

The Things Network

**ICTP/EAIFR Short Course in LoRa technologies
Kigali, June 2019 - Sebastian Büttrich**

IoT – Internet of Things

within IoT

LPWAN – Low Power Wide Area Networks

one possible LPWAN: LoRaWAN

Physical Layer – LoRa

MAC Layer – LoRaWAN

one possible LoRaWAN: The Things Network



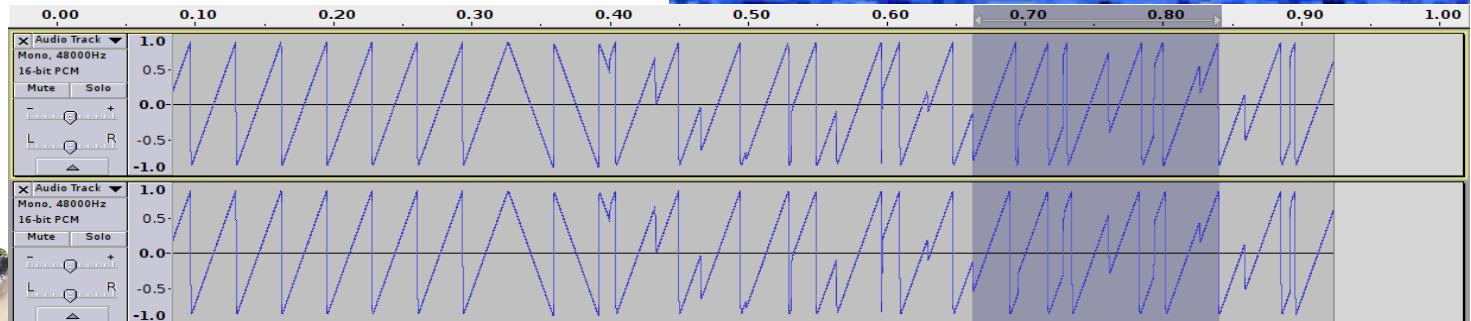
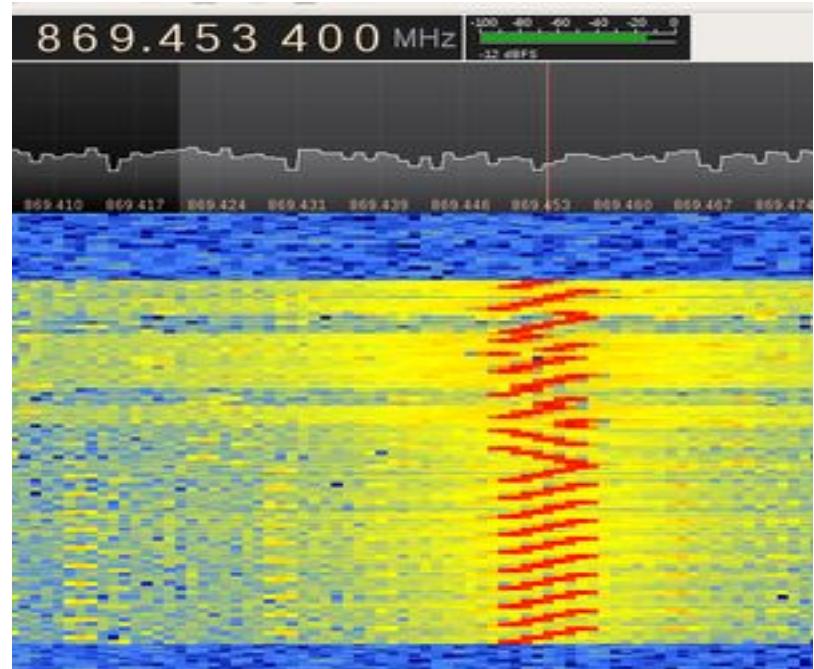
LoRa

A proprietary radio technology,
owned by Semtech

CSS Chirp Spread Spectrum



Often ISM bands 868/915 & 433
MHz, but not limited to those



LoRaWAN

An open specification, Maintained by the LoRa-Alliance

100

Network Operators

68

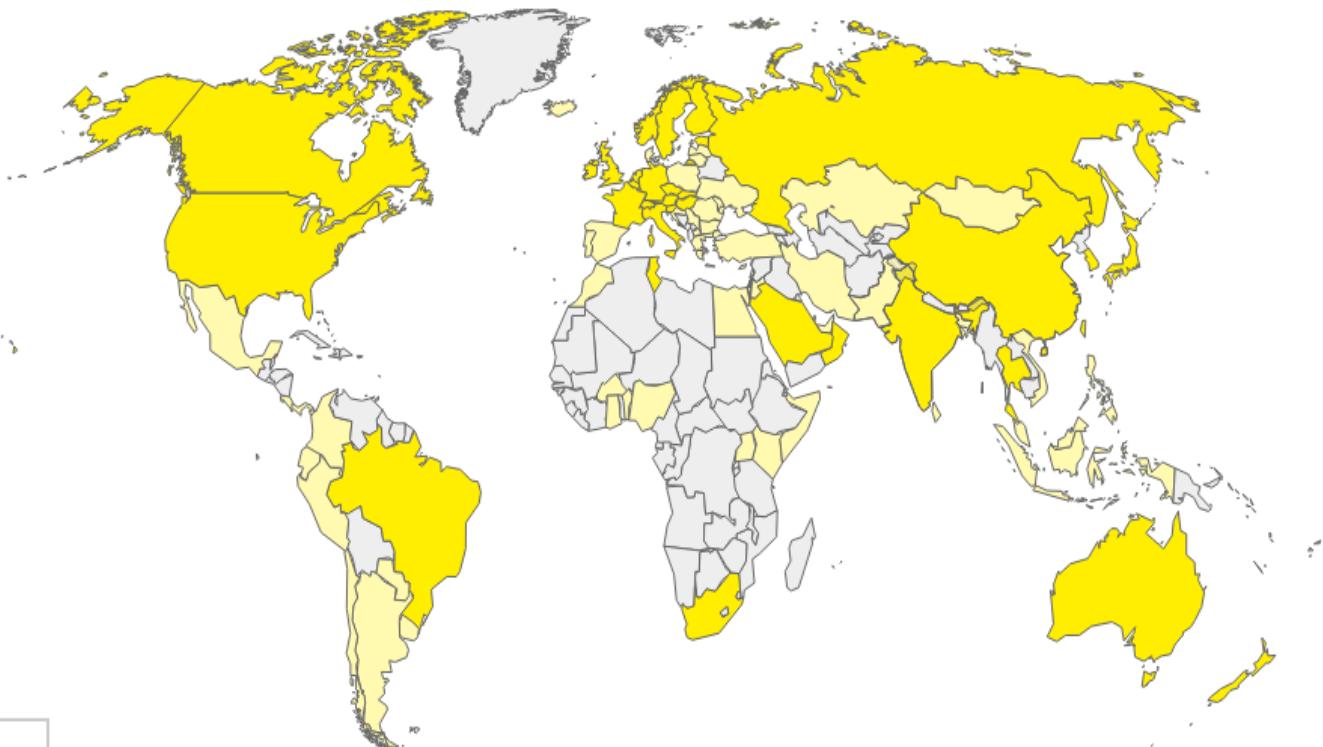
Alliance Member
Operators

51

Countries operating in

100

Countries with
LoRaWAN Deployments



- █ Alliance Member Public Networks
- █ Other LoRaWAN Deployment

LoRaWAN addresses:

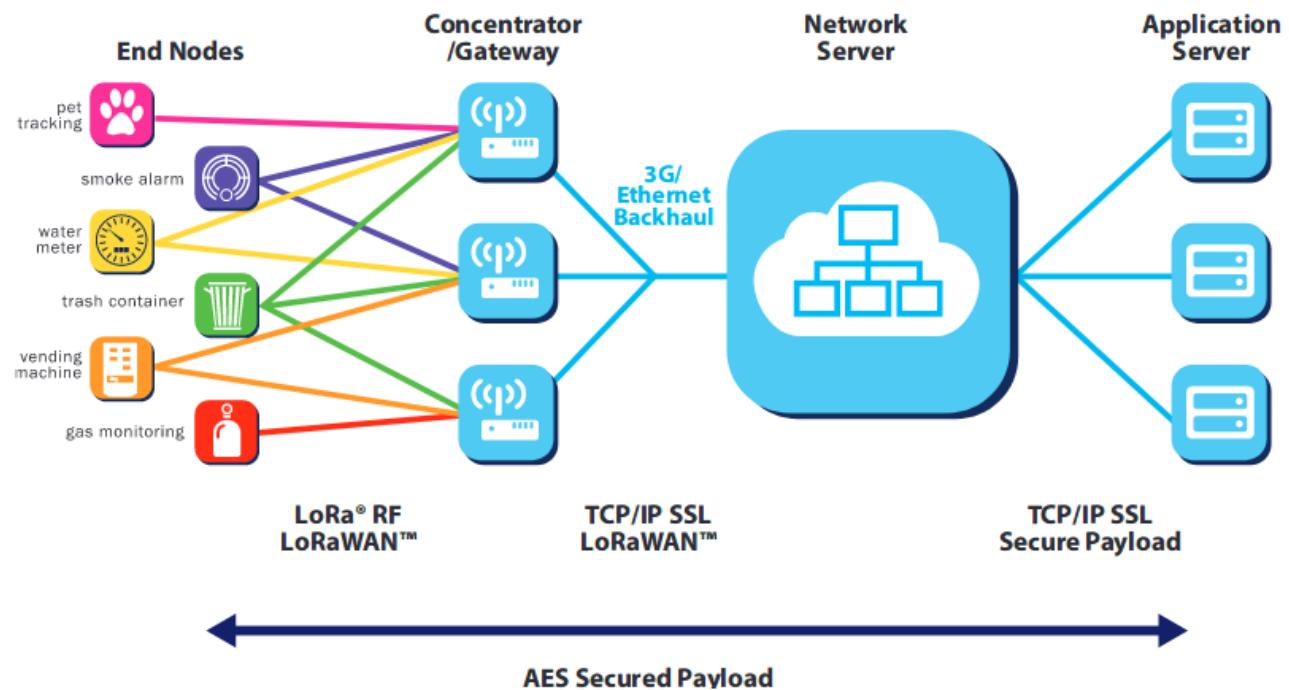
Topology

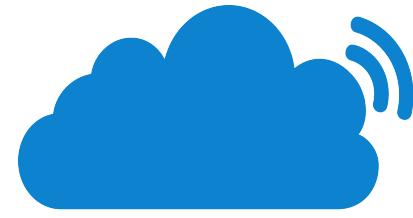
Device Classes

Data Rates

Security

Regional Info





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

Our mission is to build a **DECENTRALIZED**,

OPEN and **CROWDSOURCED**

INTERNET OF THINGS data network

OWNED and **OPERATED** by its **USERS**

The Things Network - Essentials

- Community project started in Netherlands
- Commercial side: The Things Industries
- Open source (except for web GUI)

This to some degree explains our current interest in TTN, in an educational context.

- **Great Learning resource:**

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

Source, Details:

<https://github.com/TheThingsNetwork/Manifest>

The Things Network / 1



The Things Network / 2 / Manifesto

Everything that carries power will be connected to Internet eventually.

Controlling the network that makes this possible means controlling the world. We believe that this power should not be restricted to a few people, companies or nations. Instead this should be distributed over as many people as possible without the possibility to be taken away by anyone. We therefore founded "The Things Network".

The Things Network is an open source, free initiative with the following properties:

It connects sensors and actuators, called "Things", with transceivers called "Things Gateways" to servers called "Things Access".

The first connection is "Over The Air", the second is "Over The Net". The distributed implementation of these concepts is called "The Things Network".

Anyone shall be free to set up "Things" and connect to "Things Gateways" that may or may not be their own.

Anyone shall be free to set up "Things Gateways" and connect to "Things Access" that may or may not be their own. Their "Things Gateways" will give access to all "Things" in a net neutral manner, limited by the maximum available capacity alone.

Anyone shall be free to set up "Things Access" and allow anonymous connections from the Internet. Their "Things Access" will give access to all "Things Gateways" in a net neutral manner, limited by the maximum available capacity alone. Furthermore their "Things Access" will allow connection of other "Things Access" servers for the distribution of data.

The "Over The Air" and "Over The Net" networks shall be protocol agnostic, as long as these protocols are not proprietary, open source and free of rights.

Anyone who perpetrates a "Things Access" or a "Things Gateway" will do so free of charge for all connecting devices and servers.

Anyone making use of the network is allowed to do so for any reason or cause, possibly limited by local law, fully at own risk and realizing that services are provided "as is" and may be terminated for any reason at any moment. The use may be open for anybody, limited to customers, commercial, not-for-profit, or in any other fashion. "The Things Network" providers will not pose restrictions upon its users.

We invite you to sign this Manifesto, and uphold its principles to the best of your abilities.

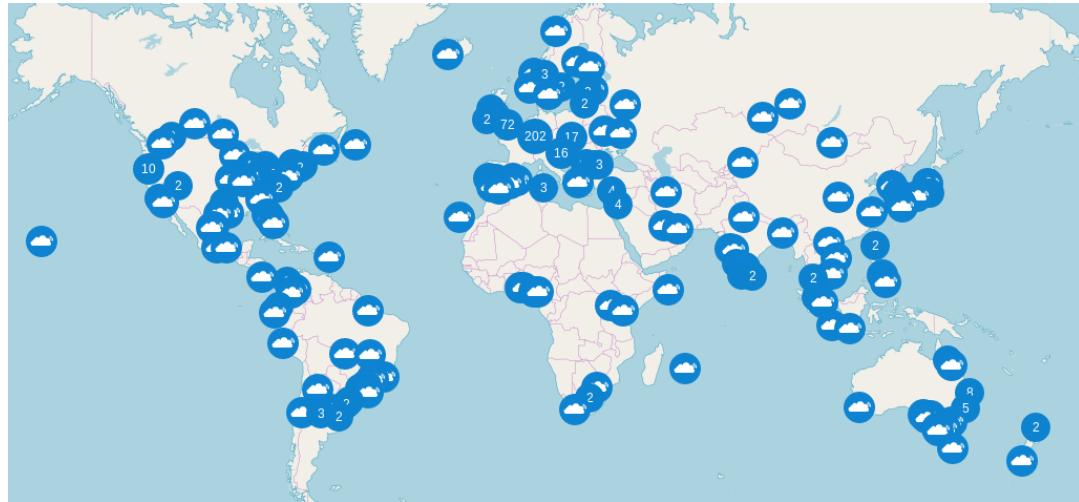
Source, Details:

<http://www.thethingsnetwork.org>

The Things Network



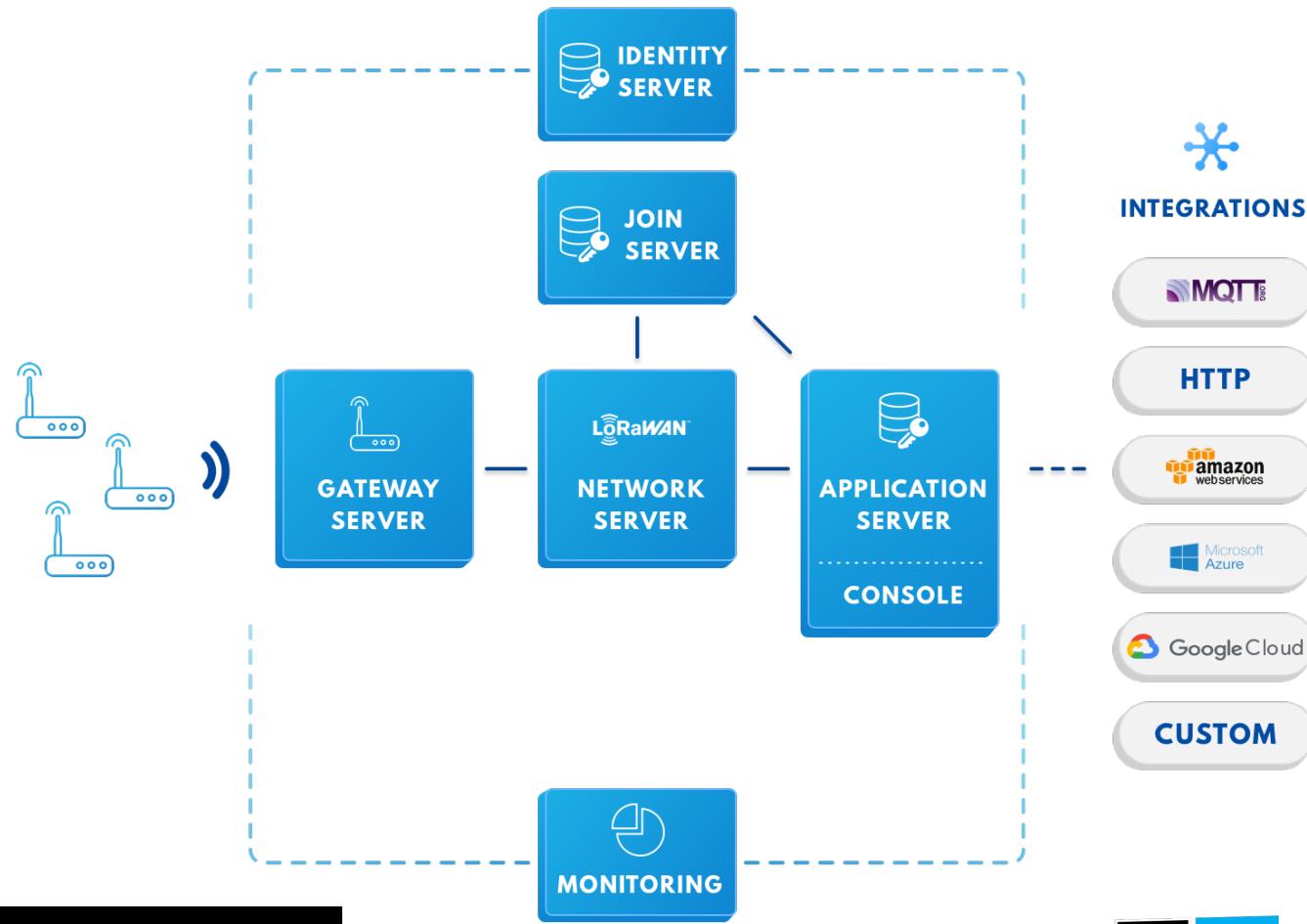
**THE THINGS
N E T W O R K**



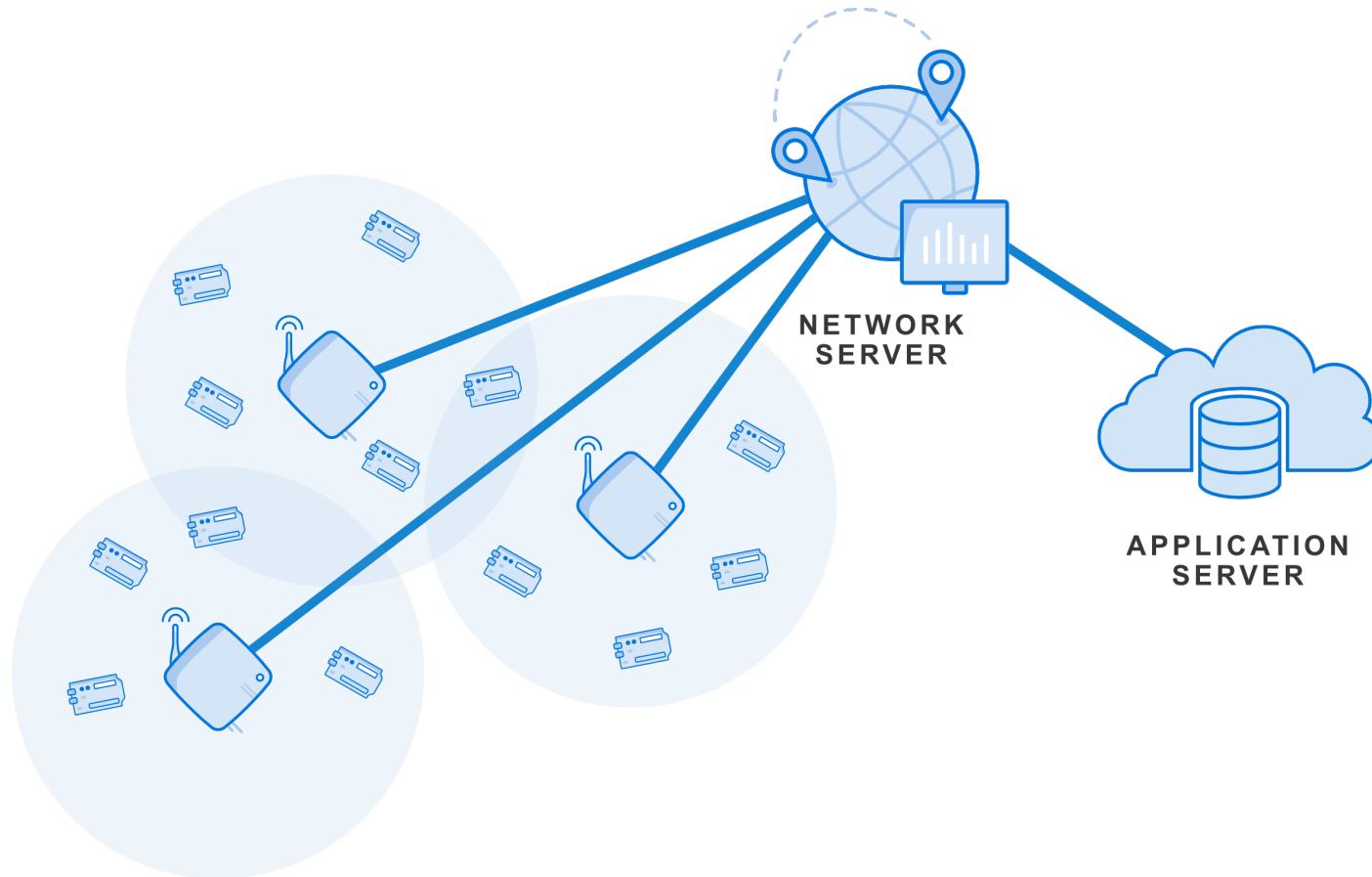
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The Things Network / 5 / Stack



The Things Network / Simplified



The Things Network / 6 / Security

= defined by LoRaWan standard

Three keys: NwkSKey, AppSKey and AppKey

Challenge of key provision

The Things Network / Security, cntd

LoRaWAN 1.0 specifies a number of security keys: `NwkSKey`, `AppSKey` and `AppKey`. All keys have a length of 128 bits.

The **Network Session Key** (`NwkSKey`) is used for interaction between the Node and the Network Server. This key is used to check the validity of messages (MIC check). In the backend of The Things Network this validation is also used to map a non-unique device address (`DevAddr`) to a unique `DevEUI` and `AppEUI`.

The **Application Session Key** (`AppSKey`) is used for encryption and decryption of the payload. The payload is fully encrypted between the Node and the Handler/Application Server component of The Things Network (which you will be able to run on your own server). This means that nobody except you is able to read the contents of messages you send or receive.

The Things Network / Security, cntd

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The Things Network / Security, cntd

What you will use, in your code:

DevEUI, AppEUI, AppKey

Source, Details:

<https://www.thethingsnetwork.org/wiki/LoRaWAN/Security>

THE OPEN, COLLABORATIVE NETWORK



70K

DEVELOPERS

15M

PACKETS ROUTED
EVERY DAY



100

COUNTRIES

950

CITIES

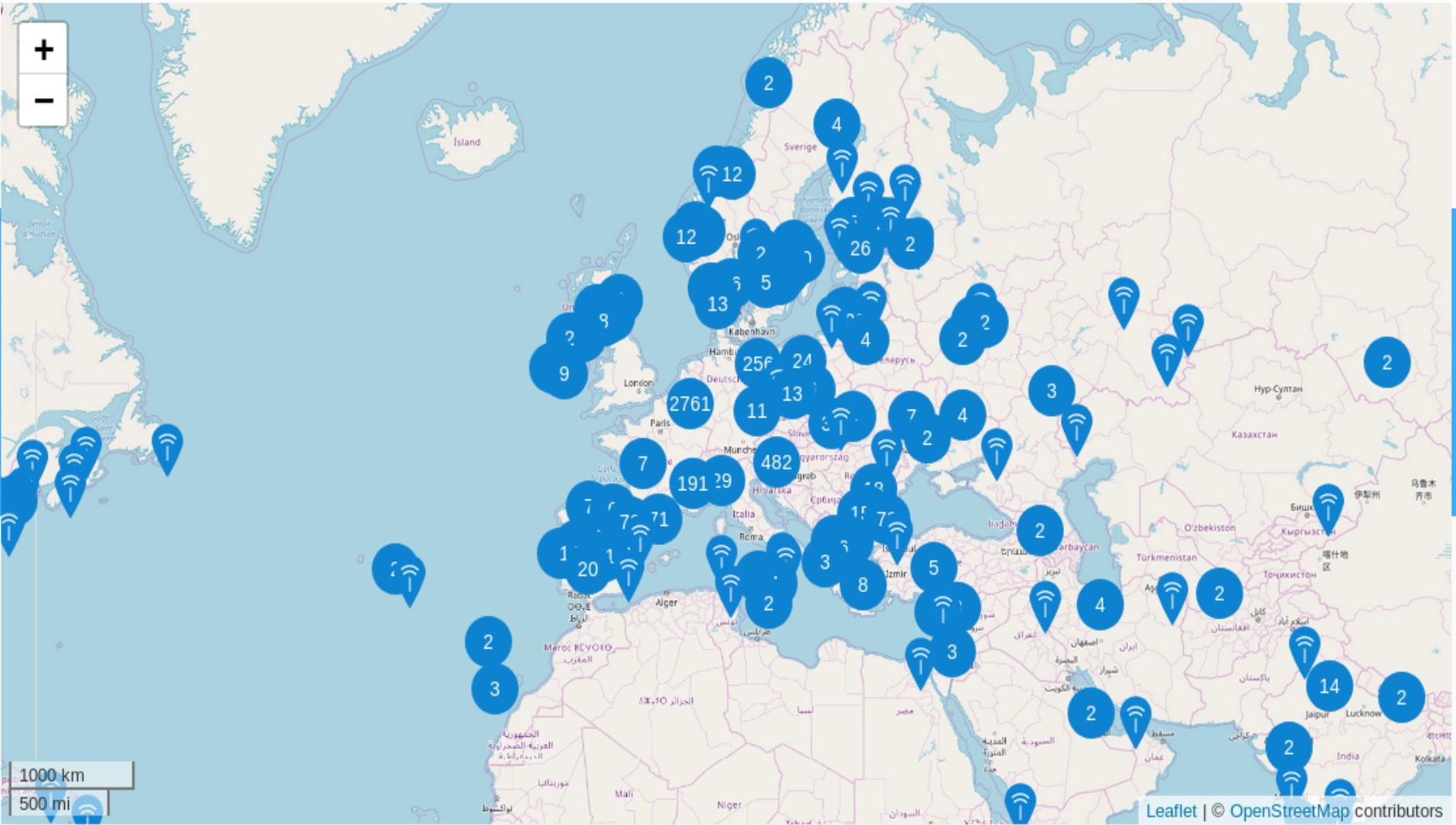
7K

GATEWAYS

At this moment, there are 7310 gateways up and running



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TTN

Orkney

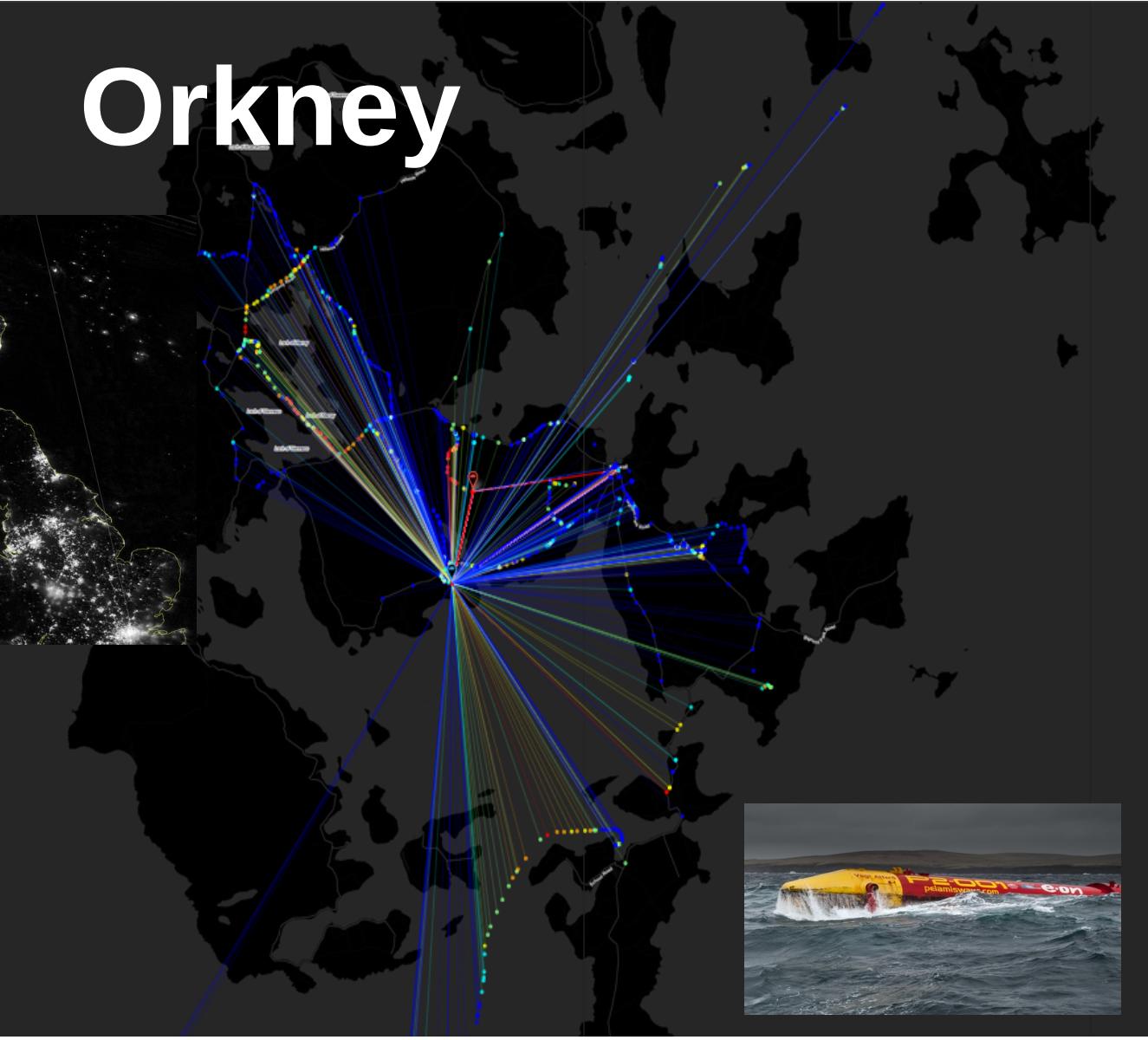
Orkney

"Here, at the edge,
infrastructure... is never
taken for granted."



WORLD
ECONOMIC
FORUM
DAVOS 2019

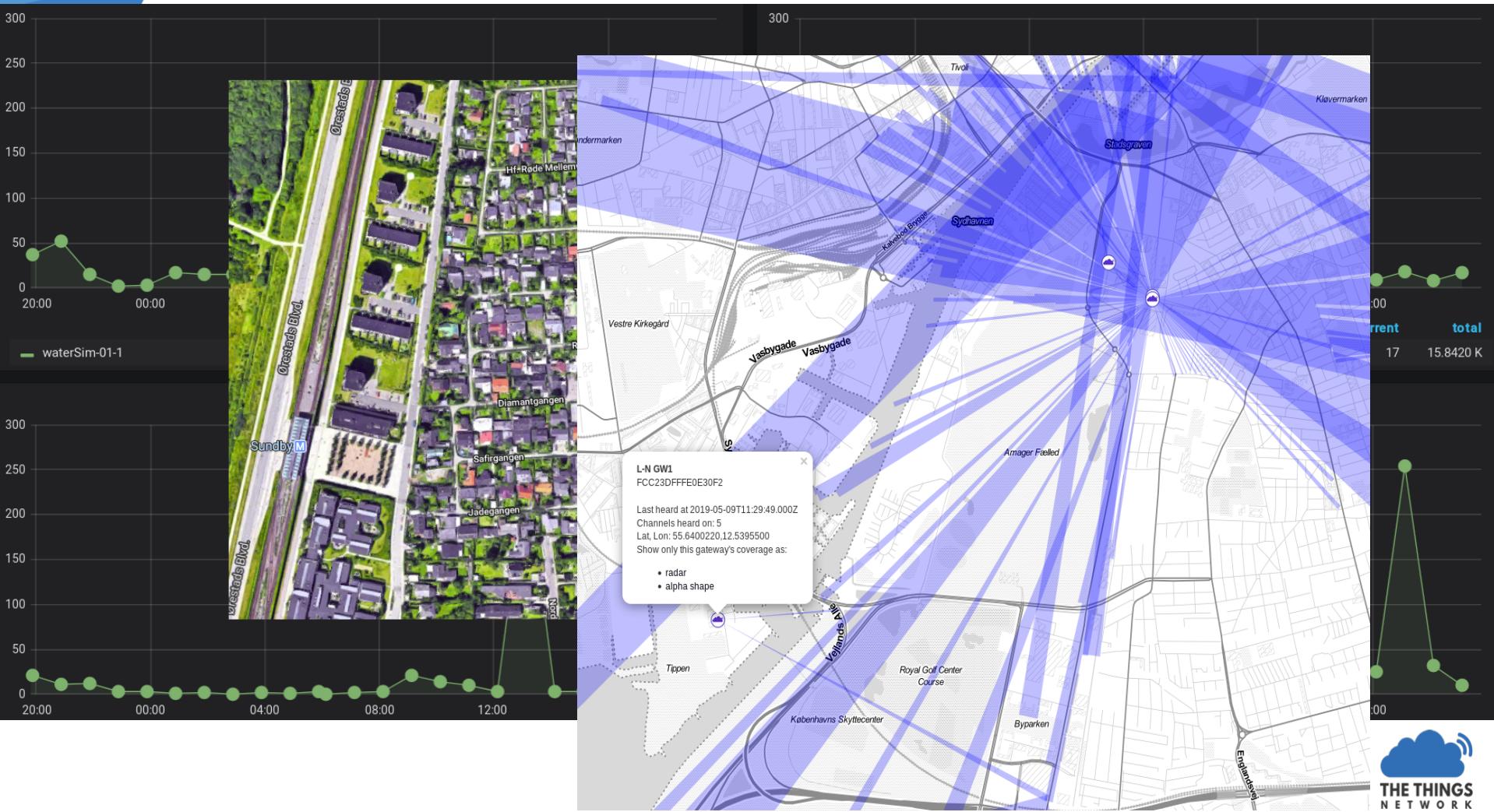
The Orkneys generate 140%
of the electricity they need



Source: Energy at the End of the World, Laura Watts



TTN in Copenhagen, Denmark



Lab

1/ Sign on to

<https://thethingsnetwork.org>

2/ Look around

3/ Let us know your username

4/ We share gateways

5/ Create applications

6/ Register devices (your LoPy's)

7/ See the data flow!