

Freifunk for Things

LoRaWAN & The Things Network

Freifunk Assembly, 33c3 Day2 -18:30
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Freifunk Münster

Hello.



kgvax

@kgvax

Hacker, Freifunker, Warpzonista, Chief
Troll Officer at Valtech, Segler und so.
Opinions are mostly my own.

📍 Germany

Freifunk Mission

*„Freifunk steht für freie Kommunikation in digitalen
Datennetzen“*

*Wir verstehen frei als öffentlich zugänglich, nicht
kommerziell, im Besitz der Gemeinschaft und
unzensiert.“*

LPWAN?

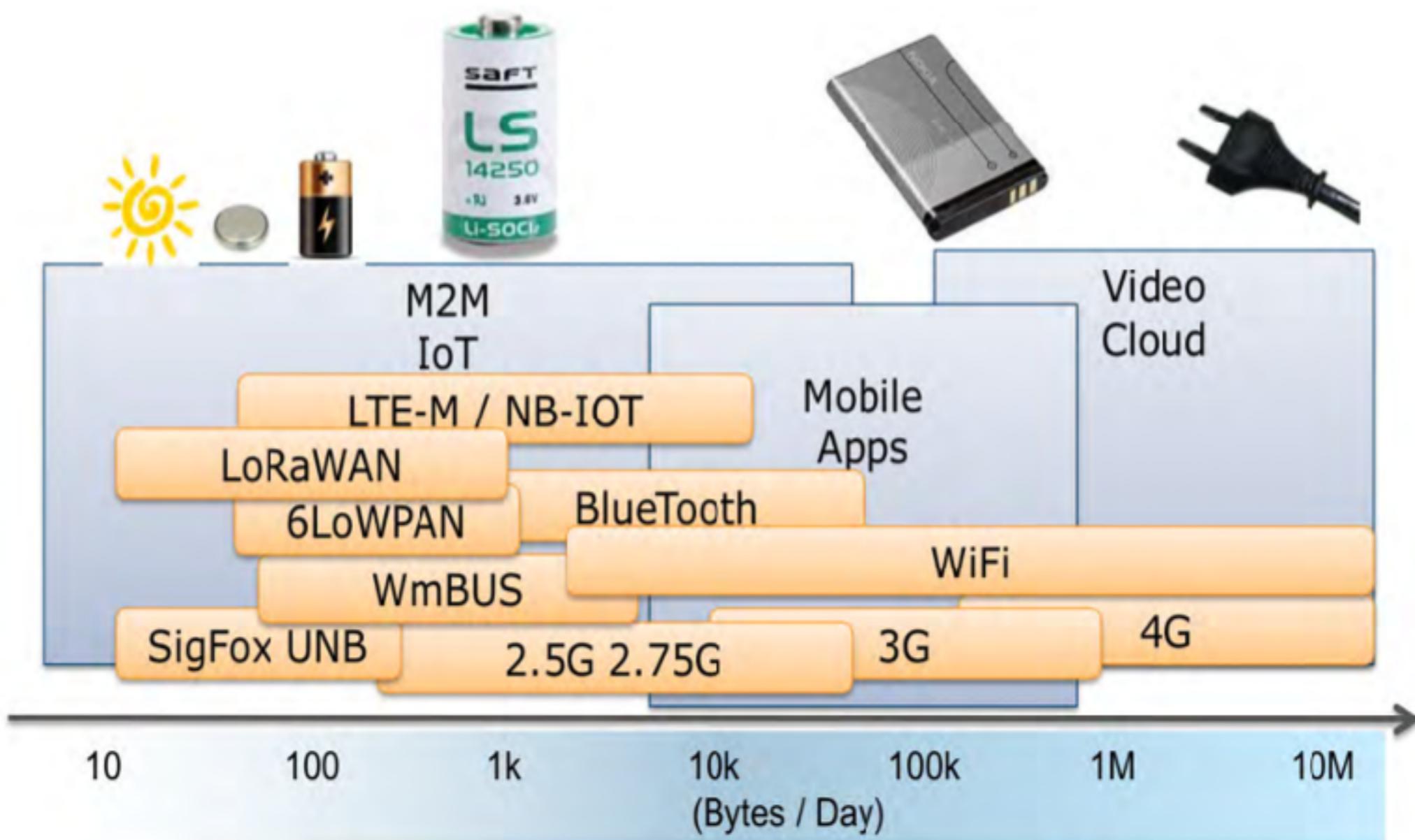
Low Power Wide Area Network

IoT Applications

- Yada yada: Wearables, Quantified Self, Smart* Home, Connected Car, “Locks”
- Field is much wider, still emerging. #Neuland
- I am interested in: Smart* *Foo*
The world around us - based on Open Data.
Let's take stock!

*with variable definitions of „Smart“

LPWAN & others



LPWAN ‘Standards’

| | SIGFOX | LoRa | clean slate | NB LTE-M Rel. 13 | LTE-M Rel. 12/13 | EC-GSM Rel. 13 | 5G (targets) |
|------------------------|--|---|--|---|---|---|--|
| |  SIGFOX |  LoRa™ |  cloT |  Lte |  Lte |  GSM |  5G |
| Range (outdoor) MCL | <13km 160 dB | <11km 157 dB | <15km 164 dB | <15km 164 dB | <11km 156 dB | <15km 164 dB | <15km 164 dB |
| Spectrum Bandwidth | Unlicensed 900MHz 100Hz | Unlicensed 900MHz <500kHz | Licensed 7-900MHz 200kHz or dedicated | Licensed 7-900MHz 200kHz or shared | Licensed 7-900MHz 1.4 MHz or shared | Licensed 8-900MHz 2.4 MHz or shared | Licensed 7-900MHz shared |
| Data rate | <100bps | <10 kbps | <50kbps | <150kbps | <1 Mbps | 10kbps | <1 Mbps |
| Battery life | >10 years | >10 years | >10 years | >10 years | >10 years | >10 years | >10 years |
| Availability | Today | Today | 2016 | 2016 | 2016 | 2016 | beyond 2020 |

(incomplete list)

LPWAN is a compromise

- Many restrictions
- Receiver is mostly ‘off’
- Rate limiting

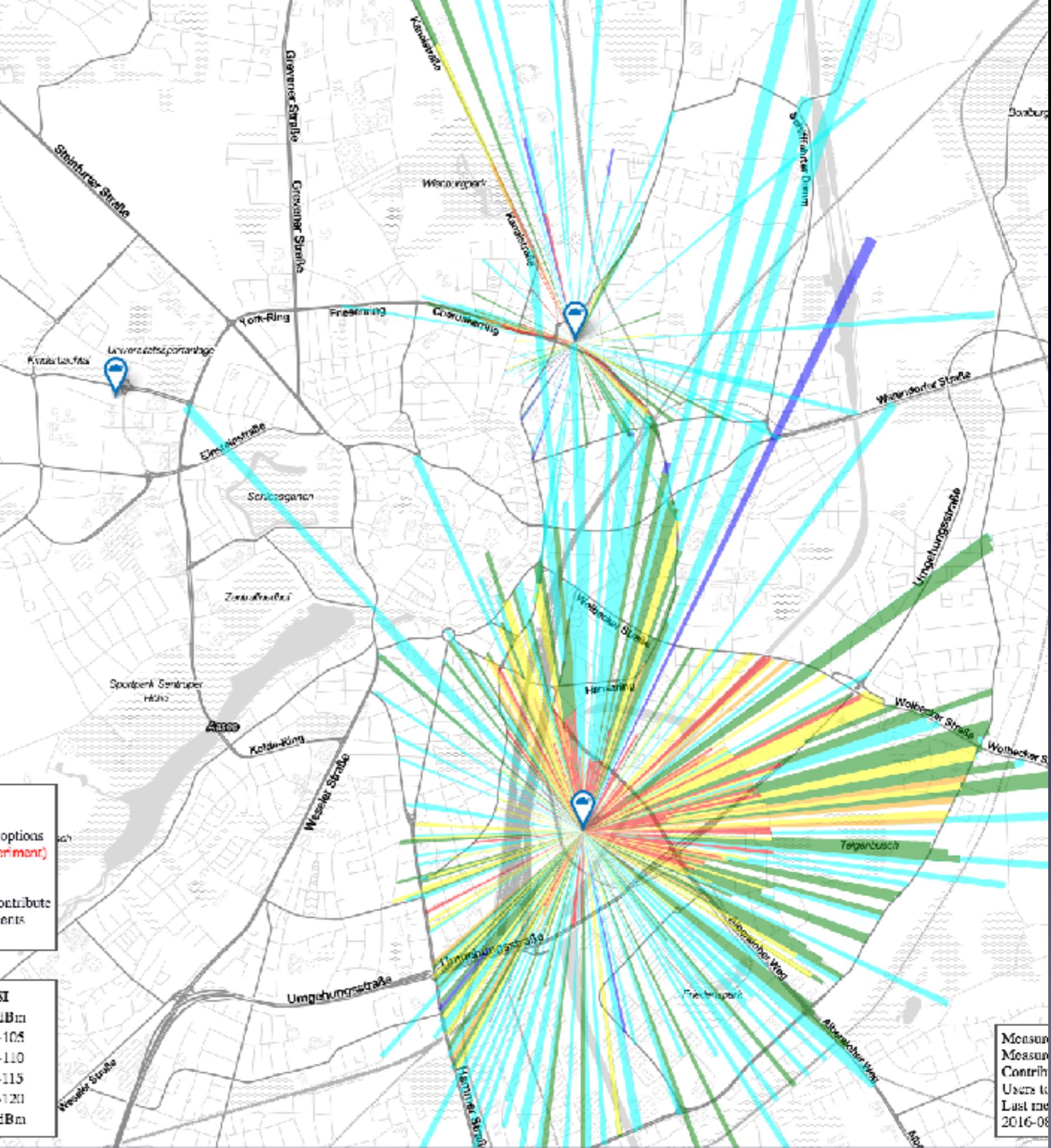
LoRaWAN Technology

LoRa Radio

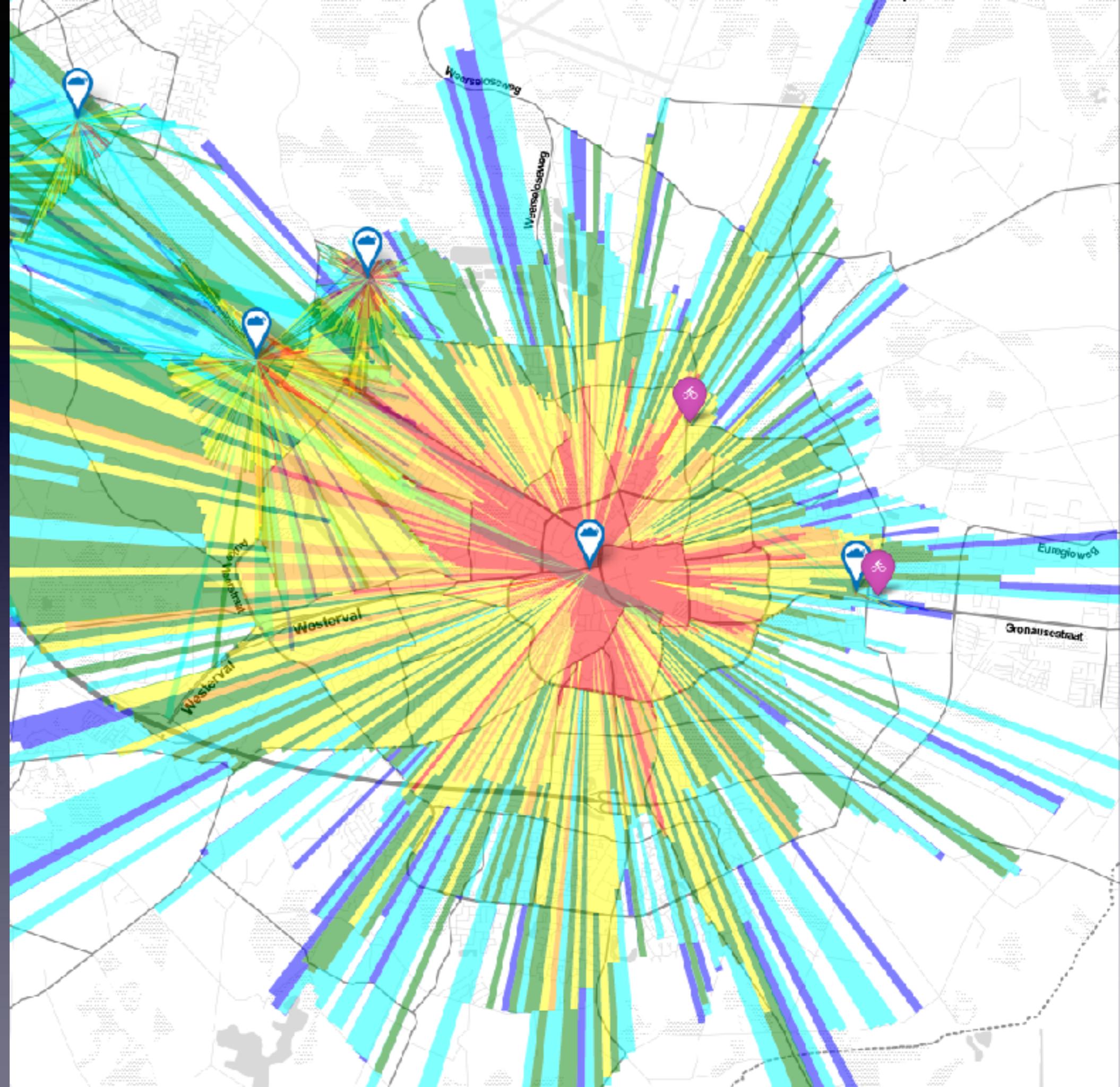
- LoRa(tm) - a modulation
- Unlicensed but regulated ISM bands
- EU: 868 Mhz, US 913Mhz, 430 China,Japan
- Chirp Spread Spectrum Modulation
 - Demodulate ~20dBm below noise floor

Long Range

ttnmapper.org



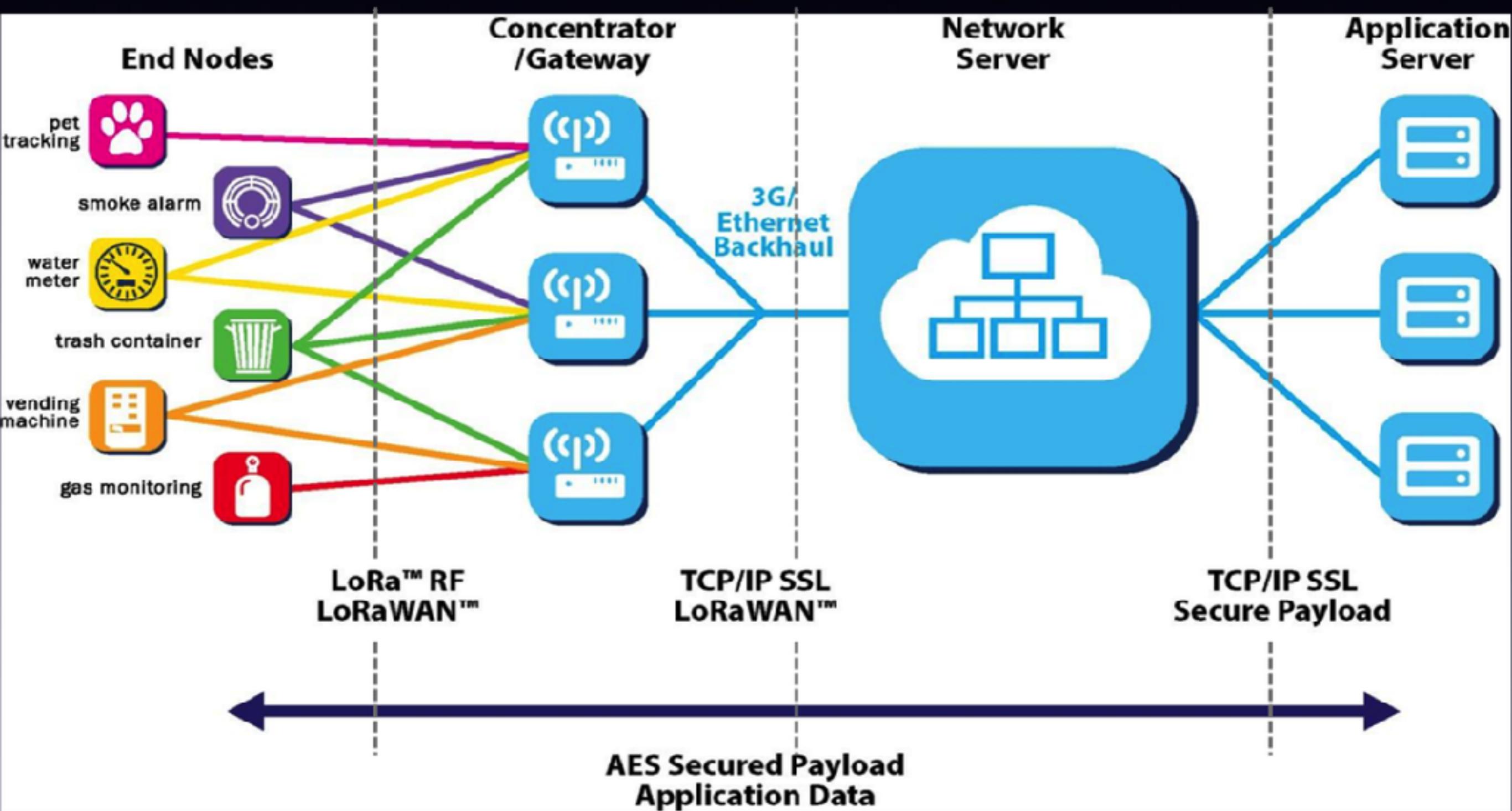
Friends At Enschede



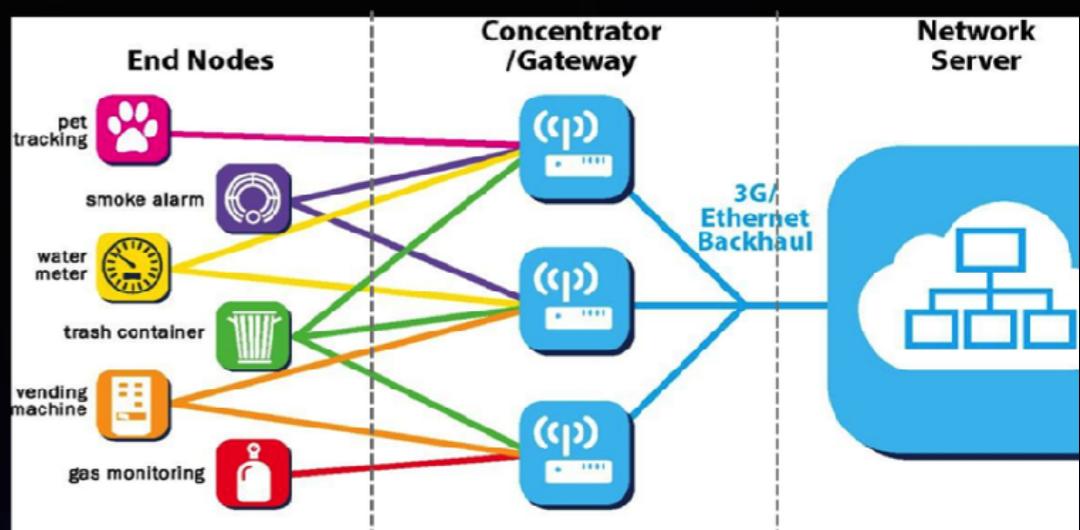
Range

- ~2-3 km urban
- >10 km rural
- > 100 km at freak conditions
- Factors
 - Line Of Sight (LOS)
 - Elevation of Gateways
 - Elevation of Node
 - Be careful with nodes close to ground.

LoRaWAN Structure



Basics



- Gateways receive on all (8) channels (concurrently)
- No overhead for coordination since there is none - “ALOHA network”
- Gateways forward packets to network
- Network is “just software”

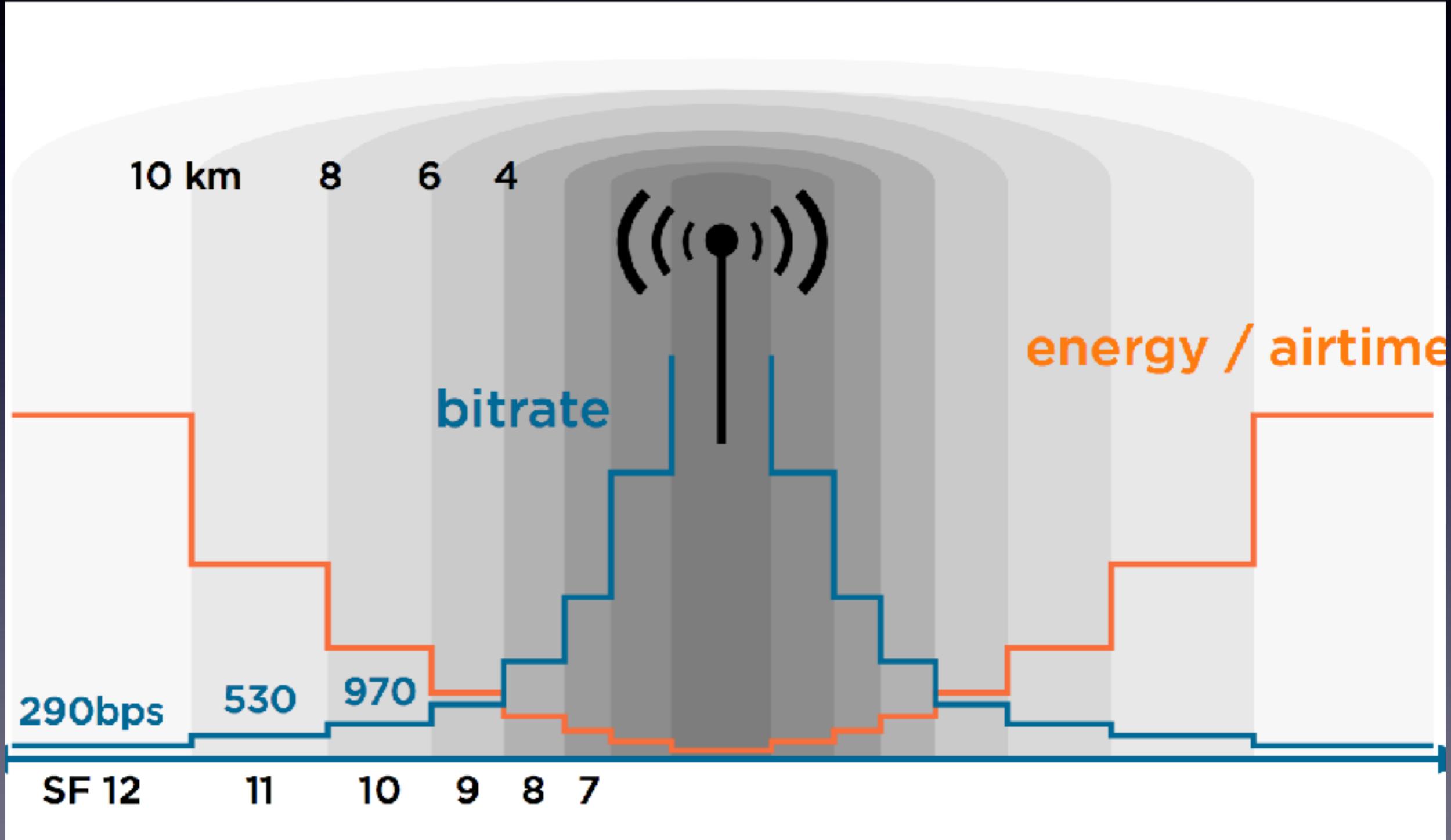
Power Consumption

- e.g. MICROCHIP RN2483 (@3,3V)
 - Transmit: 17-40 mA
 - Receive: 14mA
 - Idle: 2,8mA
 - Deep Sleep: 9 μ A <<< Most of the time

Payload

- Captain Obvious: LoRaWAN is not TCP/IP
- 51..222 byte payload per message
- Depending on data rate

Adaptive Data Rate



Why not a mesh?

- Mesh requires too much energy
 - Receiver needs to listen
 - Active Link-State protocols require regular transmissions
- Mesh collides with duty-cycle regulation

Security

- Mandatory AES128 crypto
- Shared Secret between node and application
- The verdict about the quality of this encryption (AES modes) is still out

LoRaWAN Deployments

- KPN, Netherlands
- Proximus, Belgium
- SK Telecom, Korea
- Bouygues Telecom, France
- Swisscom, Switzerland
- telent, Germany

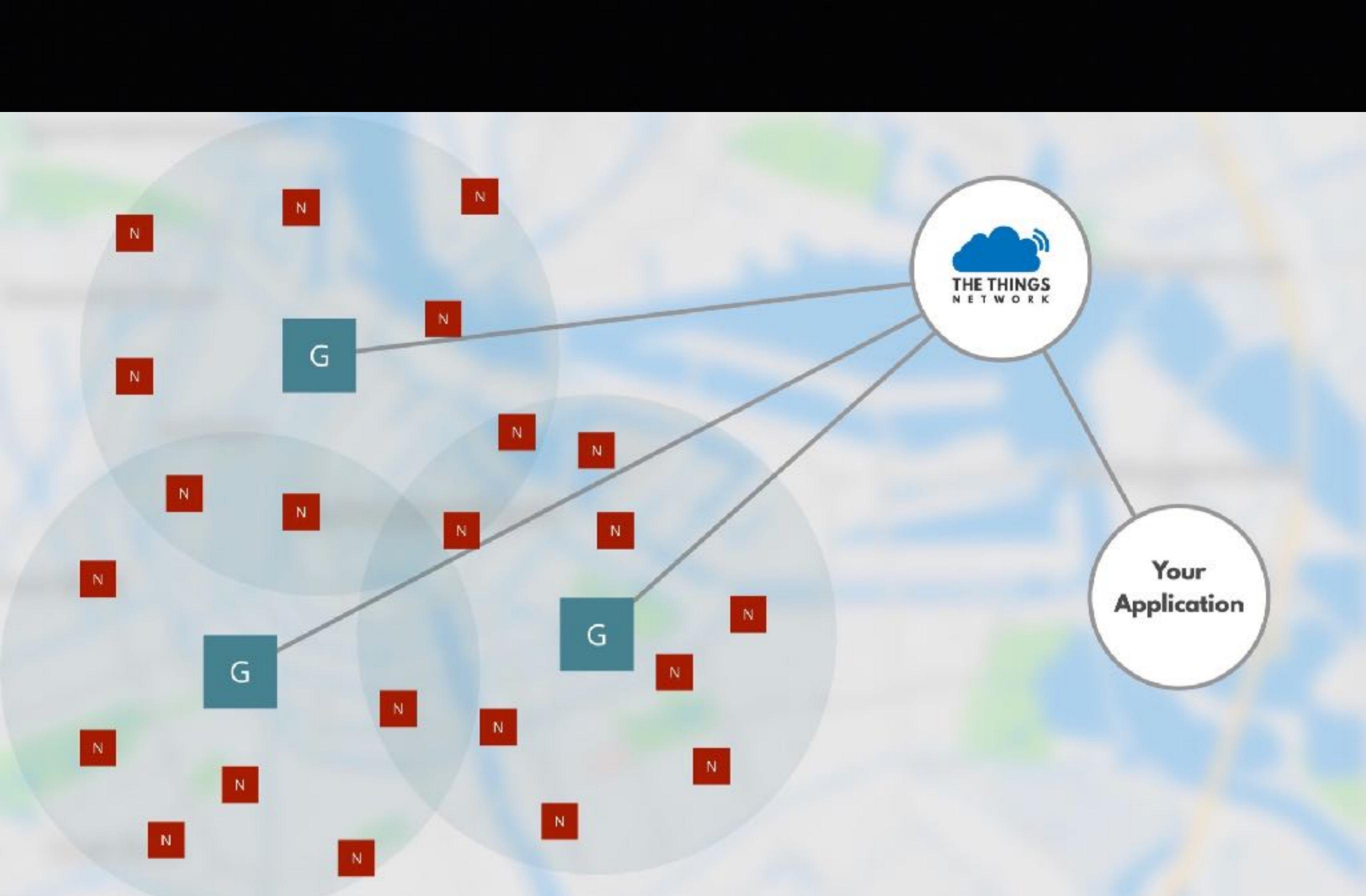
DO WANT





Unleashing the Internet of Things

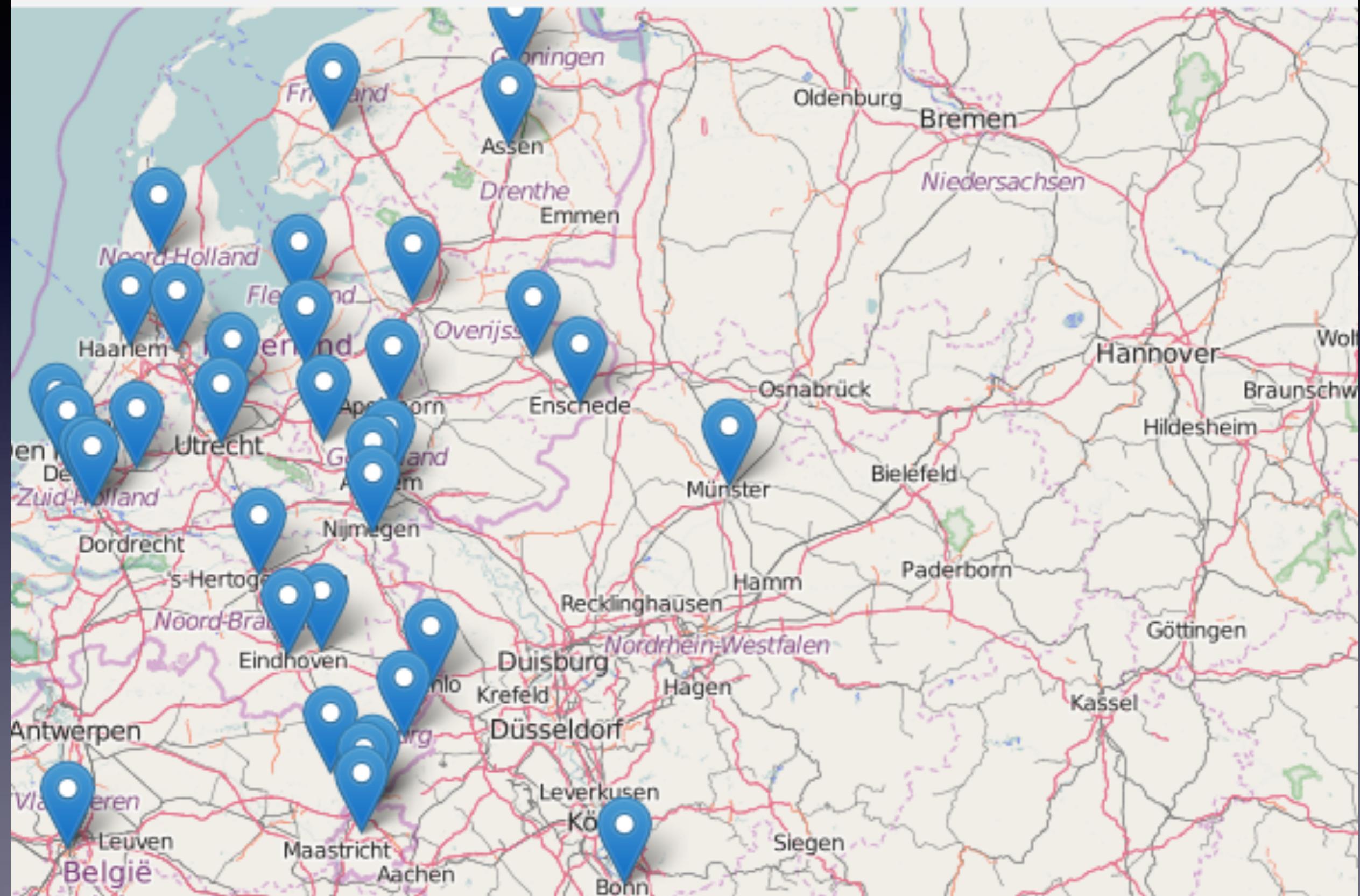
We are on a mission to build a global open crowdsourced Internet of Things data network.



The Things Network

- Crowd Sourced Network
- Gateways owned by Individuals (swarm) & Organisations
- Open Source LoRaWAN Network Stack
- Run by „The Things Network Foundation“
- Free as in free & free as in beer

Communities



Buy...

KERLINK IOT GATEWAY



The weatherproof Kerlink IoT Gateway is an operator-grade gateway providing a reach of around 7 miles. It needs a technician to be installed.

Price: ~€1500

[MORE INFO](#)

MULTI-TECH GATEWAY



+ 2 free mDot ARM mbed programmable LoRaWAN ready modules & UDK2 development boards.

The Things Network firmware for this device is currently being developed. The Conduit comes with an 8 Channel LoRa Concentrator card (comparable to the Kerlink gateway). Easy to install.

Price: €449

THE THINGS GATEWAY



This is a gateway which is easy to use and install, is low cost and will allow you to contribute to the network from your home. The range is around 5 kilometer and perfect for citizens to create their smart city.

Price: €250

[MORE INFO](#)

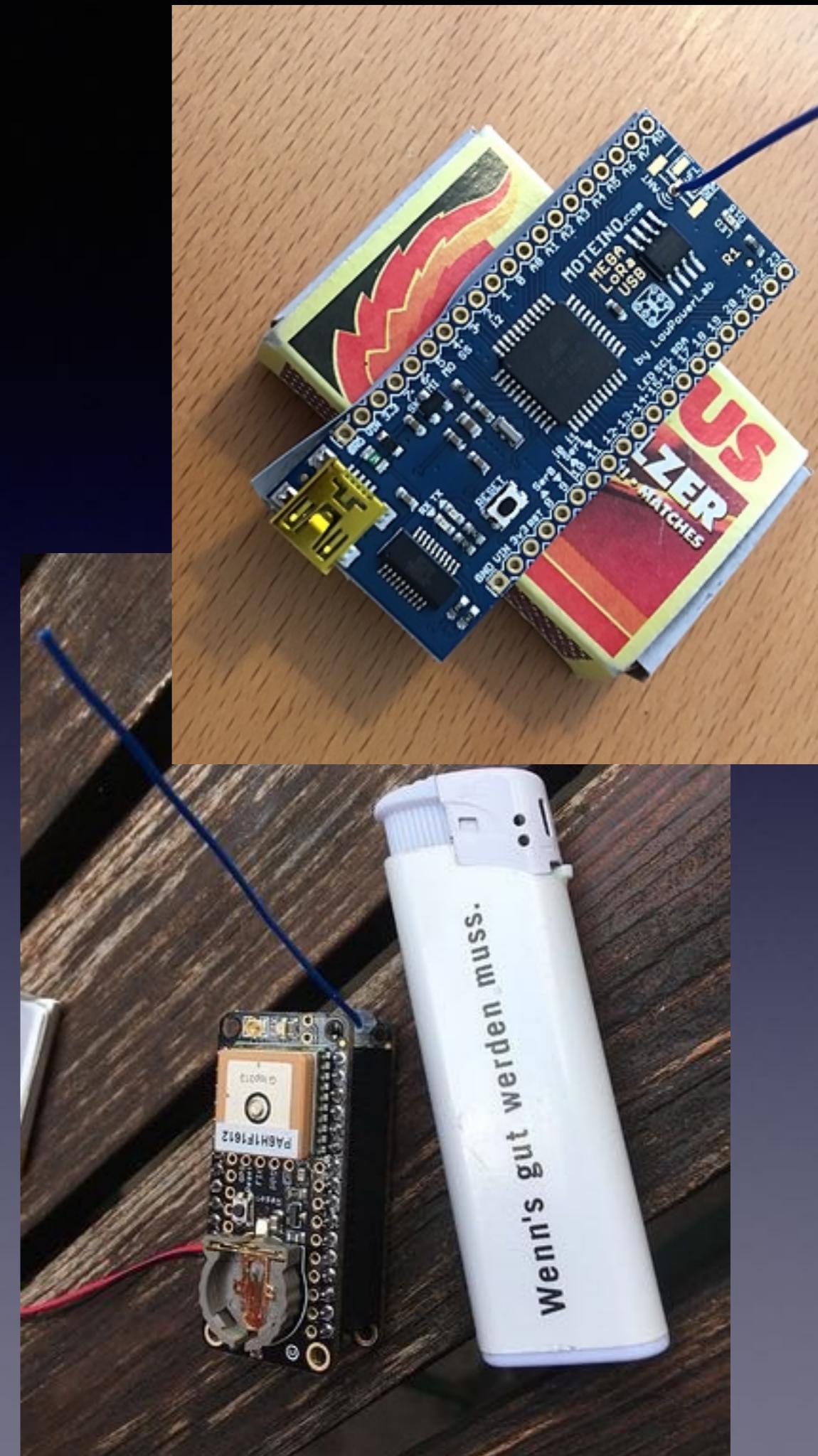
Or build your own

- IMST LoRaWAN Concentrator:
~180€
- Raspberry Pi + Open Source
- #win



Nodes

- Build your own(RN2483, HopeRF) + MCU (e.g. Arduino)
- Buy
 - Sodaq Autonomo / One
 - Moteino
 - LoPy
 - Adafruit Feather LoRa
 - Lots of stuff in development
 - Prices are coming down



TTN API

- Basic interface between app and network is MQTT
 - RESTful management API
- Web: <https://staging.thethingsnetwork.org>

TTN Fair Use Policy

- Golden rule: 30 seconds air-time per device per day
- For 10 bytes of payload, this translates in (approx.):
 - 20 messages per day at SF12
 - 500 messages per day at SF7
- This allows for >1000 nodes per gateway

Freifunk & TTN

- Create an IoT network like LoRaWAN available to everyone everywhere
- Own. The. Network.
- Create a “canvas”
Let’s play!
- Open Data by default
- Freifunk as Backhaul Network

Bootstrap Münster



wiekaltistderkanal.de

wiekaltistderkanal.de





STOLEN!

We're back!



Demo.

wiekaltistderkanal.de

Open Data on <https://opensensemap.org>.

Things we're working on

- Detect & publish occupied e-car charging spots
- Local river: Water level measurements (Use:
Flood thread detection)
- Misc. environmental sensors, together with
sensebox.de

Summary: Living with Restrictions

- Respect the Fair Use Policy!
- Do not bend the rules - Rethink use cases.
- How low can you go*?

*Look at TPL5110. 35nA

Links

- Münster
 - wiekaltistderkanal.de
 - Forum Münsterland: <https://forum.freifunk-muensterland.de/c/ffms-lp>
- Sensebox
 - Solar Prototyp:
<https://opensesemap.org/explore/57fb712811347b0011c10e80>
- The Things Network
 - <https://www.thethingsnetwork.org>
 - <https://www.thethingsnetwork.org/wiki/Home>
 - <https://www.thethingsnetwork.org/forum/>

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