



# The Things Network

Applying Eclipse Technologies to build real use cases

@gnz, @ZimMatthias

<http://bit.ly/ttn-real-use-case-with-eclipse>

# Agenda

What is LoRaWAN?

What is The Things Network?

Zurich community

Use cases

Demo time!

# What are the **connectivity needs** of IoT?



S Large CCTV Botnet Leveraged x g nz

Large CCTV Botnet Leveraged

https://blog.sucuri.net/2016/06/large-cctv-botnet-leveraged-ddos-attacks.html

SHARES t G f +

Station 8 dan  
DS10520  
delay 5  
samples 12

9VOLTS  
03-2013  
PILE ALCAINE

Energizer

© by Micah Elizabeth Scott [CC-BY-SA]

# Internet of humans

WiFi - 3G/4G - Bluetooth

# Internet of things

LPN



# LoRa & LoRaWAN

## LoRa

Radio modulation

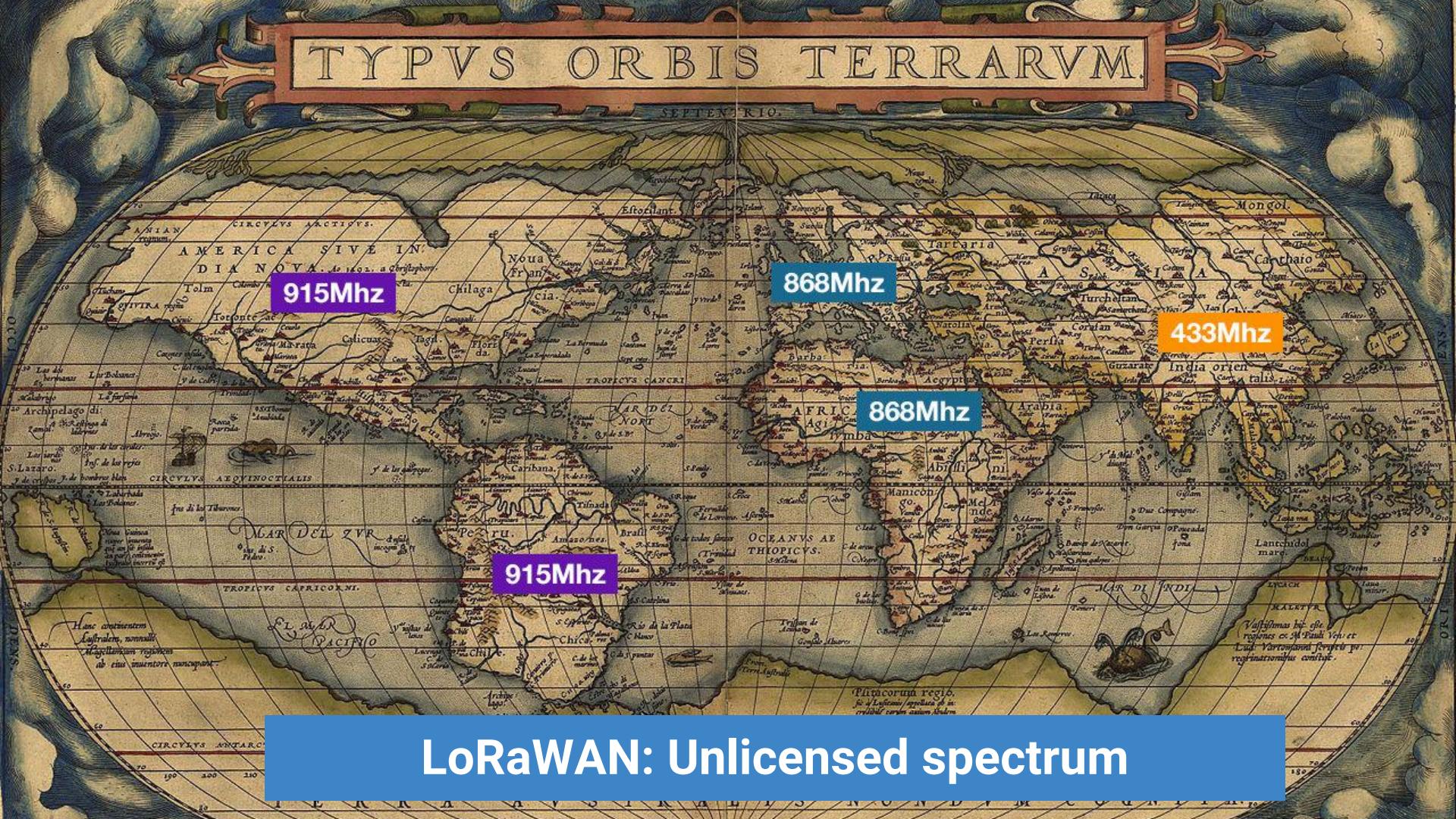
## LoRaWAN

Standard, star-of-stars topology

**Range:** 5km (urban) to +40km (rural)

**Power:** ~14mA (RX) and ~28mA (TX) -> years of battery life

**Cost:** ~\$12 (modem), ~\$300 (gateway), OSS stack, unlicensed spectrum



915Mhz

868Mhz

433Mhz

868Mhz

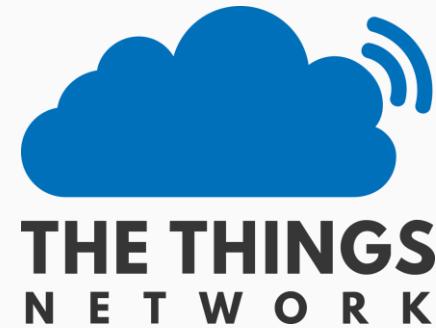
915Mhz

LoRaWAN: Unlicensed spectrum

# The Things Network

A **global community**, building **open source** software and hardware to operate a **crowd-sourced** network.

<https://www.thethingsnetwork.org/>



# The Things Network **around the world**



# Zurich community



THE SPARK

# The Things Network wants to make every city smart – starting with Amsterdam



by MARTIN BRYANT — 10 months ago in INSIDER



## Recommended



Conquer machine learning with this complete 10-course bundle (94% off)

TNW Deals · 3 days ago

## Most popular



1

Facebook's new algorithm sucks -- here's how to beat it and see whatever you want

Bryan Clark · 3 days ago



2

Facebook now lets you raise funds for your favorite charities

Abhimanyu Ghoshal · 2 days ago



3

Facebook now lets everyone translate posts to any language they want

Nate Swanner · 2 days ago



4

Messenger chatbots can now add quick reply buttons and send GIFs in conversations

Abhimanyu Ghoshal · 2 days ago



SK-iM880A

www.wireless-solutions.de/products/starterkits/sk-im880a.html

Wireless Solutions

Search ... Search

IMST

Home Products Services References / Partners Contact About Us Login News

Products > Evaluation Tools > SK-iM880A

STARTER KITS  
Plug & Play Solutions

LoRa™

SK-iM880A – Long Range Radio Starter Kit

The Starter Kit is a plug & play solution to explore the features and capabilities of the Long Range Radio module soldered on specific adapter boards. The modules are pre-programmed with the Long Range Radio firmware.

Details

The demo board is the basic platform of the Starter Kit and provides several functional units. These units include a supply, USB interface, and several input and output elements, such as push buttons, DIP switches, potentiometers. In addition all pads of the attached radio module can be accessed via pin connectors.

Connection between the radio module and the demo board is established via a module-specific adapter board. This module is soldered on the adapter board which is attached to the demo board through pin connectors. The adapter board also has a SMA jack connected to the RF output of the radio module, which can be used to connect an external antenna or RF measuring and test equipment.

By using the adapter boards all WiMOD radio modules can be attached to the same demo board. This allows a comparison between the modules to be achieved to determine which one is the best for a target product.



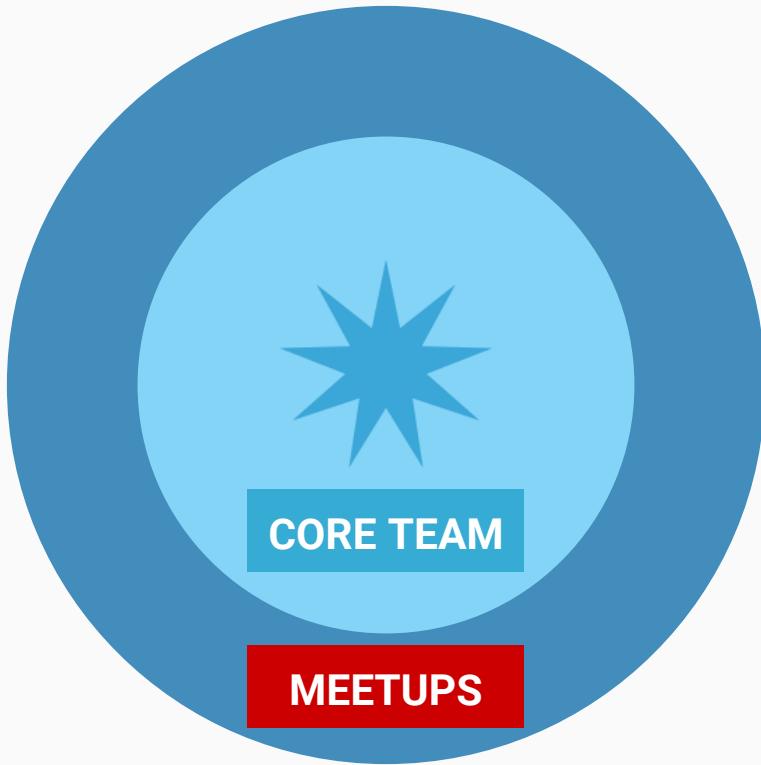


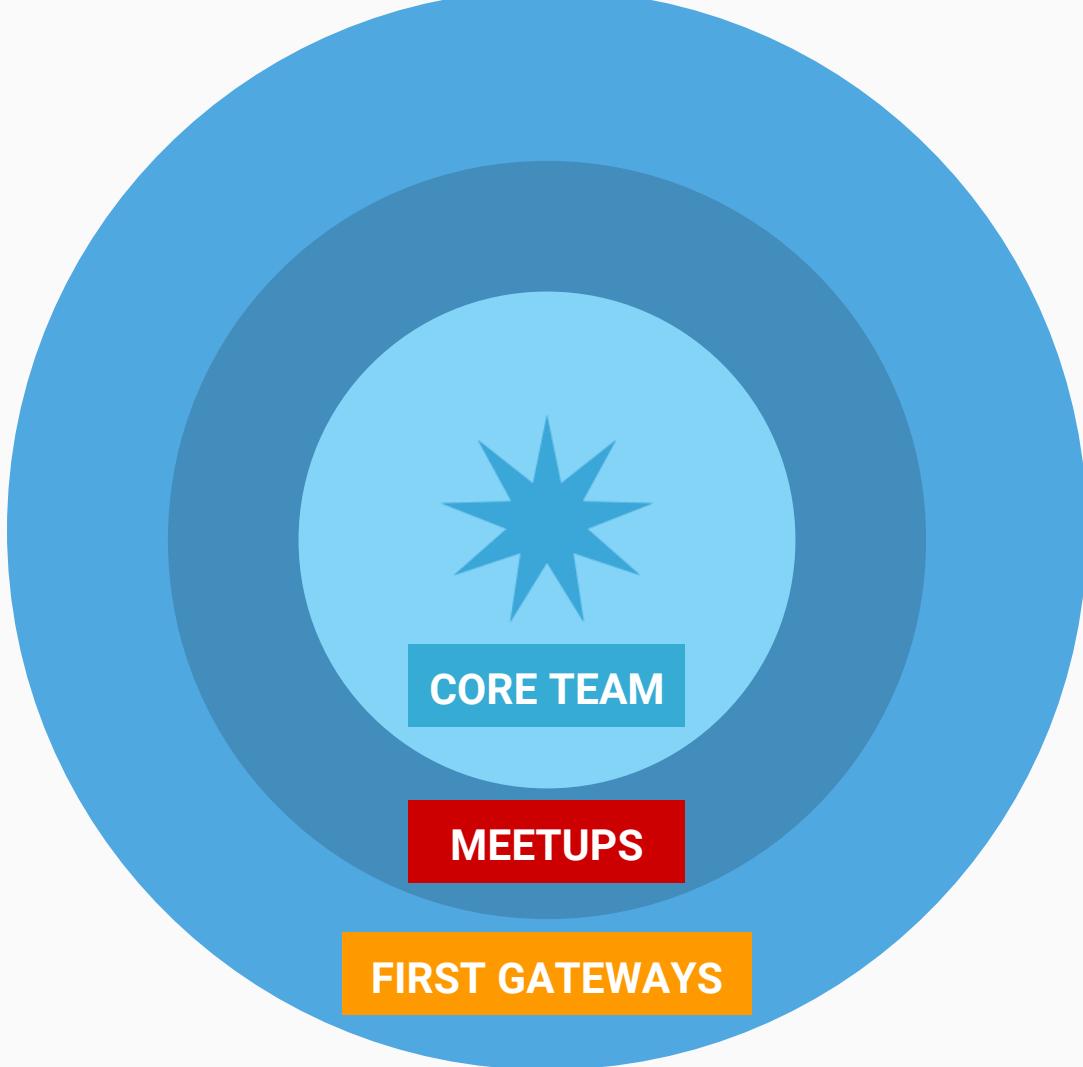


Photo by Ali Soy, @alisoy1502

The screenshot shows a Meetup group page for "IOT/ZH". The main header features the text "IOT/ZH" in large red letters with a black diagonal line through the middle. Below this, a banner reads "Internet of Things Zurich Meetup". The event details are for "LoRaWAN Connectivity for IoT" on Sep 29, 2015, at 6:00 PM. It lists speakers from Swisscom M2M and Loriot, and mentions Vit Prajizer from Thalwil-based Loriot. The page includes sections for "About us...", "Members", "Sponsors", "Photos", "Discussions", and "More". On the right, there's a sidebar with user profiles for Thomas Amberg, Gonzalo Casas, and Vikram Kripalany, along with a "Good to see you" message.



Photos by @gnz, CC-BY-SA





**€1200**

Home · mirakonta/lora\_gateway · [https://github.com/mirakonta/lora\\_gateway/wiki](https://github.com/mirakonta/lora_gateway/wiki)

## Home

Nestor edited this page on Aug 30, 2015 · 12 revisions

# MAKE your own 200€ LoRa gateway

This tutorial explains the steps to make an inexpensive LoRa gateway and how I managed to run it. Then I show a complete scenario with nodes, gateways and cloud all together. Finally I will explore the possibility to manufacture a cheaper one.



A photograph showing a Raspberry Pi Model B+ connected to a breadboard. On the breadboard, there is a LoRa module (Featherwing) and a USB WiFi adapter (ASUS USB-N13). Various wires connect the Pi's GPIO pins to the breadboard components. A white power cable is also visible.

Pages 5

- Home
- Part 1: Choose the hardware
- Part 2: Hardware modifications
- Part 3: Compile LoRa gateway software
- Part 4: Software modifications

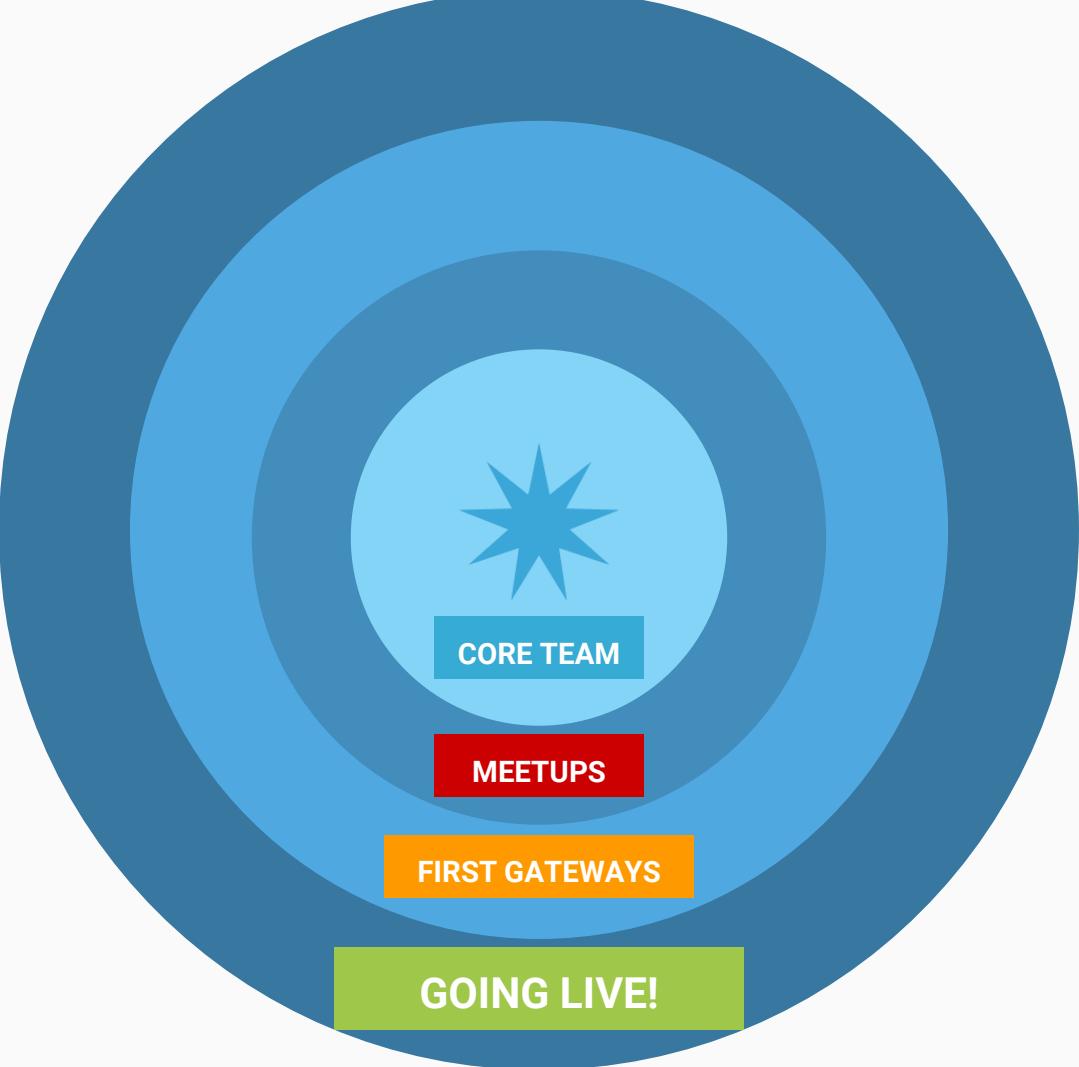
Clone this wiki locally

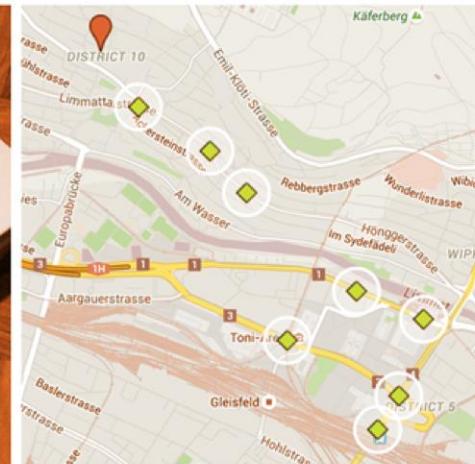
[https://github.com/mirakonta/lora\\_gateway](https://github.com/mirakonta/lora_gateway)

[Clone in Desktop](#)



Photos by @gnz, CC-BY-SA





Photos by @gnz, CC-BY-SA







Photos by @ZimMatthias

ttn-zh/ic880a-gateway at spi · GitHub

<https://github.com/ttn-zh/ic880a-gateway/tree/spi>

Create new file Upload files Find file

Branch: **spi** New pull request

This branch is 46 commits ahead, 9 commits behind master.

gonzalocasas Show hostname and updated API link Latest commit

**images** Add more images

.gitignore Initial commit

LICENSE Initial commit

README.md Update README.md

install.sh Show hostname and updated API link

start.sh Merge pull request #2 from abouillot/nowiringpi

ttn-gateway.service Make it a service

README.md

# The Things Network: iC880a-based gateway

Reference setup for [The Things Network](#) gateways based on the iC880a SPI concentrator with a Raspberry Pi.

This installer targets the **SPI version** of the board, if you have the USB version, [check this branch](#).

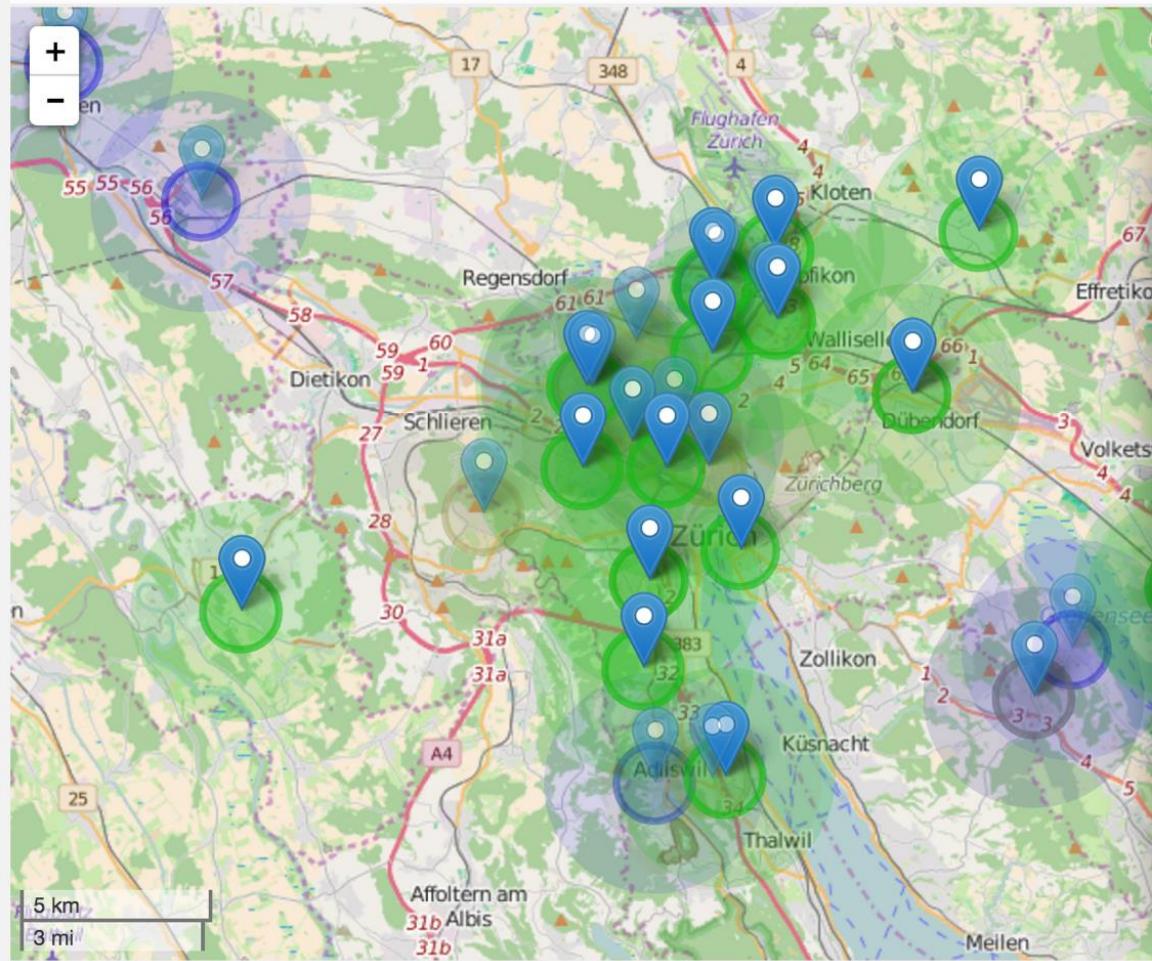
## Setup

Check [a step-by-step HOWTO](#) in our [wiki](#) for a detailed explanation of the hardware that needs to be purchased and how to assemble it.



## OUR GATEWAYS

Add a gateway



Join The Things Network Switzerland on Slack.

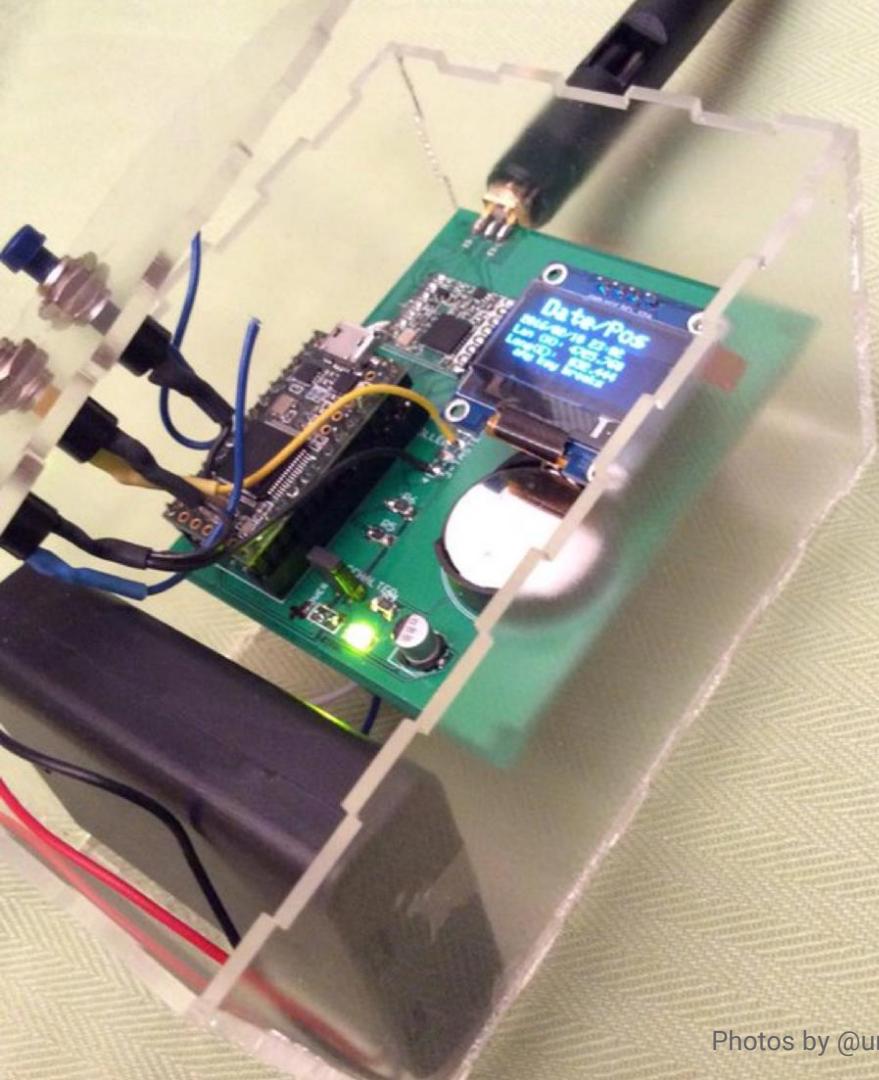
1 users online now of 176 registered.

**GET MY INVITE**

or sign in.

<https://ttn-ch.herokuapp.com>

© OpenStreetMap contributors



Photos by @ursmii



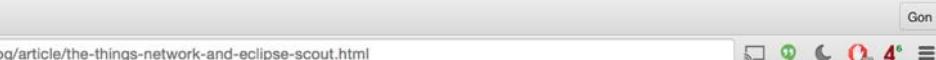
Photos by @gnz, CC-BY-SA

The Things Network and Eclipse Scout

Scout Blog, Technologies

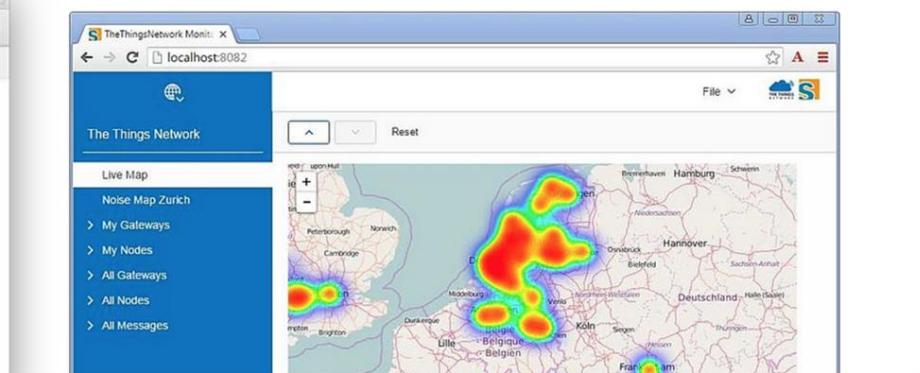
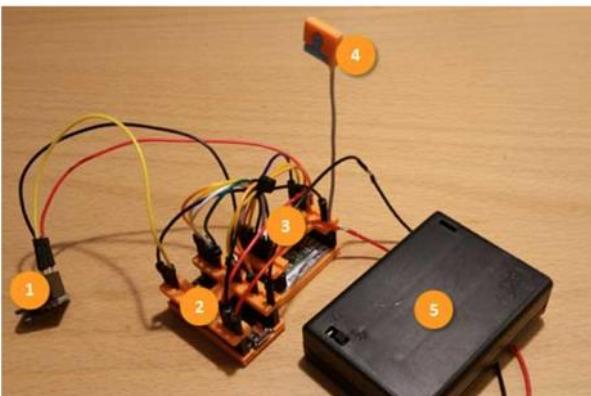
17.03.2016, Matthias Zimmermann

The Things Network (TTN) is an open source project that aims at a global crowdsourced Internet of Things data network. In this blog post we describe a complete TTN show case to create real-time noise maps using the TTN in Zurich using a backend application based on Eclipse Scout and the MQTT Paho library.



were using Teensy TTN node described in [TTN Wiki](#). Due to additional taxes and some minor "mishaps" during production we ended up at €44 per node instead.

As shown below, the final node contains a microphone (1), a Teensy LC (2), a RFM95 LoRa module (3), an antenna with a company flag (4) as well as a battery box (5) including 3 AA batteries.





Balloon Position (LIVE)

Döttingen Basel-Landschaft Solothurn A2 Olten Oftwil Langenthal A1 Solothurn A1 Rüttihubelbach

In reply to octanis

← decentlab @decentlab · Apr 2  
@octanisorg Congrats! According octanis

6 6

map data point

L'ASTROLABE INSTITUT POLAIRE TAAF

© O.Kovalenko  
MarineTraffic.com



urs marti @ursmii · Sep 13

@ttn\_zh @thethingsntwrk

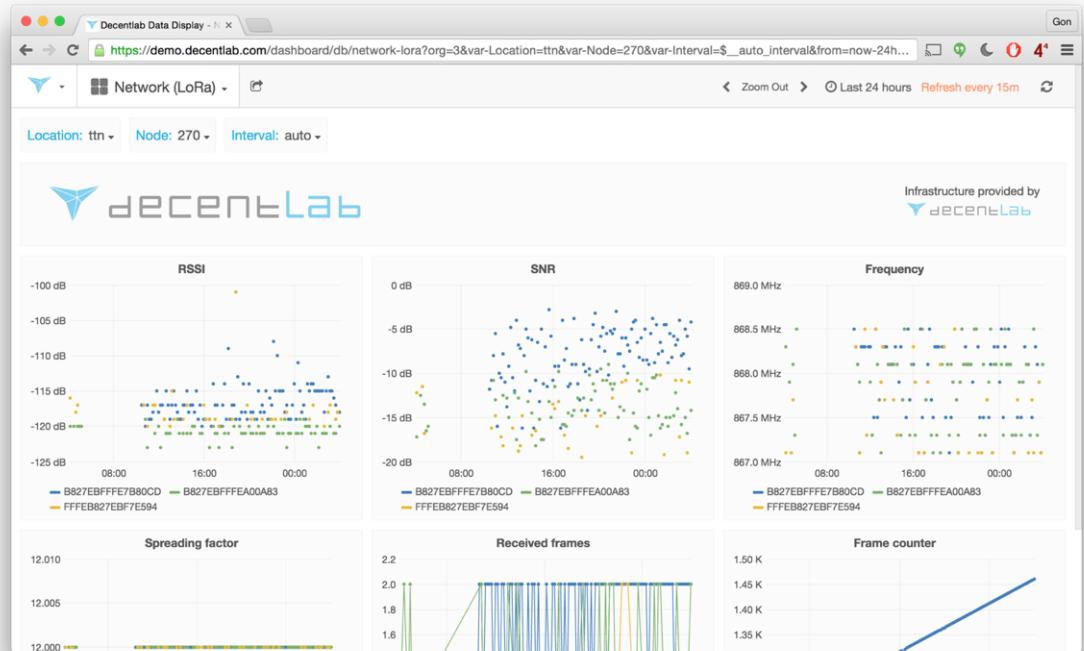
another nice distance covered with my RFM95W Gateway Locator

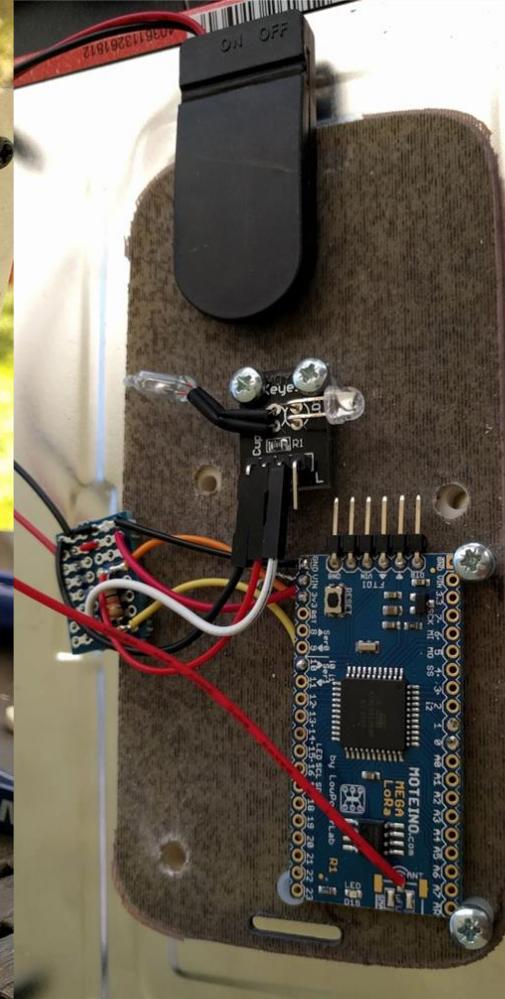


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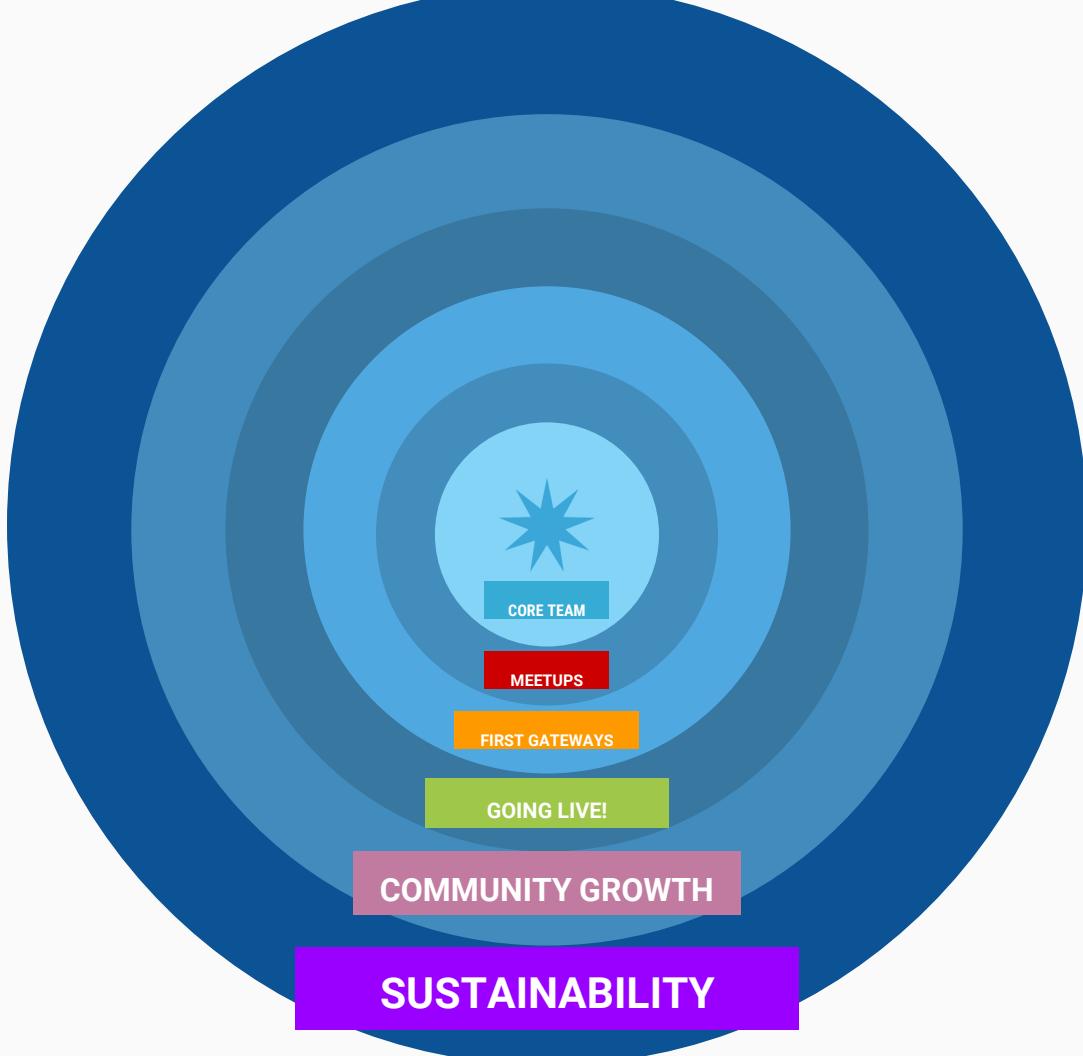
Photo by decentlab.com

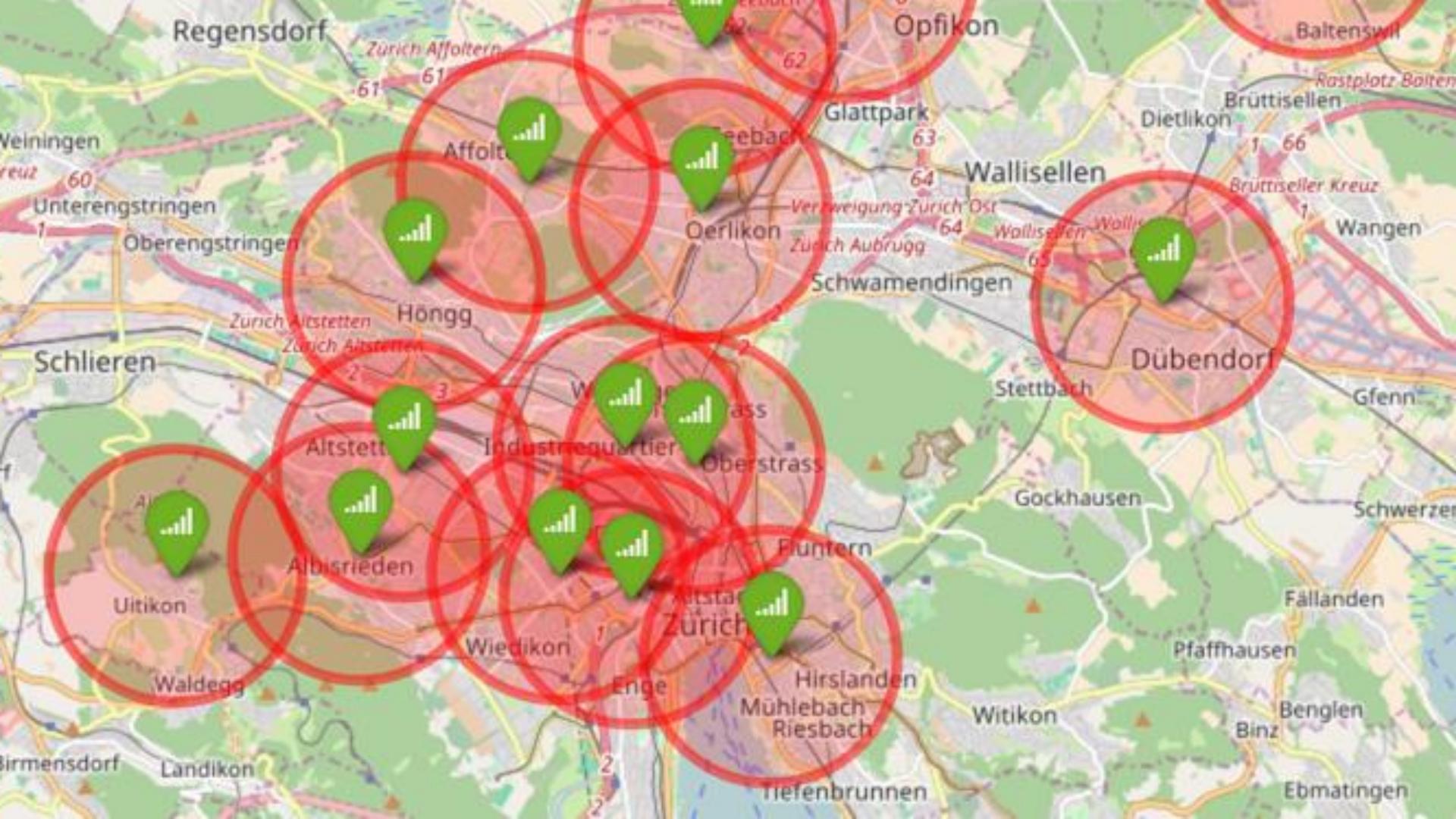




Photos by @gnz, CC-BY-SA







Civil Association

# Open Network Infrastructure

Legal entity

Promotion of community infrastructure projects

Organization of events (*workshops, hackathons, etc.*)

Sustainable network operation



Photos by @MakerFaireZH

USE CASES

HARDWARE

INNOVATION

SMART CITIES

SUSTAINABILITY

COMMUNITY GROWTH

GOING LIVE!

MEETUPS

FIRST GATEWAYS

CORE TEAM



**Give me a theoretical  
network and I will come up  
with use cases.**

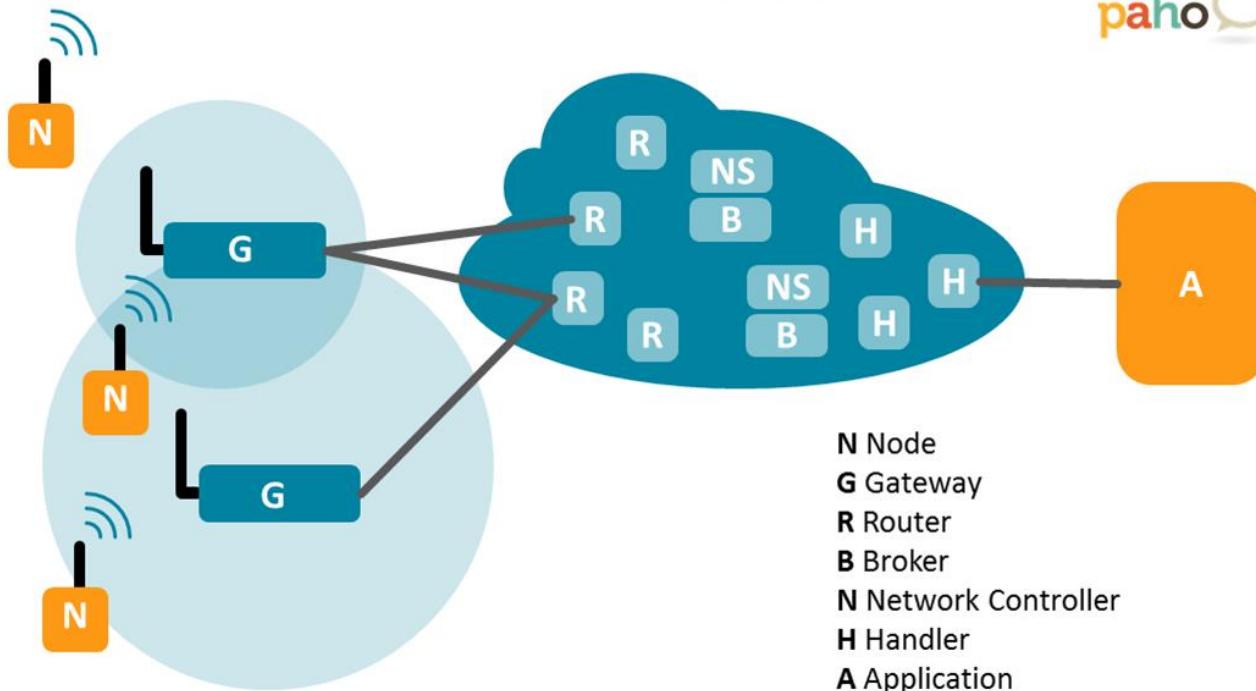
**No one, ever.**

# Demo Time

Setup Overview

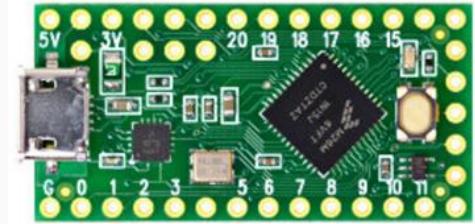
Noise Measuring Node

Backend Application



# Noise Measuring Node

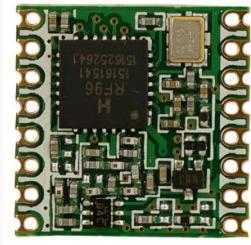
**Board:** Teensy LC (€10)

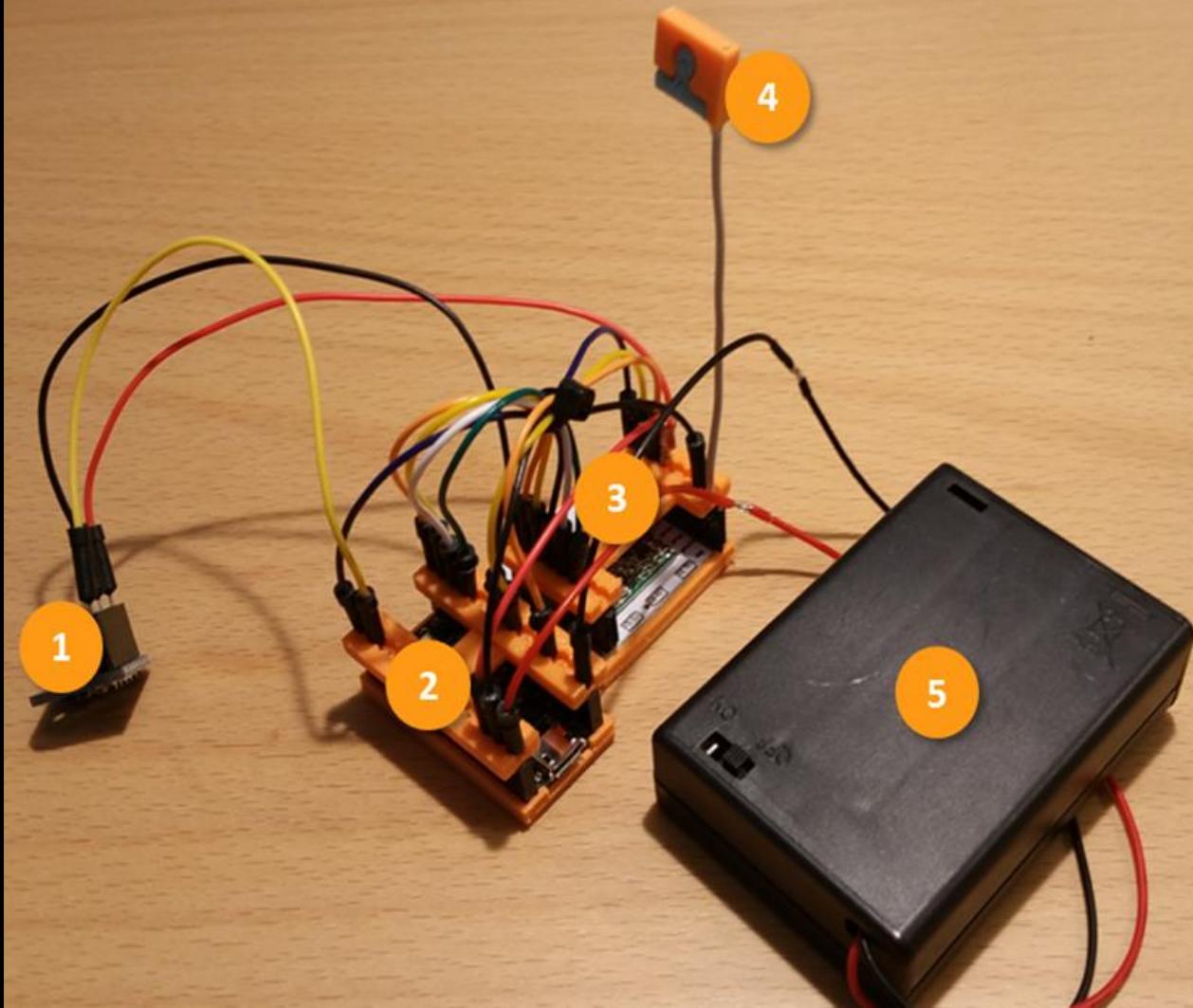


**Sensor:** Adafruit MEMS Microphone (€4.5)



**LoRa Module:** RFM95W (€11)







noise\_monitor LoRa.cpp LoRa.h

```
void setup() {
    Serial.begin(9600);
    pinMode(13, OUTPUT);

    if (PRINT_DEBUG) {
        Serial.println(LINE);
        Serial.println("Starting setup ...");
    }

    initLora();
    initSensor();
    resetRawSensorValues();
    resetNoiseLevelValues();

    if (PRINT_DEBUG) {
        Serial.println(LINE);
    }
}

void loop() {
    updateRawSensorValues(analogRead(PIN_NOISE));

    // update/print current noise level
    if (cnt == CNT_MAX) {
        updateNoiseLevelCalibration();
        diff = val_max - val_min < diff_min? 0: val_max - val_min - diff_min;
        ...
    }
}
```

Arduino Leonardo on COM14

Send

Autoscroll

No line ending 115200 baud

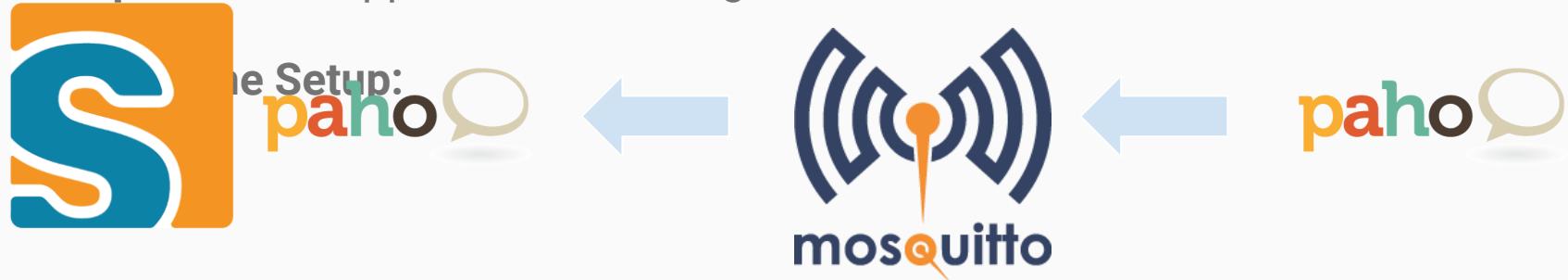
```
.          0 (min 272 max 274 diff_min 2) cnt=184
##          2 (min 271 max 275 diff_min 2) cnt=185
.          0 (min 272 max 274 diff_min 2) cnt=186
.          0 (min 272 max 274 diff_min 2) cnt=187
###          6 (min 268 max 276 diff_min 2) cnt=188
#####          15 (min 263 max 280 diff_min 2) cnt=189
.          0 (min 273 max 274 diff_min 2) cnt=190
##          2 (min 271 max 275 diff_min 2) cnt=191
.          0 (min 273 max 274 diff_min 2) cnt=192
###          5 (min 270 max 277 diff_min 2) cnt=193
.          0 (min 273 max 274 diff_min 2) cnt=194
.          0 (min 273 max 274 diff_min 2) cnt=195
.          0 (min 273 max 275 diff_min 2) cnt=196
```

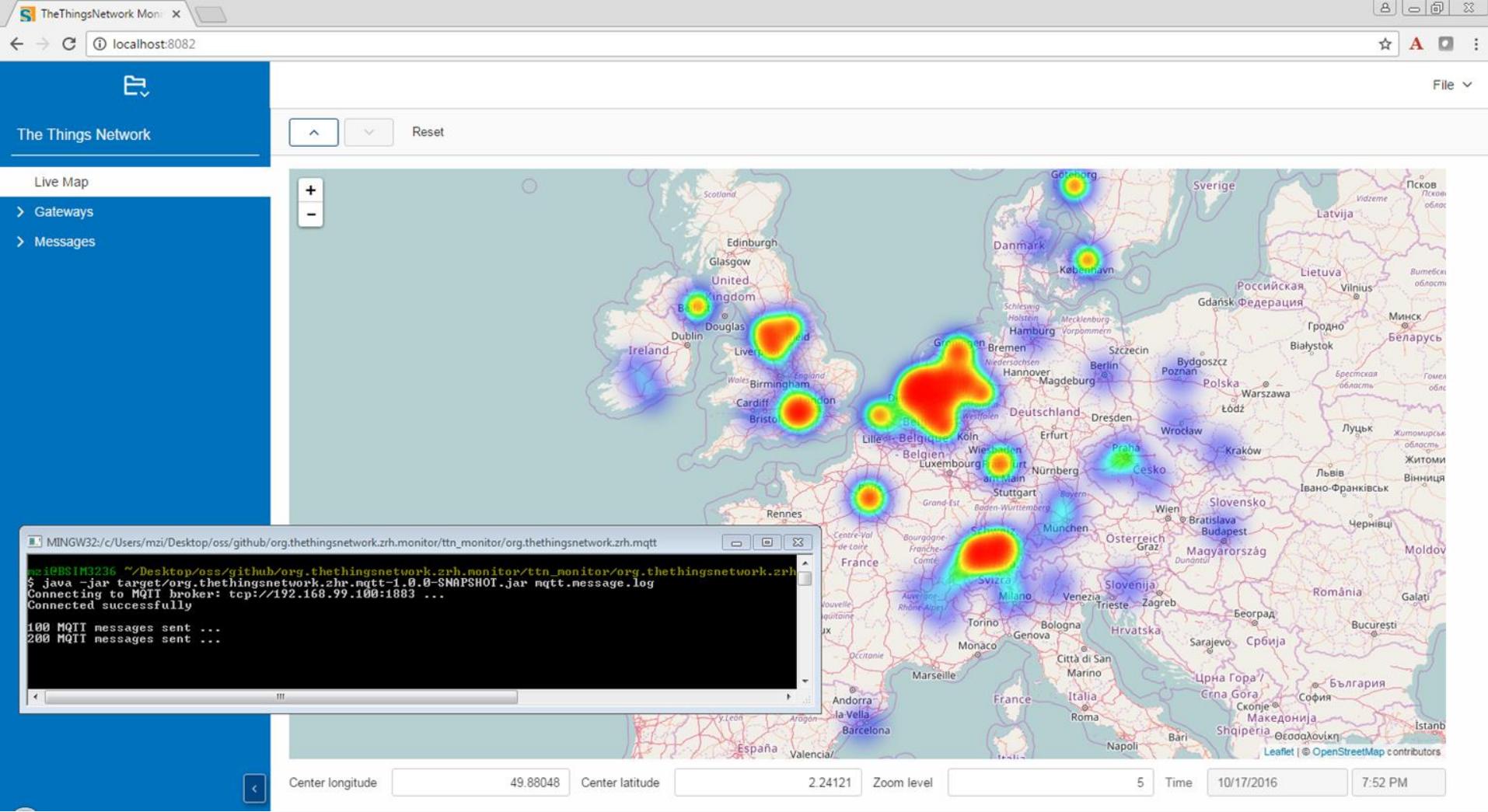
# A TTN Backend with Eclipse

Eclipse Mosquitto MQTT Broker (part of TheThingsNetwork)

Eclipse Paho: MQTT Client Library (included in web application)

Eclipse Scout: Application including a Web UI





# Use Case

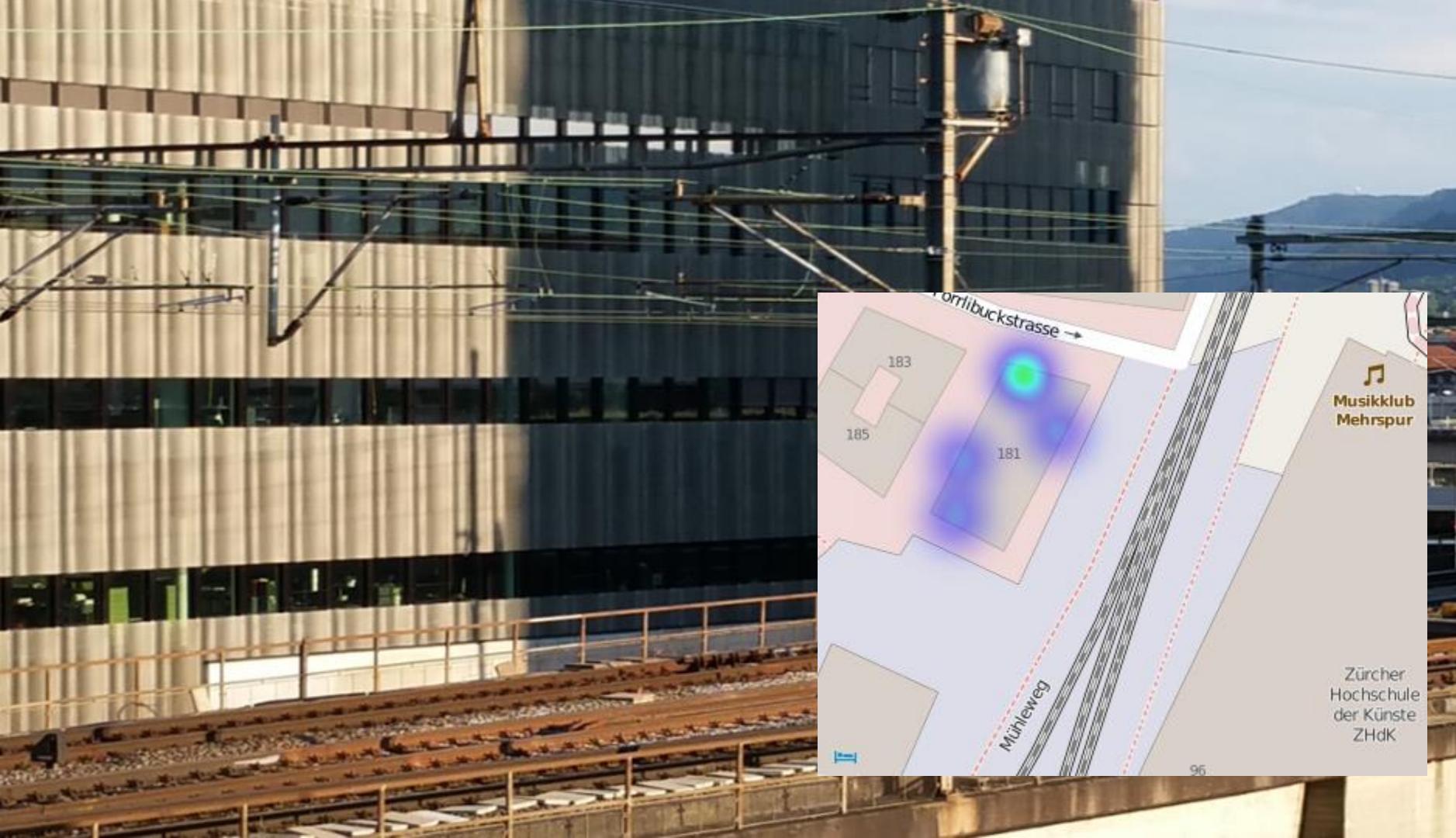
## Real Time Noise Monitoring

Place Noise Nodes at outdoor Locations

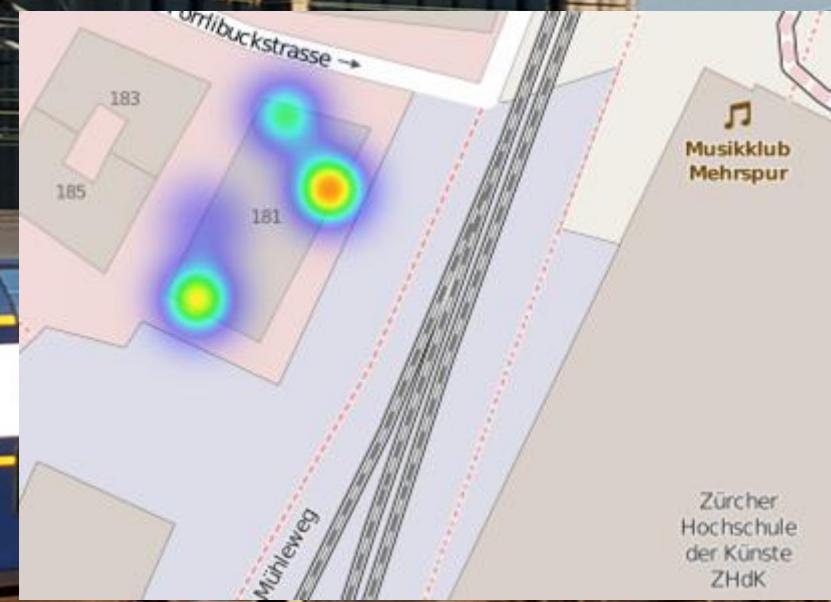
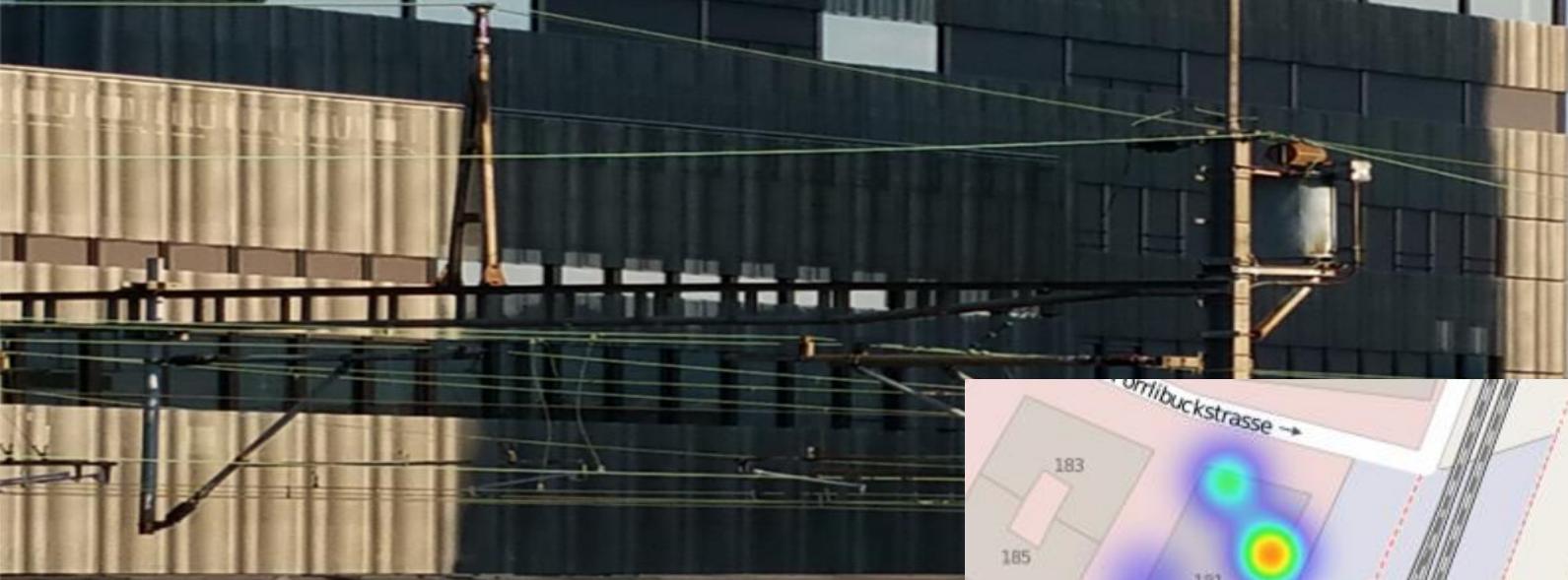
Assign Coordinates to Nodes

Collect Noise measurements

**Testing:** Our Zurich Office is next to some Train Tracks ...



Zürcher  
Hochschule  
der Künste  
ZHdK



# Noise Monitor Learnings

Noise Monitoring is CPU intensive -- not friendly to the Battery

Noise is highly subjective: Annoying noise seems louder

However, setting up TTN Use Cases is a lot of fun

Next time, we will go for a simpler use case ...

# Take Home Message

TheThingsNetwork covers a complete Network Infrastructure

TTN Software and Hardware is Open Source

Eclipse Technology helps to build Use Cases

You can do it too...



Evaluate the Sessions

Sign in and vote at **eclipsecon.org**

- 1

0

+ 1

# More resources

[Reversing LoRa](#), by Matt Knight (Bastille Networks)

[LoRaWAN specification](#)

[The Things Network Wiki](#)

[This slidedeck](#)

# TTN backend in detail

