NRENs and Internet-of-Things

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September 23, 2016

SURF NET

NRENs and the Internet of Things

SURFnet activities on IoT (LoRaWAN),

what can we do in the future (together)...

- Kind of IoT/sensor-networks
- LPWAN, LoRaWAN
- Architecture
- Where does the NREN fit in

Sensor networks, Things

MESH TOPOLOGY

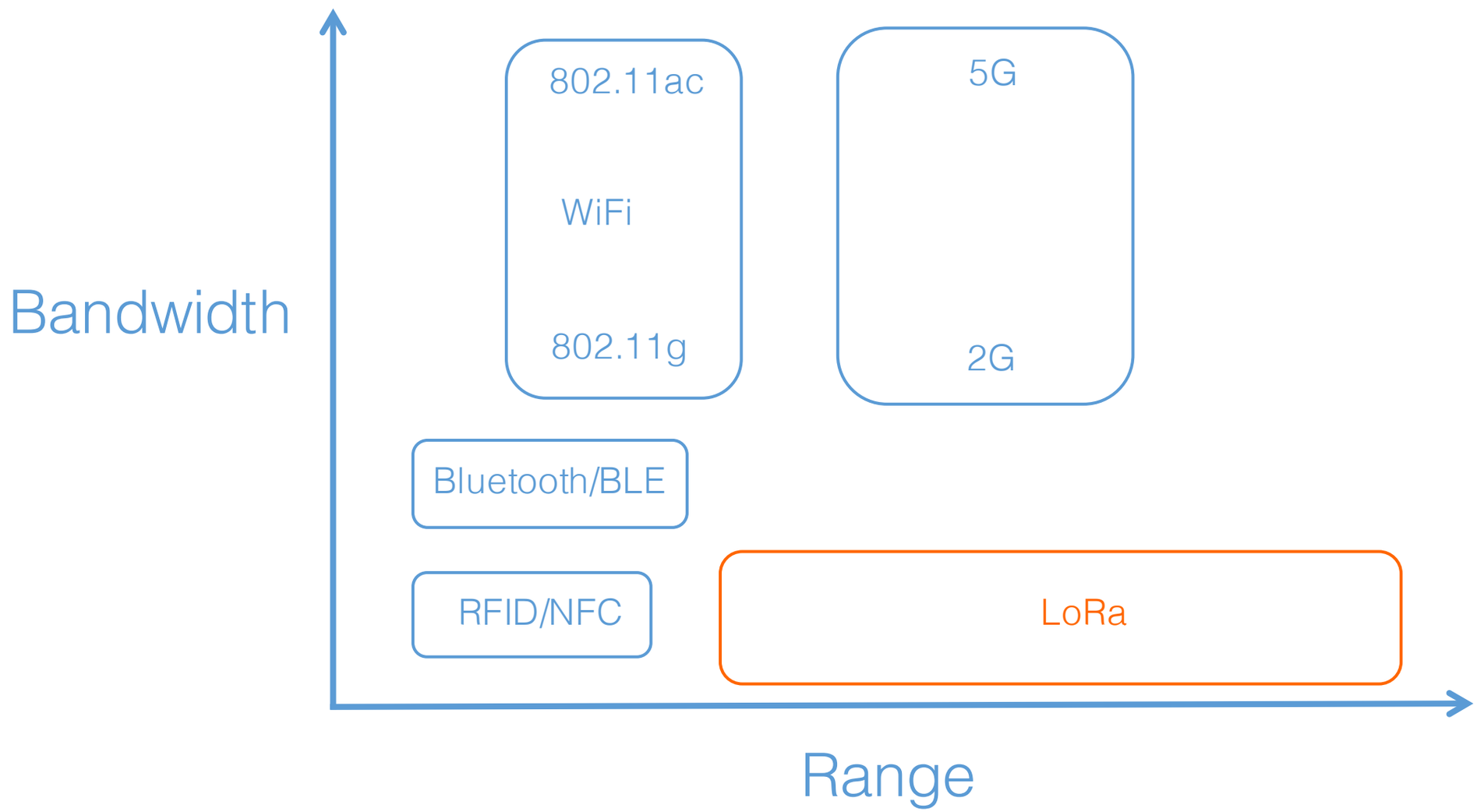
STAR TOPOLOGY

A mesh network is impractical: low range, passing on data costs energy, coordination

bron: link-labs

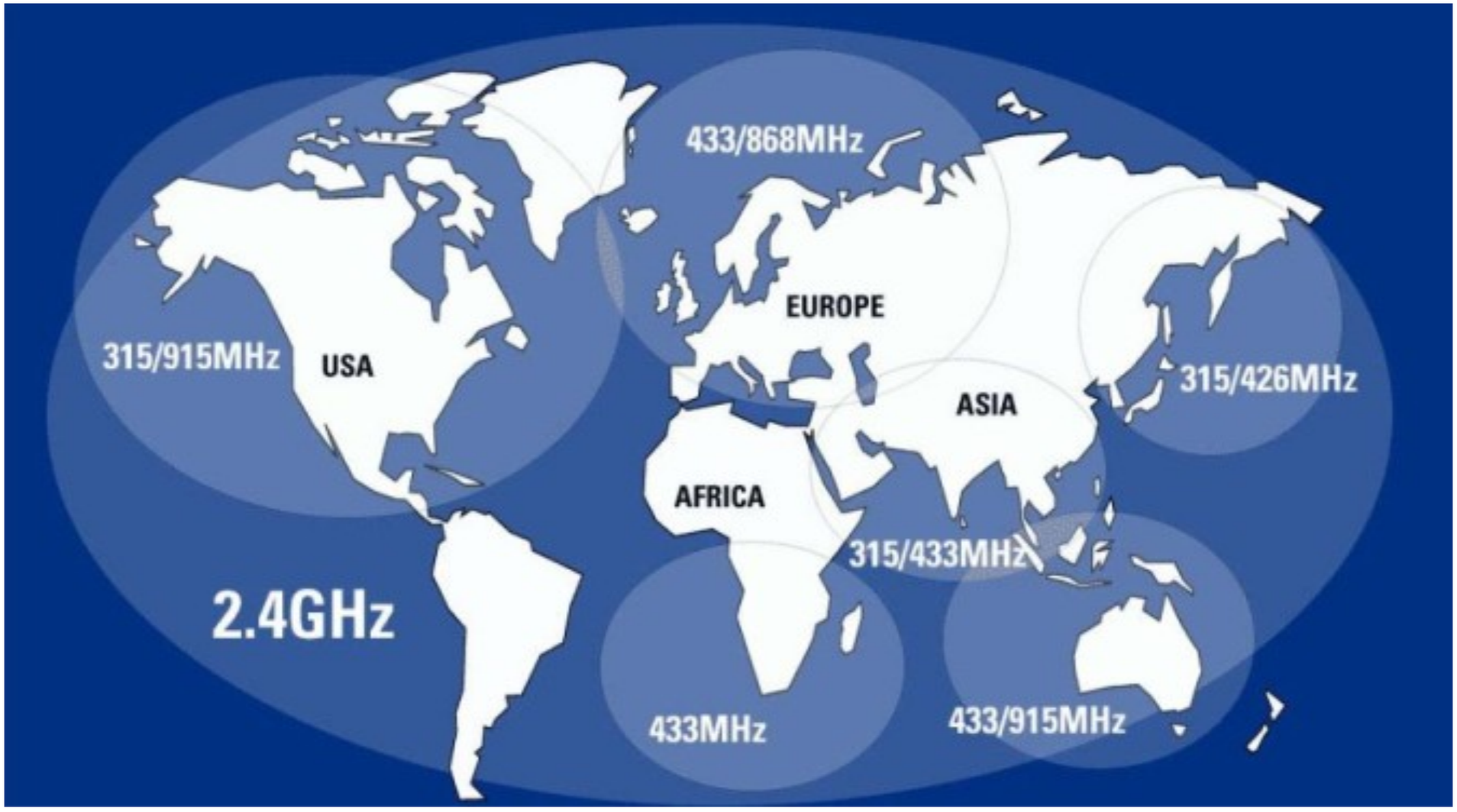
LoRa: bandwidth vs. range

When Bluetooth, BLE, WiFi, NFC, Zigbee limited range, and M2M 2-4G too costly...



bron: TTN

Global ISM bands



source: predictabledesigns.com

LoRa, LoRaWAN, LPWAN...?

- LPWAN name for Low Power WAN
  - Star topology
  - Long range
  - Low bandwidth

- Unlicensed spectrum under 1 GHz, range! (433, 868, 915 MHz)

  but regulated

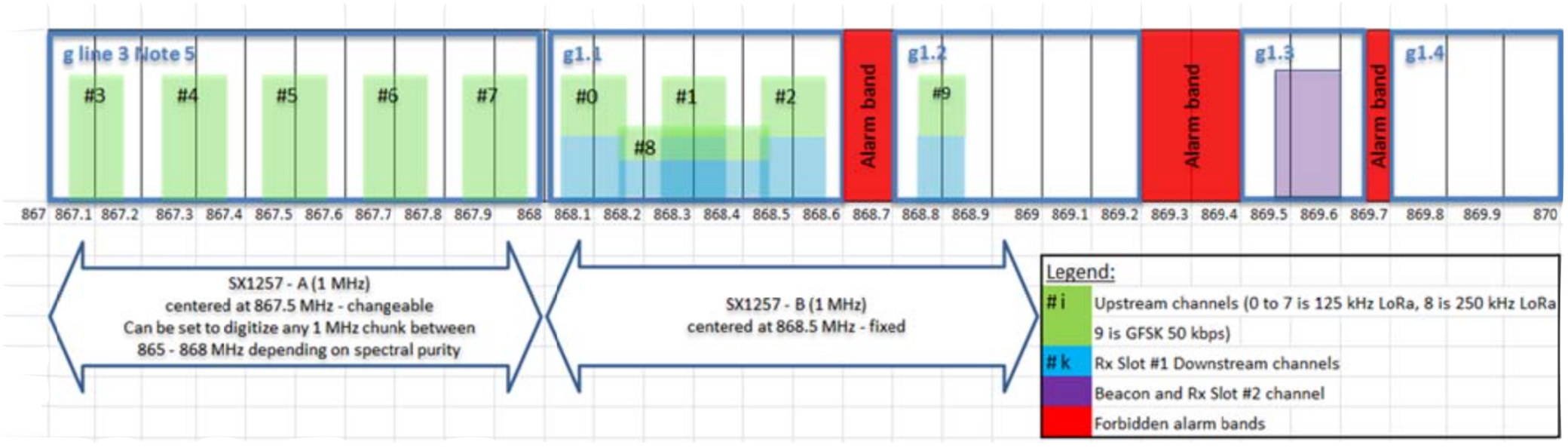
- Multiple solutions, LoRa(WAN) extra interesting:

SIGFOX
One network A billion dreams

LoRa™

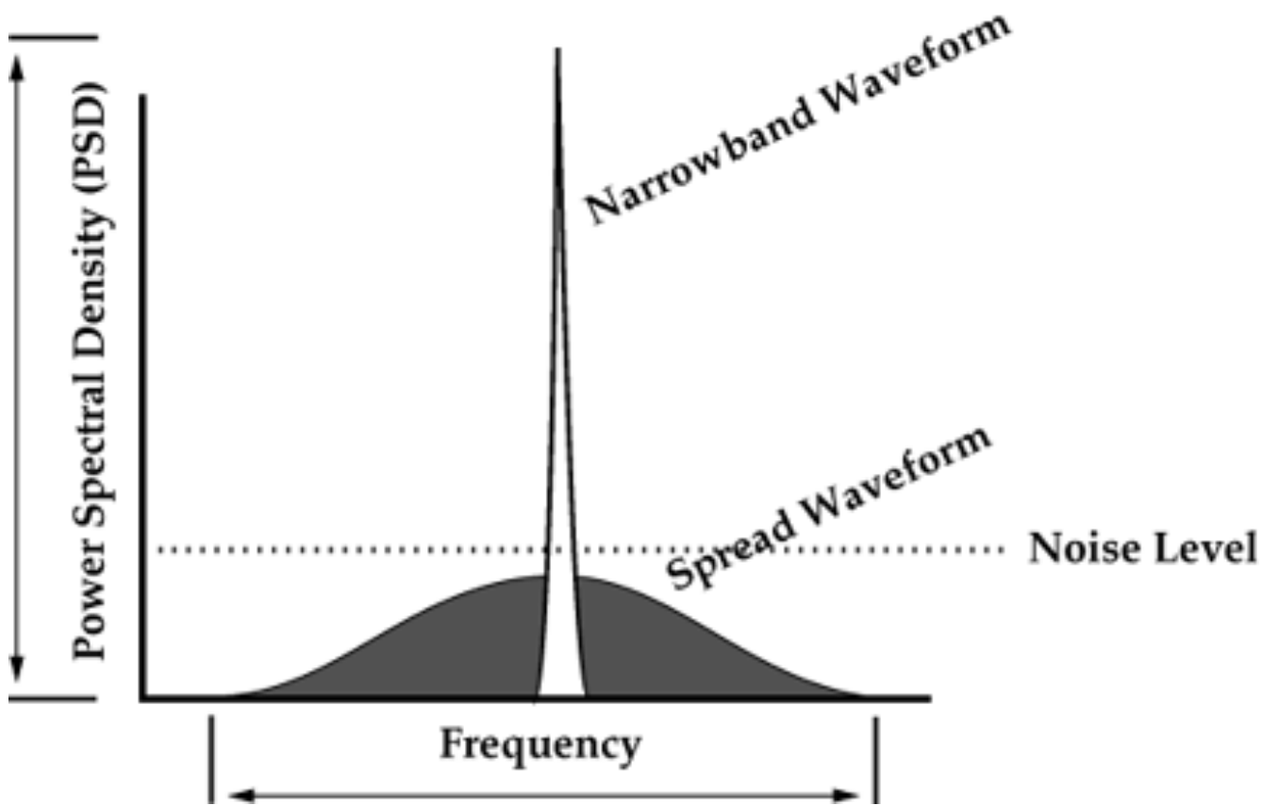
Frequencies, bw, duty-cycle, power

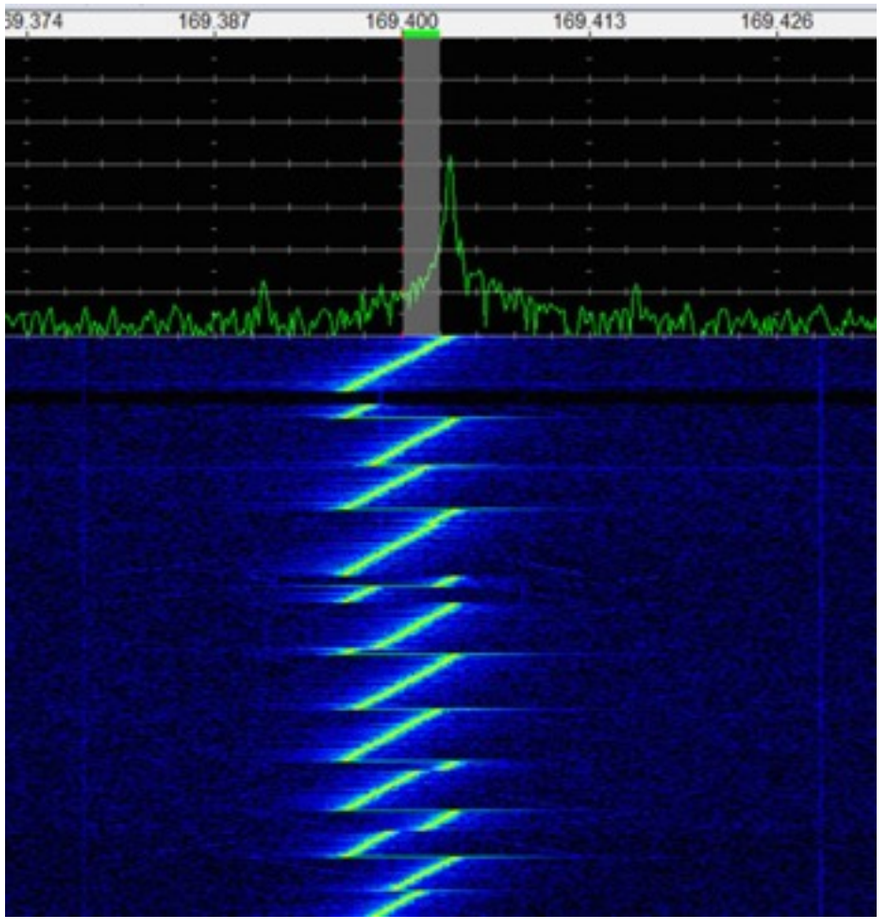
band	frequenties	max. power	duty cycle
433	433.175 433.375 433.575	10 dBm (10 mW)	0,1% (3,6 sec/hour)
867, g	867.1 867.3 867.5 867.7 867.9	14 dBm (25 mW)	1% (36 sec/hour)
868, g1	**868.1 868.3 868.5**	14 dBm (25 mW)	1%
869, g3	**869.5**	27 dBm (500 mW)	10% (6 min/hour)



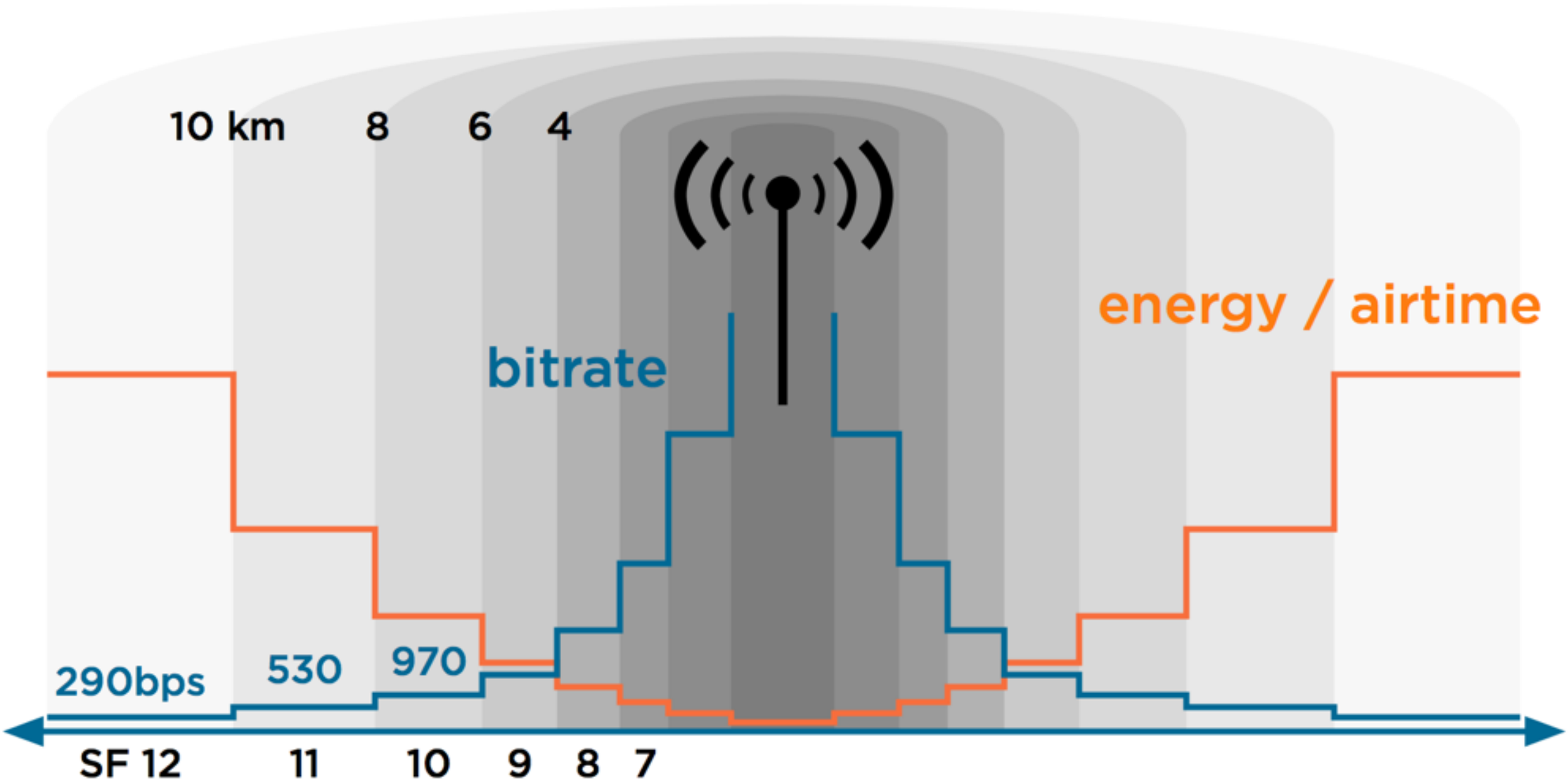
LoRa (PHY, modulation technique)

- **Chirp Spread Spectrum**: bandwidth, decodable under noise-level, even with interference and fading
- Lower speed when higher speeds don't work
- Localisation, timing





LoRa speeds


10 km
8
6
4
energy / airtime
bitrate
290bps
530
970
SF 12
11
10
9
8
7

LoRaWAN classes: we use A

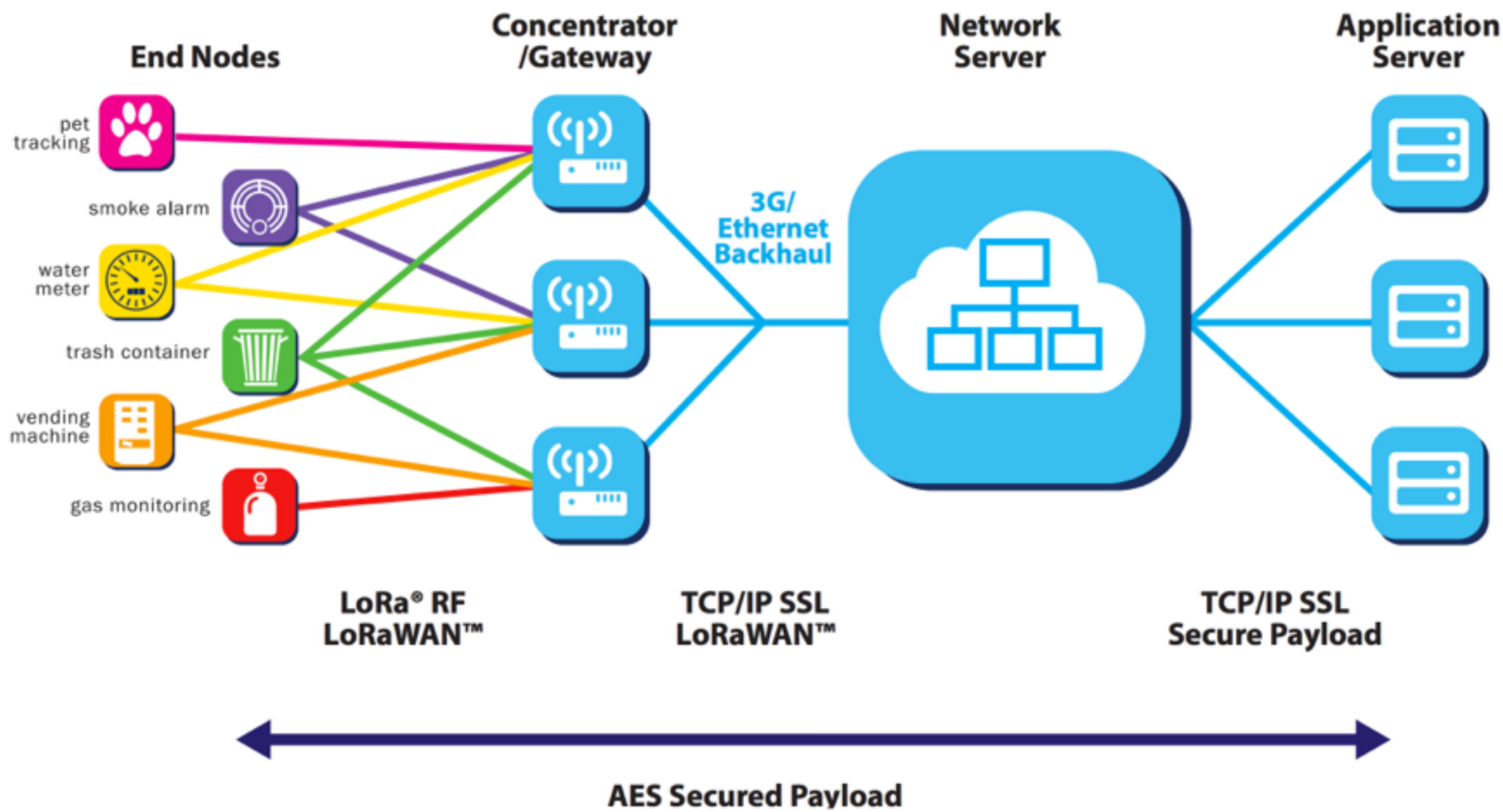
Three classes:

Class A: transmit from a node, transmit window (~52 bytes), 2 receive windows (ACK, evt. data, ~10 bytes)

(**Class B**: besides A also receive windows on set intervals, time-synchronisation beacons - in development)

Class C: continuous receive window (except while sending), if there is sufficient power (and low latency is required)

Typical LoRaWAN network



bron: LoRa Alliance

SURFnet demo-portal

my.lora.surfnet.nl

SURFnet LoRaWAN

WELCOME, **PAUL**. CHANGE PASSWORD / LOG OUT

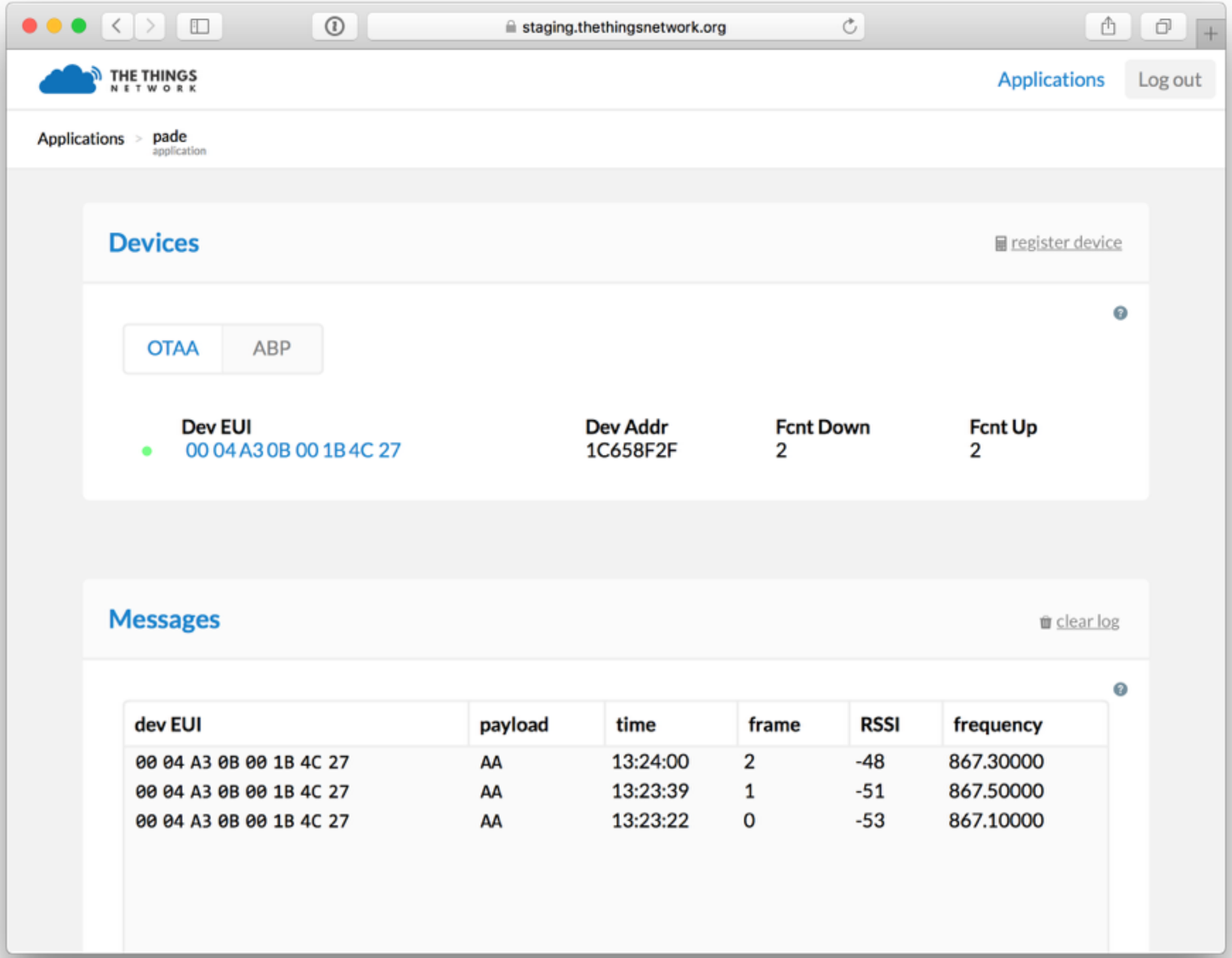
Home › Things › Sessions › Add session

Add session

Device Address:	010bd039
Device EUI:	---------
Created:	-
☑ Enabled	
Network session key:	7a0771ef49b449eea16571056b0c2e24
Application session key:	f9ce31d3b58085005b8e12000edfd98c
Frame count up:	0

Save and add another | Save and continue editing | SAVE

The Things Network (staging) portal



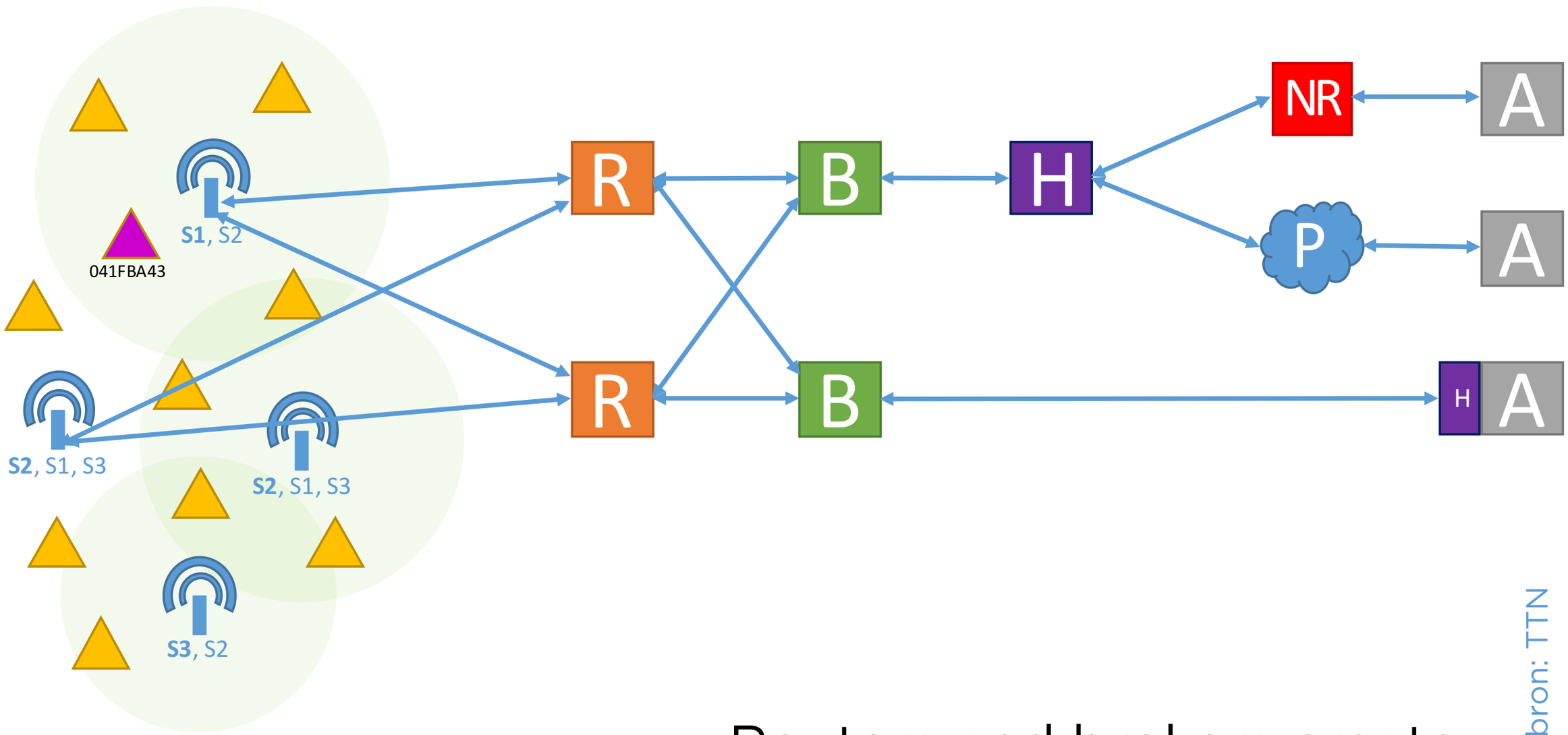
The Things Network

- **Global community LoRaWAN network crowdsourced** (think eduroam)
- **No “single point of control”**
- End-to-end encryption
- Can be combined with private LoRaWAN
- No country borders

The Things Network, Architecture

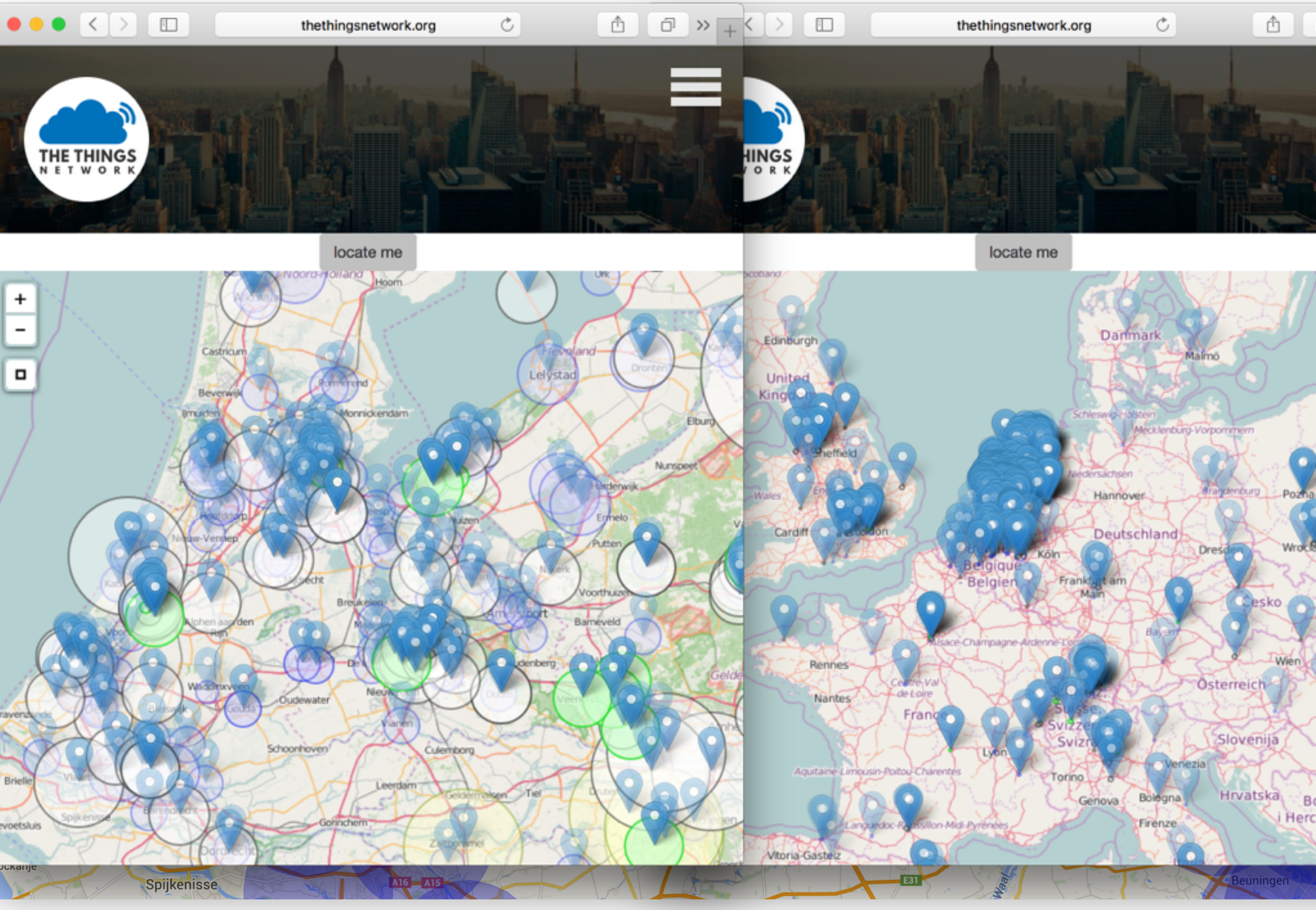
Community network, no centralised infrastructure:

we can be part of this infrastructure!



bron: TTN

Routers and brokers create
message-bus for applications to subscribe to


thethingsnetwork.org
THE THINGS NETWORK
locate me
Castricum
Beverwijk
Ijmuiden
Monnickendam
Lelystad
Dronten
Elburg
Nunspeet
Harderwijk
Ermelo
Putten
Voorthuizen
Barneveld
Oudewater
Gouda
Schoonhoven
Culemborg
Leerdam
Tiel
Gorinchem
Dordrecht
Brielle
Spijkenisse
thethingsnetwork.org
locate me
Edinburgh
Sheffield
Cardiff
Danmark
Malmö
Schleswig-Holstein
Mecklenburg-Vorpommern
Niedersachsen
Hannover
Brandenburg
Deutschland
Köln
Dresden
Belgique
Belgien
Frankfurt am Main
Česko
Wien
Österreich
Rennes
Nantes
Lyon
Slovenija
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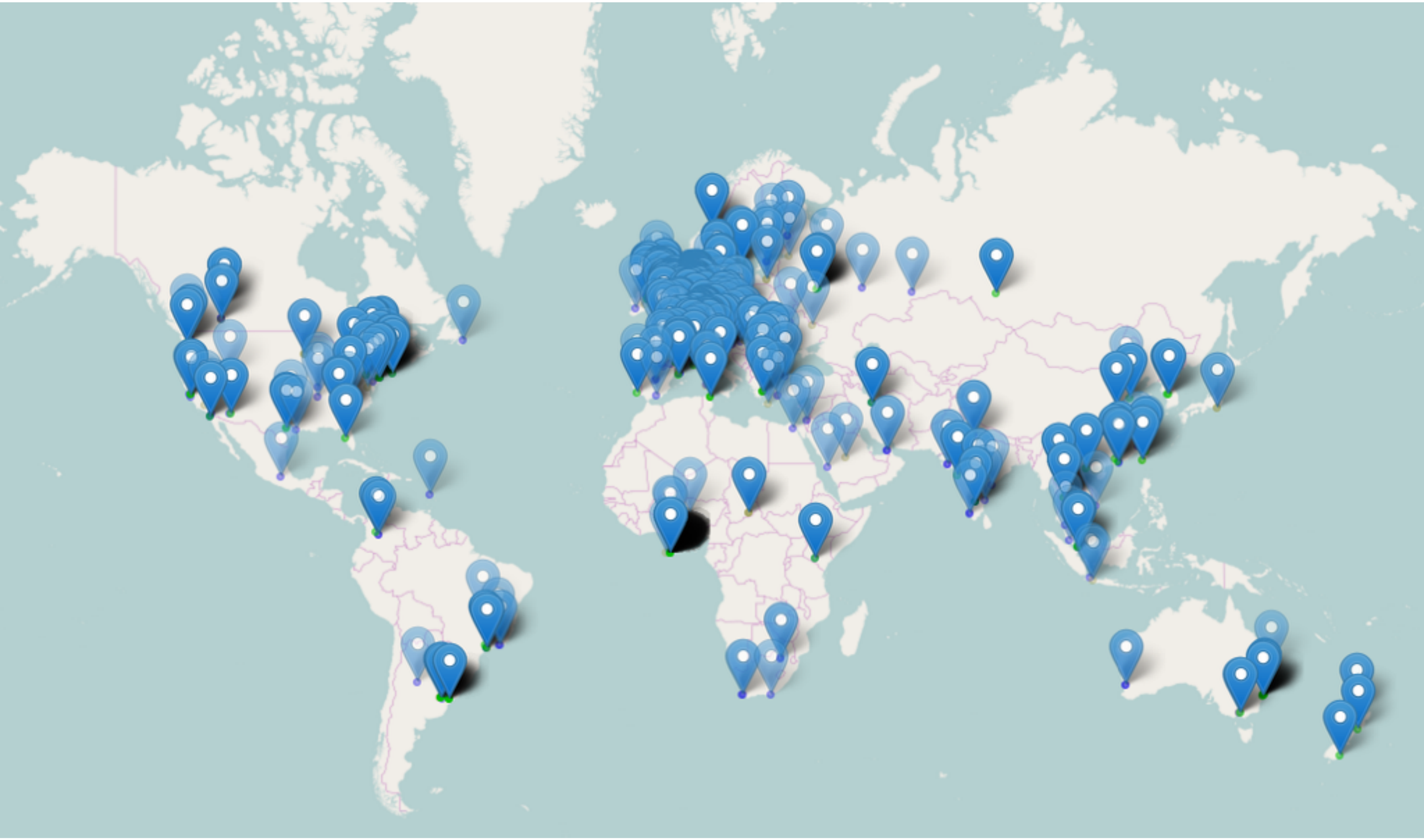
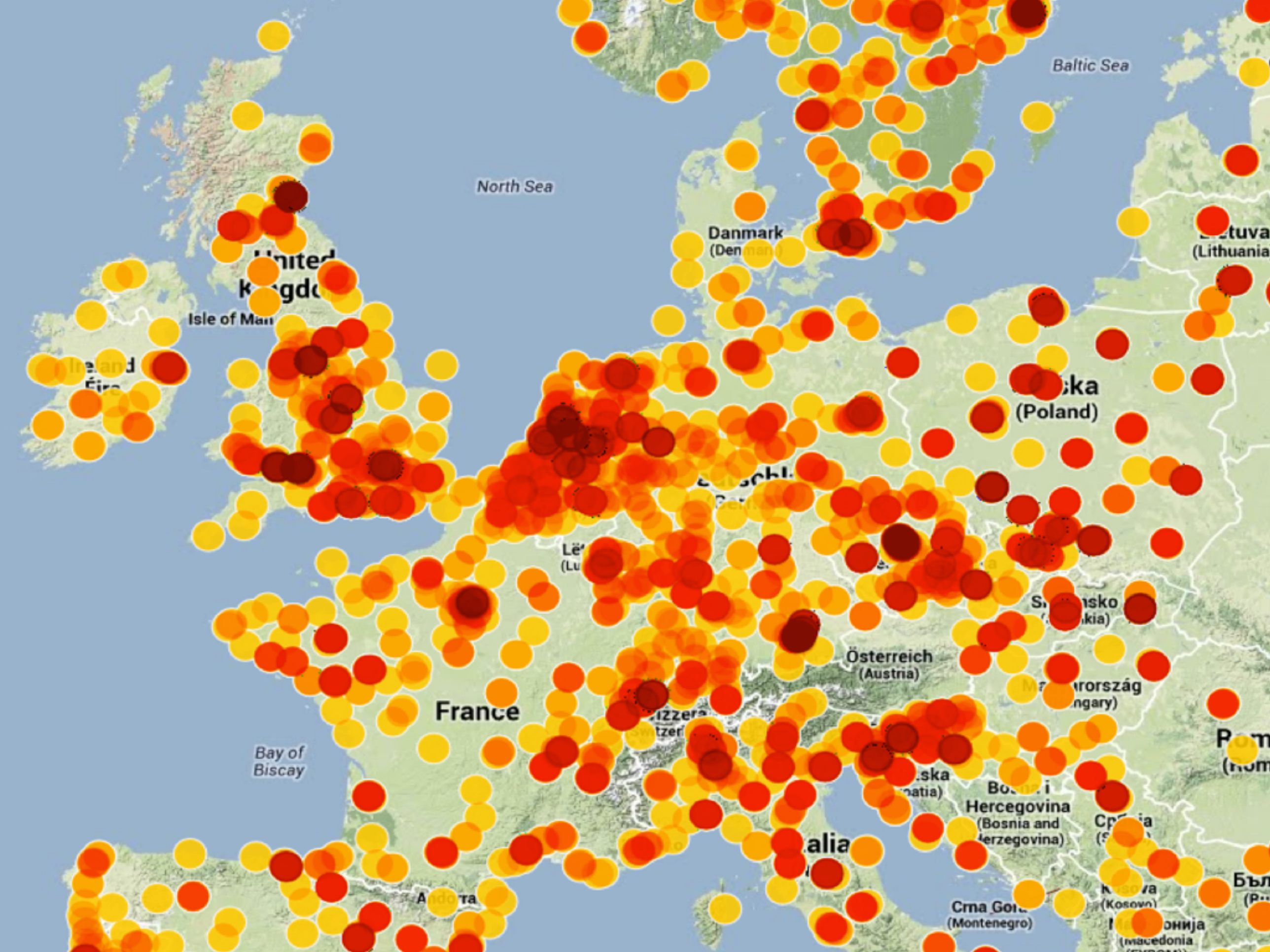
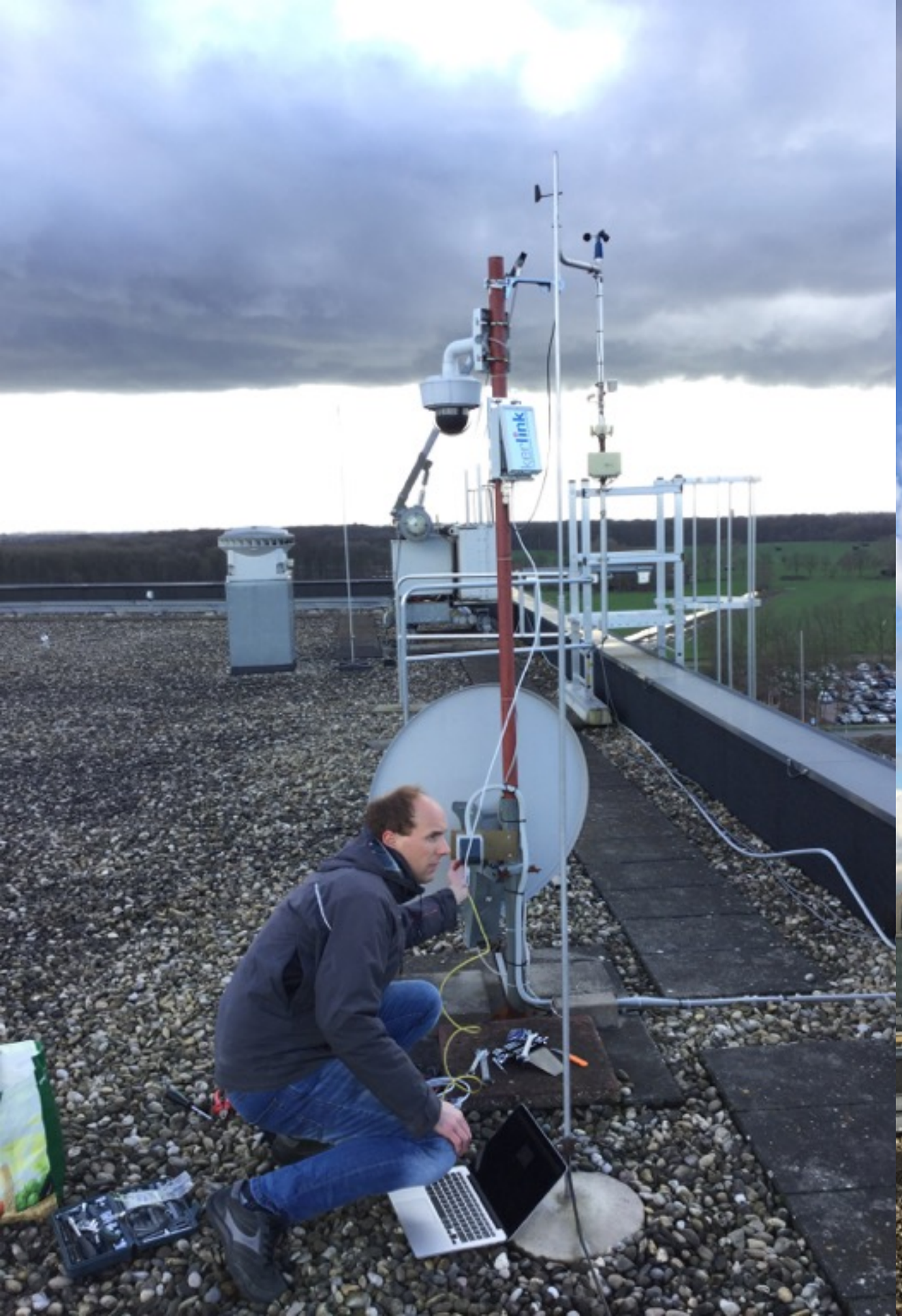
Torino
Genova
Bologna
Firenze
Hrvatska
Vitoria-Gasteiz
Beuningen

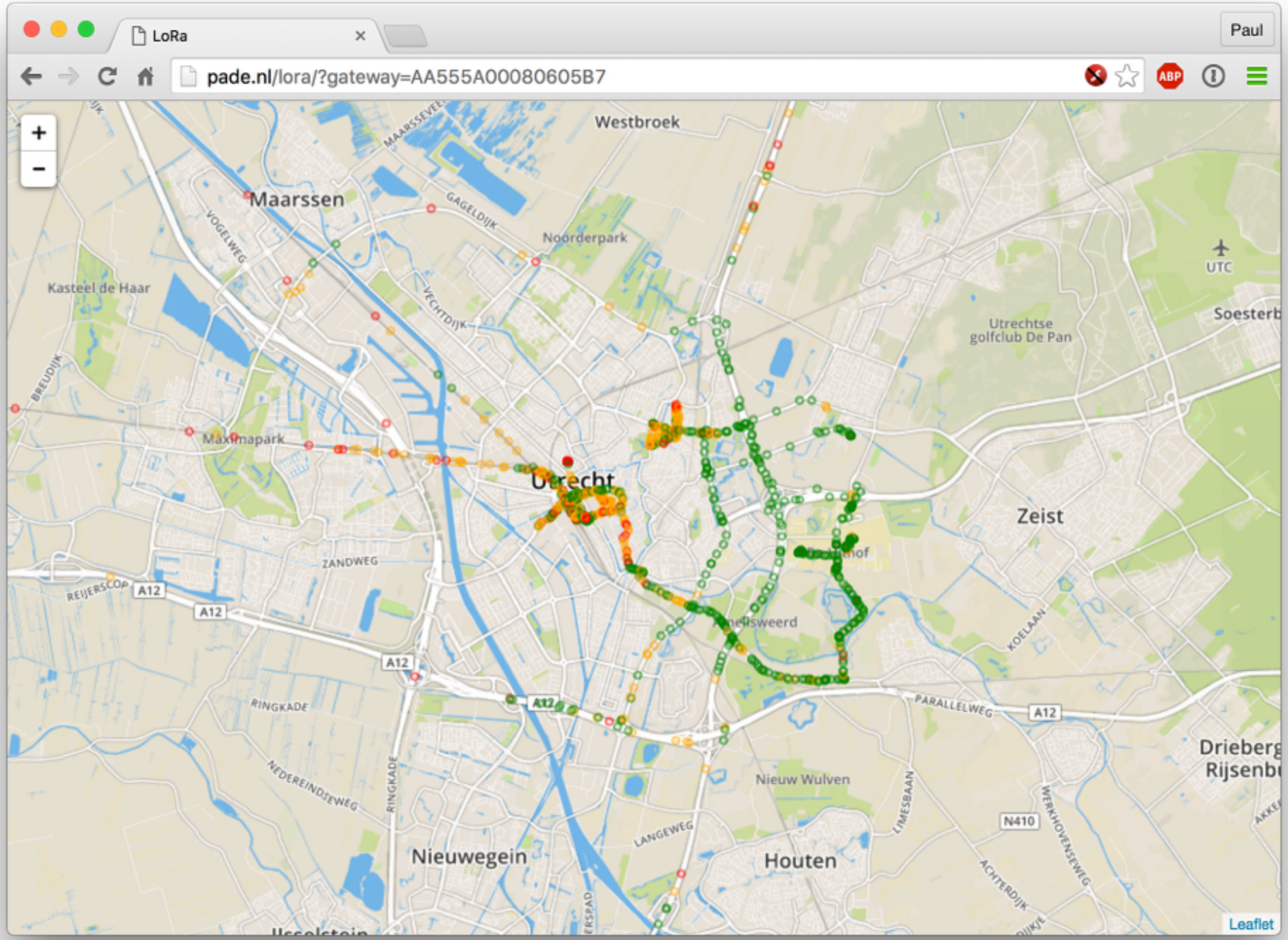


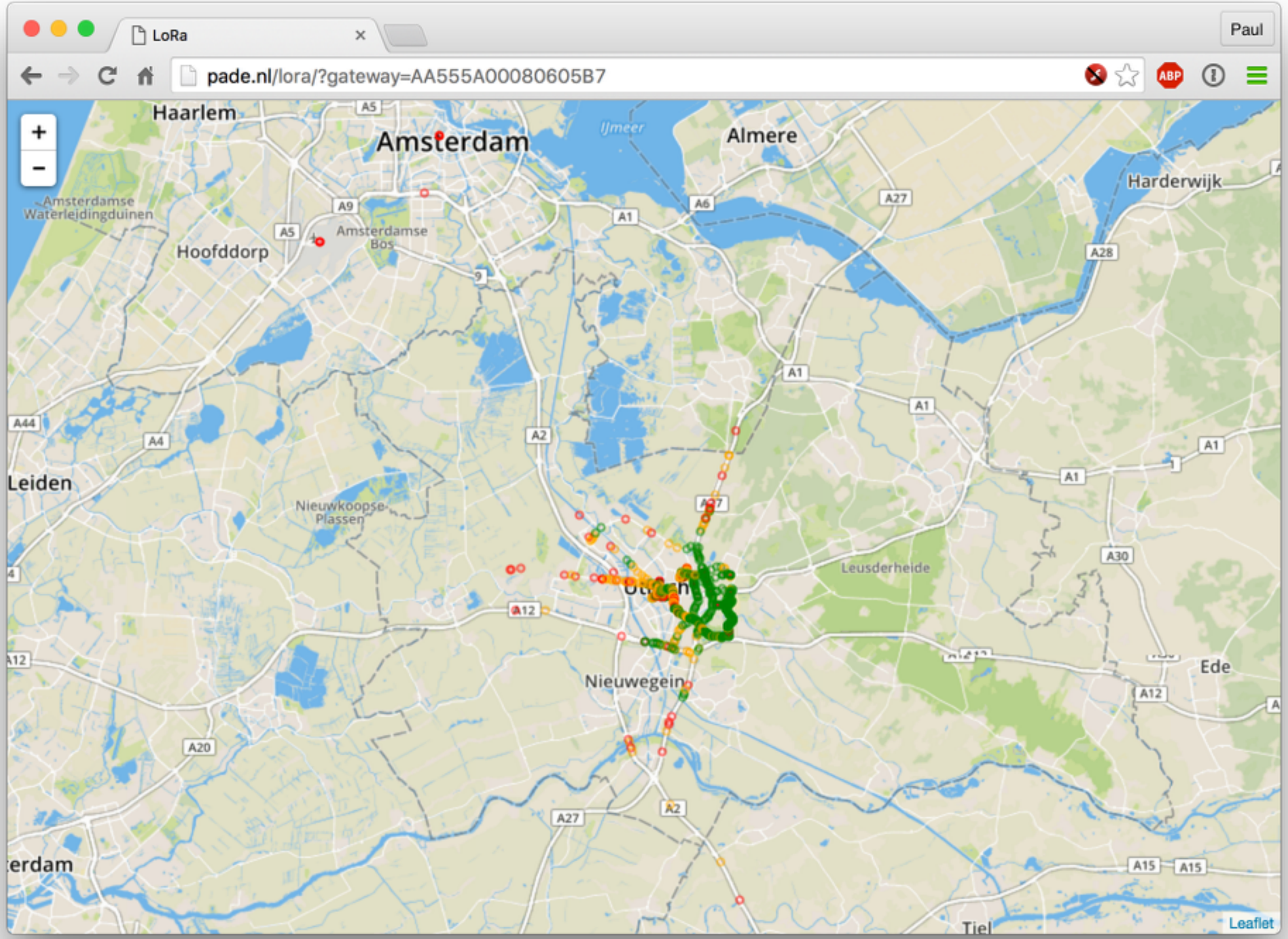

Baltic Sea
North Sea
Danmark
Isle of Man
(Poland)
France
Bay of
Biscay
Österreich
(Austria)
Hercegovina
(Bosnia and
Crna Gora
(Montenegro)
(Kosovo)
(Lithuania


MULTITECH
MultiConnect Conduit


kerlink


kerlink


LoRa
Paul
pade.nl/lora/?gateway=AA555A00080605B7
Westbroek
Maarssen
Noorderpark
Kasteel de Haar
Utrechtse golfclub De Pan
Soesterb
Maxmapark
Utrecht
Zeist
Amerisweerd
Nieuw Wulven
Nieuwegein
Houten
Drieberg
Rijsenbu
A12
N410
Leaflet


LoRa
Paul
pade.nl/lora/?gateway=AA555A00080605B7
Haarlem
Amsterdam
IJmeer
Almere
Harderwijk
Amsterdamse Waterleidingduinen
Hoofddorp
Amsterdamse Bos
Leiden
Nieuwkoopse Plassen
Leusderheide
Nieuwegein
Ede
Tiel
A5
A9
A1
A6
A27
A28
A44
A4
A2
A30
A12
A20
A15
Leaflet

forum.thethingsnetwork.org/t/measuring-coverage-gateway/1051/70

Measuring coverage gateway

Gateways

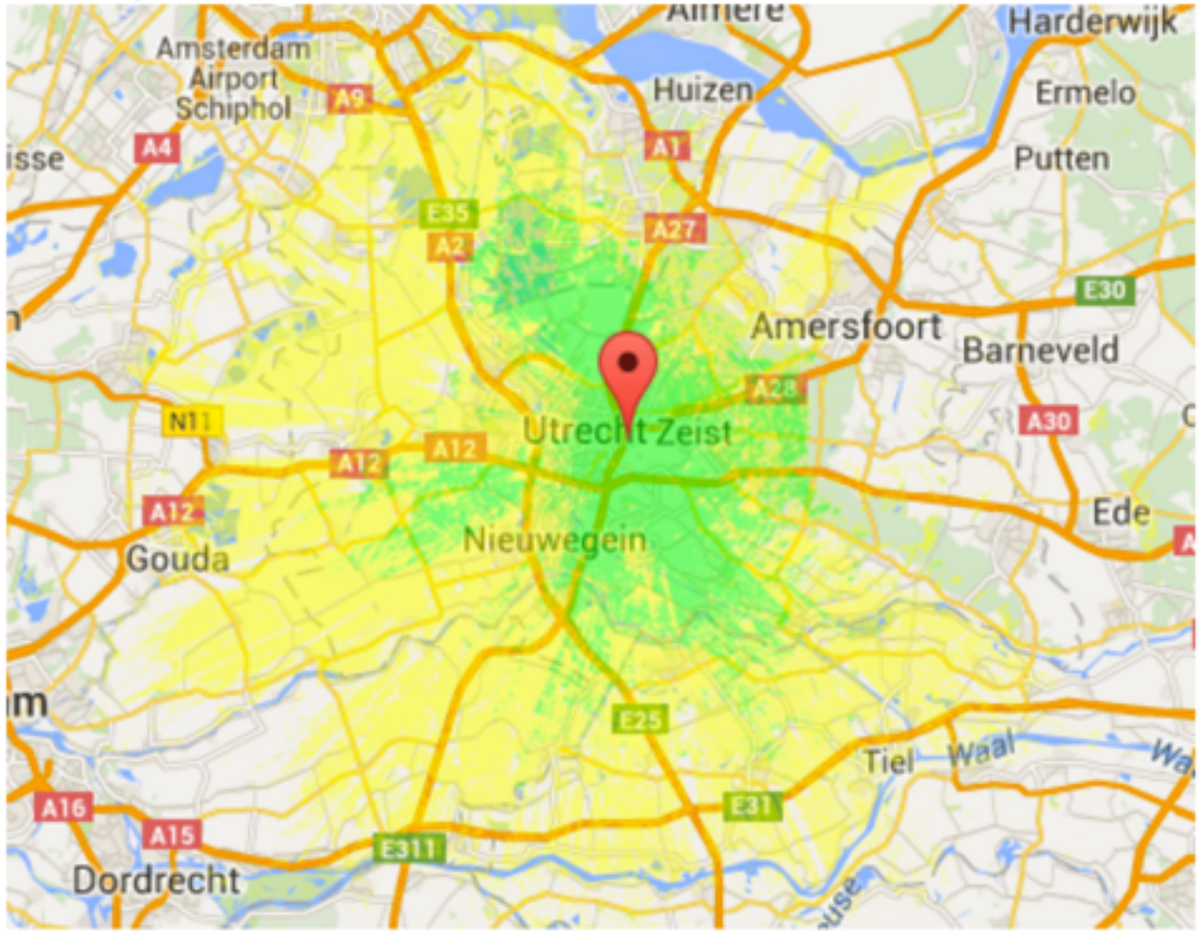
PH3V 21d + Reply

Today i did some Predicted vs Realtime calculations ..

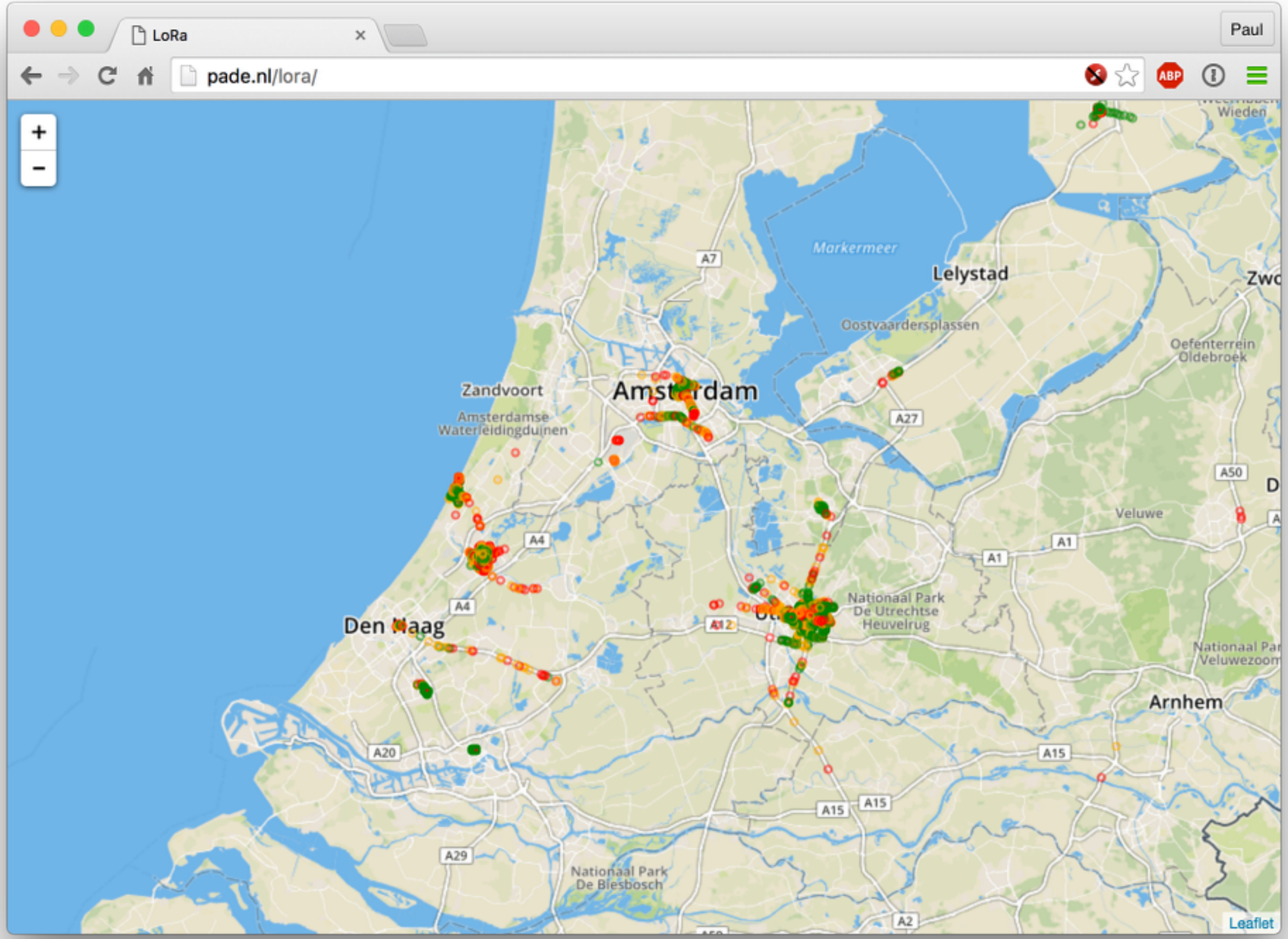
Remarkable how well the prediction comes close to the real-time measurements.
The original contains pixels of 50 by 50 meters.
For example, on the bridge at Zaltbommel there is indeed, albeit limited, coverage.
It is also clear to see that there is less eastward coverage. That's because of the hills. (Utrecht Ridge)

The same prediction made on the basis of my antenna setup ... Antenna 7 meters, urban canyon.
That was a big disappointment compared to Utrecht setup 😉

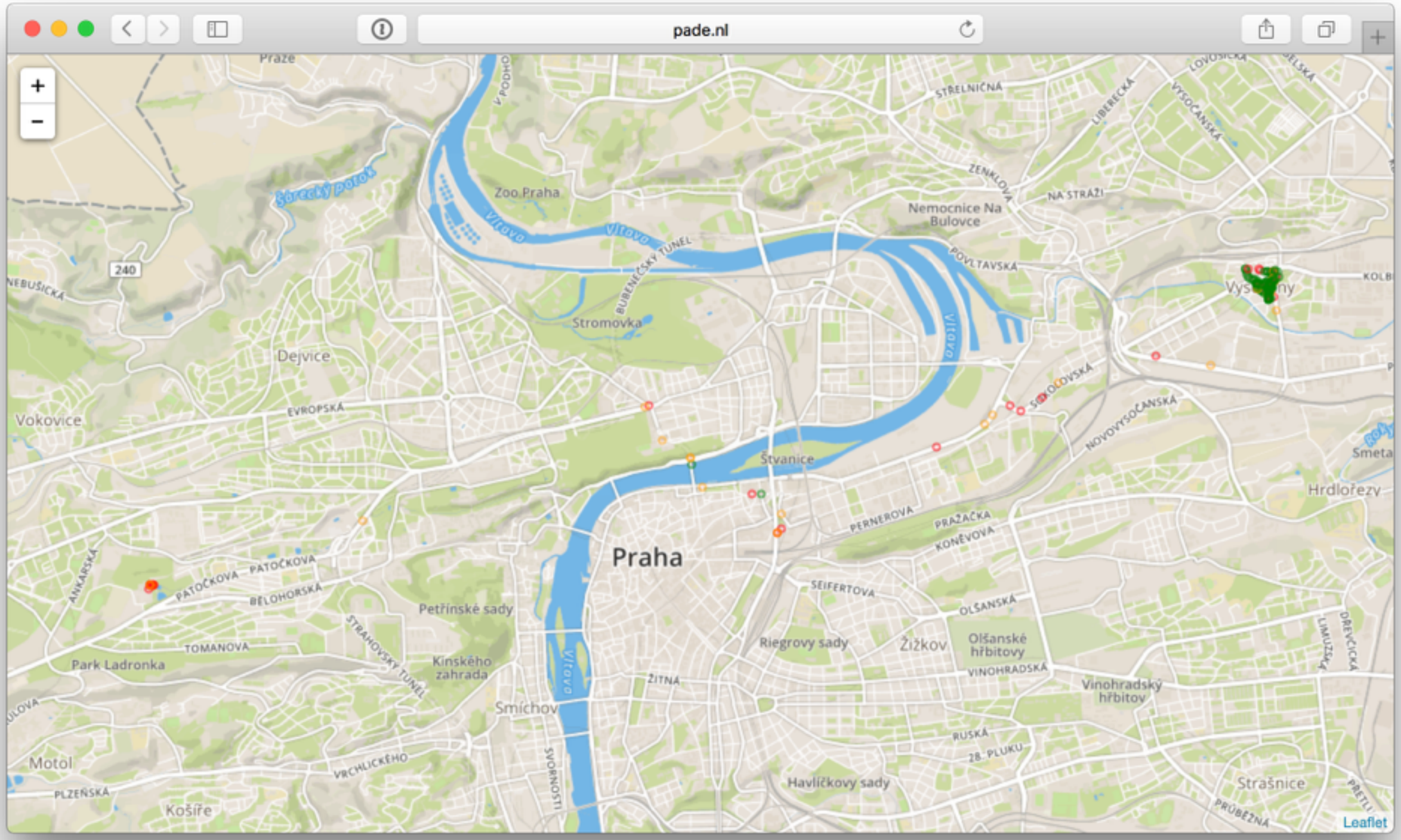
Gateway AA555A00080605B7 'De Uithof' Utrecht, The Netherlands

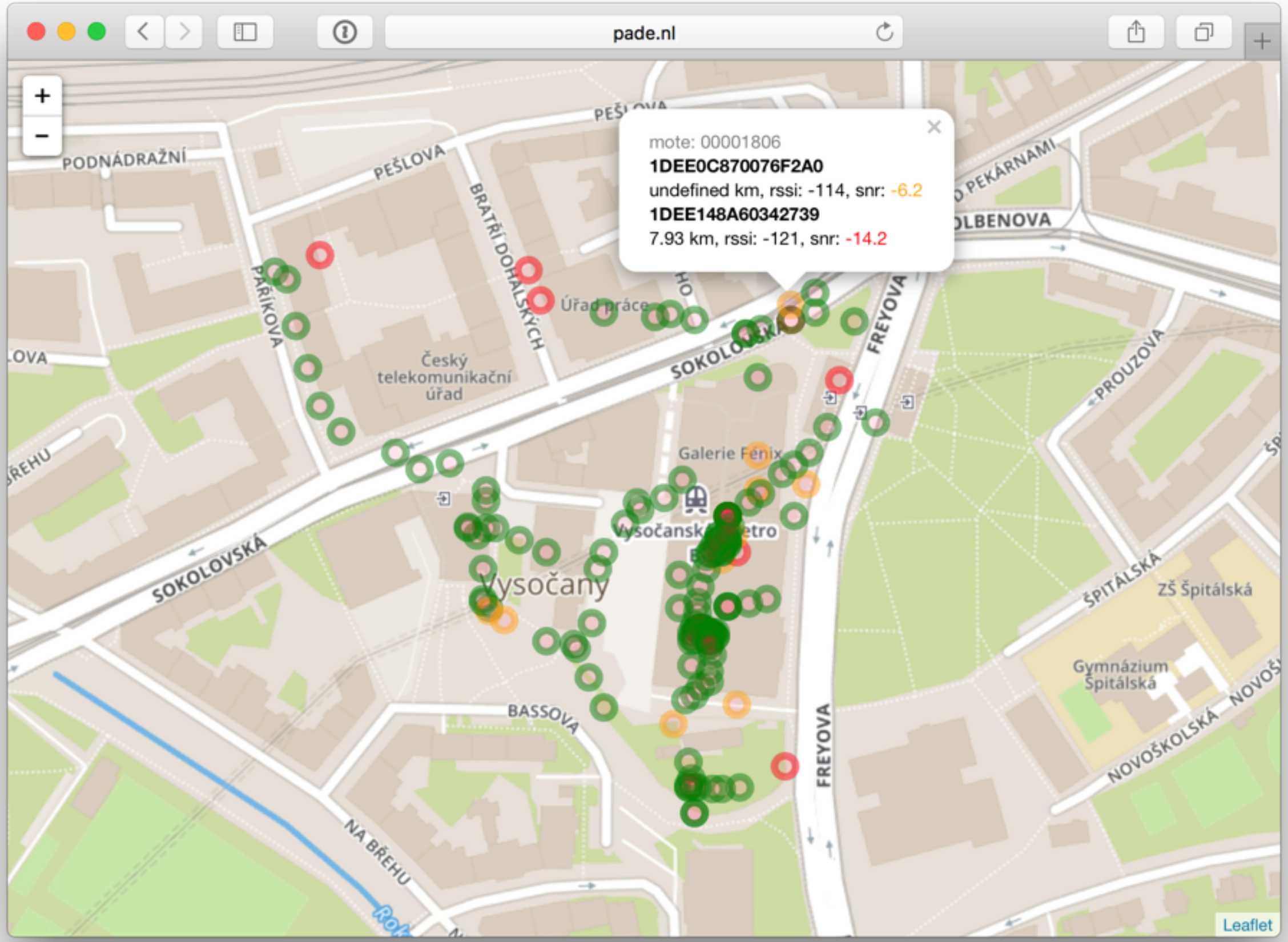


Green > -112dBm
Yellow > -127dBm < -112 dBm



ook metingen in Eindhoven... ;-)


pade.nl
Praha
Zoo Praha
Vltava
Stromovka
Dejvice
Vokovice
Štvanice
Nemocnice Na Bulovce
Vysočany
Hrdlořezy
Smeta
Petřínské sady
Kinského zahrada
Smíchov
Riegrovy sady
Žižkov
Olšanské hřbitovy
Vinohradský hřbitov
Havlíčkovy sady
Strašnice
Park Ladronka
Motol
Košíře
Šárecký potok
BUBENEČSKÝ TUNEL
STRAHOVSKÝ TUNEL
EVROPSKÁ
PATOČKOVA
BĚLOHORSKÁ
TOMANOVA
ANKARSKÁ
PLZEŇSKÁ
VRCHLICKÉHO
SVORNOSTI
ŽITNÁ
SEIFERTOVA
PERNEROVA
PRAŽAČKA
KONĚVOVA
OLŠANSKÁ
VINOHRADSKÁ
RUSKÁ
28. PLUKU
PRŮBĚŽNÁ
NOVOVYSOČANSKÁ
POVLTAVSKÁ
ZENKLOVA
NA STRÁŽI
STŘELNIČNÁ
LIBERECKÁ
VYSOČANSKÁ
LIMUŽSKÁ
DŘEVČICKÁ
NEBUŠICKÁ
240
Leaflet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mote: 00001806
1DEE0C870076F2A0
undefined km, rssi: -114, snr: -6.2
1DEE148A60342739
7.93 km, rssi: -121, snr: -14.2
PODNÁDRAŽNÍ
PEŠLOVA
BRATŘÍ DOHALSKÝCH
PAŘÍKOVA
Úřad práce
Český telekomunikační úřad
SOKOLOVSKÁ
FREYOVA
PROUZOVA
Galerie Fenix
Vysočany
BASSOVA
NA BŘEHU
ŠPITÁLSKÁ
ZŠ Špitálská
Gymnázium Špitálská
NOVOŠKOLSKÁ
Leaflet

Applications? The network is there...

vacuum pump

environmental, air-quality, noise

asset-management

CO2 in lecture rooms

dikes

digital seal

cleaning-cart

trash-containers

earthquakes

smart meters

maintenance bridges

track OV-bike usage (maintenance)

traffic

overstroming

building mgmt

trains

fridge researchers

streetlights

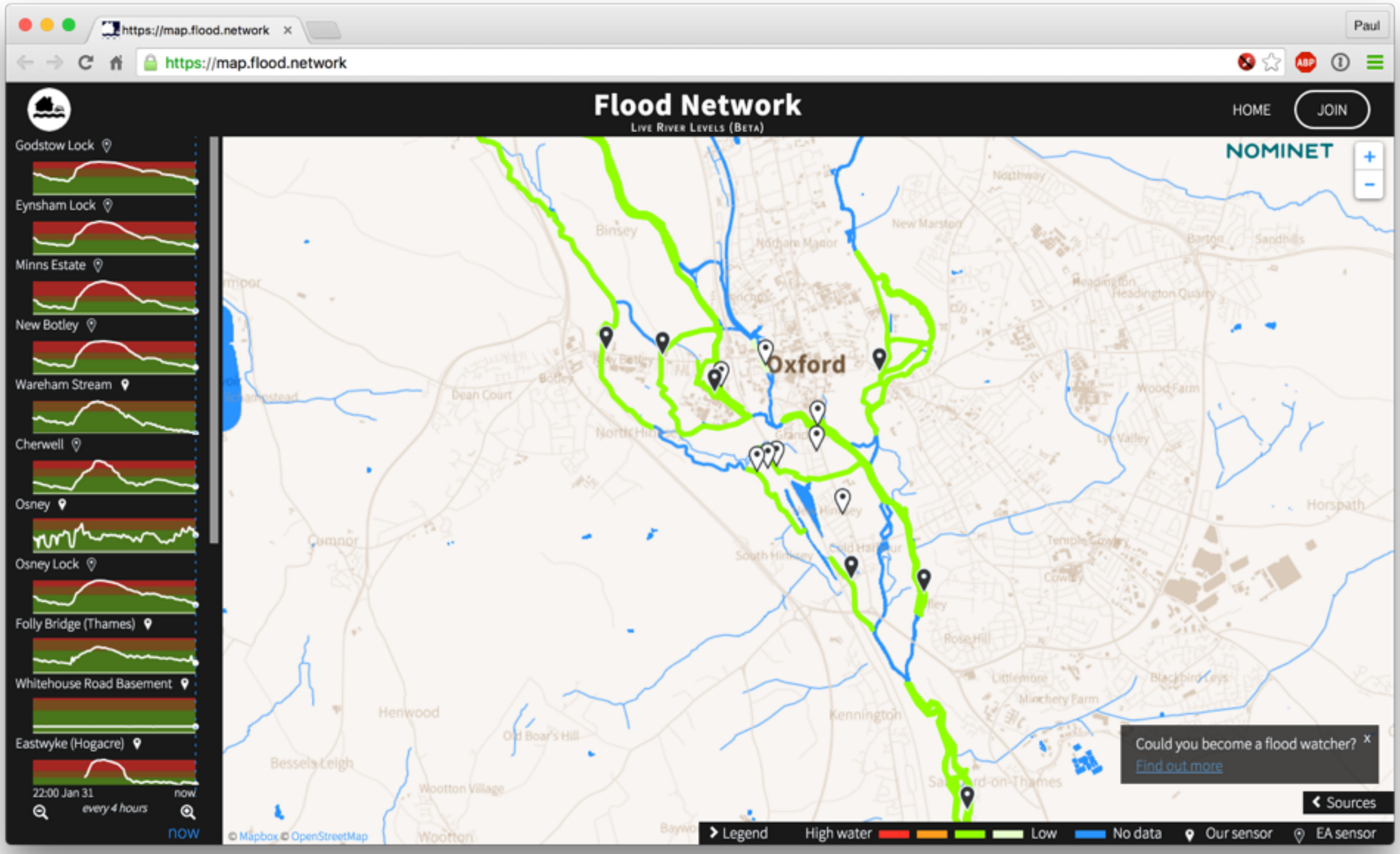
parking spots

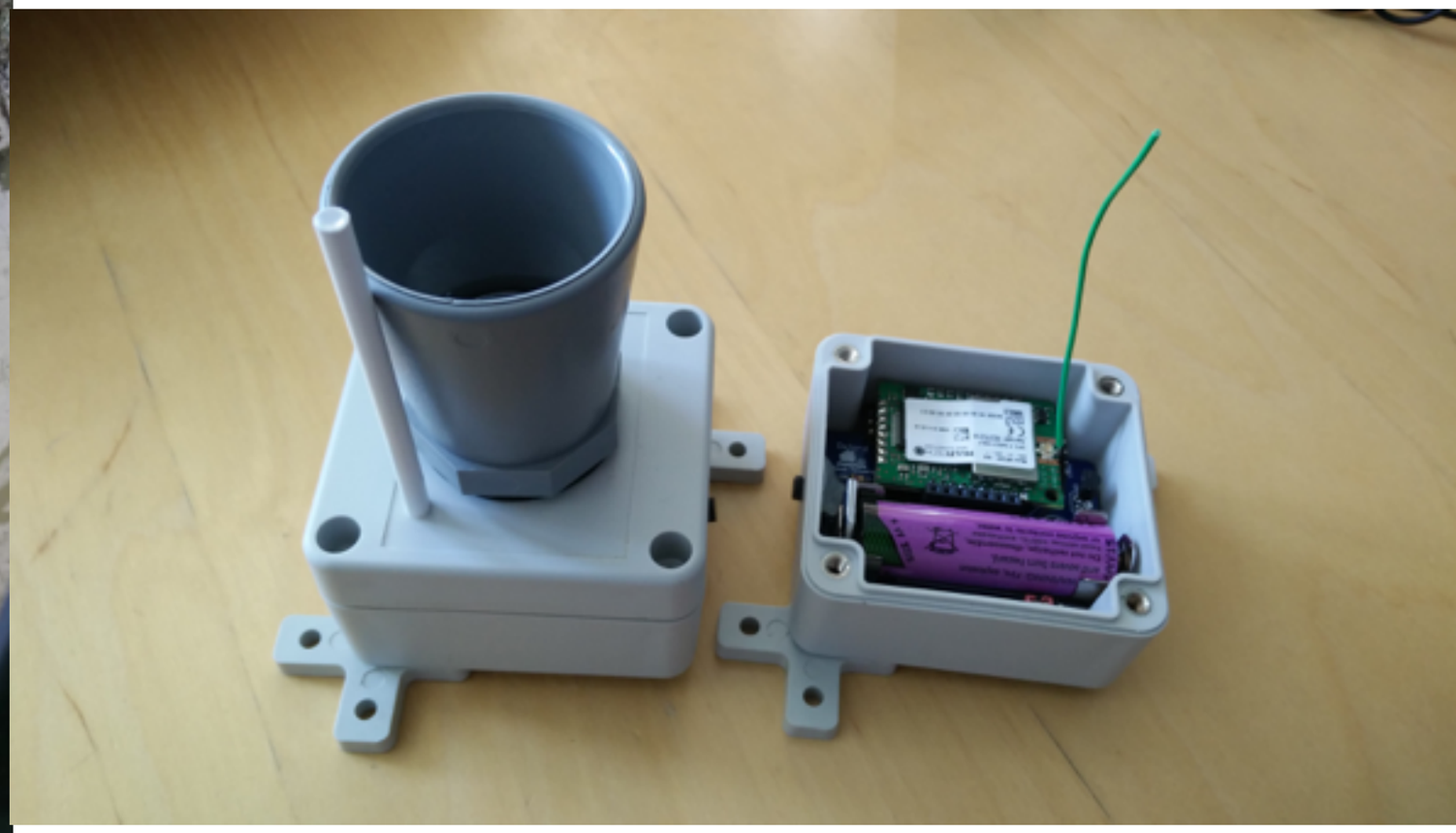
leakage

water plants

track wildlife


Biologisch


https://map.flood.network
Paul
https://map.flood.network
Flood Network
Live River Levels (Beta)
HOME
JOIN
Godstow Lock
Eynsham Lock
Minns Estate
New Botley
Wareham Stream
Cherwell
Osney
Osney Lock
Folly Bridge (Thames)
Whitehouse Road Basement
Eastwyke (Hogacre)
22:00 Jan 31
now
every 4 hours
now
NOMINET
Oxford
Binsey
Dean Court
Cumnor
Henwood
Bessels Leigh
Wootton Village
Wootton
Kennington
Cowley
Rose Hill
Littlemore
Minchery Farm
Blackbird Leys
Horspath
Wood Farm
Headington
Headington Quarry
Barton
Sandhills
New Marston
Northway
Could you become a flood watcher?
Find out more
Sources
© Mapbox © OpenStreetMap
Legend
High water
Low
No data
Our sensor
EA sensor



https://blog.surf.nl/en/lora-the-internet-of-things/

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LoRa, the Internet of Things

Paul Dekkers Internet of Things, IoT, LoRa, LoraWAN 25 JAN 2016

Previous post Next post

‘Things’ online

We are constantly surrounded by things; as far as I am concerned, there is no need for them to be online all the time – although I wouldn’t have minded if my fridge had let me know there was still some old bread in the freezer compartment. Come to think of it, quite a few things in life might be better if they were online: just take a walk through the city and you’ll see full waste containers, half submerged boats, parking spaces, bicycles, lantern posts. The air quality in some places also seems a bit suspect, and could certainly do with the odd measurement. I also keep running into more amusing and useful ‘Internet-of-things’ applications developed by LoRa users, such as beehive monitoring systems.

Tag Cloud

App MOLGENIS learning feedback network management IaaS OAuth IDP

Blogs

- Network »
- Cloud »
- Security & Privacy »
- Mobile & Wireless »
- SURFnet corporate »

SURFnet
@SURFnet

RT @raoulteeuwen: Hands-on LoRaWAN workshop @SURFnet door @pauldekkers

and SURFnet / NRENs?

- Collaborate with The Things Network
  - create infrastructure connected to eduGAIN / SURFconext
  - collaborate with open courseware (future MOOC)

and SURFnet / NRENs?

- Workshops, share knowledge, collaborate
- Gateways at certain institutions: applications and coverage on campuses, challenge use
- eduroam monitoring sensor, report via LoRaWAN
- Strong authentication, not connected 2nd factor
- **How do we help researchers, lecturers, students, ...?**

Questions?

paul.dekkers [at] surfnet.nl