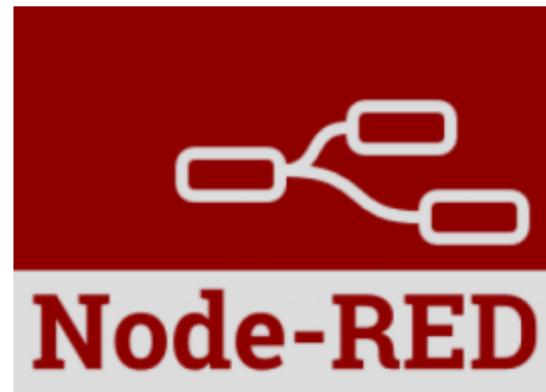
2. Process data in Node RED



3. Collect data in a database



4. Integrate IoT cloud platform





forum.thethingsnetwork.org

THE THINGS NETWORK

all categories ▾ **Latest** New (6) Unread (24) Top Categories + New Topic

| Topic   | Category            | Users   | Replies | Views | Activity |
|---|---------------------|---|---------|-------|----------|
| Node based on Raspberry?  | Nodes               |      | 24      | 2.7k  | 10m      |
| Adafruit LoRa Feather -> Gateway  | Nodes               |      | 32      | 2.0k  | 17m      |
| Where in LMIC is the "fCnt" parameter stored? • new   |                     |     | 2       | 43    | 1h       |
| IP server for Europe • new  |                     |     | 2       | 72    | 1h       |
| The LIBRARY basement  | News                |      | 44      | 2.8k  | 2h       |
| Lost with LORAWAN • new   | How to get started? |      | 2       | 59    | 2h       |
| Which backend component sends an ACK (acknowledgment) response to a node for a confirmed message? | Network and Routing |       | 11      | 234   | 2h       |



# LABS

Leveraging The Things Network to create true value.

## LABS

Feedback

Browser window showing the website [thethingsnetwork.org](http://thethingsnetwork.org). The page features a navigation menu with links for WIKI, FORUM, LABS, POSTS, and SHOP. A user profile for "Hi Johan" is visible in the top right corner.

### ABOUT THIS STORY

 [The Things](#) [Application](#)

 May 30, 2016

 ComeEmpty.Me

This story consists of 4 steps

- 1** Link The Things Uno with Ultrasonic Sensor
- 2** Pass data on to AWS-IOT
- 3** Pick up the data in an Arrow app
- 4** Build the Titanium app

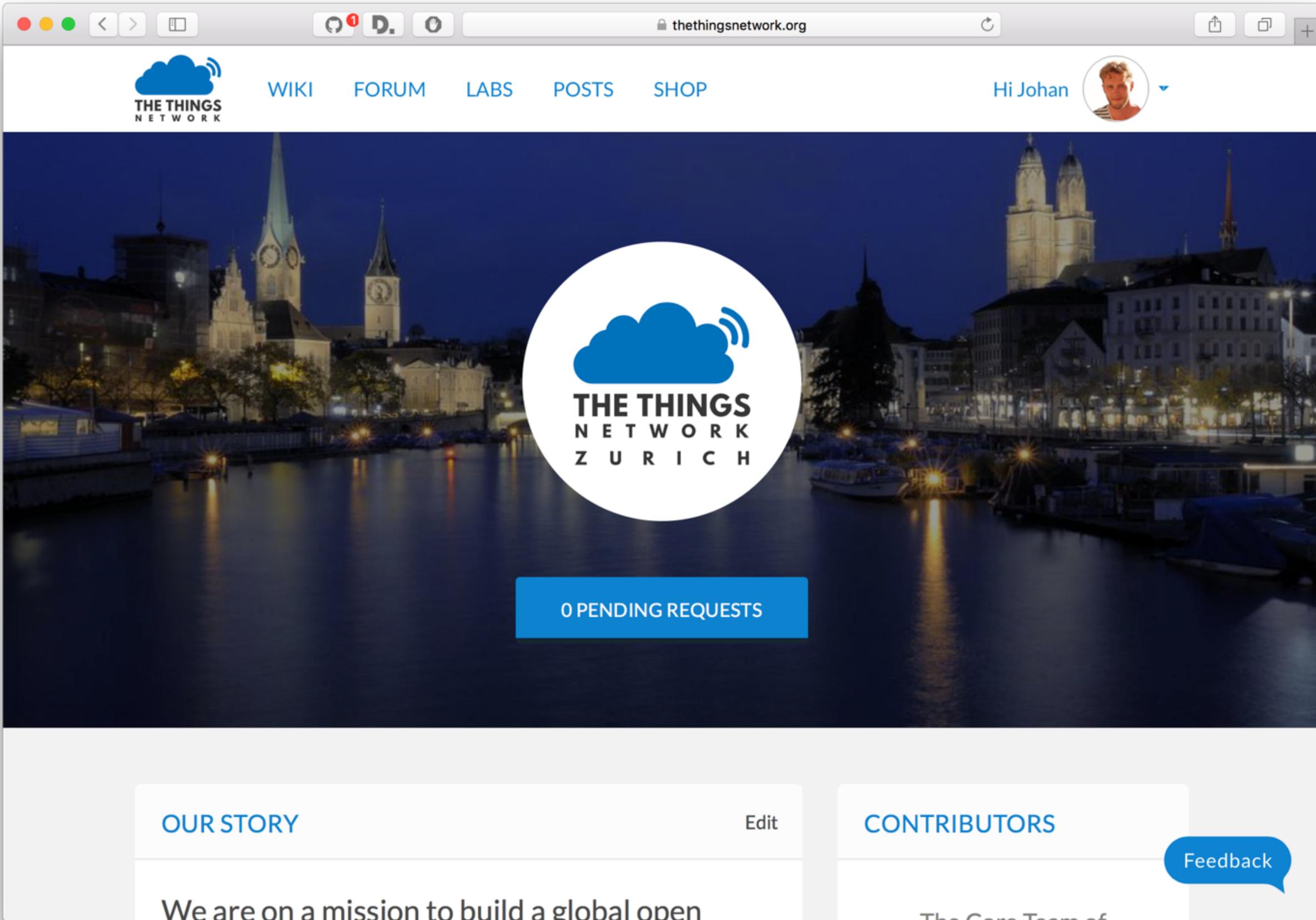
The available sensor that made most sense to use was the Ultrasonic Sensor HC-SR04. By following [this Random Nerd Tutorial](#) and [The Things Uno Workshop](#) I got it to send the distance in cm to TTN.

Here's the full script:

```
#include "TheThingsUno.h"

// Set your app Credentials
const byte appEui[8] = {}; // SET
const byte appKey[16] = {}; // SET
```

[Feedback](#)



[WIKI](#) [FORUM](#) [LABS](#) [POSTS](#) [SHOP](#)

Hi Johan



0 PENDING REQUESTS

[OUR STORY](#)

[Edit](#)

[CONTRIBUTORS](#)

[Feedback](#)

We are on a mission to build a global open

The Core Team of



### ABOUT THIS COMMUNITY

50

Gateways

40

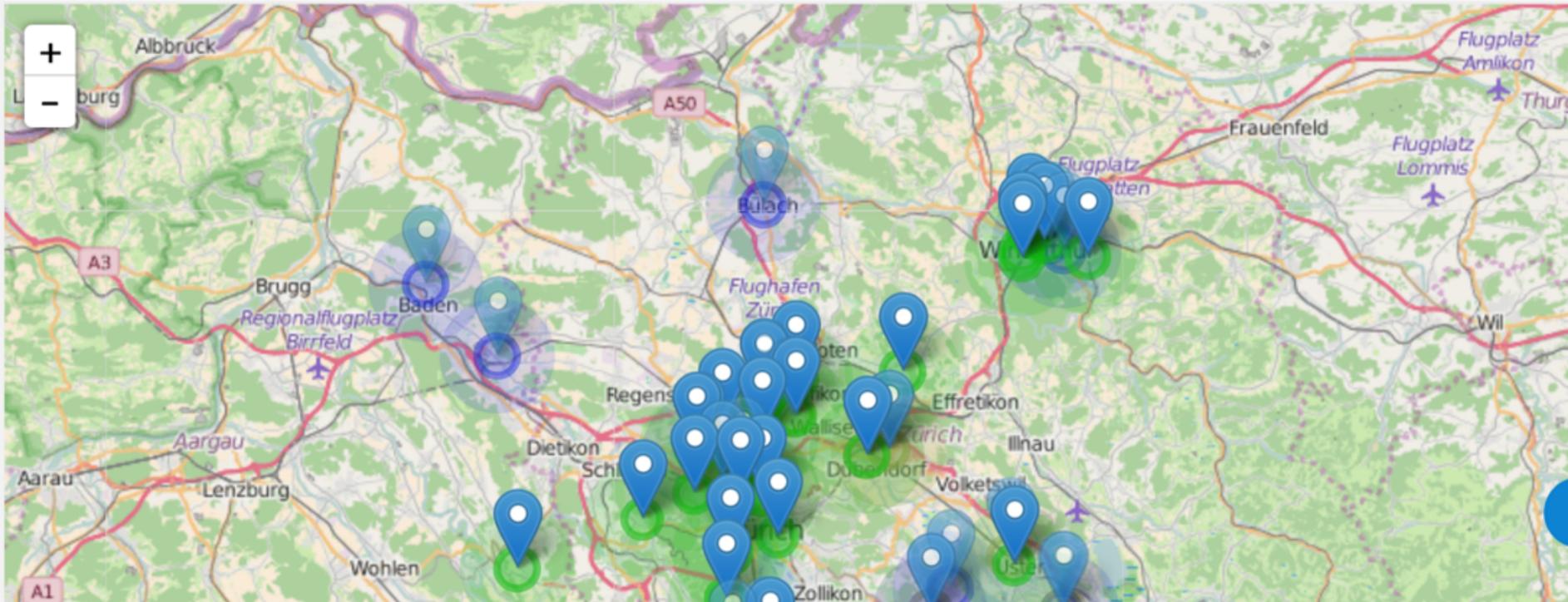
Contributors

09/15

Founded

### OUR GATEWAYS

Add a gateway



Feedback

## Messages

[clear log](#)

| payload                      | time     | frame | RSSI | frequency |
|------------------------------|----------|-------|------|-----------|
| lux 103<br>temperature 18.84 | 18:47:10 | 16472 | -106 | 868.10000 |
| lux 106<br>temperature 18.84 | 18:46:48 | 16471 | -105 | 868.10000 |

● connected



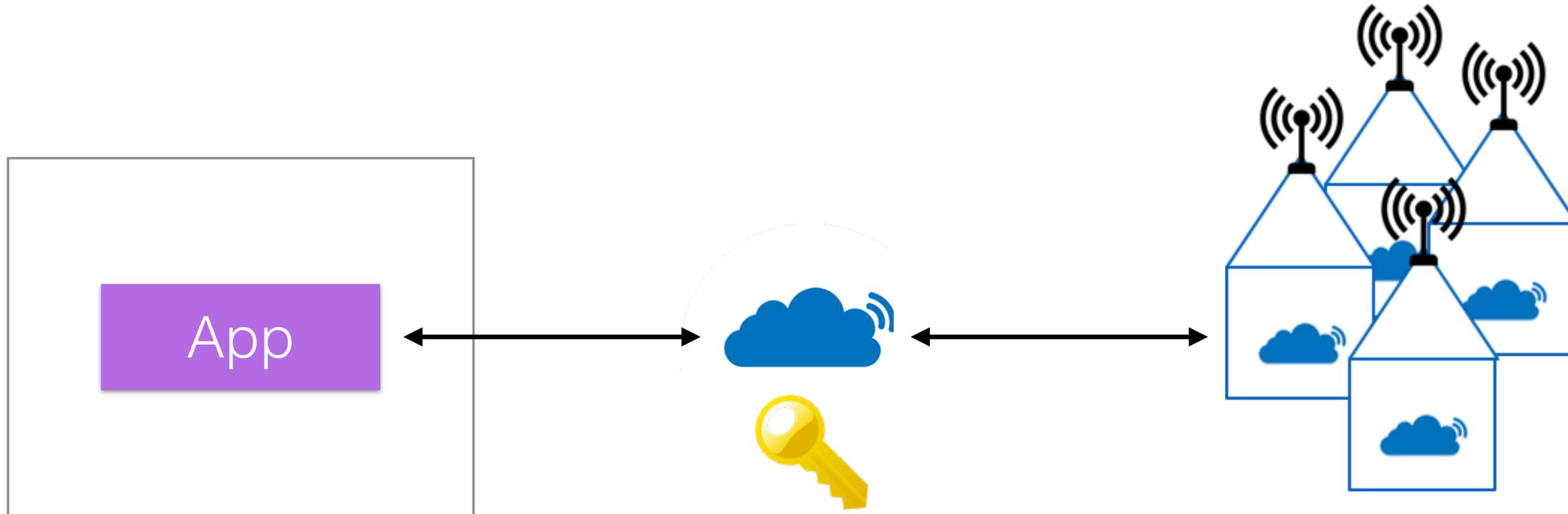




# Deployment Strategy

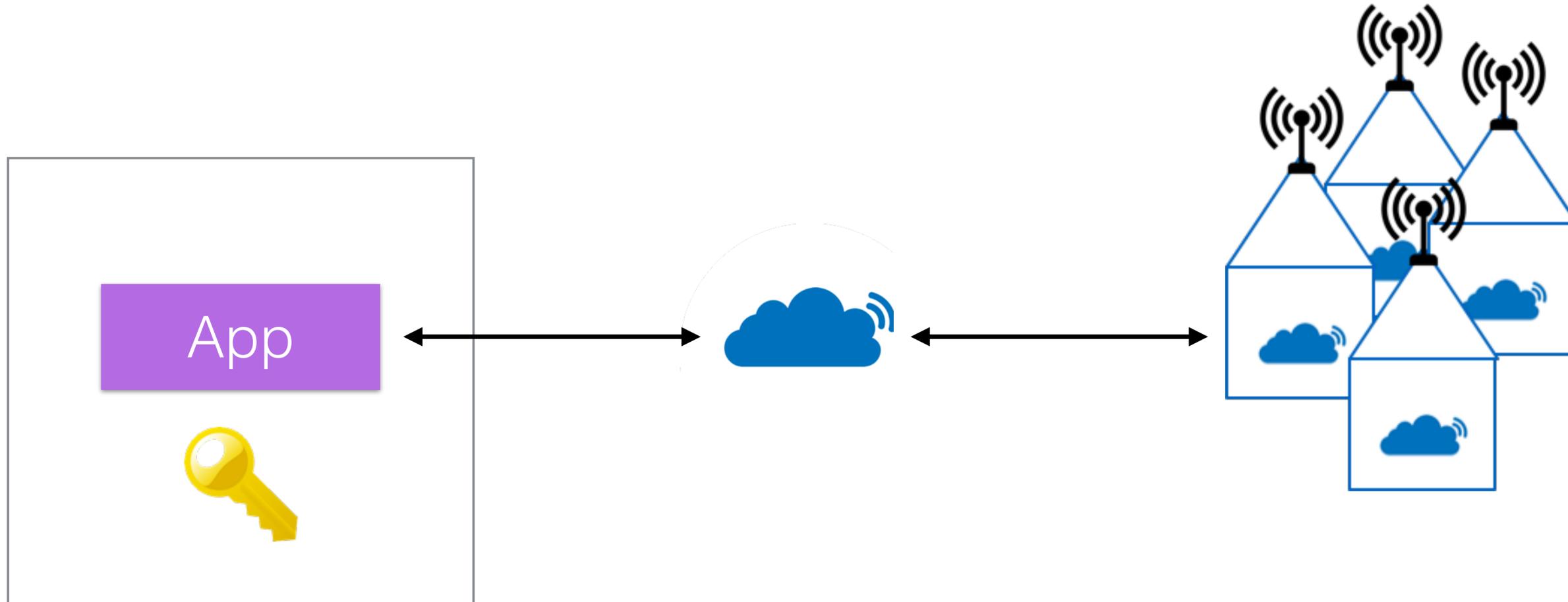
- Deploy or use the network that you need
- Control the required quality of service
- Control the required security level per app
- Add capacity where you need it

# Public Community Network Managed Keychain

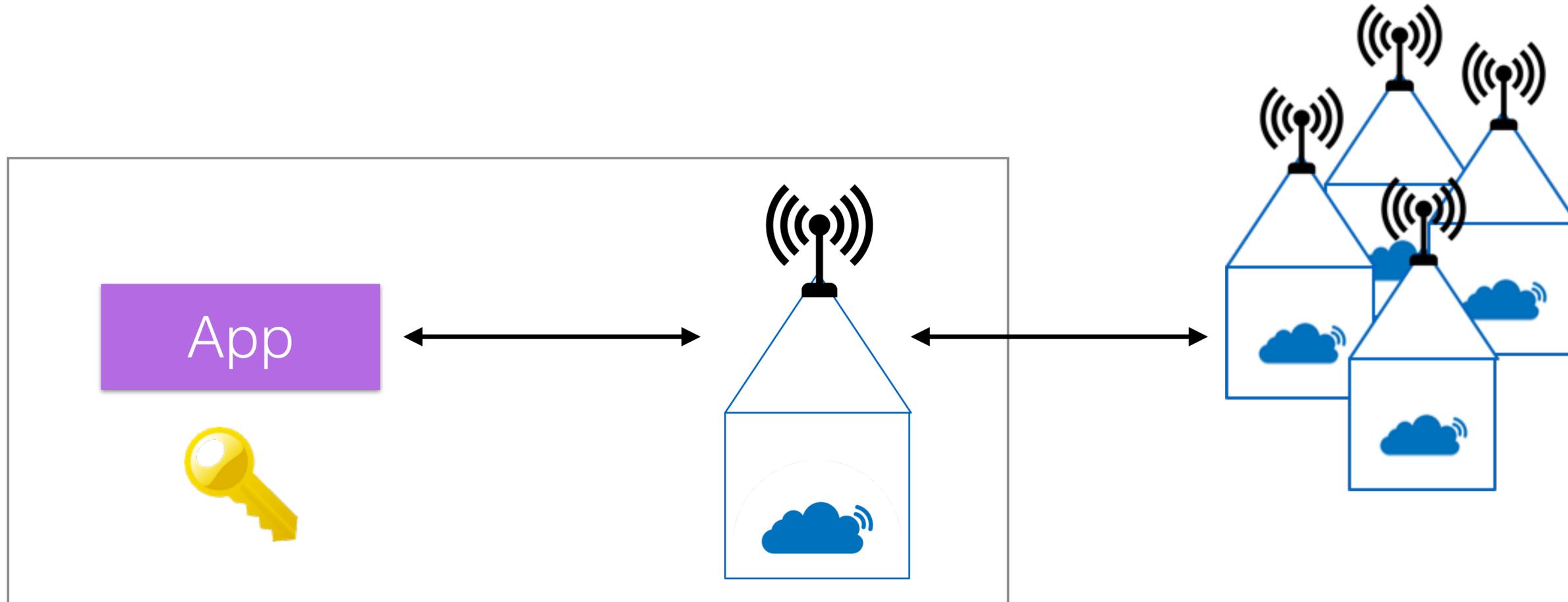


# Public Community Network

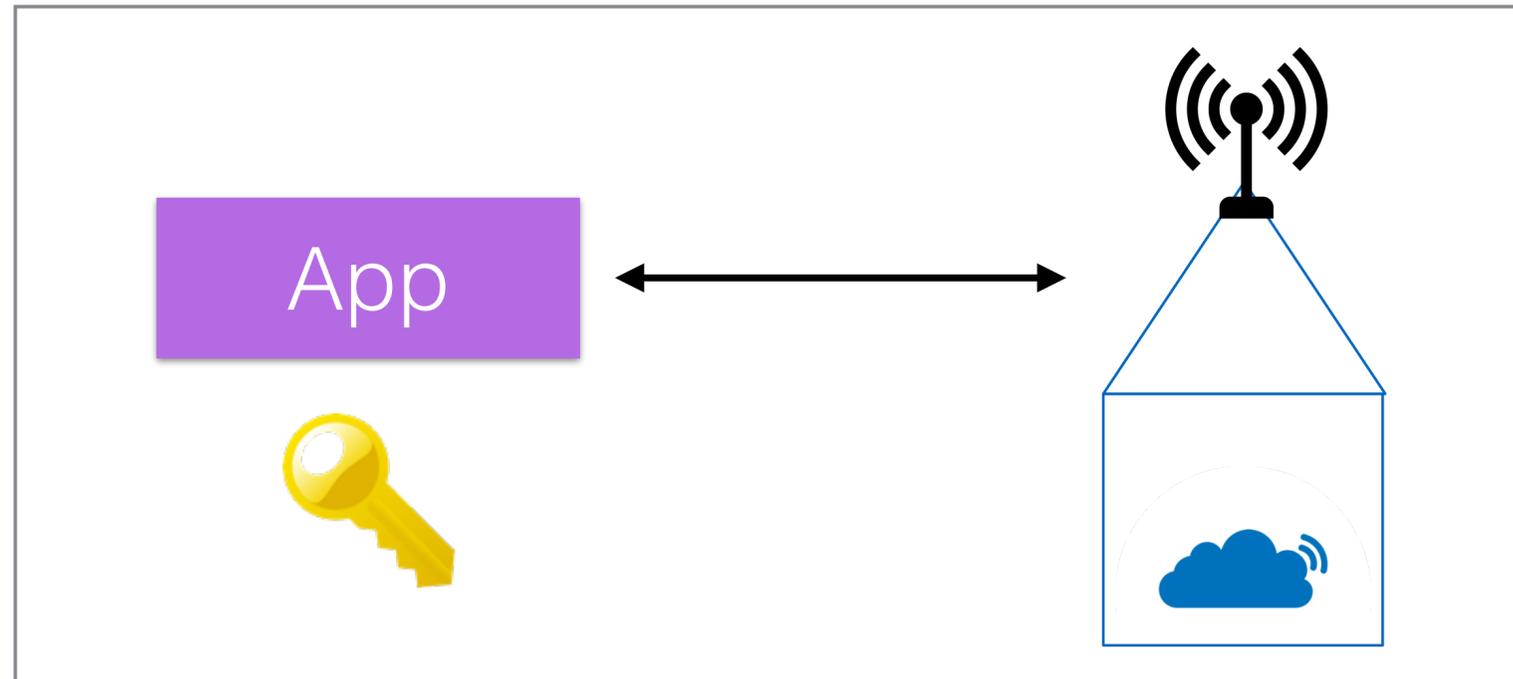
## Private Key



# Private Attached Network



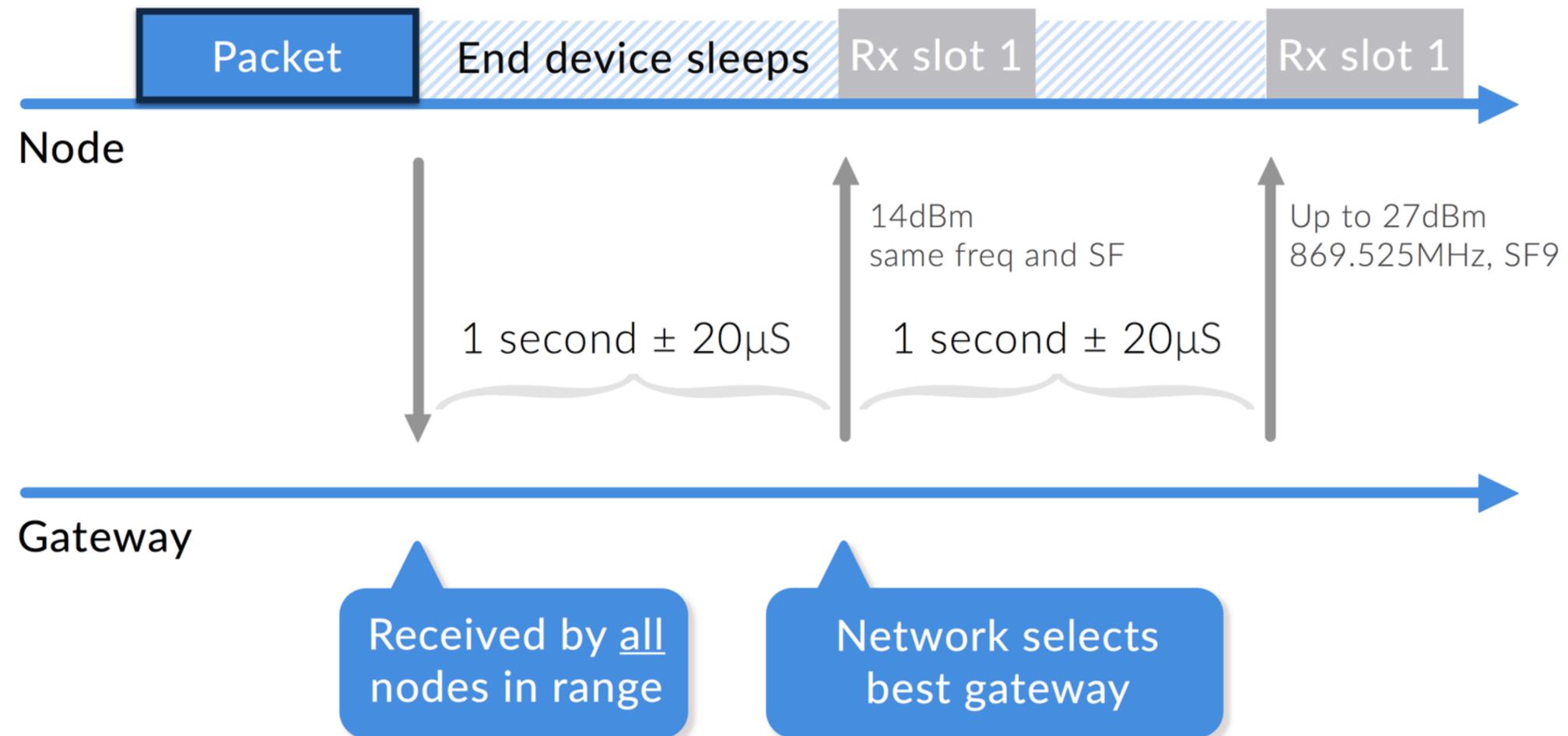
# Private Network



# LoRaWAN Device Classes

- **Class A:** Each device's uplink transmission is followed by two short downlink receive windows
- **Class B:** In addition to the Class A functionality, Class B devices open extra receive windows at scheduled times
- **Class C:** These devices have a continuous open receive window, except when transmitting

# LoRaWAN Class A



# Security

## Keys

- Remember: LoRa is low power and low cost
- LoRaWAN supports end-to-end encryption from device to application
- Shared key: **AppKey**
- Derived session keys:
  - **NwkSKey**: device identification, message integrity check using CMAC and MAC command encryption
  - **AppSKey**: payload encryption
  - Every session has a public **DevAddr** with network identifier
- 128-bit key length, AES encryption

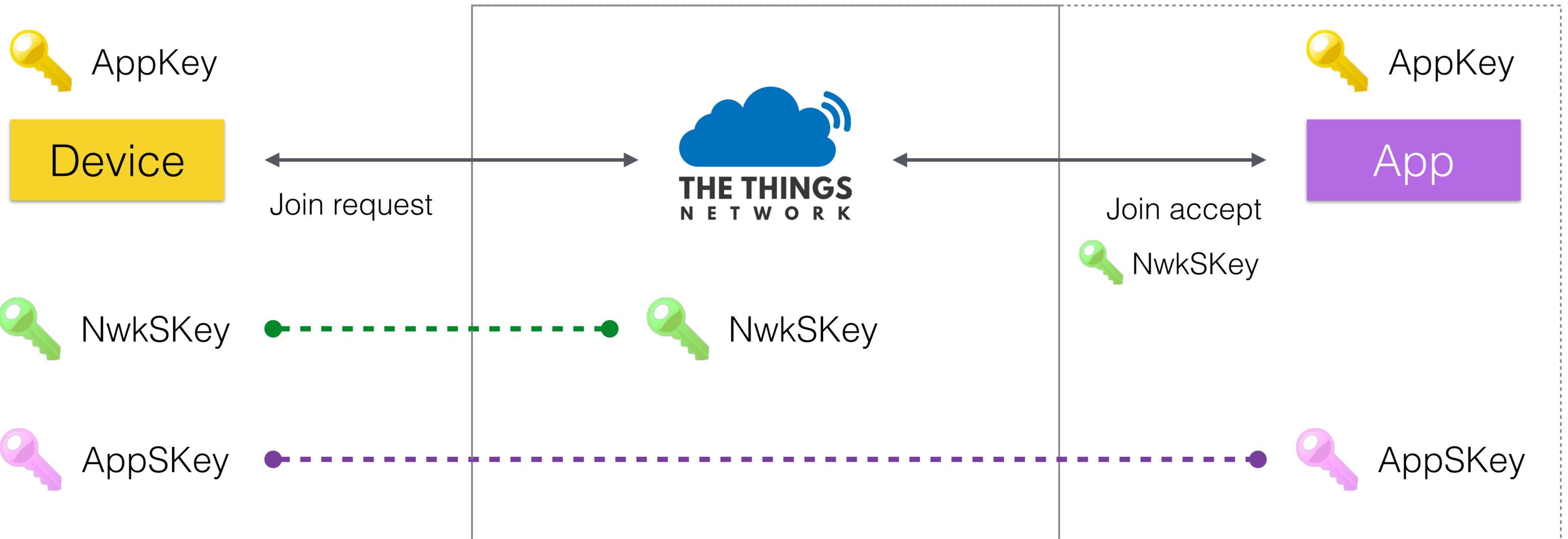
# Security

Two flavours of provisioning

- **Over the air activation (OTAA)**; the device activates itself and creates a new session
  - Pro: keys are regenerated for each session
  - Con: needs downlink for join accept
- **Activation by personalization (ABP)**; the device is preconfigured with session keys
  - Pro: no need for downlink
  - Con: requires persistent session state, harder to provision

# Security

Support for end-to-end encryption



# Limitations

data rate \* payload size = airtime

airtime <= 30 seconds per day

payload size <= 51 bytes

data rate is variable

# Don't waste your airtime

Simple:

- { "Count": 1234, "Temperature": 20.635 }
- 40 bytes: 292 messages per day (SF7)

Remove counter, spaces, and compress names:

- {"t":20.63}
- 11 bytes: 486 messages per day

# Don't waste your airtime

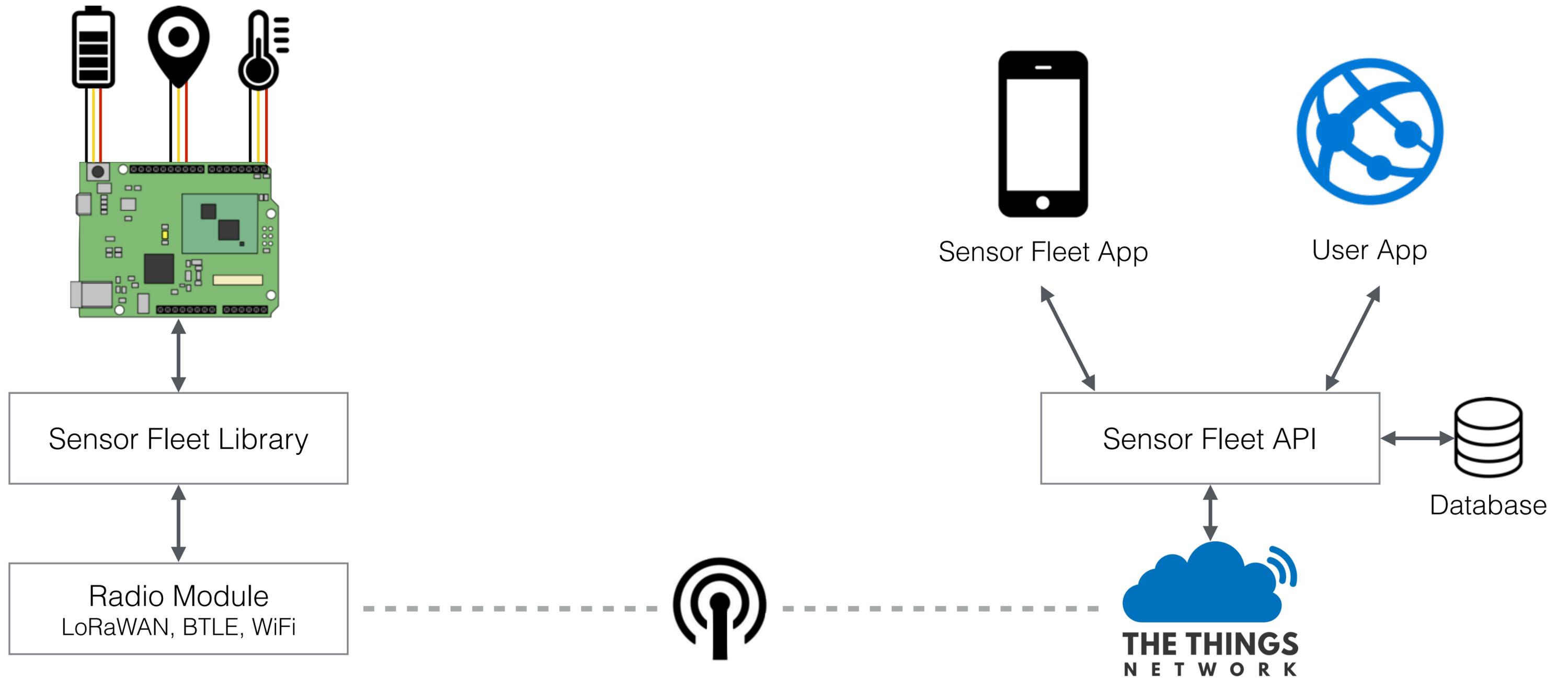
No JSON:

- 20.63
- 5 bytes: 582 messages per day

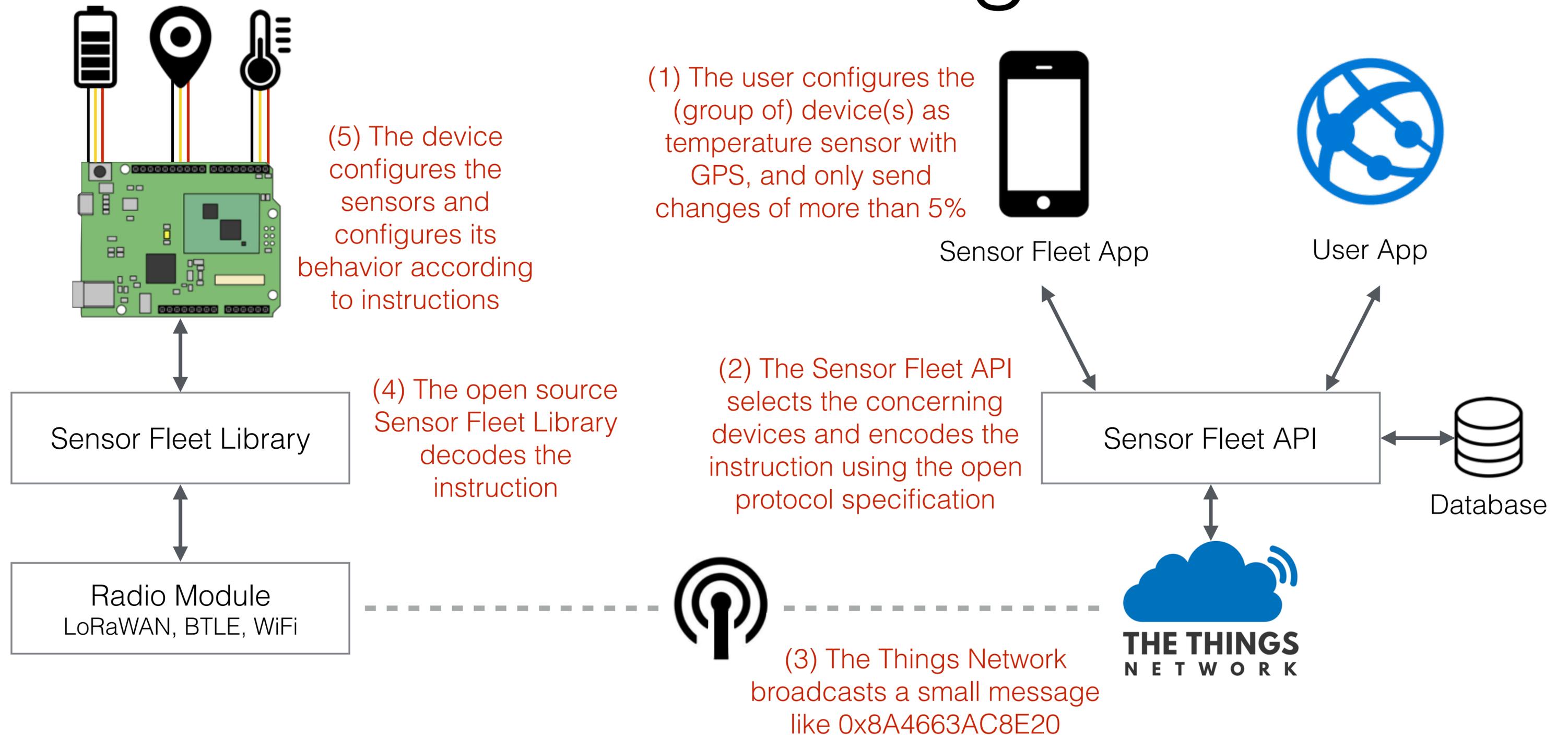
Signed 16 bit integer

- 0x080F
- 2 bytes: 648 messages per day

# Sensor Fleet



# Provisioning

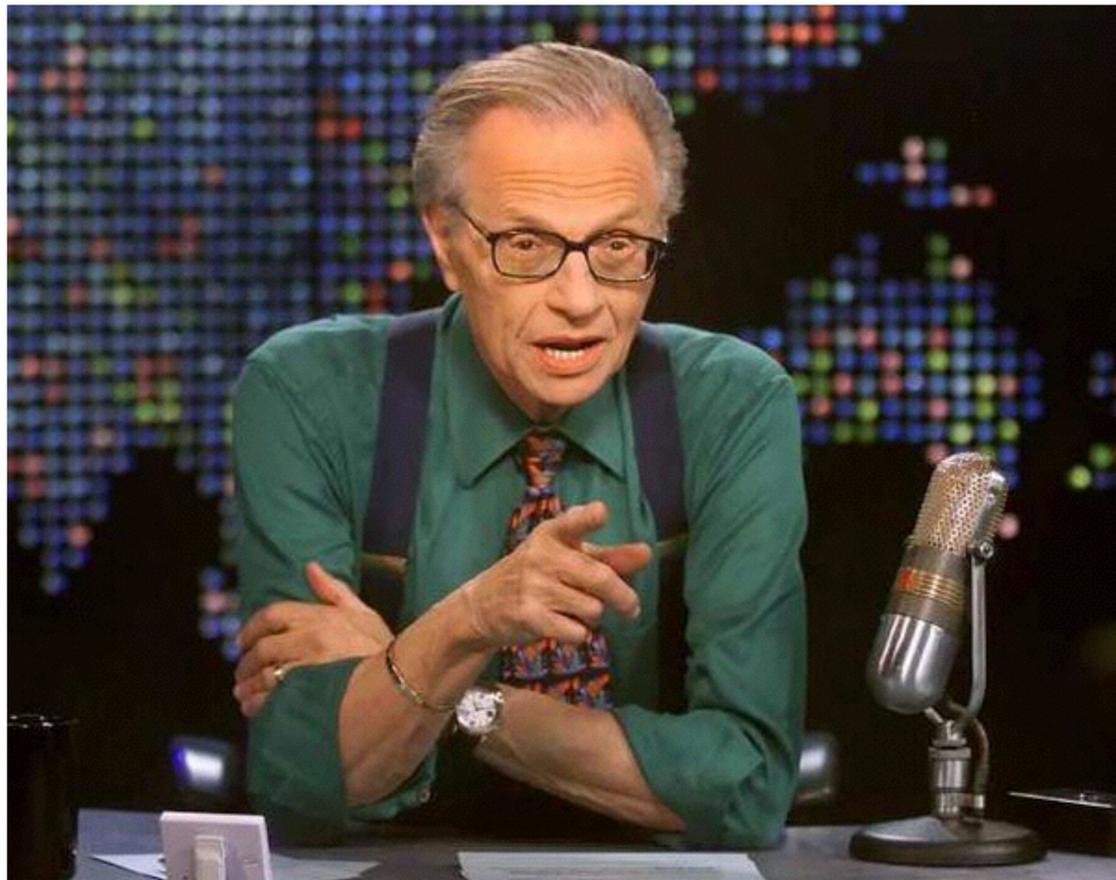


# The Usual Suspects

Don't worry, we've got them

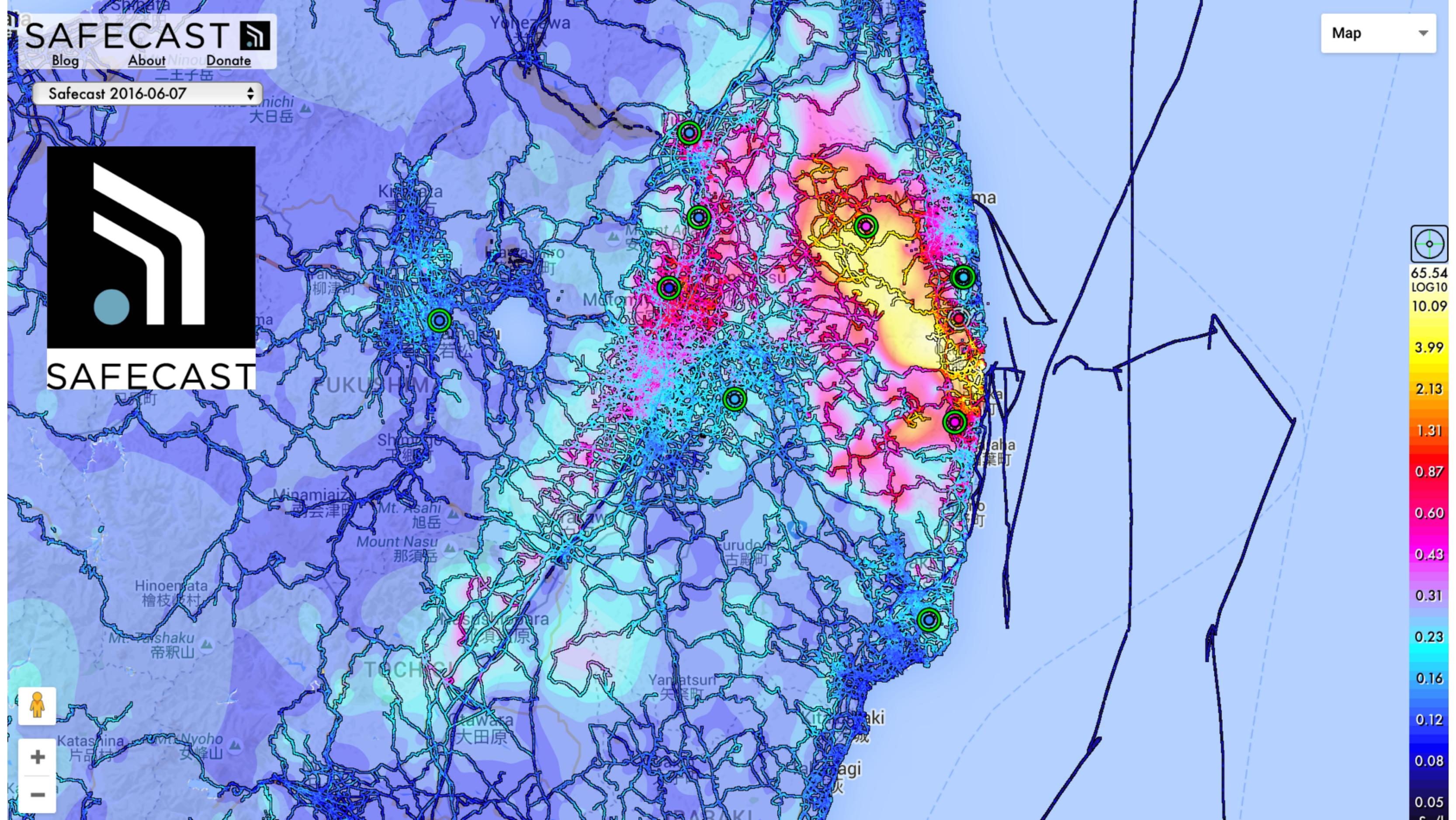
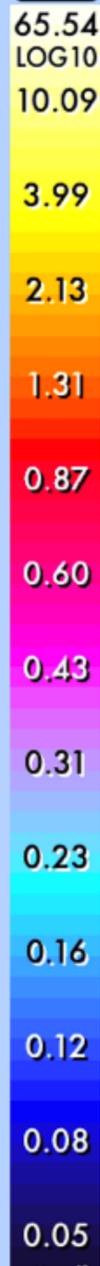
- ✓ Parking space monitoring
- ✓ Smart trashcans
- ✓ Air quality in buildings

# It's Moving Forward, Looking Backward

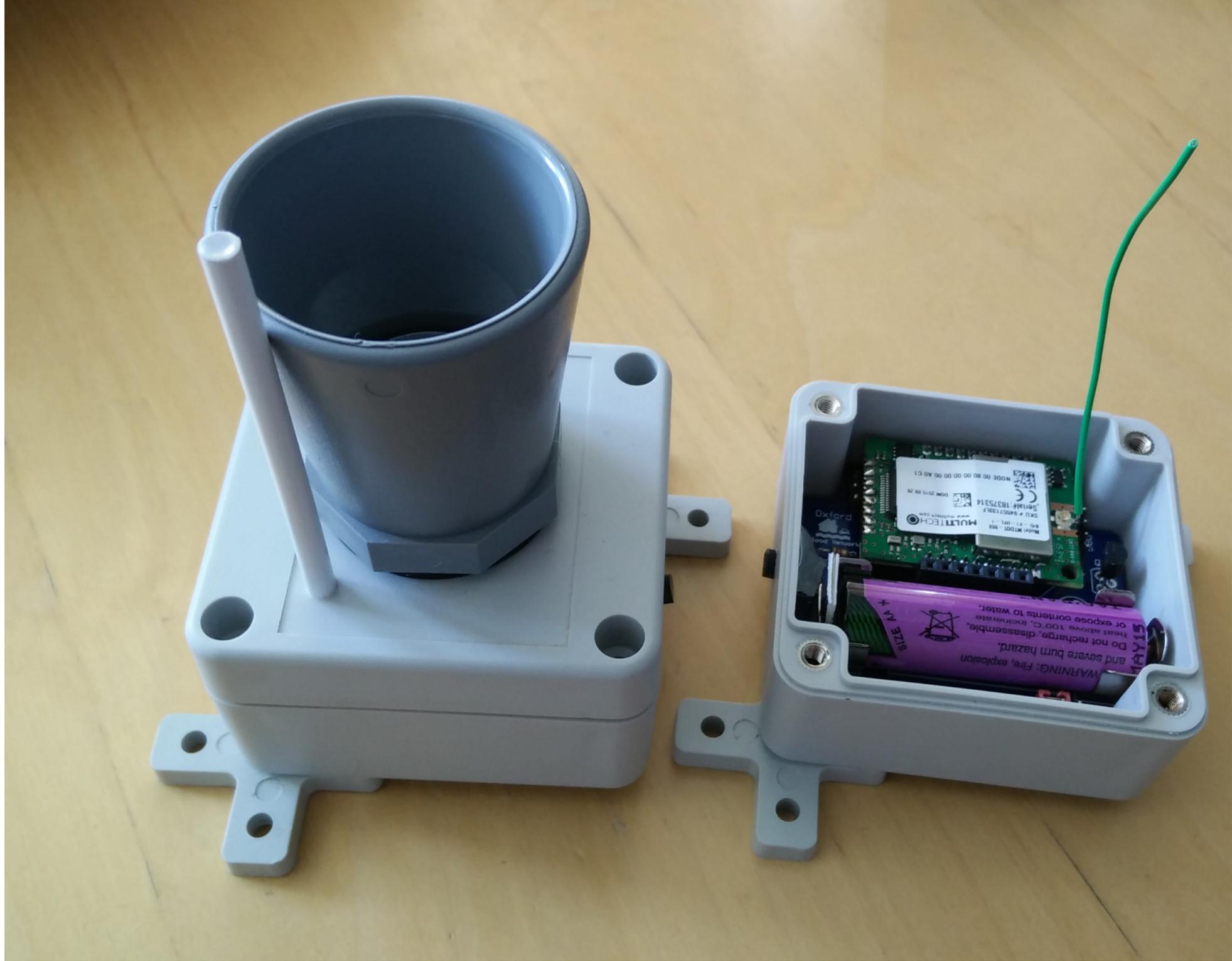


Innovate

Safecast 2016-06-07







# Flood Network

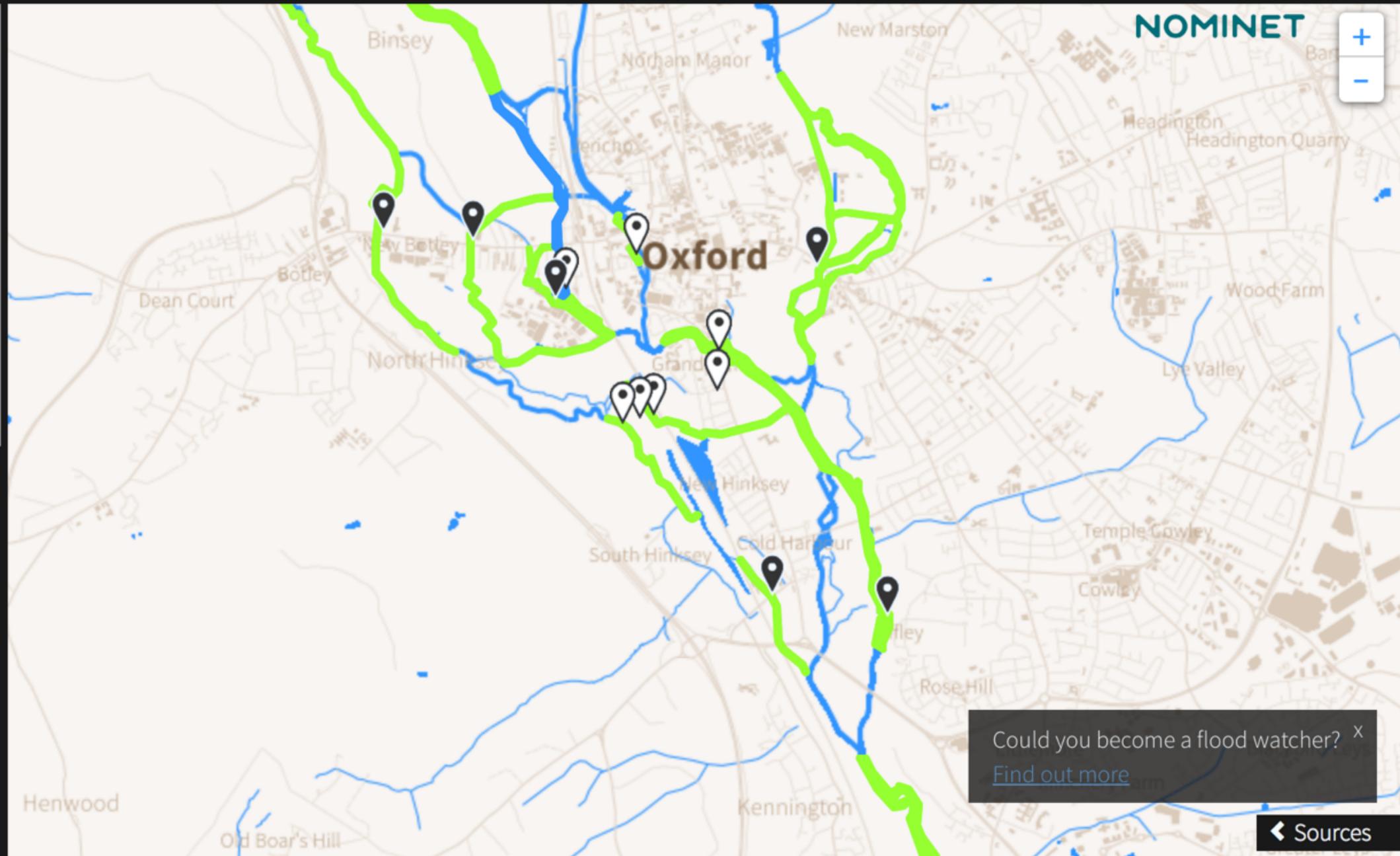
LIVE RIVER LEVELS (BETA)

HOME

JOIN



- Godstow Lock
- Eynsham Lock
- Minns Estate
- New Botley
- Wareham Stream
- Cherwell
- Osney
- Osney Lock
- Folly Bridge (Th...)
- Whitehouse Roa...



now

14:50 May 14 now

Could you become a flood watcher? ×  
[Find out more](#)

← Sources

Our **mission**  
is to build  
a **decentralized,**  
**open** and  
**crowd sourced**  
IoT data network

Owned and operated by its users

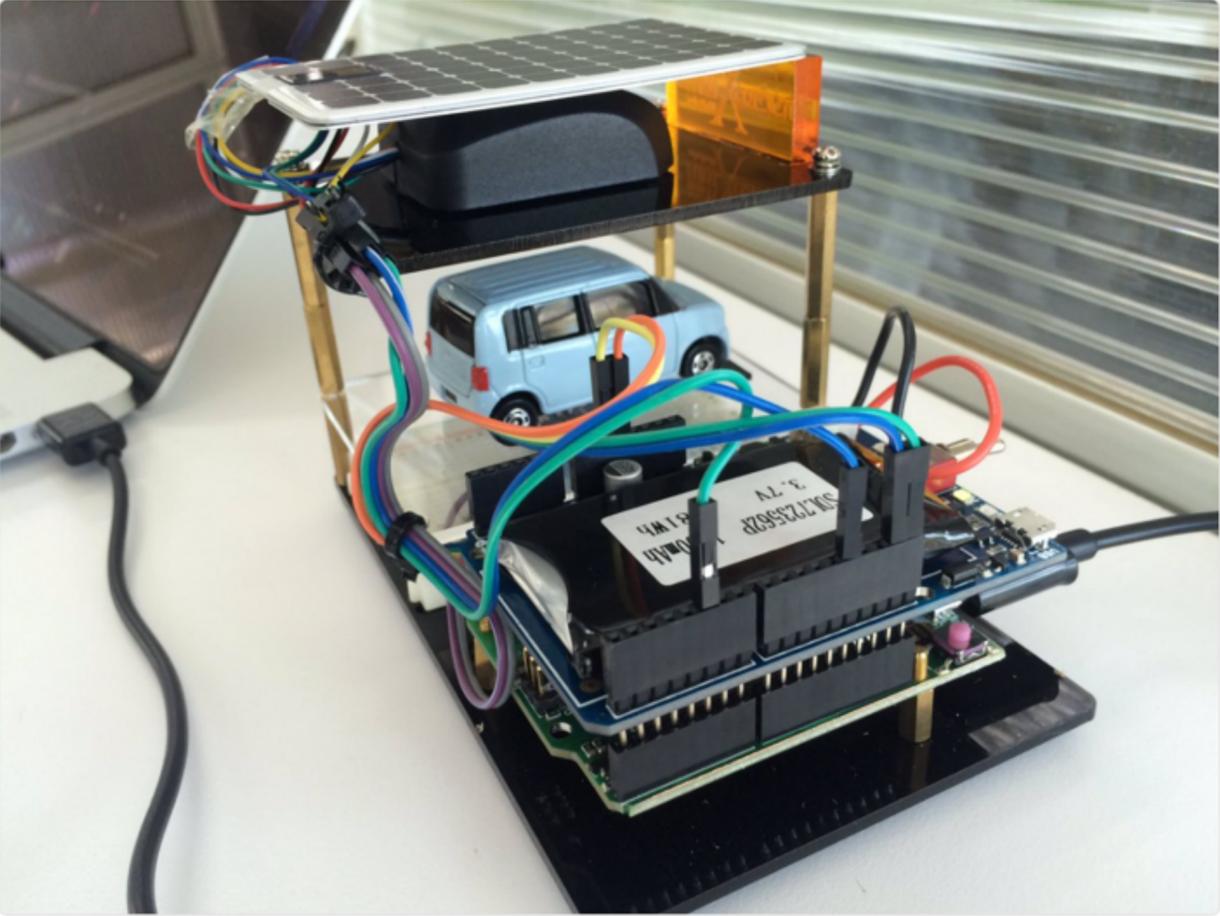
Twitter, Inc.

Home

Johan Stokking  
@johanstokking

Follow

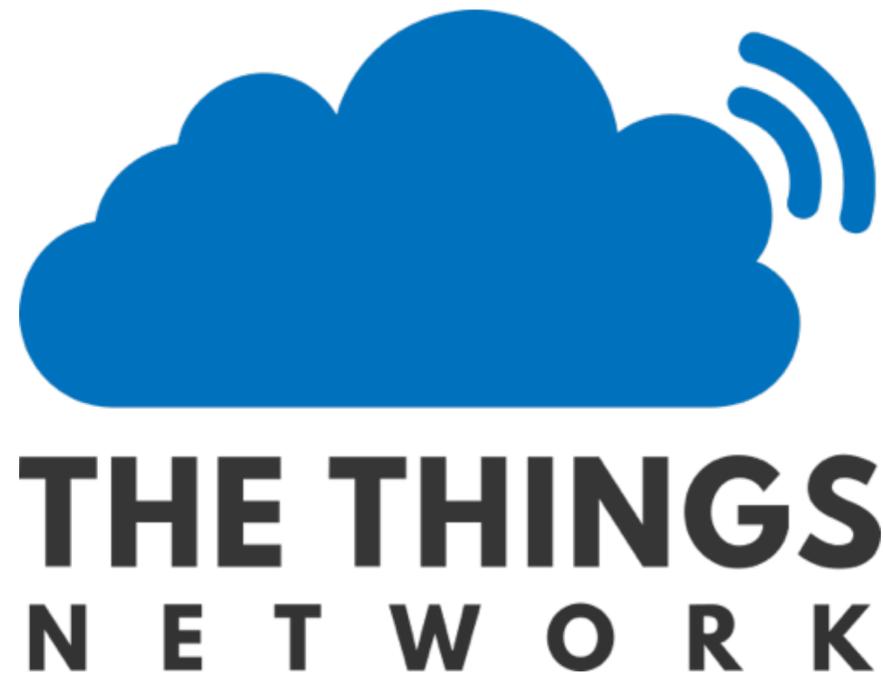
Smart parking with zero coding! Less code is more. @thethingsntwrk @jomhackmy



RETWEETS 12 LIKES 7

7:06 PM - 6 Aug 2016

12 7



You are the network  
Let's build this thing together

[@johanstokking](#) [@thethingsntwrk](#)