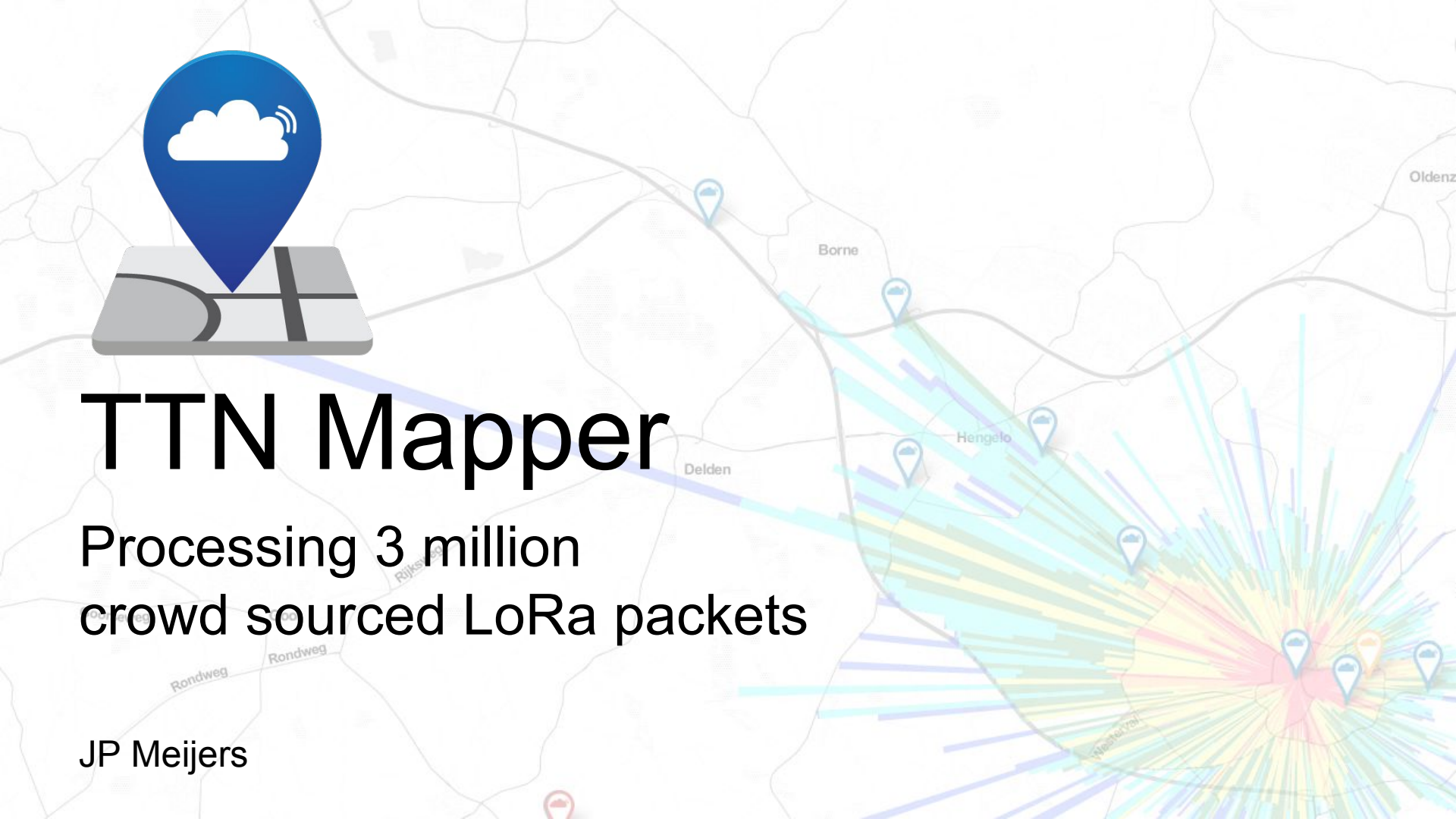




TTN Mapper

Processing 3 million
crowd sourced LoRa packets

JP Meijers

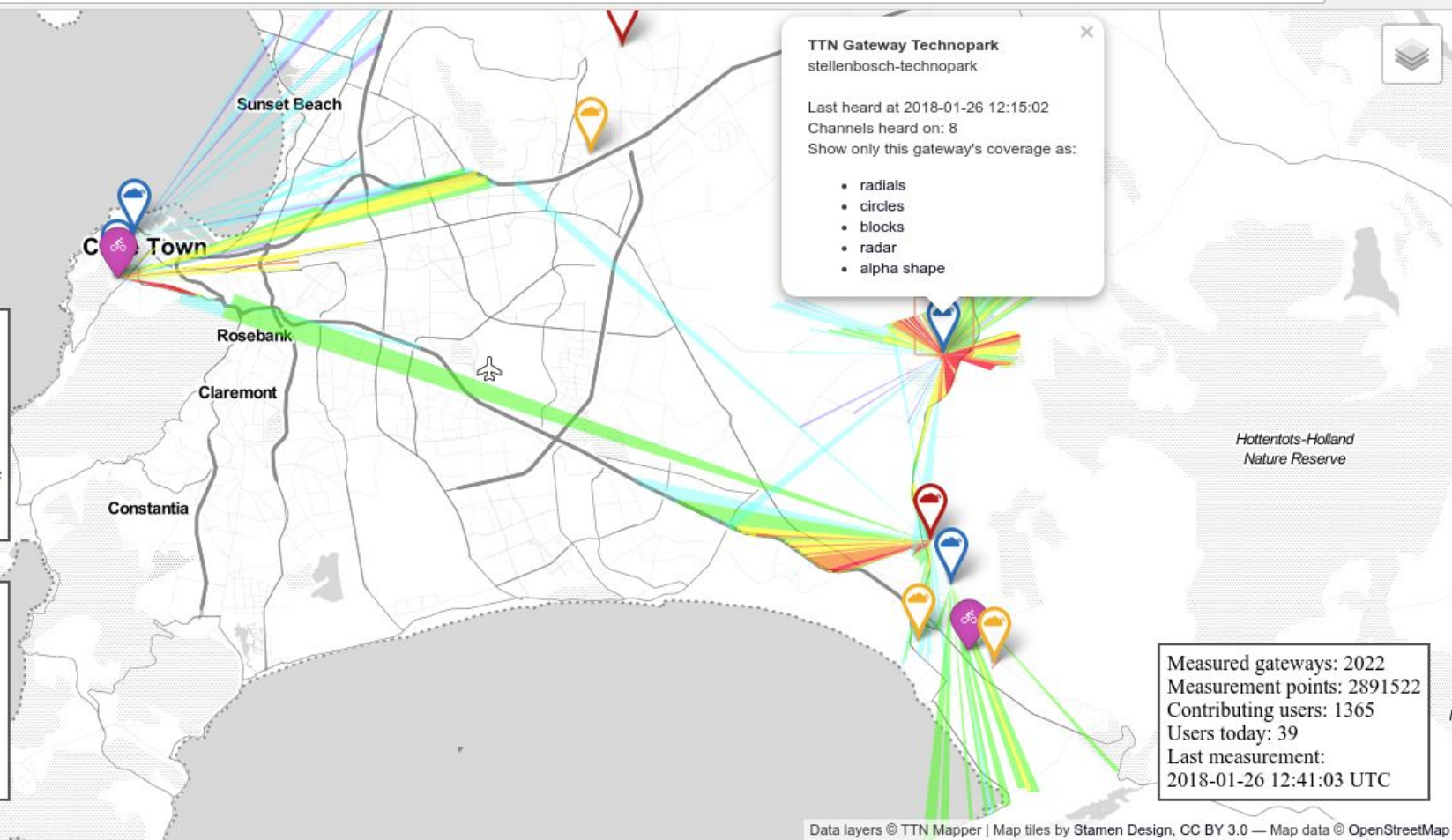


**Menu**

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Colour RSSI

Red	> -100dBm
Orange	-100 - -105
Yellow	-105 - -110
Green	-110 - -115
Cyan	-115 - -120
Blue	< -120dBm

**TTN Gateway Technopark**
stellenbosch-technopark

Last heard at 2018-01-26 12:15:02

Channels heard on: 8

Show only this gateway's coverage as:

- radials
- circles
- blocks
- radar
- alpha shape

Measured gateways: 2022
Measurement points: 2891522
Contributing users: 1365
Users today: 39
Last measurement:
2018-01-26 12:41:03 UTC

Who am I?

Creator of TTN Mapper

- Based on methods used during my masters research
- Masters in Electronic Engineering (Telecommunication)
University of Stellenbosch, South Africa
- Internship at The Things Industries
- Currently mobile developer at Polymorph Systems

Interests:
radio, weather,
electronics, computers.

Amateur radio (HAM)
ZS1JPM

No experience in:
GIS, design, UI, UX

So I installed a new
TTN gateway - how
well does it actually
work?

I went to measure it.



Technology stack used

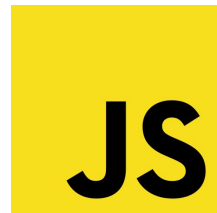
LAMP:

- VPS running Ubuntu
- MySQL database
- PHP and Javascript for hosting
- Leaflet mapping library
- Python for processing



python
powered

powered
by



Not the ideal stack. A **hobby project** grew out of hand!

Challenges in building a community project

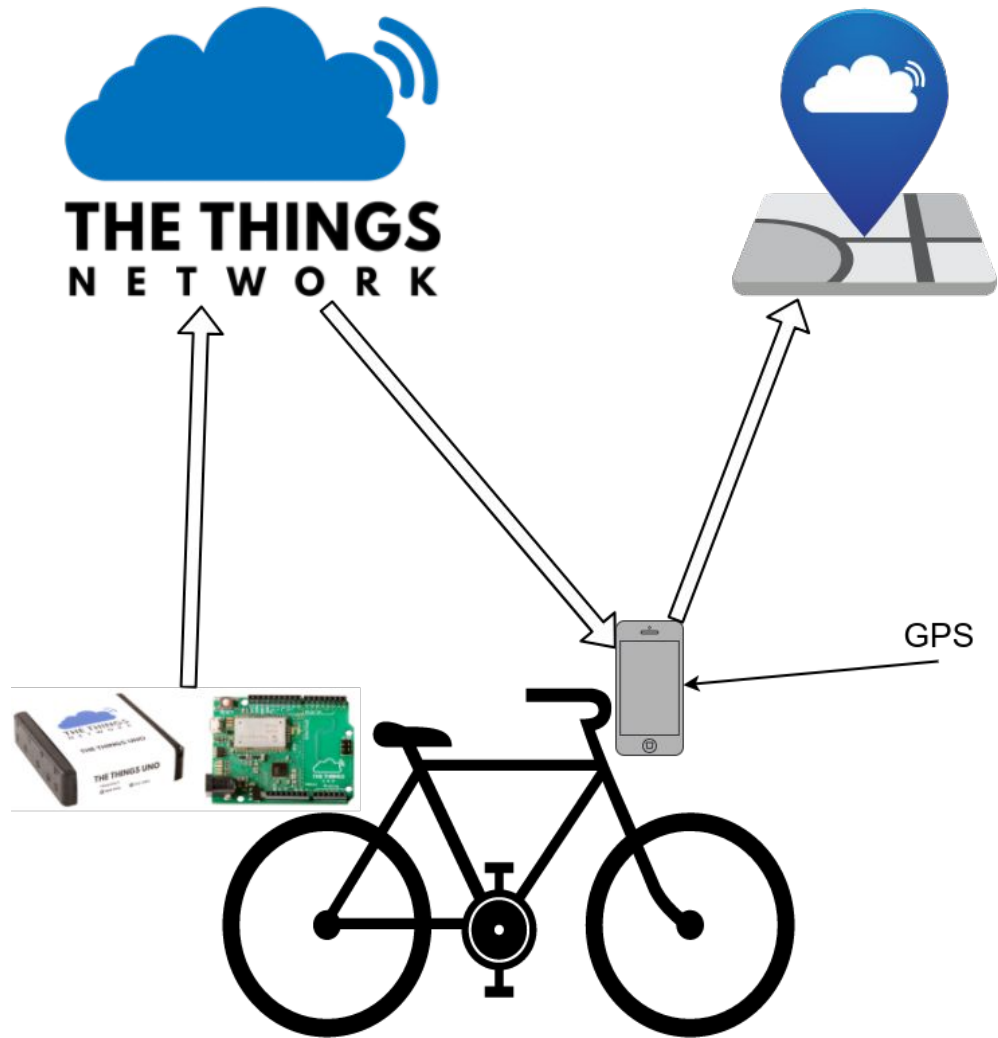
- Make it easy for anyone to contribute data
= Android app, iOS app, example embedded software
- Support for wide range of data formats and mapping methods
(bikes, cars, drones, balloons, aeroplanes)
- Make results available online
- Filter outliers and "bad" data
- SCALABILITY!

Getting data into TTN Mapper

Method 1: Mobile app

A LoRaWAN packet is sent from an end device, via TTN and received by a smartphone app. It's geotagged and uploaded to TTN Mapper.

- Easiest
- Works with any device

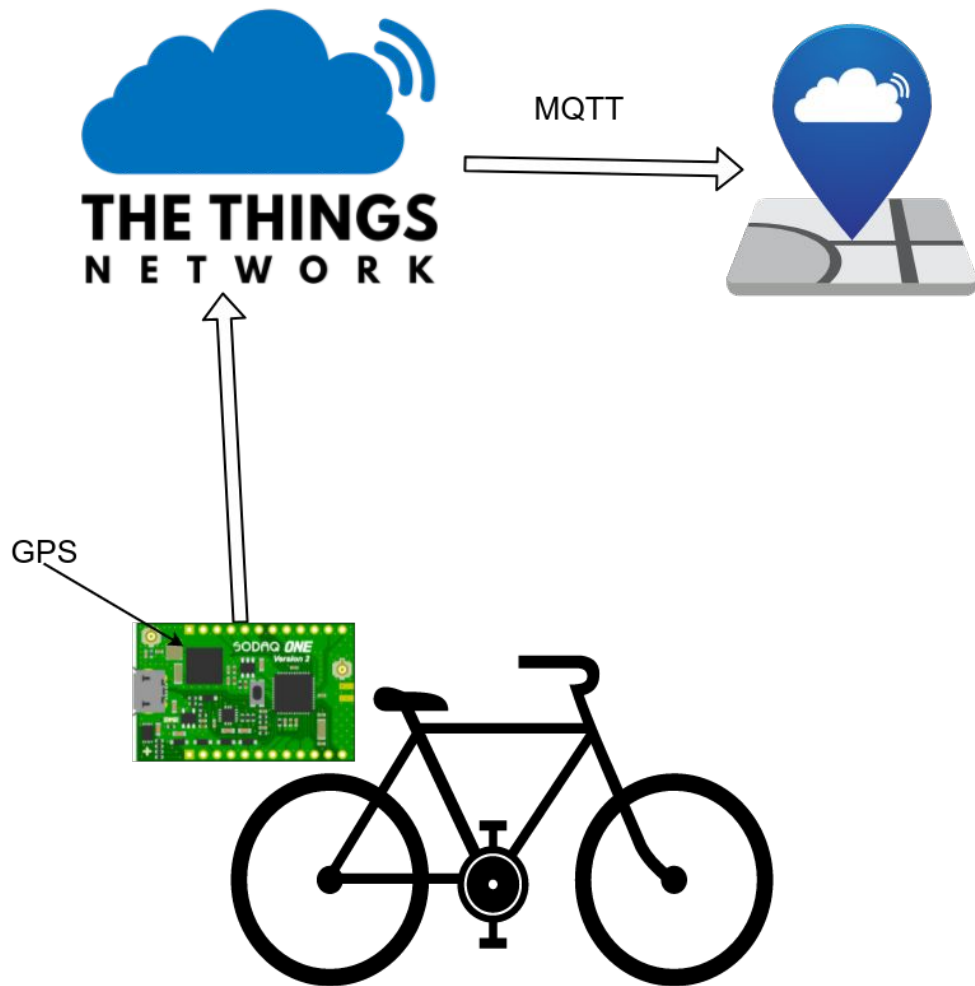


Getting data into TTN Mapper

Method 2: GPS tracker

An end device with a GPS sends coordinates via TTN. The coordinates in the payload is received by TTN Mapper, where the metadata is geotagged.

- No smartphone required
- Share application credentials

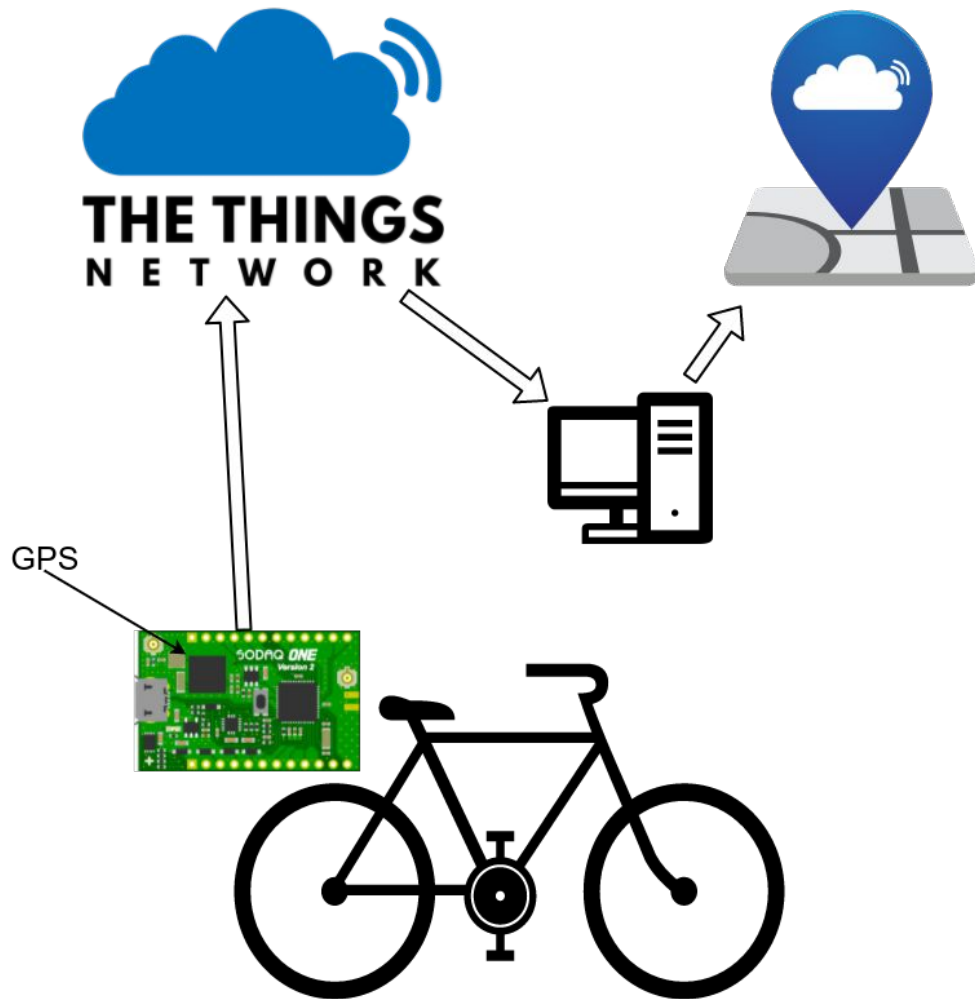


Getting data into TTN Mapper

Method 3: Upload to the TTN Mapper API

<https://ttnmapper.org/api>

This is **not a preferred** method.
Metadata is not obtained directly from TTN.

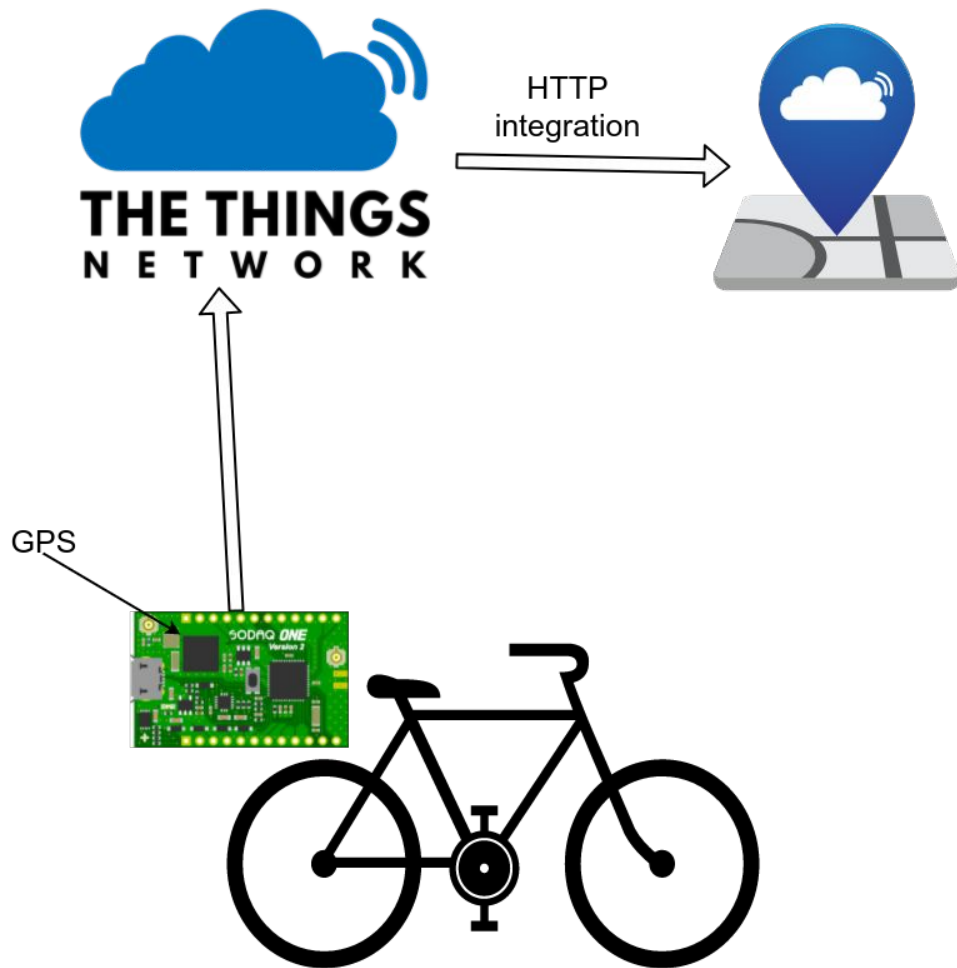


Getting data into TTN Mapper

Method 4: Post data using HTTP integration

Available since 29 Jan 2018

- For details see:
<http://ttnmapper.org/faq.php>
- TTN v3 - dedicated integration



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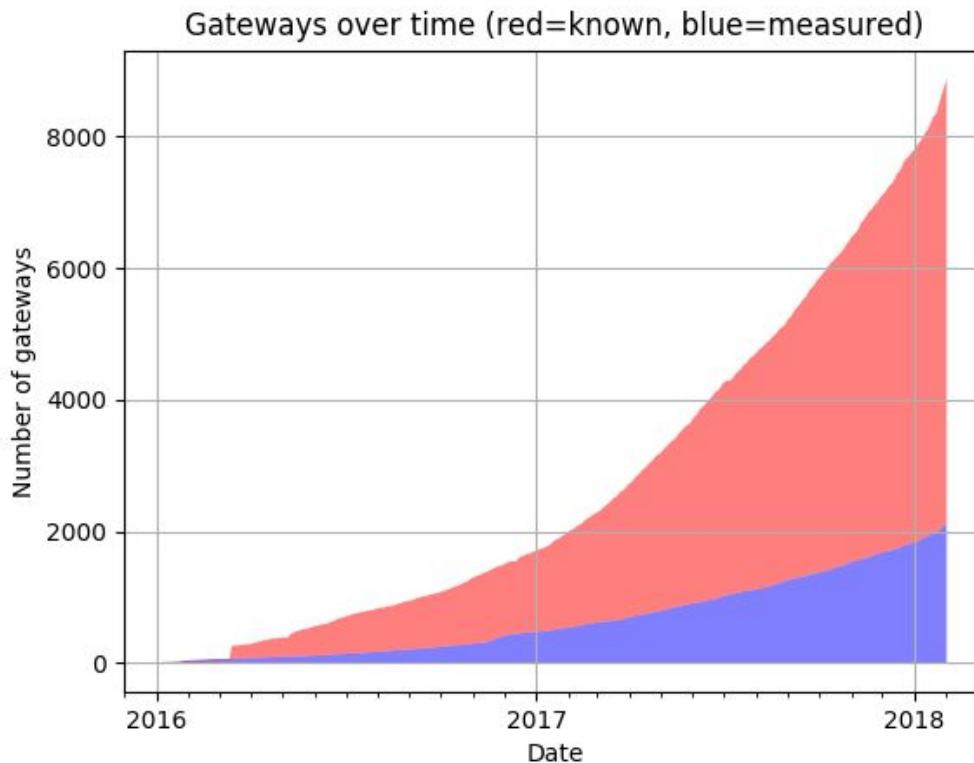


Measured gateways: 2022
Measurement points: 2891522
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Time for some stats

Since December 2015:

- 8524 unique gateways seen on TTN.
- 2024 gateways mapped by 1365 contributors.
- 3 752 826 packets received, but only 2 892 380 left after cleaning.

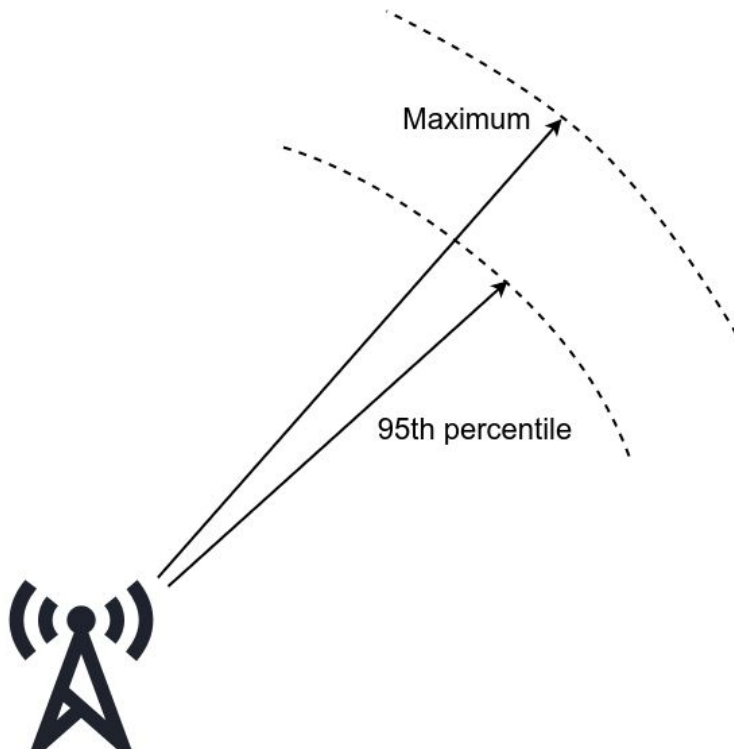


How to visualise 3 million data points in a web browser?

Server side preprocessing and aggregation.

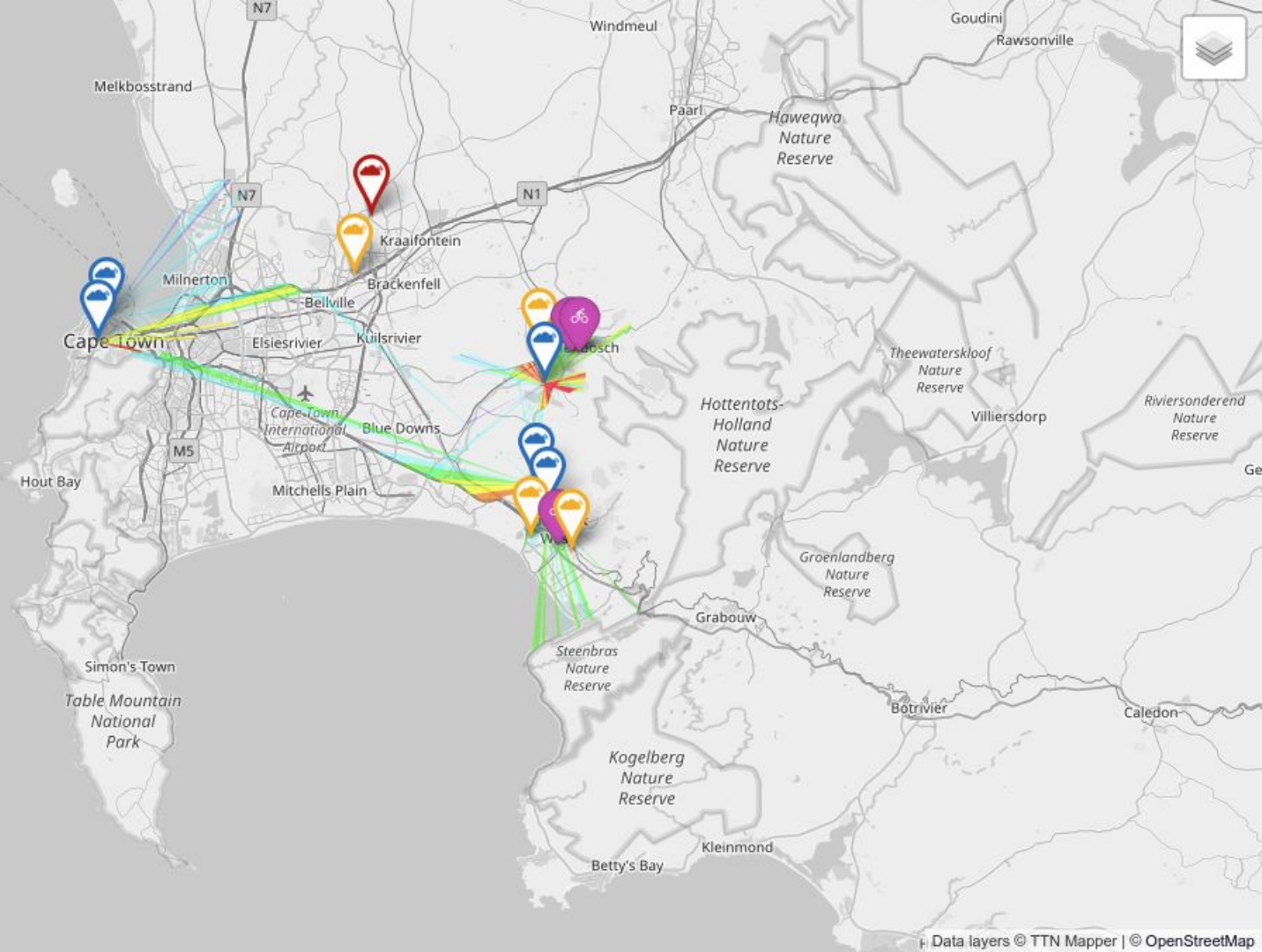
Simple naive aggregation: circles

- Maximum distance as radius
 - Too optimistic
 - Outliers
- 95th percentile as radius
 - Filters outliers
 - Better, but still too optimistic
 - Shadows of hills, buildings ignored

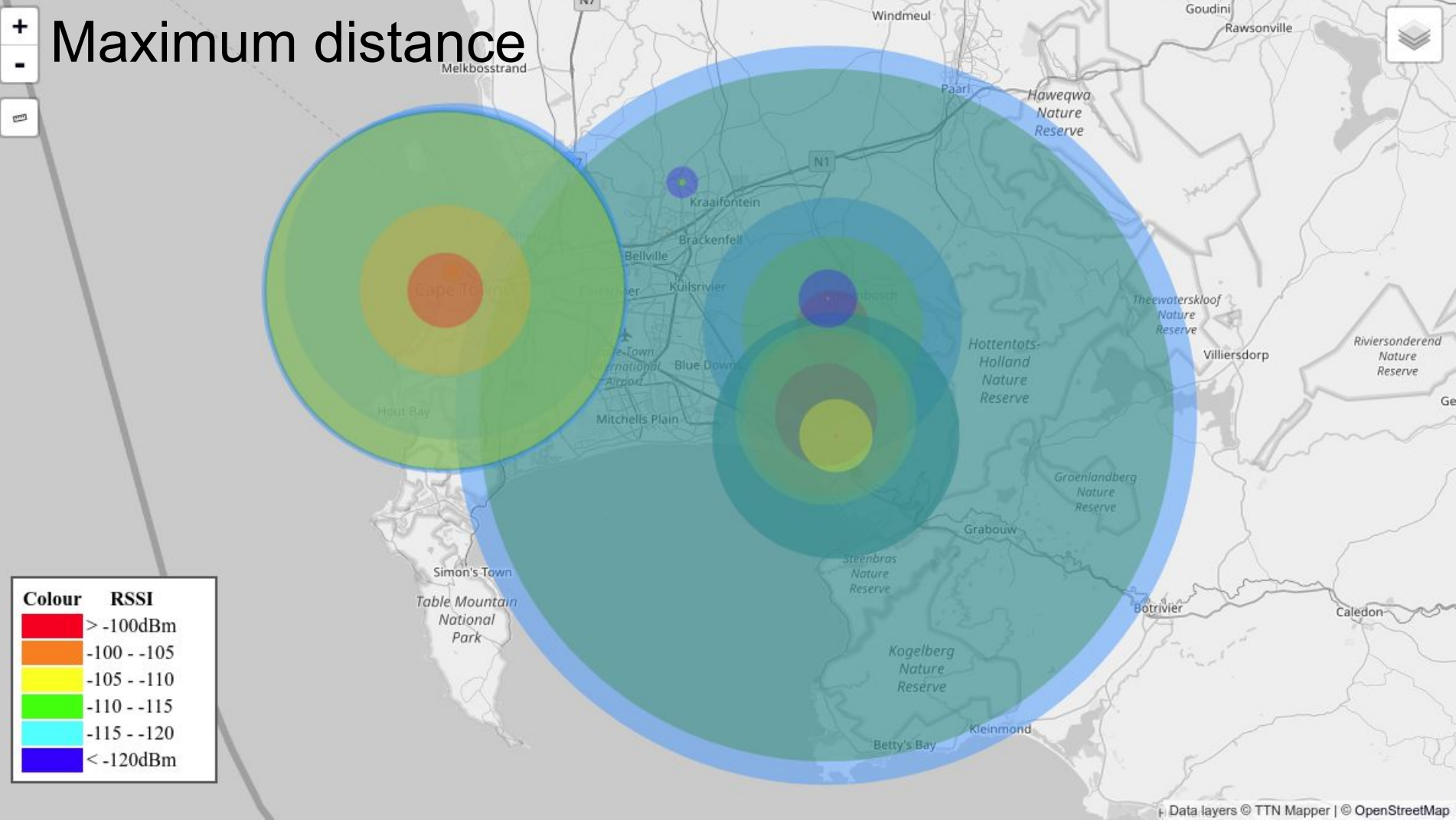




Radar



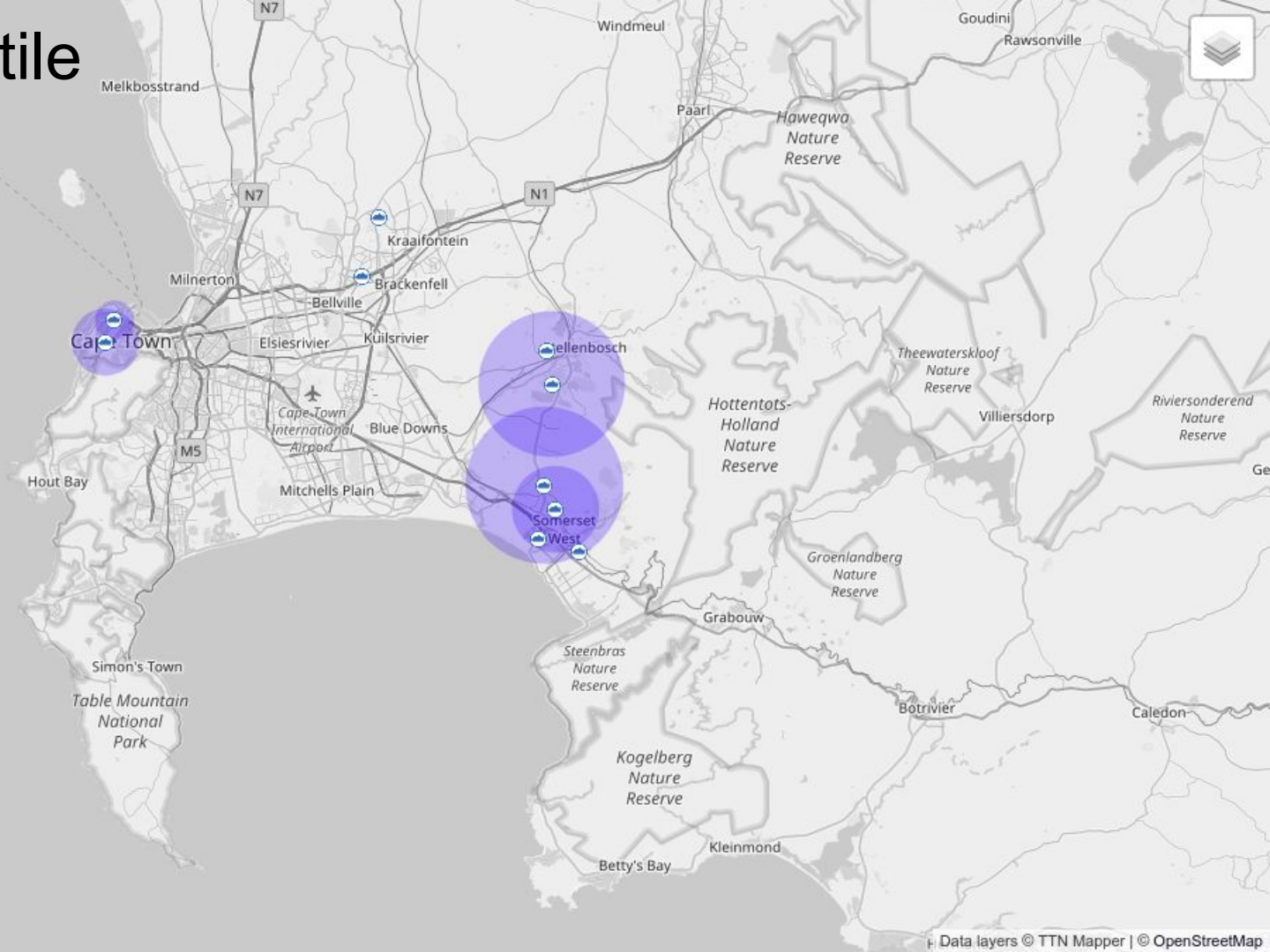
Maximum distance



+

-

95th percentile



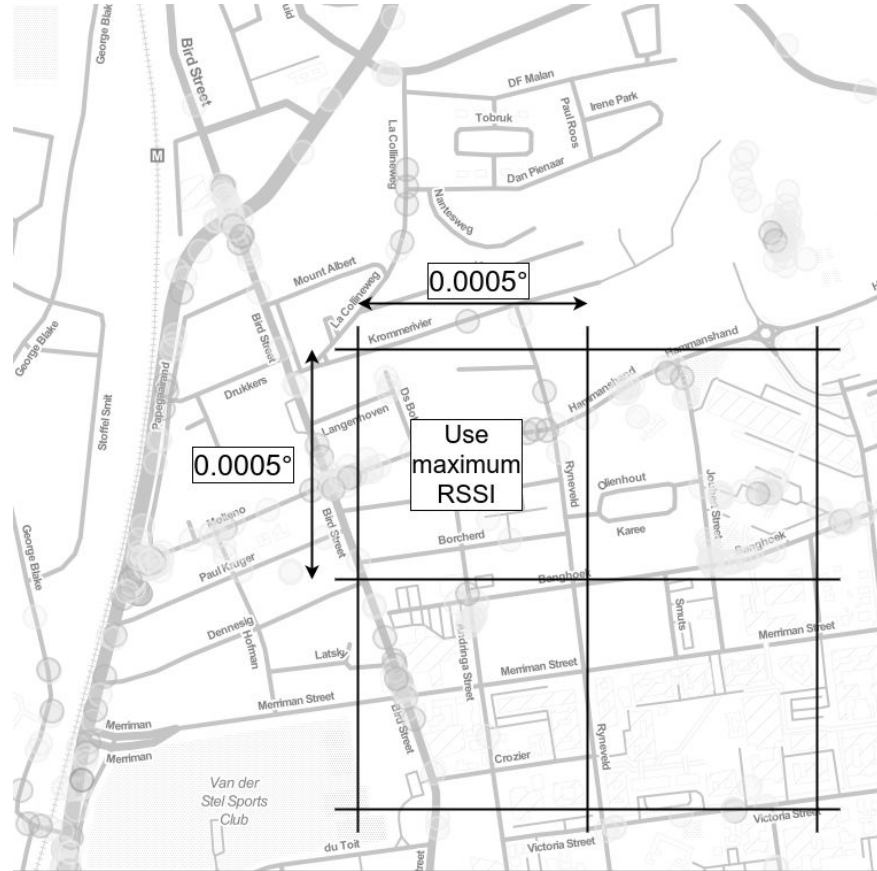
Colour	RSSI
	> -100dBm
	-100 - -105
	-105 - -110
	-110 - -115
	-115 - -120
	< -120dBm

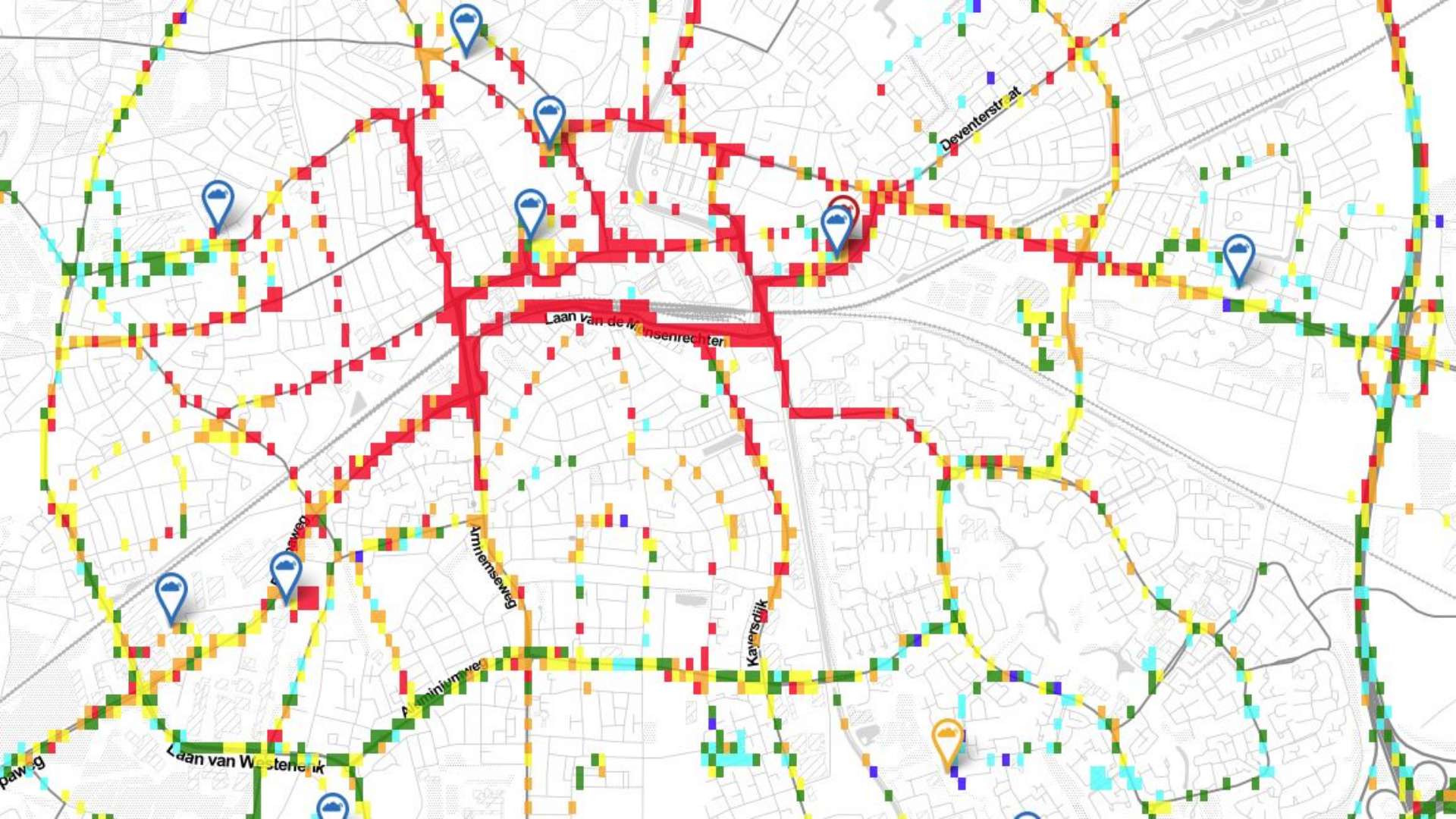
Aggregate per surface area

Done for 0.0005° and 0.005° .

Used for radials and heatmap.

Raw	2 892 380 points
0.0005°	197 158 polygons
0.005°	68 142 polygons





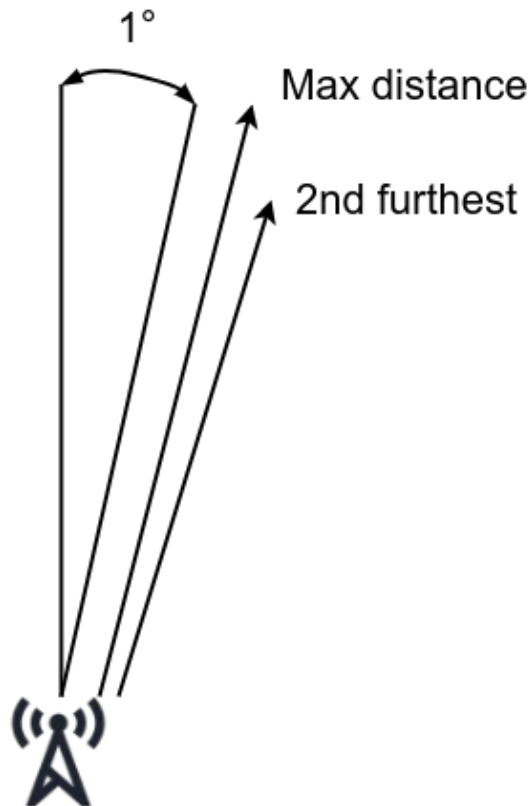
Radar plot: bearing and distance

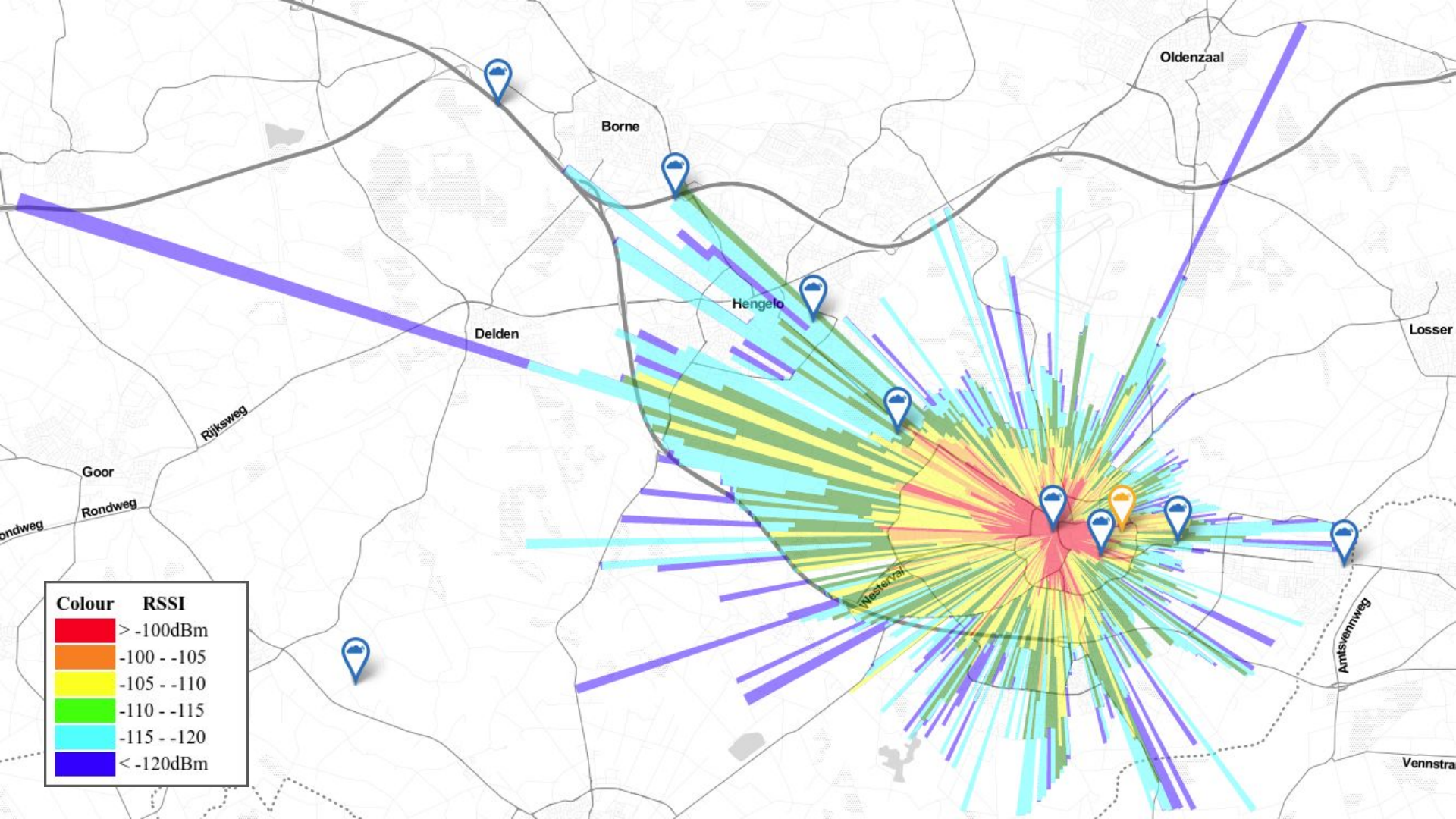
- Radio signals travel in straight lines unless reflected.
- Coverage can be visualised as a radar plot.
- Max distance considered outlier.
- Calculated per RSSI colour range.

$360^\circ \times 6 \text{ buckets} = 2160 \text{ features per gateway}$

$2160 \times 2024 \text{ gateways} = 4\,371\,840 \text{ features}$

More data, but vectors better than points!

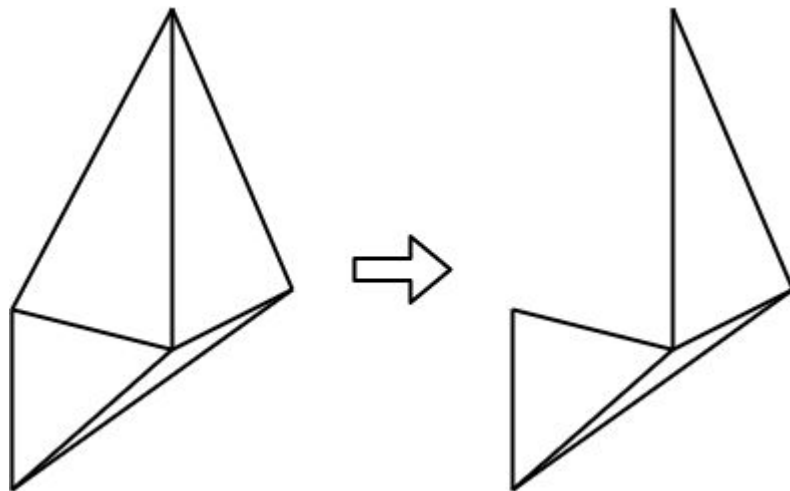


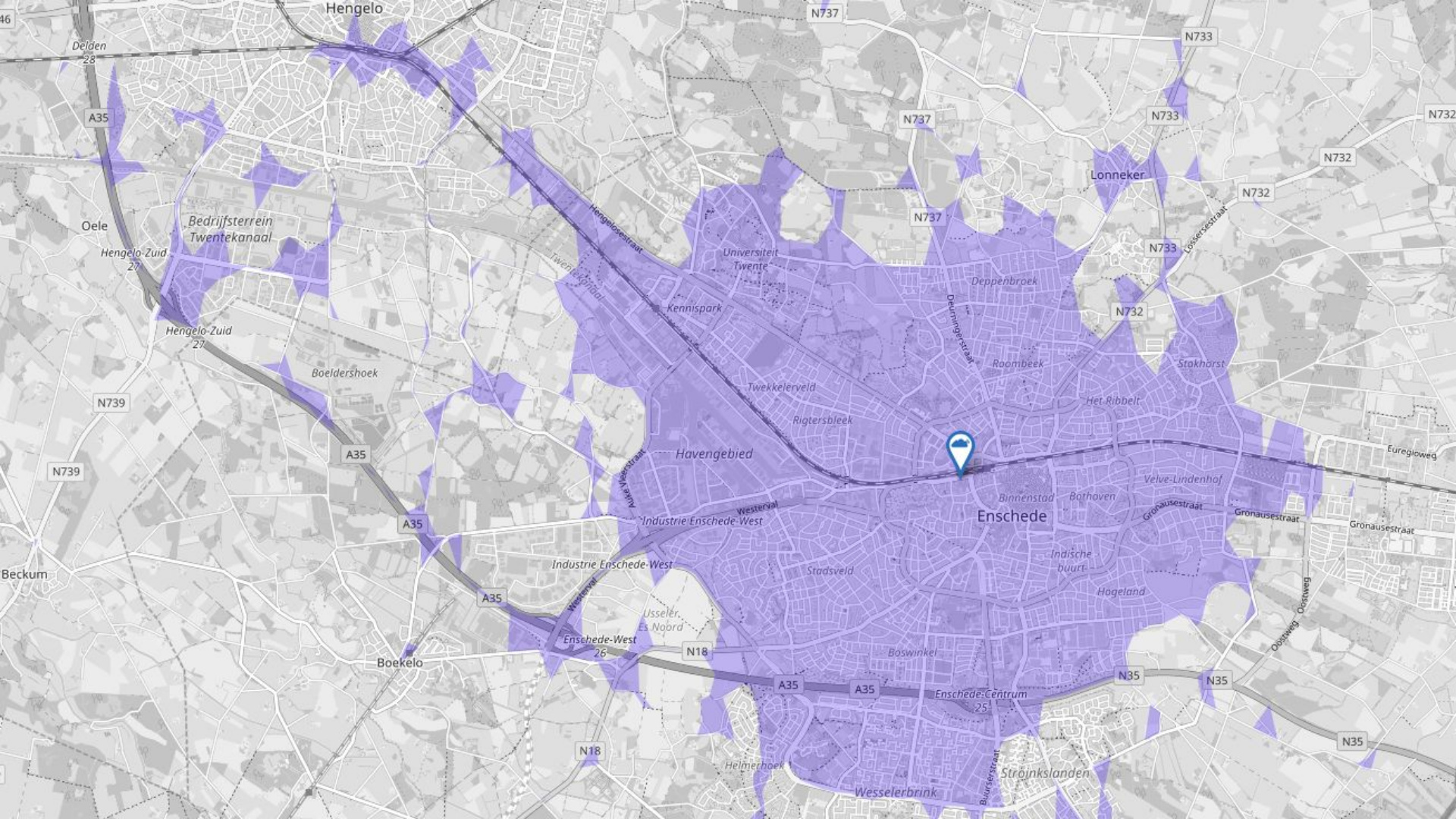


α -shapes (concave hulls)

- All points connected together to form triangles.
- If a triangle's surface area is bigger than α , delete the triangle.

What remains is a polygon of the coverage area.



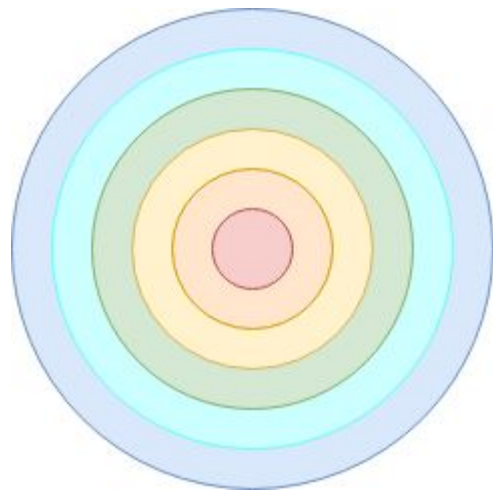


Point based heatmap

- Radius of circle inversely proportional to RSSI
- Points drawn from weakest to strongest
- Strongest has smallest radius and is on top - weak points still partially visible

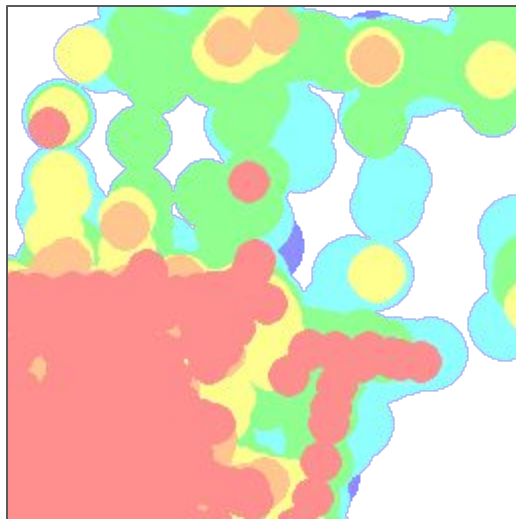
Use slippy map format to generate cacheable PNG tiles

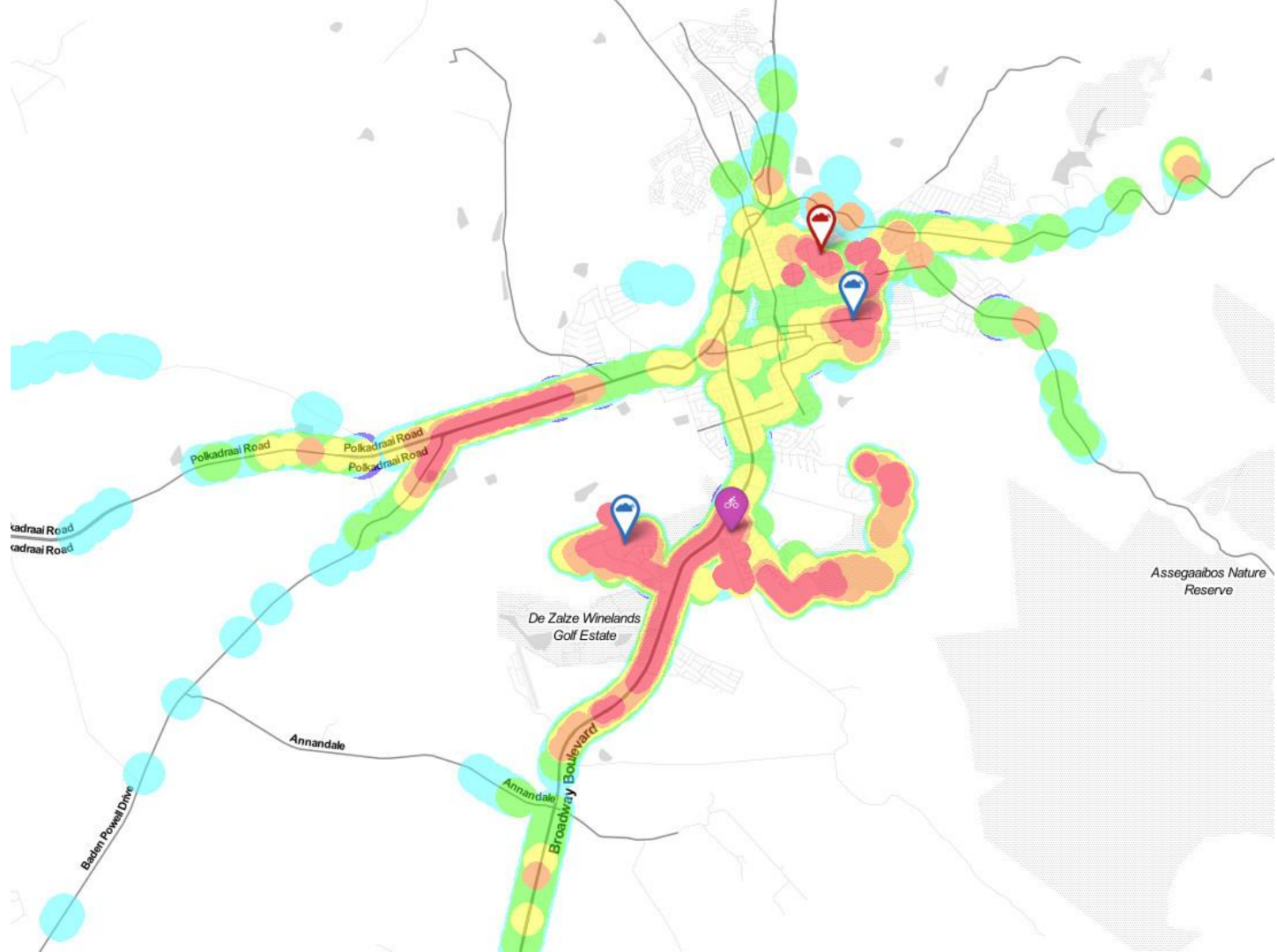
- Same format as Openstreetmap tiles
- Custom Tile Map Server



Credit: Sylvain Prost

An example tile

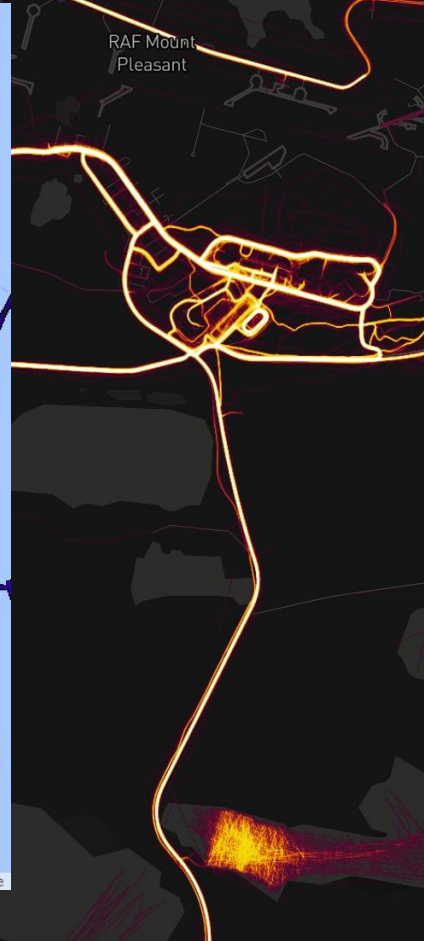
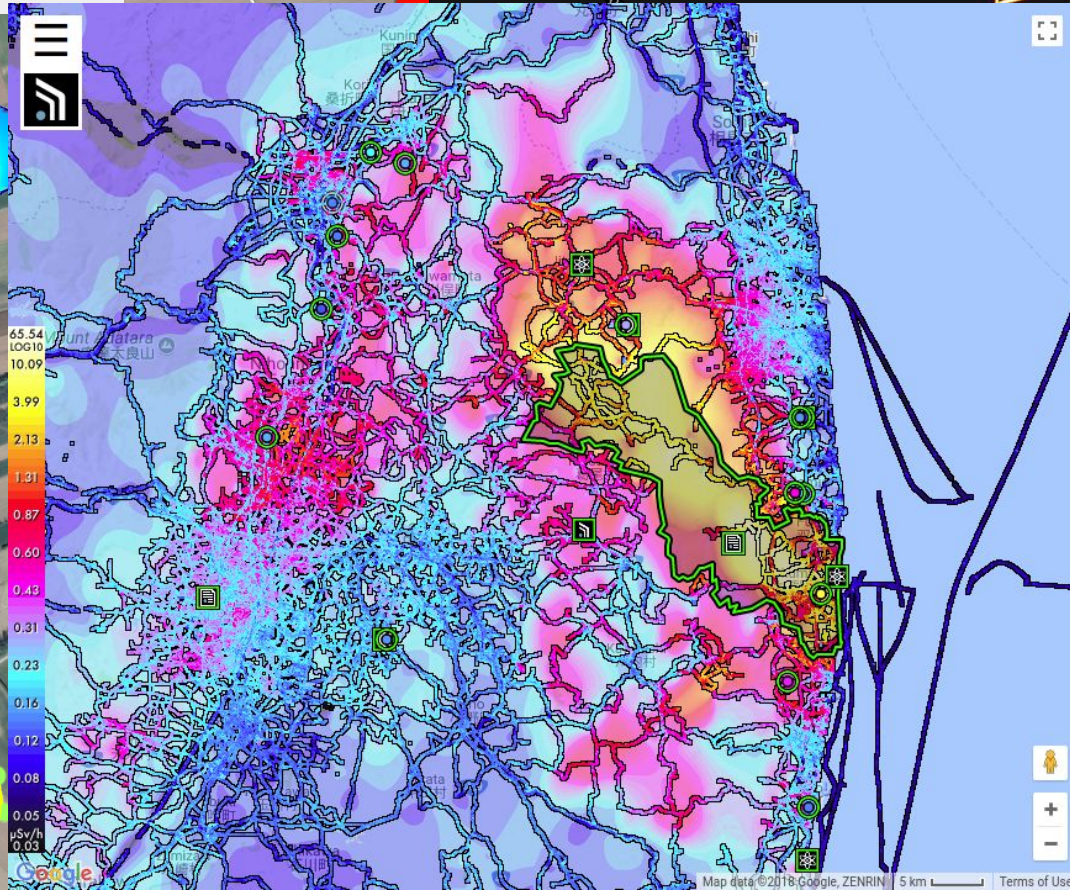
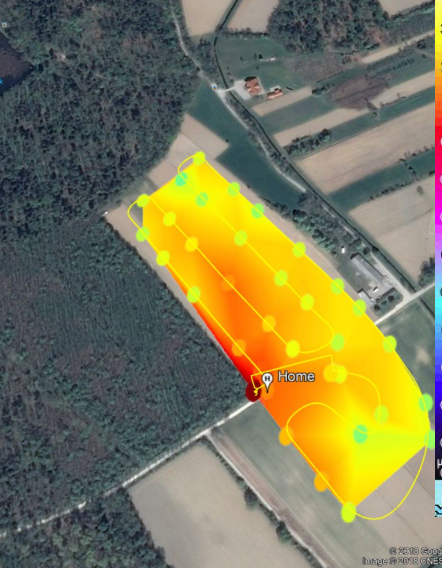






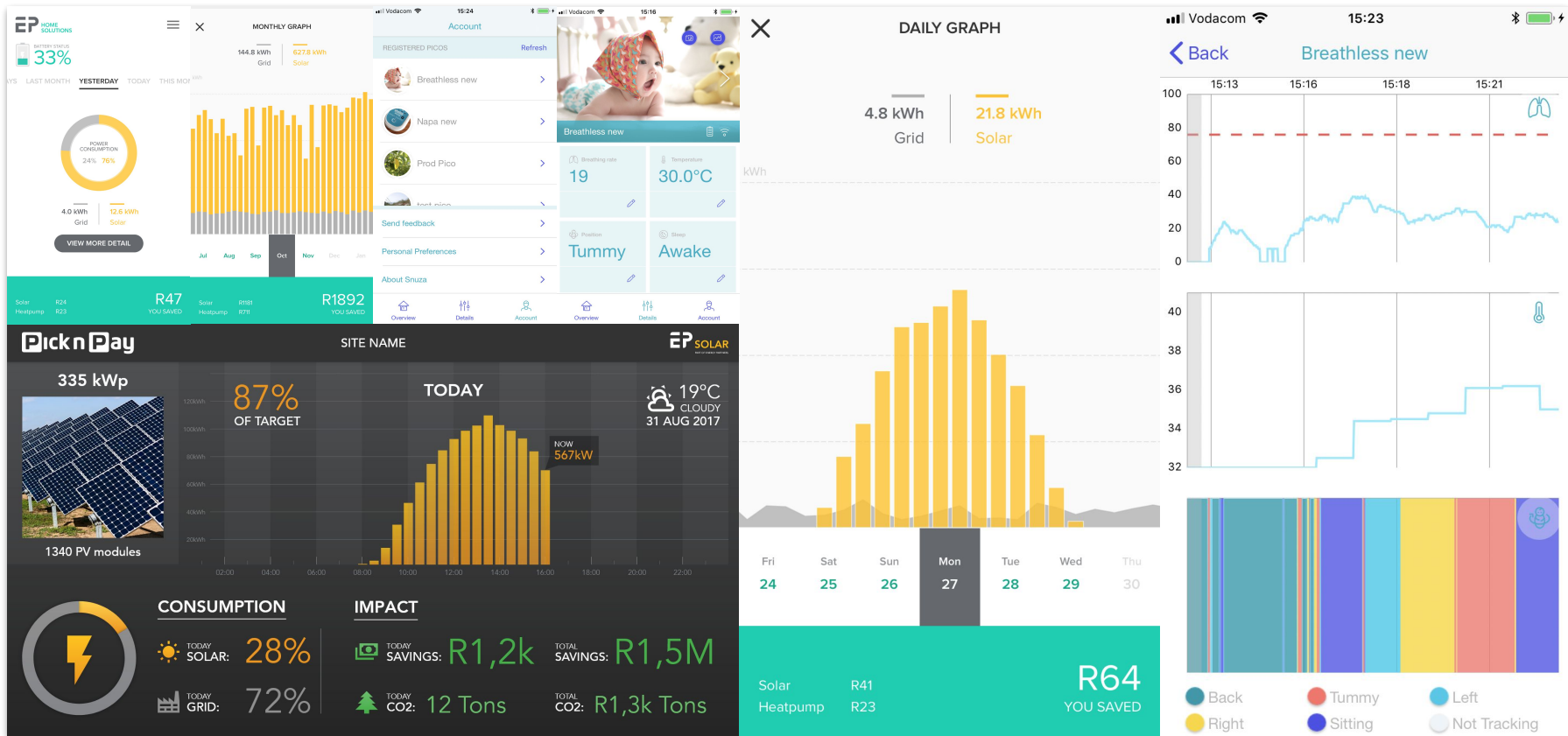
Which one do you like
the most?

Other methods



Final remarks

- Hobby project
 - Never intended for the service to grow this big
 - Successful in answering:
 - *So I installed a new TTN gateway - how well does it actually work?*
- Better tech stacks out there
 - Use what you know to get it working quickly
 - Agile, fail fast
- Needs major refactoring before future open sourcing
- Workshop this afternoon
 - (15h30) - how to map coverage
- Visualisation is key to the adoption of IoT



polymorph

Questions and suggestions?

Twitter: @ttnmapper
Email: info@ttnmapper.org

