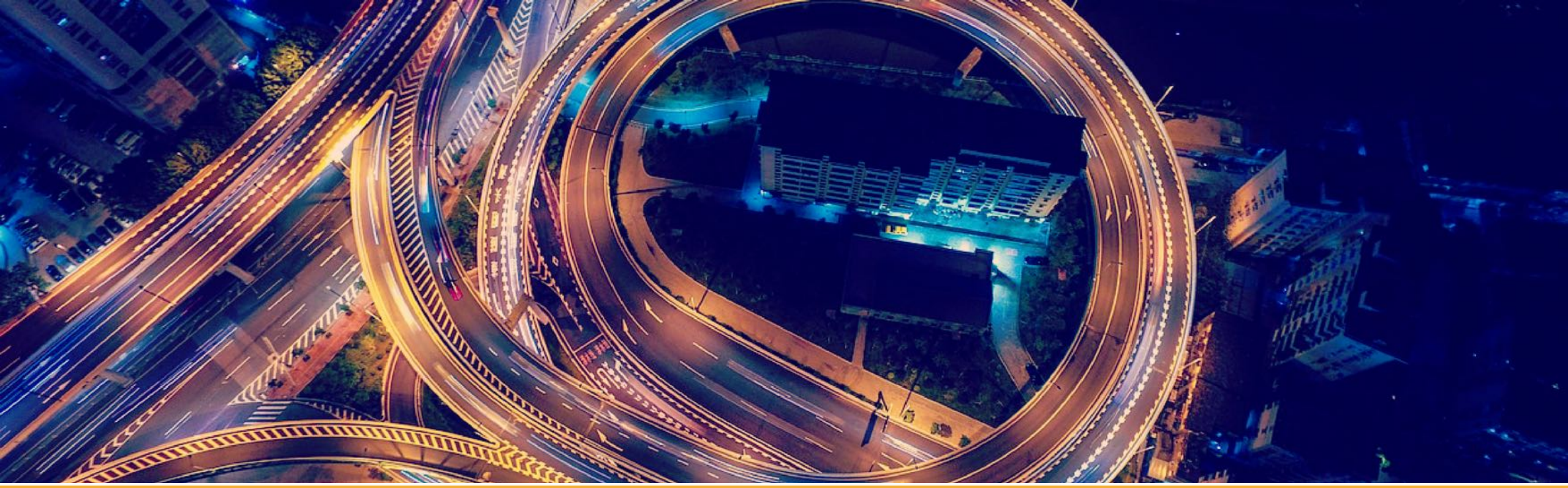

Getting Started With **The Things Network** And Crowdsourced **LoRaWAN**

Your hosts

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Agenda

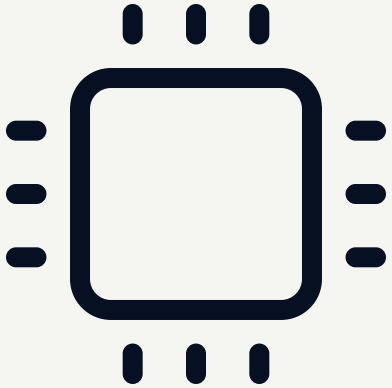
1. Introduction
2. LoRa, LoRaWAN and The Things Network explained
3. Pre-flight checklist
4. Slack channel and Meetup group
5. The Things Network Console
6. Controller setup and a wireless “HelLoRa WAN!”

— 15 minute break —

7. Real world example
8. Exploring on your own

LoRa, LoraWAN and The Things Network explained

LoRa = Long Range



Wireless modulation technology

Proprietary hardware

Uses the unlicensed ISM band

Strengths

Long range

Several kilometers

Low power

Can operate for years on a battery

Low bandwidth

Between 250 bit/s and 11 kbit/s

Low cost

Cheap to by and operate

Coverage everywhere

You are the network! Add your own gateways.

Secure

128 bit end-to-end encrypted

Weaknesses

Not real time

Can only send small packets every few minutes

No phone calls

Stick to your 4G subscription for this

No smart lights

Check out Z-Wave or ZigBee for Home Automation

No Netflix

Consider using a decent WiFi network for streaming

How long range is Long Range?

Range in different environments

Urban

2-5 km

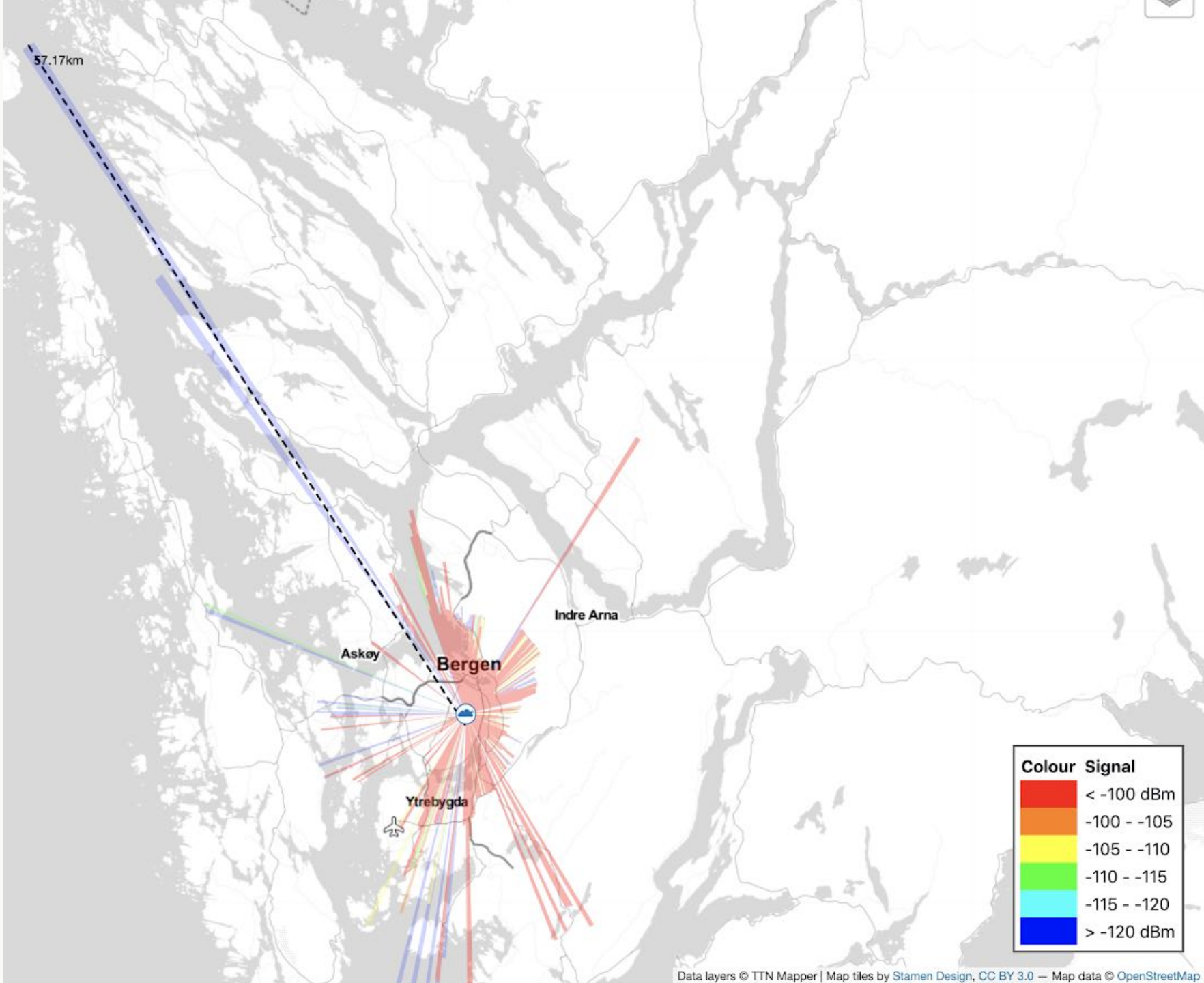
Rural

5-15 km

Direct line of sight

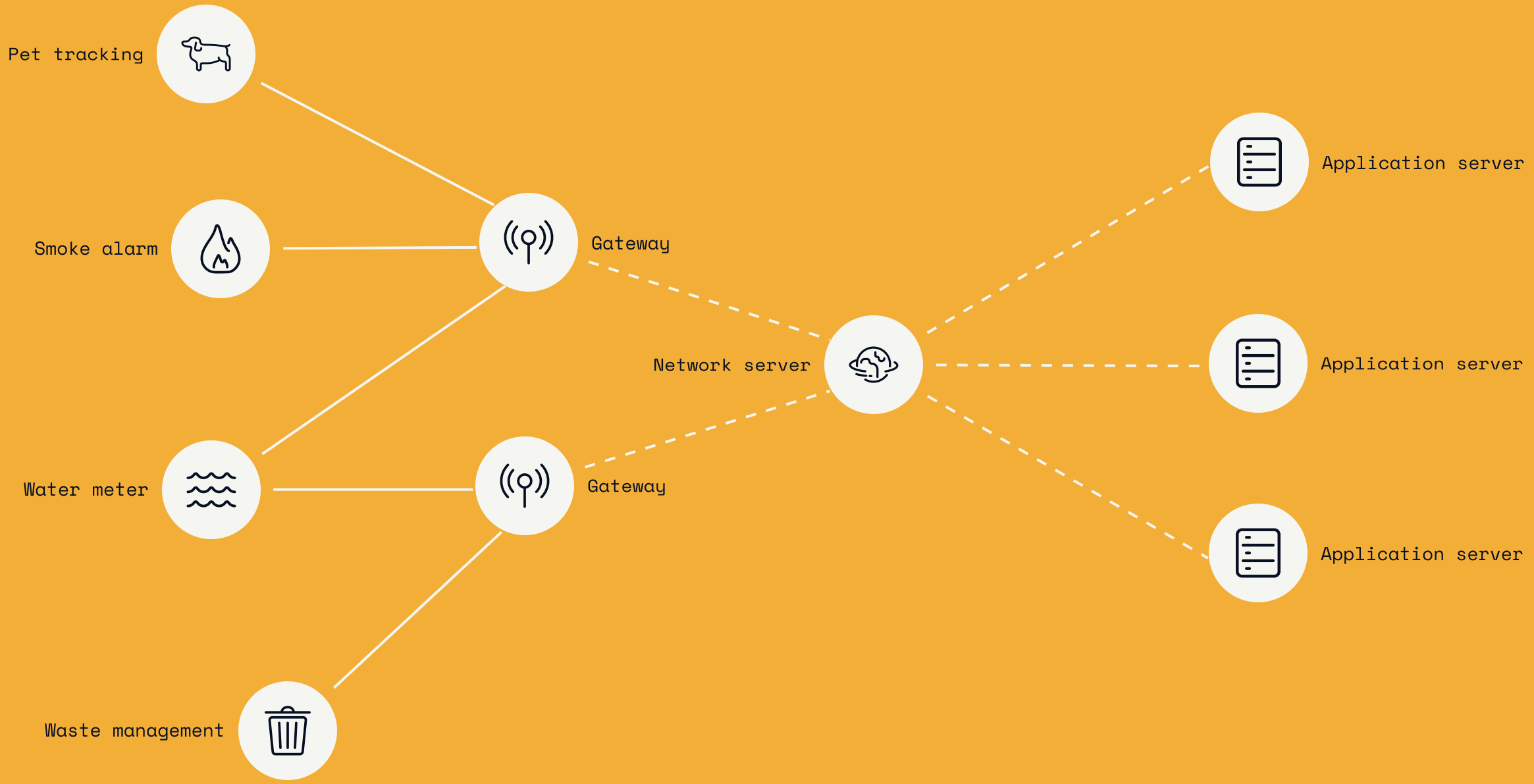
15+ km

Current local range record?



Future stretch goal

Let's talk about LoRaWAN


Pet tracking
Smoke alarm
Water meter
Waste management
Gateway
Gateway
Network server
Application server
Application server
Application server

Hey, you mentioned crowdsourcing!

“Our **mission** is to build a **decentralized open** and **crowd sourced** IoT data network, owned and operated by its users.”

The Things Network

ALL OVER THE WORLD

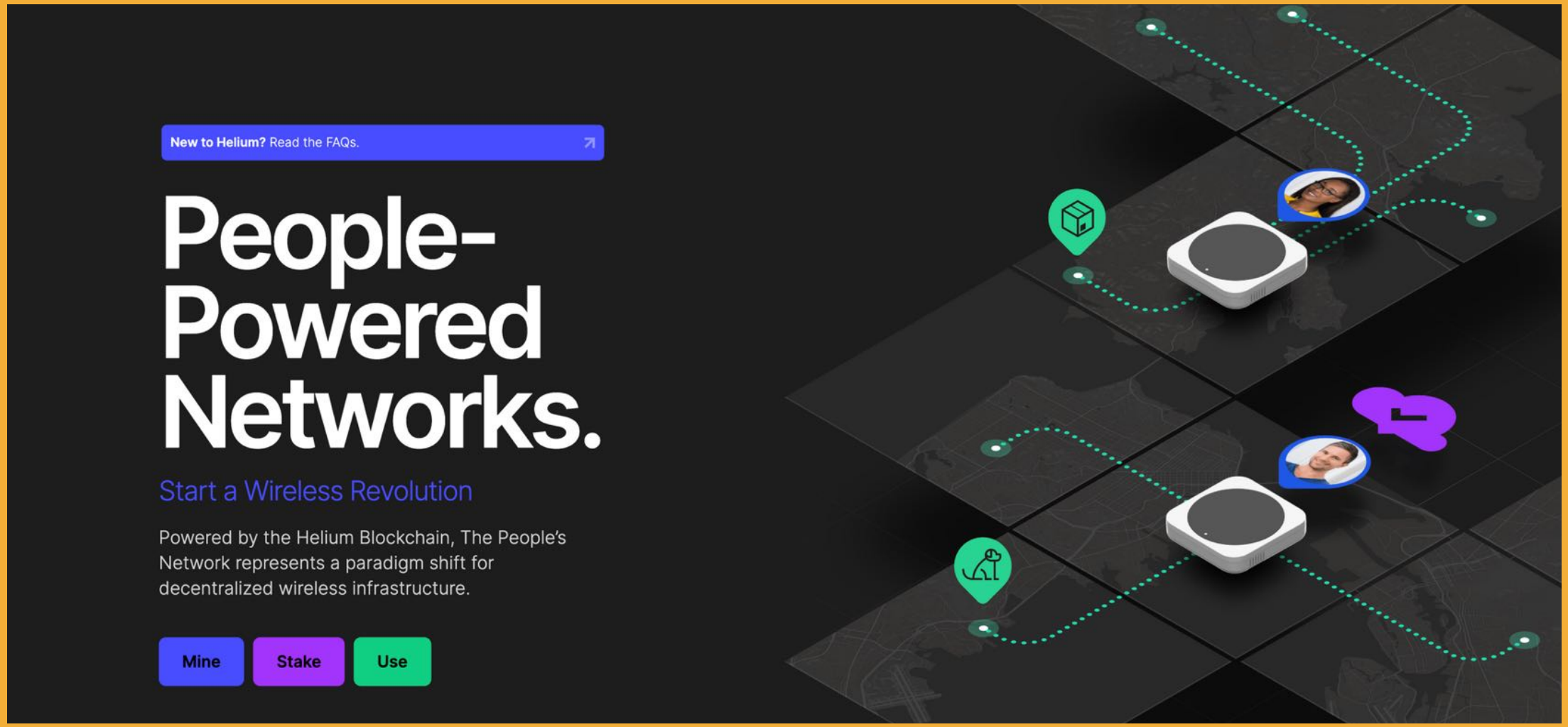
One of the local gateways

But this will work, too

The Things Indoor Gateway

An interesting contender to TTN

Helium



Before takeoff, let's go through the

Pre-Flight Checklist

Stick to the legal frequencies

Respect the local duty cycle

Adhere to The Things Network's fair use policy

Use the proper activation mode

Consider spreading factors

Connect the antenna!

Stick to the legal frequencies

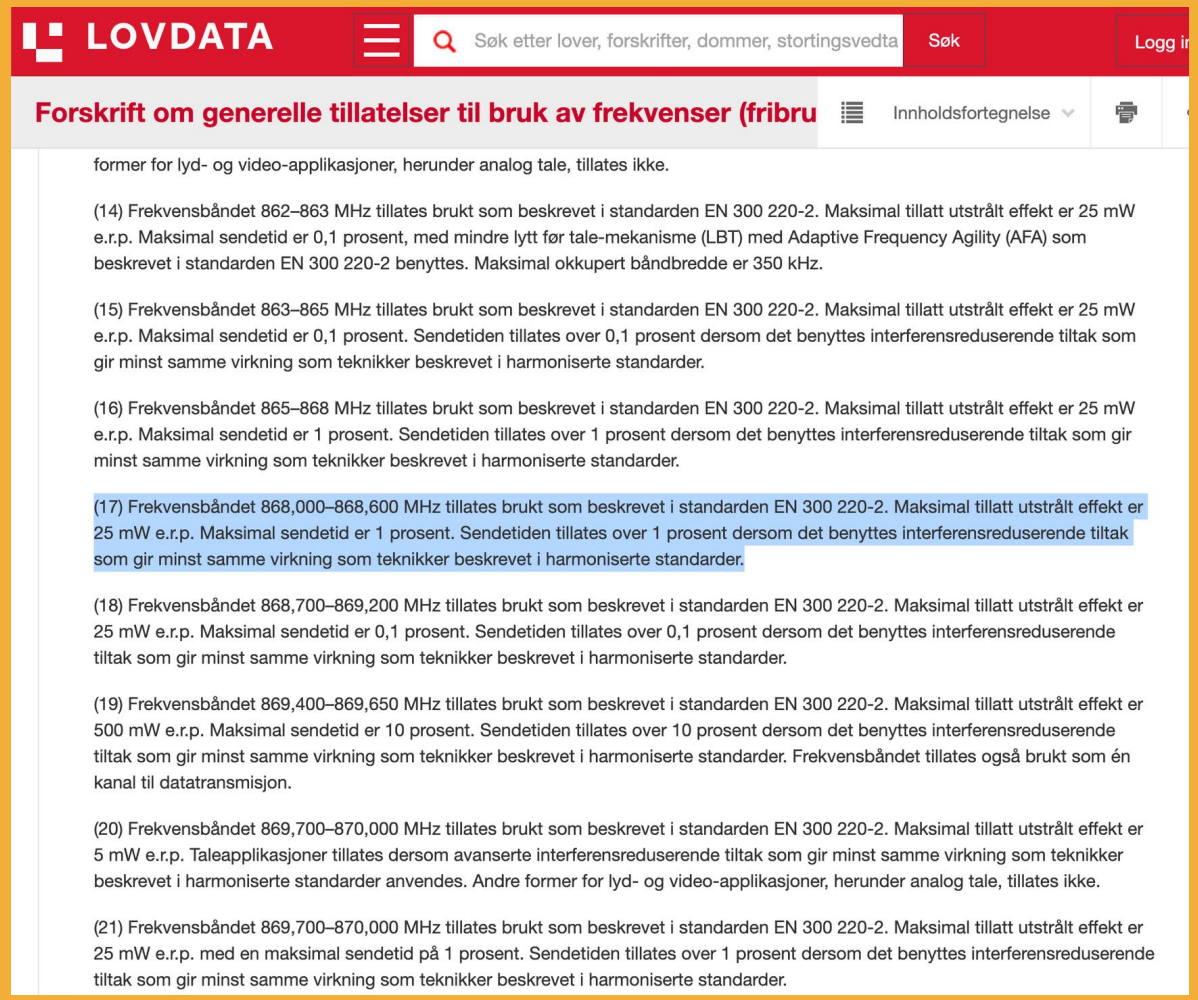
Different frequencies are used in different geographical regions.

In Norway and most of Europe, the legal frequencies are in the **868 MHz** range.

Respect the local duty cycle

The local duty cycle **dictates the amount of airtime** we can spend on transmitting data.

In Norway, the duty cycle is **1%**, meaning we can **transmit 1% of the time** and must **stay silent 99% of the time**.



former for lyd- og video-applikasjoner, herunder analog tale, tillates ikke.

(14) Frekvensbåndet 862–863 MHz tillates brukt som beskrevet i standarden EN 300 220-2. Maksimal tillatt utstrålt effekt er 25 mW e.r.p. Maksimal sendetid er 0,1 prosent, med mindre lytt før tale-mekanisme (LBT) med Adaptive Frequency Agility (AFA) som beskrevet i standarden EN 300 220-2 benyttes. Maksimal okkupert båndbredde er 350 kHz.

(15) Frekvensbåndet 863–865 MHz tillates brukt som beskrevet i standarden EN 300 220-2. Maksimal tillatt utstrålt effekt er 25 mW e.r.p. Maksimal sendetid er 0,1 prosent. Sendetiden tillates over 0,1 prosent dersom det benyttes interferensreduserende tiltak som gir minst samme virkning som teknikker beskrevet i harmoniserte standarder.

(16) Frekvensbåndet 865–868 MHz tillates brukt som beskrevet i standarden EN 300 220-2. Maksimal tillatt utstrålt effekt er 25 mW e.r.p. Maksimal sendetid er 1 prosent. Sendetiden tillates over 1 prosent dersom det benyttes interferensreduserende tiltak som gir minst samme virkning som teknikker beskrevet i harmoniserte standarder.

(17) Frekvensbåndet 868,000–868,600 MHz tillates brukt som beskrevet i standarden EN 300 220-2. Maksimal tillatt utstrålt effekt er 25 mW e.r.p. Maksimal sendetid er 1 prosent. Sendetiden tillates over 1 prosent dersom det benyttes interferensreduserende tiltak som gir minst samme virkning som teknikker beskrevet i harmoniserte standarder.

(18) Frekvensbåndet 868,700–869,200 MHz tillates brukt som beskrevet i standarden EN 300 220-2. Maksimal tillatt utstrålt effekt er 25 mW e.r.p. Maksimal sendetid er 0,1 prosent. Sendetiden tillates over 0,1 prosent dersom det benyttes interferensreduserende tiltak som gir minst samme virkning som teknikker beskrevet i harmoniserte standarder.

(19) Frekvensbåndet 869,400–869,650 MHz tillates brukt som beskrevet i standarden EN 300 220-2. Maksimal tillatt utstrålt effekt er 500 mW e.r.p. Maksimal sendetid er 10 prosent. Sendetiden tillates over 10 prosent dersom det benyttes interferensreduserende tiltak som gir minst samme virkning som teknikker beskrevet i harmoniserte standarder. Frekvensbåndet tillates også brukt som én kanal til datatransmisjon.

(20) Frekvensbåndet 869,700–870,000 MHz tillates brukt som beskrevet i standarden EN 300 220-2. Maksimal tillatt utstrålt effekt er 5 mW e.r.p. Taleapplikasjoner tillates dersom avanserte interferensreduserende tiltak som gir minst samme virkning som teknikker beskrevet i harmoniserte standarder anvendes. Andre former for lyd- og video-applikasjoner, herunder analog tale, tillates ikke.

(21) Frekvensbåndet 869,700–870,000 MHz tillates brukt som beskrevet i standarden EN 300 220-2. Maksimal tillatt utstrålt effekt er 25 mW e.r.p. med en maksimal sendetid på 1 prosent. Sendetiden tillates over 1 prosent dersom det benyttes interferensreduserende tiltak som gir minst samme virkning som teknikker beskrevet i harmoniserte standarder.

Adhere to The Things Network's fair use policy

The Things Network's **Fair Use Policy** limits the **uplink airtime** to **30 seconds per day (24 hours) per node** and the **downlink messages** to **10 messages per day (24 hours) per node**.

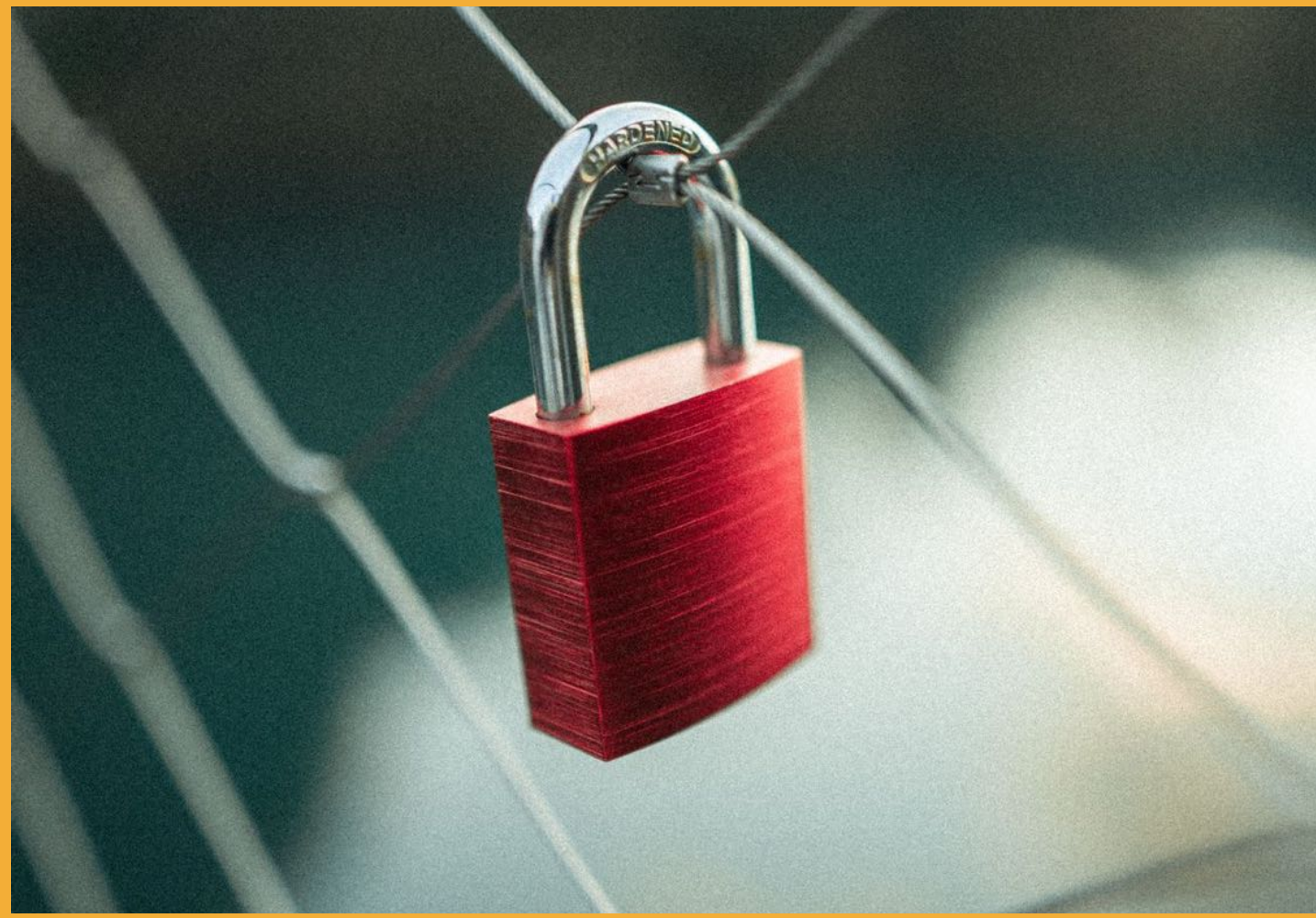
If you use a private network, these limits do not apply, but you still have to be compliant with the governmental and LoRaWAN limits.

Use the proper activation mode

LoRaWAN supports two modes of activation on end-devices: **ABP (Activation By Personalization)** and **OTAA (Over-The-Air Activation)**.

ABP employs fixed keys on the device, while **OTAA** receives new keys from the server on each activation.

ABP is simpler, but **OTAA** is more secure and recommended.



Consider spreading factors

Lower spreading factors **reduce the range of LoRa** transmissions, because they reduce the processing gain and increase the bit rate.

Changing spreading factor allows the network to increase or decrease data rate for each end device at the cost of range.The network also uses spreading factors to control congestion.

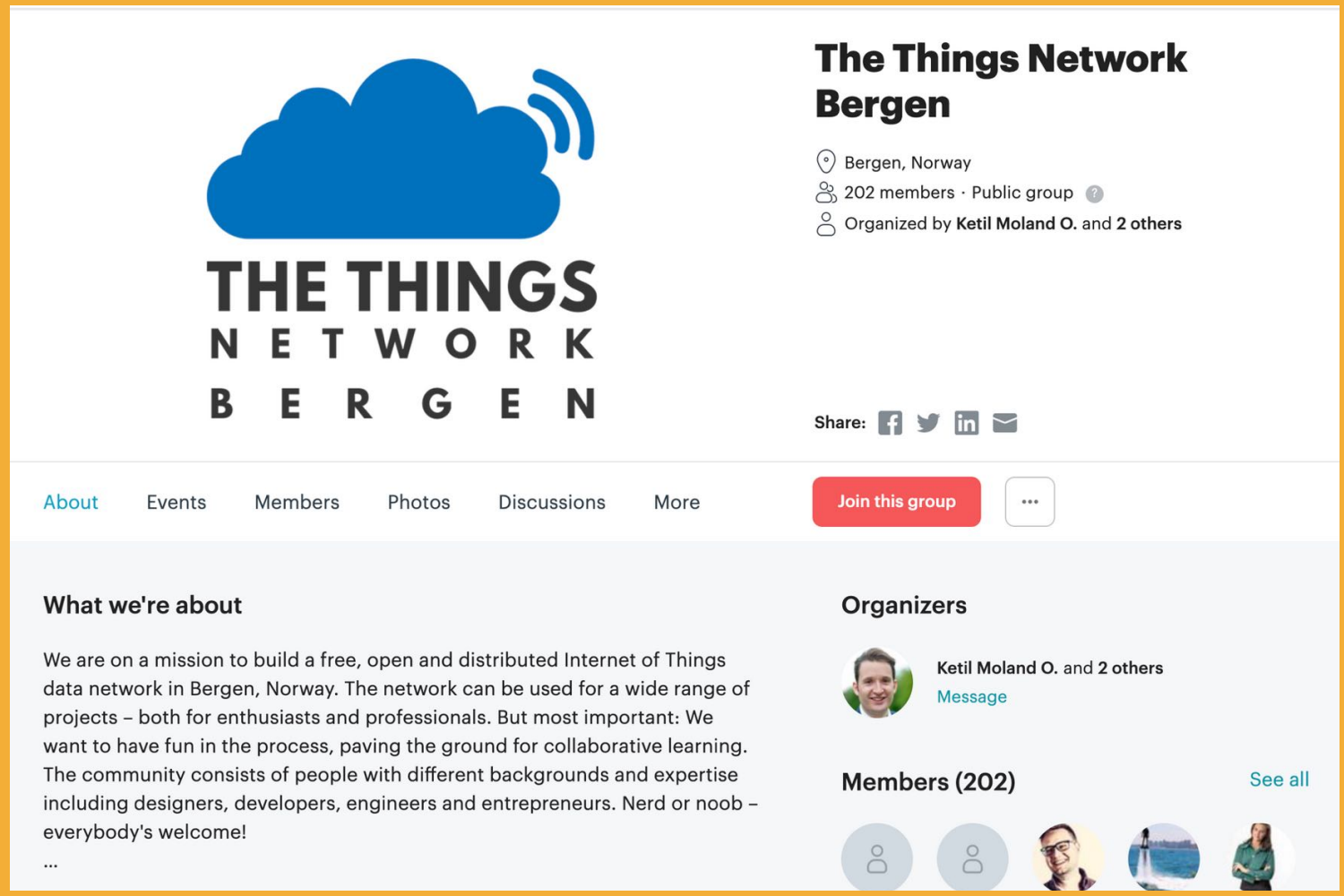
Connect the antenna!

Newer power up the board without the antenna connected!

You might accidentally fry the LoRa chip, also known as concentrator.

Meetup group

https://bit.ly/3JAvkQH

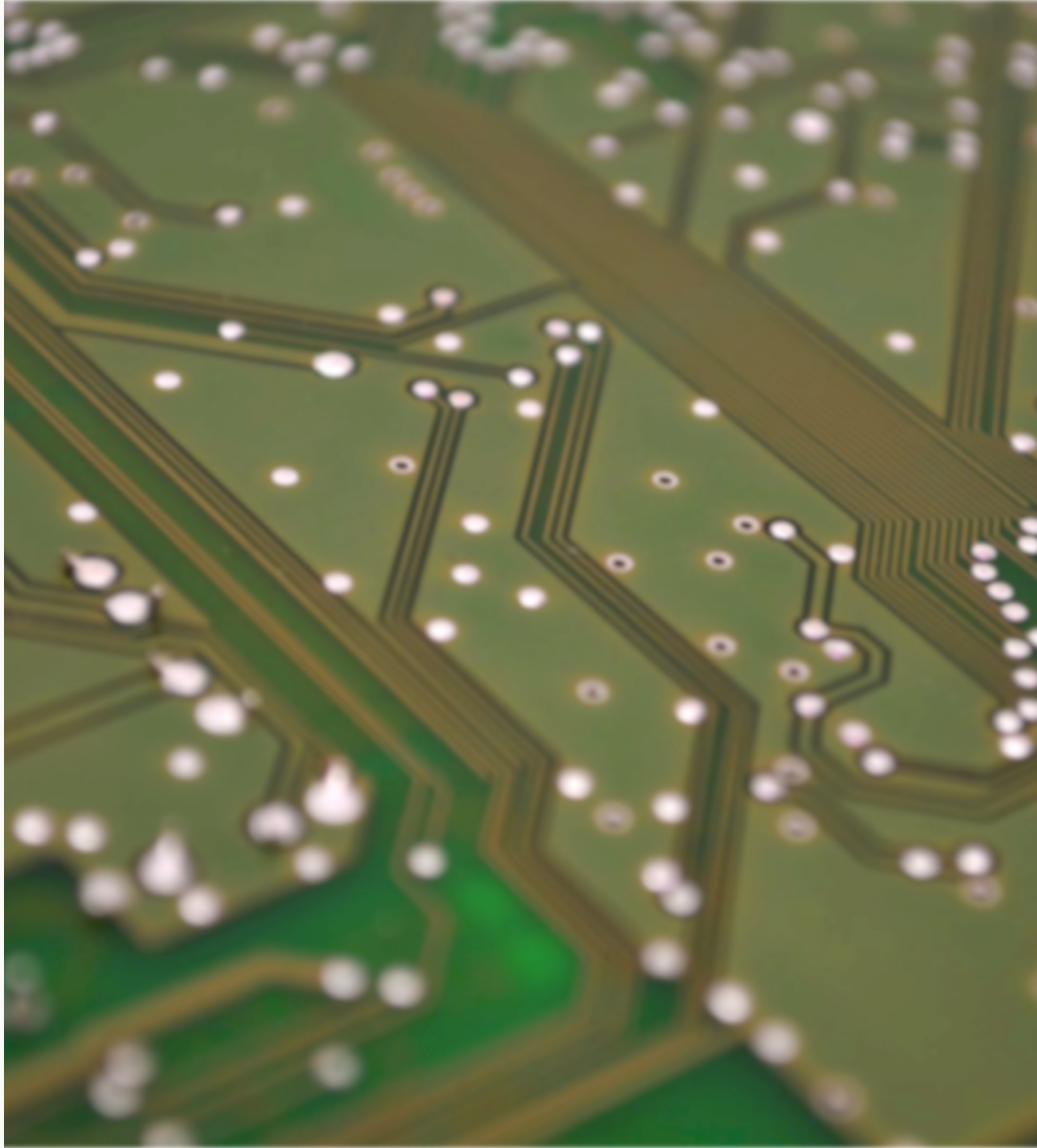


Slack channel

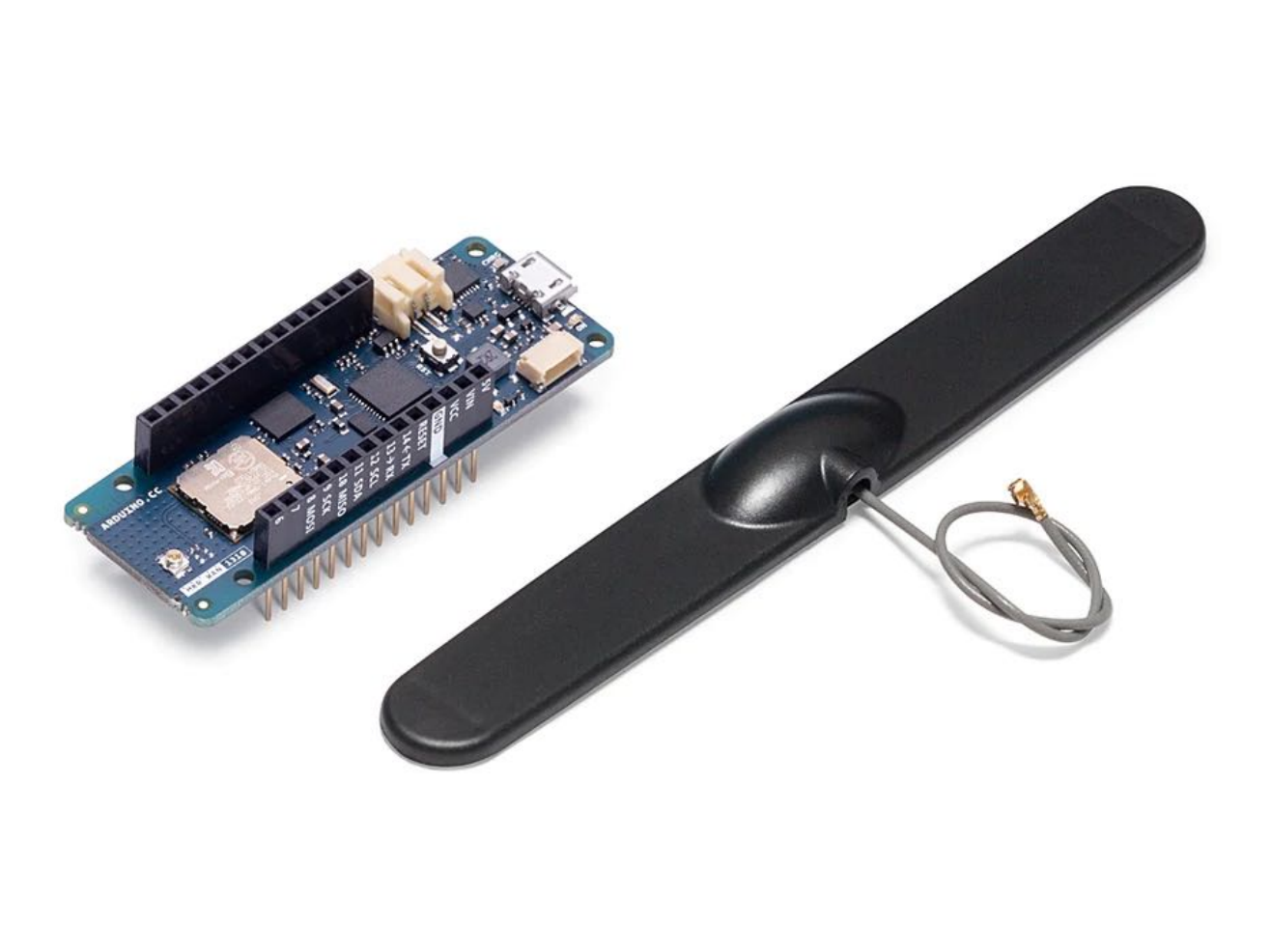
https://bit.ly/3upm4bp

Then, /join #boosterconf2022

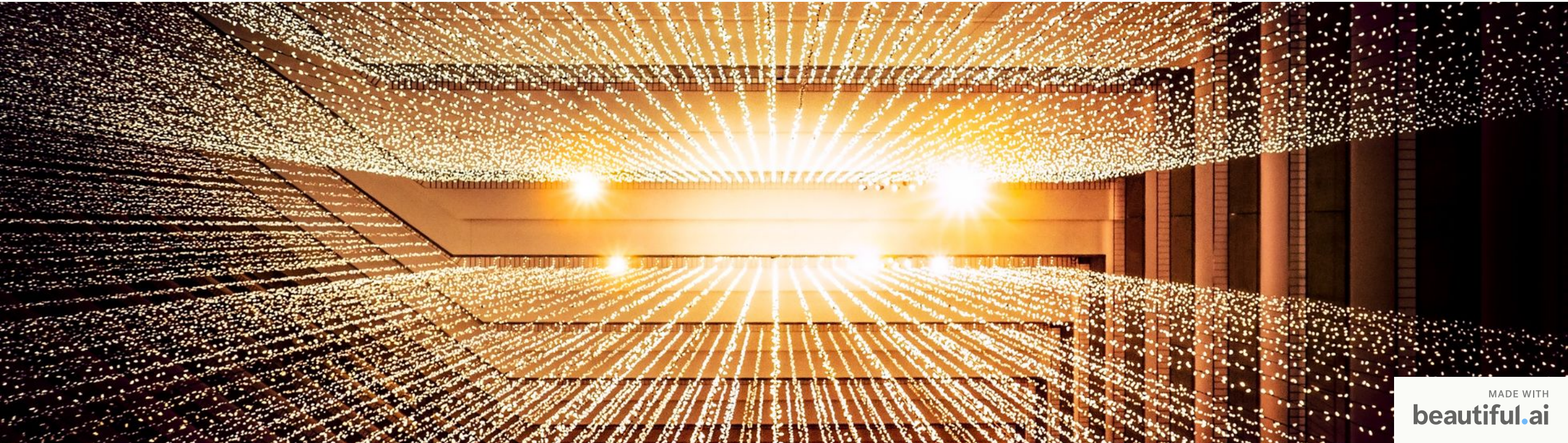
Let's get to the candy!

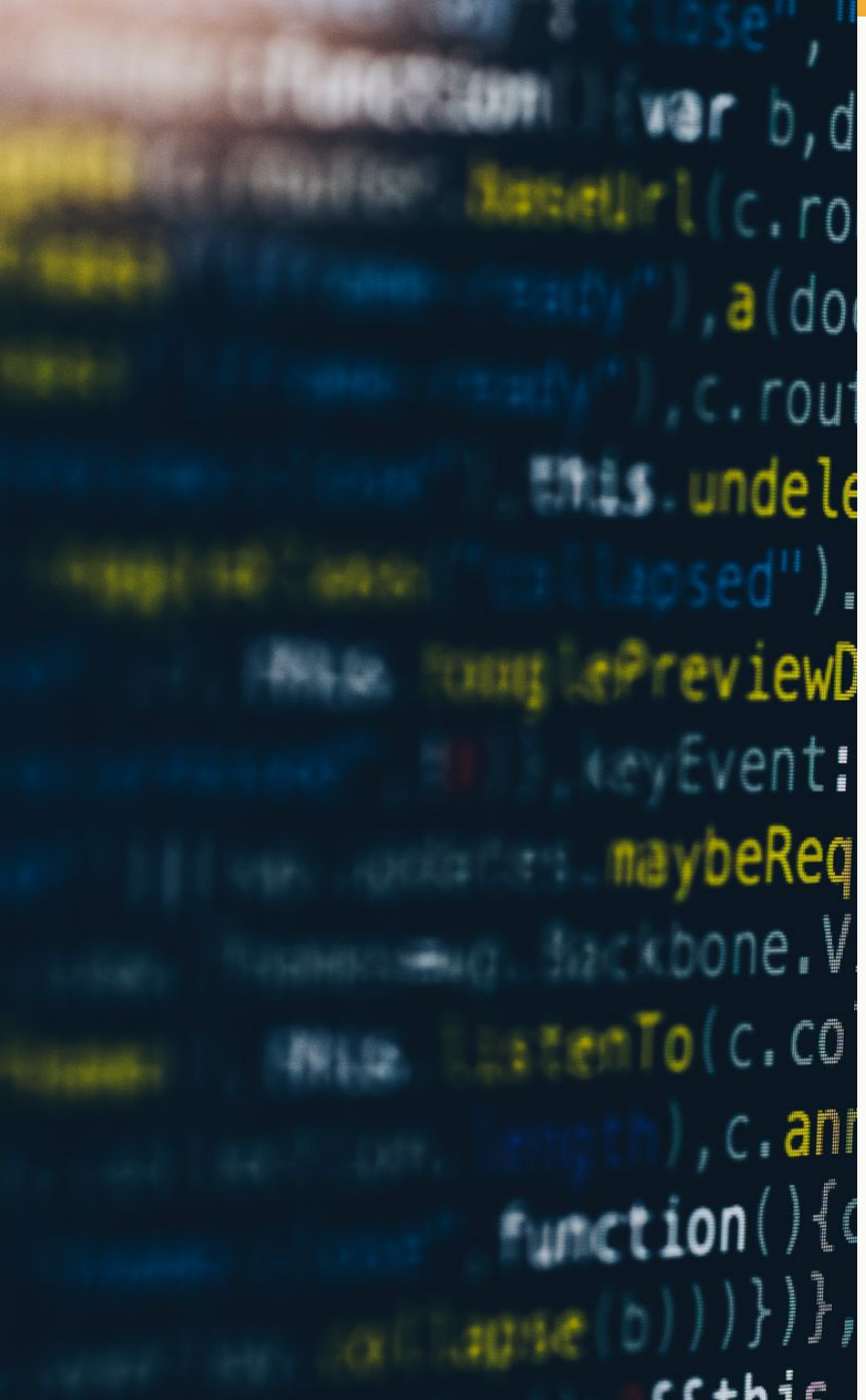


MKR WAN 1310



Programming the Arduino





agenda

1. Controller setup
2. HelLoRa WAN!
3. Real world example
4. Exploring on your own

Caution!

Don't power on the Arduino

before the antenna has been connected!

- ## Connecting the Arduino

  We connect the antenna and laptop.

- ## Arduino IDE

  We get familiar with Arduino IDE and install the necessary drivers.

- ## HelLoRa Wan!

  Let's write a sample program and send it to The Things Network.

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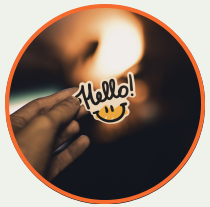


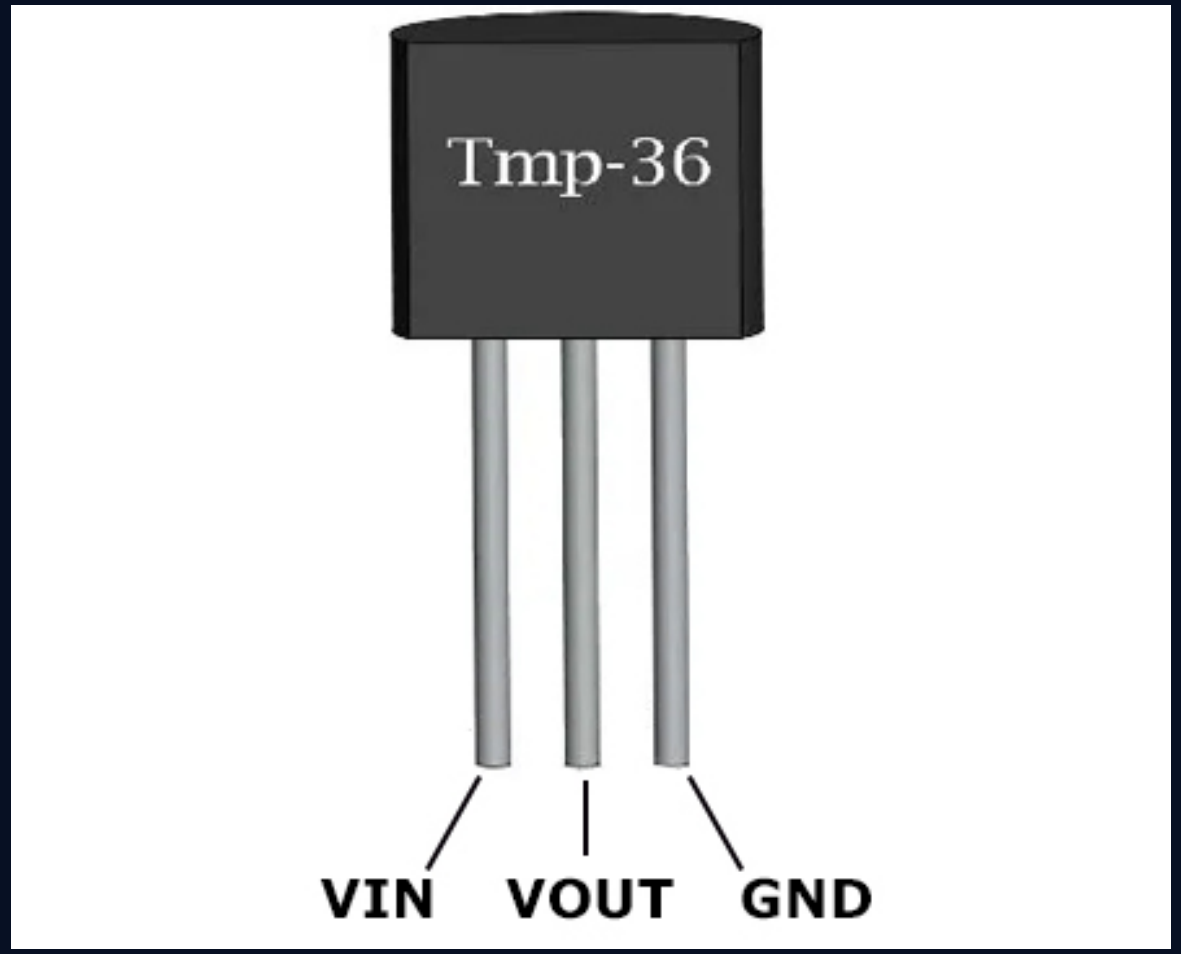
HelLoRa Wan!

Wire up the sensor

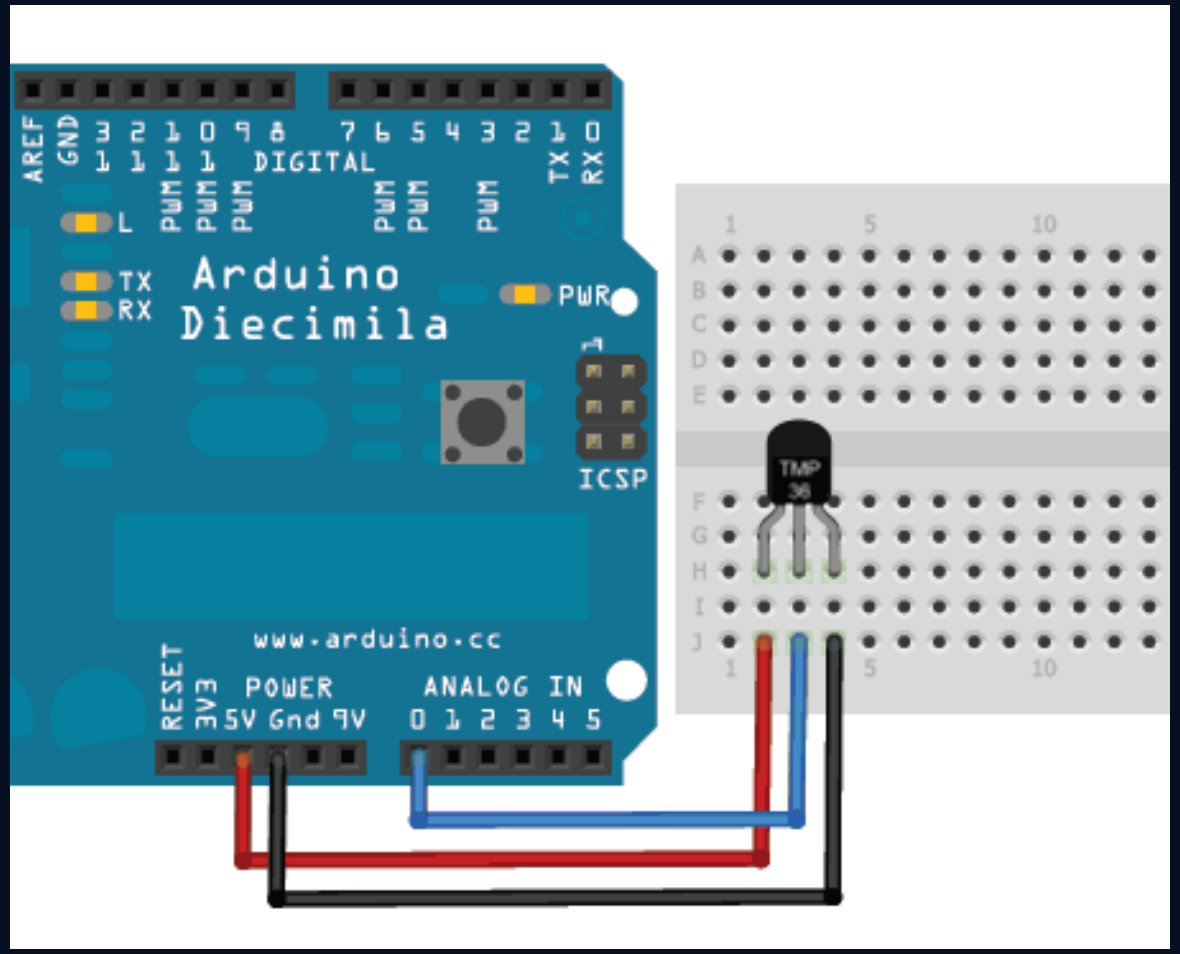
Extend our program to read the temperature and send it to TTN

Make sense of our data with a Payload Formatter

1



Sensor pins



Connecting the sensor

Calculating the temperature

- As temperature increases the voltage increases
- Reading is proportional with voltage
- Analog reading is a value between 0-1024
- Convert the reading to millivolts: `reading * (5000 / 1024)`
- Convert millivolts to degrees Celcius: `(voltage - 500) / 10`

Payload Formatters

- Lets you convert and format your data server-side
- Supports JavaScript
- Works for both uplink and downlink (we will use uplink here)

Further exploring

- Extract the data from TTN with MQTT (or other integrations)
- Build a dashboard with your data
- Send more data from the Arduino
- Create payload formatters to organize your data

Useful documentation

- LoRa Wan modem: https://www.arduino.cc/en/Reference/MKRWAN
- Payload Formatters: https://www.thethingsindustries.com/docs/integrations/payload-formatters/
- The Things Network MQTT Server: https://www.thethingsindustries.com/docs/integrations/mqtt/