LoRa Mesh Lab

Workshop on Communication in Extreme Environments for Science and Sustainable Development
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IT UNIVERSITY OF COPENHAGEN

… and often with the

NSRC
Network Startup Resource Center

LoRa Mesh Lab

Quick intro to LoRa mesh & Meshtastic (max. 20 minutes)

Only the absolute basics – we rather focus on:

Hands-on: Build a local mesh and test it in and around ICTP

(1 hour today, more tomorrow)

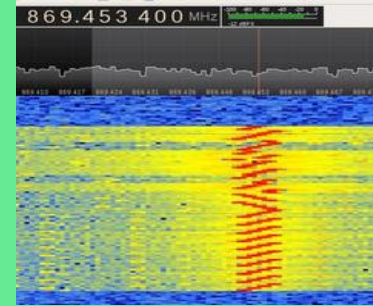And re-visit in-depth questions along the way,

LoRa Mesh Lab

LoRa – Layer 1 (physical layer) network technology
      Chirp Spread Spectrum (CSS)
      & extension LR-FHSS
      (frequency hopping – satellites!)

LoRaWAN – Layer 2 (MAC layer) network standard

Not limited to, but often on license-exempt / ISM frequencies
     EU433 MHz, EU863-870 MHz, US902-928, … 2.4 GHz

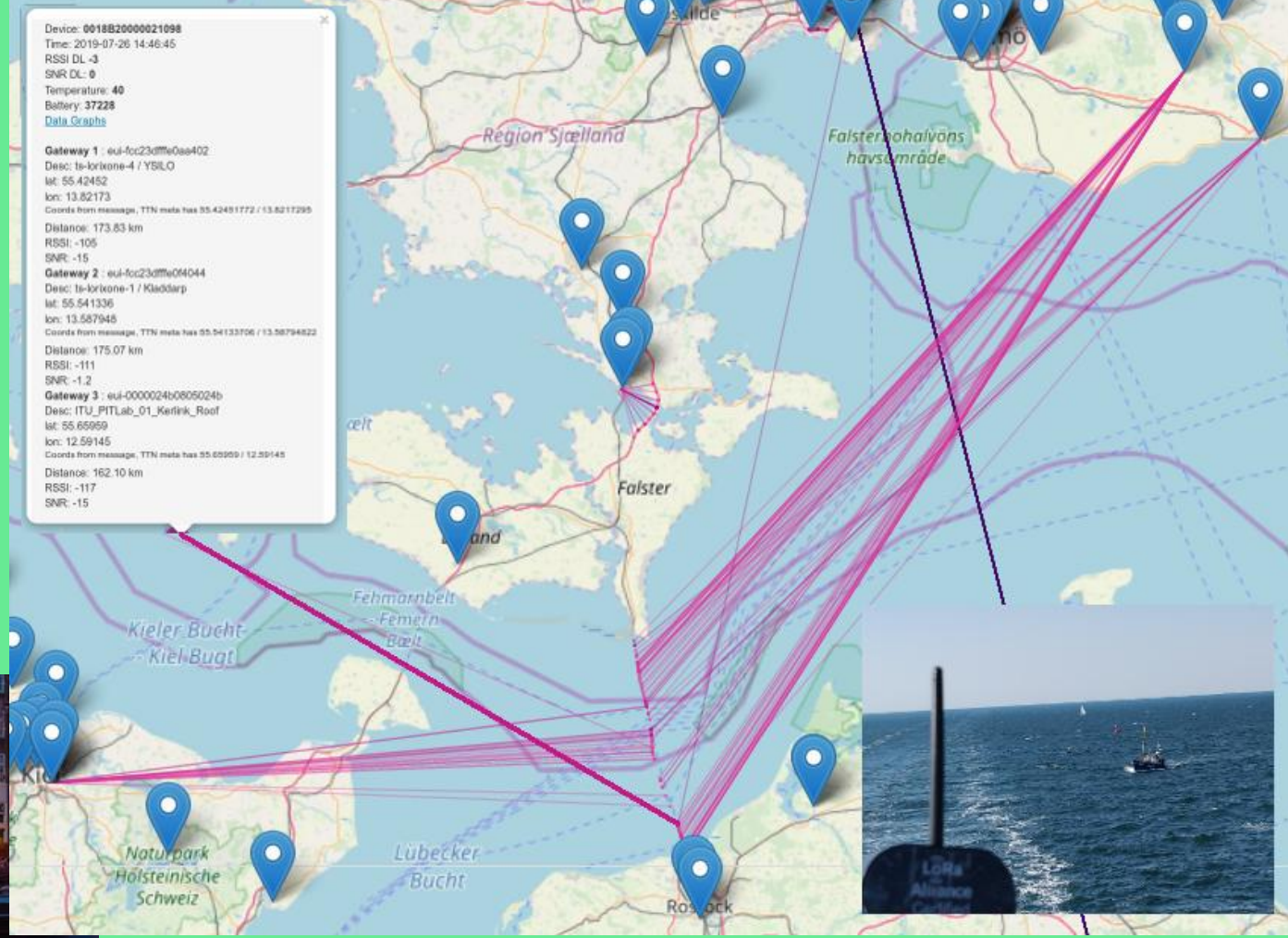**ITU: 6 years LoRa on EU868 in Research, Education and Deployments**

LoRa Mesh has been tried various times over the last years:
PyMesh, LoRaMesh, etc

LoRa
at ITU.dk

**50- 100 km
every day,**

**200 km
on good days**

Device: 0018B20000021098
Time: 2019-07-26 14:46:45
RSSI DL -3
SNR DL: 0
Temperature: 40
Battery: 37228
Data Graphs

Gateway 1 : eui-fcc23dfffe0aa402
Desc: ts-lorixone-4 / YSILO
lat: 55.42452
lon: 13.82173
Coords from message, TTN meta has 55.42451772 / 13.8217295

Distance: 173.83 km
RSSI: -105
SNR: -15
Gateway 2 : eui-fcc23dfffe0f4044
Desc: ts-lorixone-1 / Kladdarp
lat: 55.541336
lon: 13.587948
Coords from message, TTN meta has 55.54133706 / 13.58794822

Distance: 175.07 km
RSSI: -111
SNR: -1.2
Gateway 3 : eui-0000024b0805024b
Desc: ITU_PITLab_01_Kerlink_Roof
lat: 55.65959
lon: 12.59145
Coords from message, TTN meta has 55.65959 / 12.59145

Distance: 162.10 km
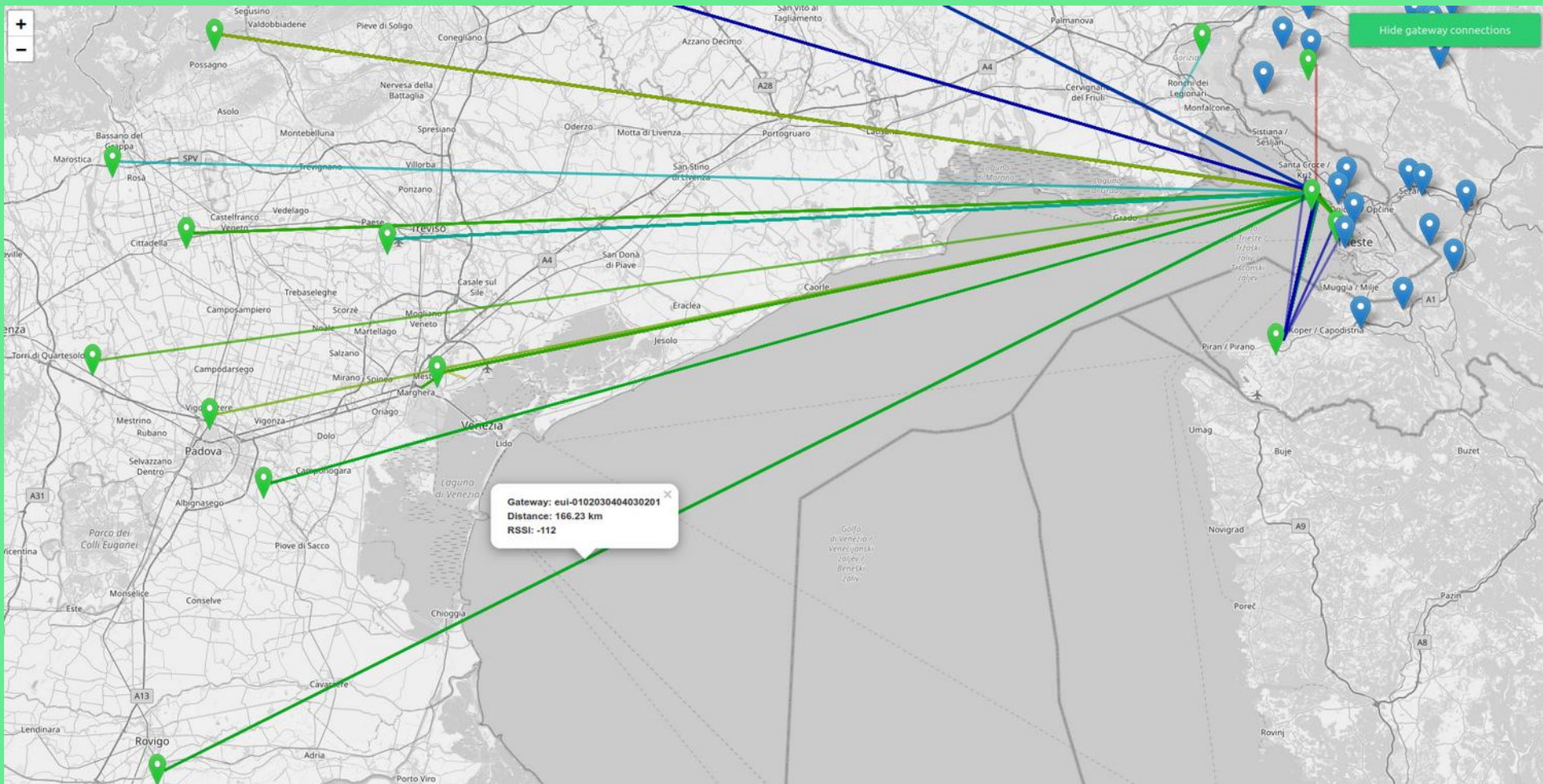RSSI: -117
SNR: -15

… and always happy to be back @ ICTP

(thank you, ICTP people!)

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Satellite LoRaWAN at ITU

3 years of satellite LoRa on EU868

with Lacuna.space

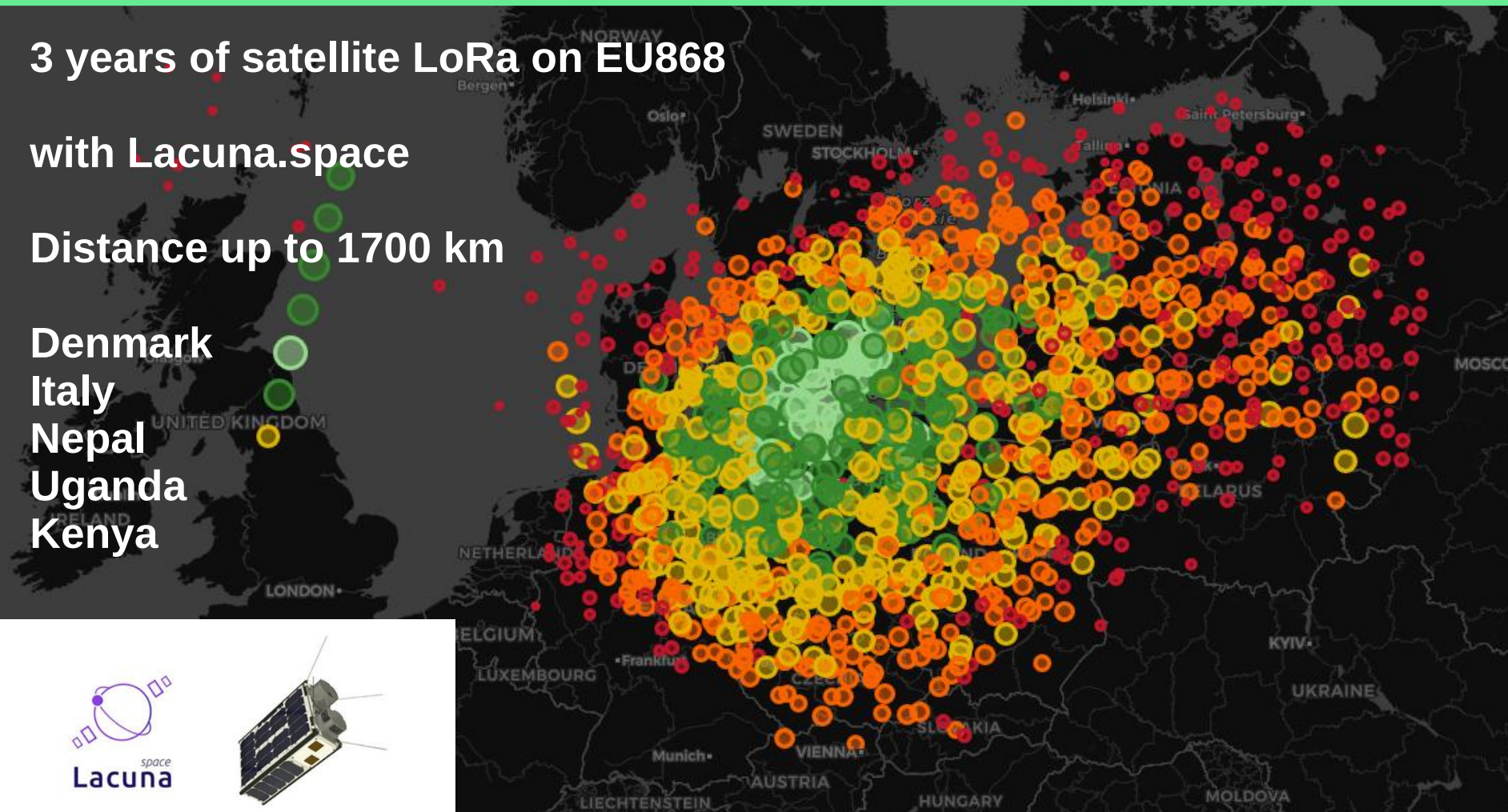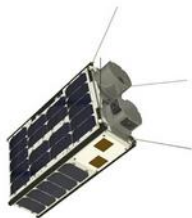**Distance up to 1700 km**

Denmark
Italy
Nepal
Uganda
Kenya

But now, just LoRa, no LoRaWAN, on earth

LoRa Mesh - general Idea & motivation:

Messaging without any central infrastructure – think:
SMS without mobile provider

In areas without communications infrastructure:

      Disaster situations

      Rapid response

      Autonomy

      Privacy

Some use cases

Any situation where communications infrastructure is absent

From this workshop:

Hybrid LoRa Network for Underserved Community Internet (LUCI)

LoRa out at sea?

You get messaging with location tracking

LoRa into high mountain valleys?

Long distance meshing around obstacles

And many more

Meshtastic – who and what is it?

"Meshtastic® is a project that enables you to use inexpensive LoRa radios as a long range off-grid communication platform in areas without existing or reliable communications infrastructure. This project is 100% community driven and open source!"

https://meshtastic.org

Some characteristics:

A number of different software components – device firmware, mobile apps, web API, python API, CLI, simulators, integrations, ..

Meshtastic – who and what is it?

"Meshtastic® is a project that enables you to use inexpensive LoRa radios as a long range off-grid communication platform in areas without existing or reliable communications infrastructure. This project is 100% community driven and open source!"

The initial developers are IT professionals with an evening hobby :)

Active development community

<u>Well-documented</u> and communicated:

https://meshtastic.org

+ Discord + Discourse + ….

Meshtastic – how it works

Mobile phone talks to

LoRa node

via Bluetooth

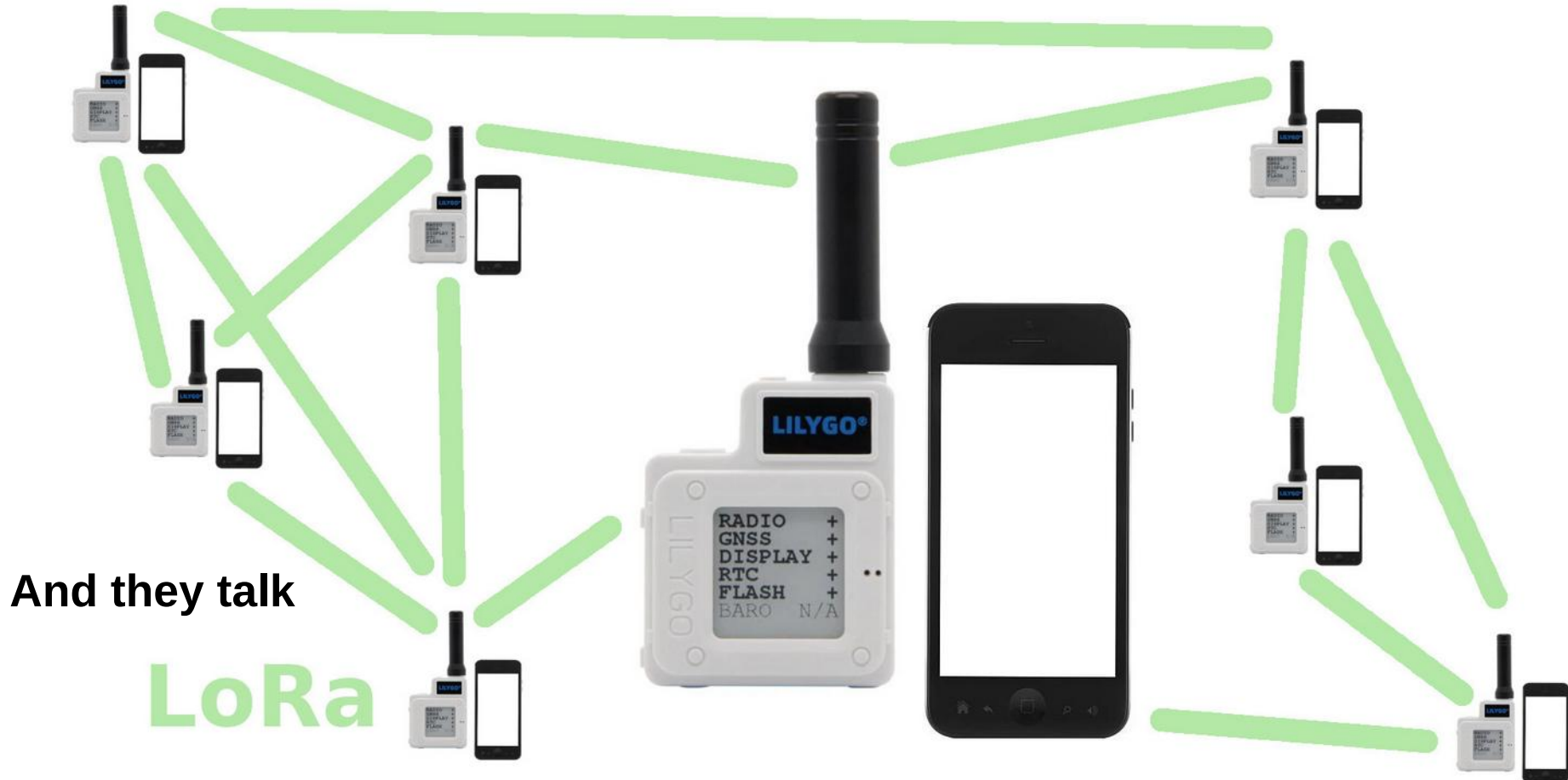There are other ways
to connect to the node:

Serial ------------------------->

Web interface --------------->

Meshtastic – how it works

Then we add many users ...

Meshtastic – how it works

And they talk

LoRa

Meshtastic – how it works

You can have headless nodes …………………..& Internet

* Internet uplinks enable full integration with anything that can talk MQTT

Meshtastic – Mesh routing

Passive mesh routing - "Naive broadcast flooding":
The initial node sends out a message. The receiving node re-broadcasts anything that
- has not hit the maximum re-broadcast count yet
- it has not heard before

Details: https://meshtastic.org/docs/overview/mesh-algo
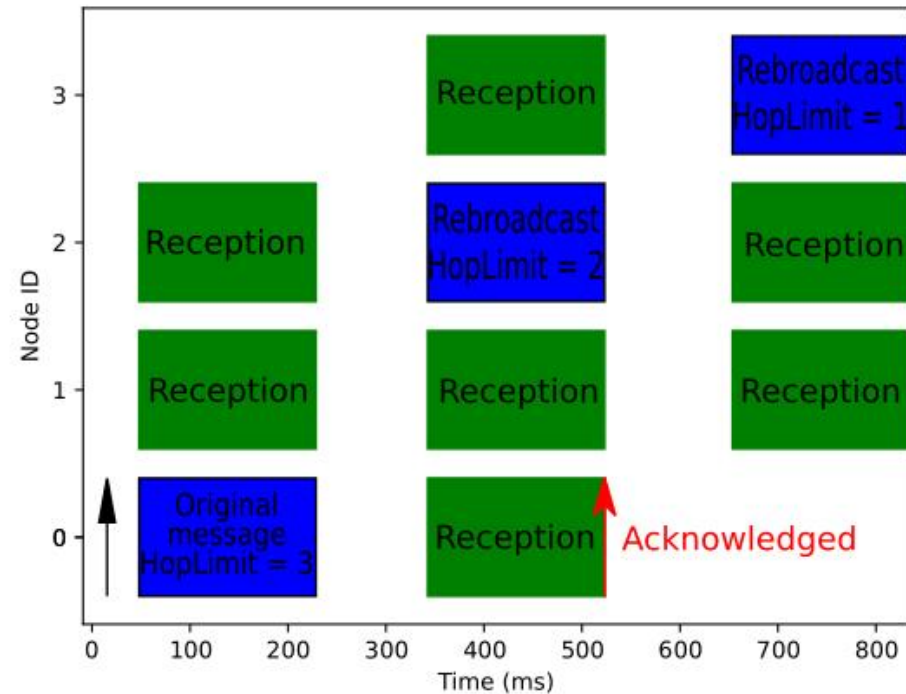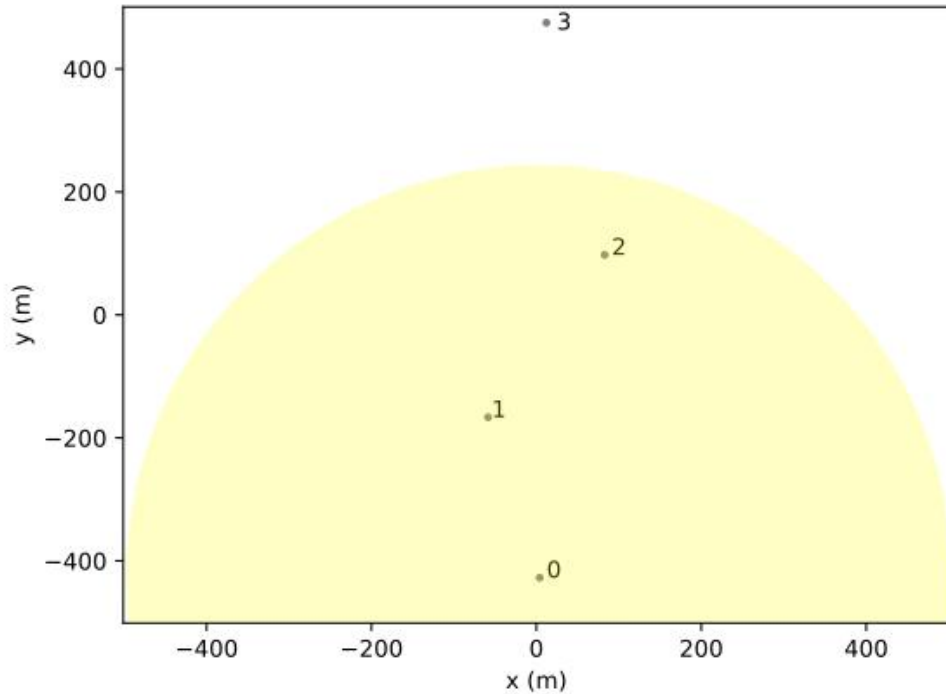
Meshtastic – Mesh routing

Passive mesh routing - "Naive broadcast flooding":

The algorithm favors weak signals, in order to make sure that messages from far away get re-broadcasted.

Message sent with Max Hops = 3

3 2 1

Message received with Hop Count = 0 and will not rebroadcast

Details: https://meshtastic.org/docs/overview/mesh-algo

Meshtastic – Hardware

ESP32 based: T-Beam ($30)

nRF52 based: T-Echo ($50)

**There is more, from about $20 -
https://meshtastic.org/docs/hardware**

Meshtastic – website has all info you need
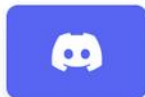
Meshtastic – limitations

Distance: it depends :) *… current record is 254 km

* on all the things that "normal" LoRa transmissions depend on: power, antennas(!), locations, …

Number of nodes in one mesh network: limited to 80

What it is NOT:

It is not "Connecting the Unconnected".
It is not broadband access, but of course can relay data form the internet to the users.
It is not closing any "digital gap".

It is also not a finished product or standard. It is under development.

Let us get started

We have

12 x Lilygo T-ECHO (easiest) (firmware already updated)

And some

Lilygo T-BEAM (more difficult – no screen – experts pls grab those!)

We need

The Meshtastic mobile app   →

(find it in the Play Store, or via https://f-droid.org/)
– **install it now!**

Also for iPhone

Naming our devices

We each will have a long name -

please make your long name

Owner + the 4-digit Hex ID – example:

SEBA E95C

and a short name -

Please make that a name that allows us to know who you are, like

SEBA

For T-Echo: keep this image ... you need it :)

Get it here:

So let s get it to work

And take a walk in the park?

Up to Galileo? Maybe this evening?

Step 0

Find your device ID (white sticker on the back of the T-ECHOs)

Always connect to that one device ONLY!

Else you are re-configuring your neighbour :)

ps.

All devices should have recent firmware (2.2.11 and up).
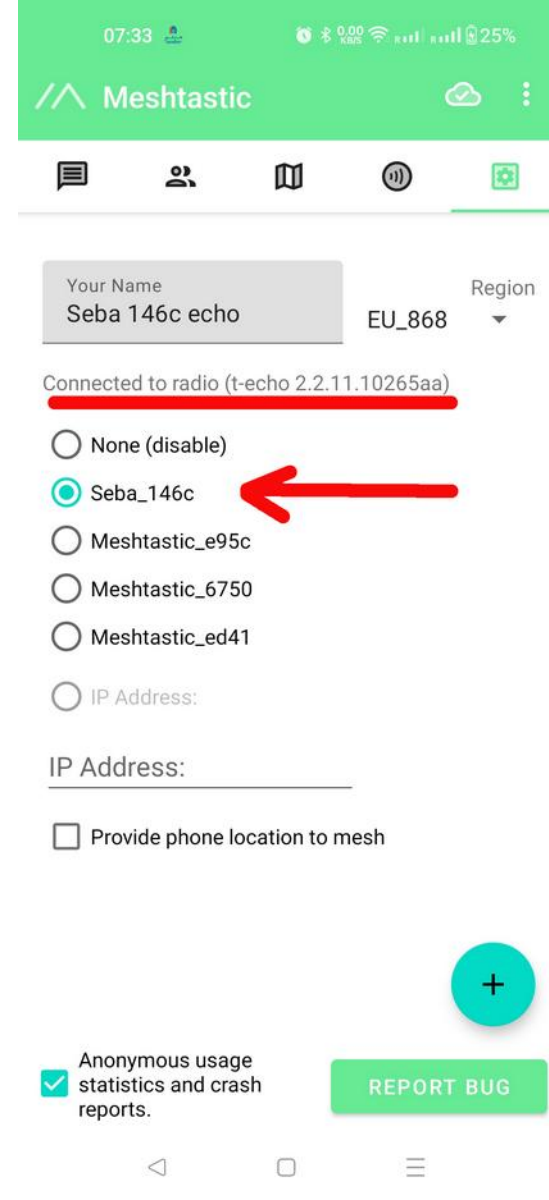If your device does not, you need to update**.**

Step 1

Bluetooth connect to that device

You might need to find it in your
Phone's Bluetooth list first
and pair with it

Watch out for pairing pin codes needed!

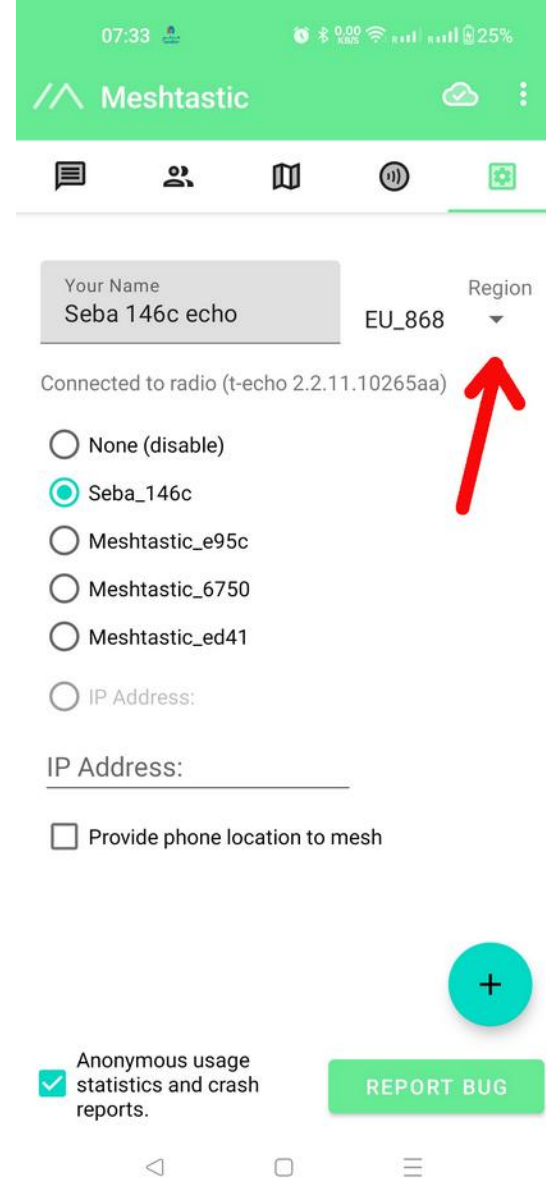**Watch for the line that says**

Connected to radio ….

Step 2

Choose a region/frequency

We use

EU_868

Step 3

Channels:

Adding

Sharing

Joining

The terms might be confusing:

Add   = add a new channel yourself

Scan   = join a channel
            you are being invited to

Send   = save to device

Step 3

We invite you right now – to channel

"extreme" →

Channels
have settings that we can discuss later →

Step 3

Settings that we can discuss later:

Channels can be optimized for various
Ranges and speeds -

These are presets for LoRa
Bandwidth, Spread Factor, and Coding Rate
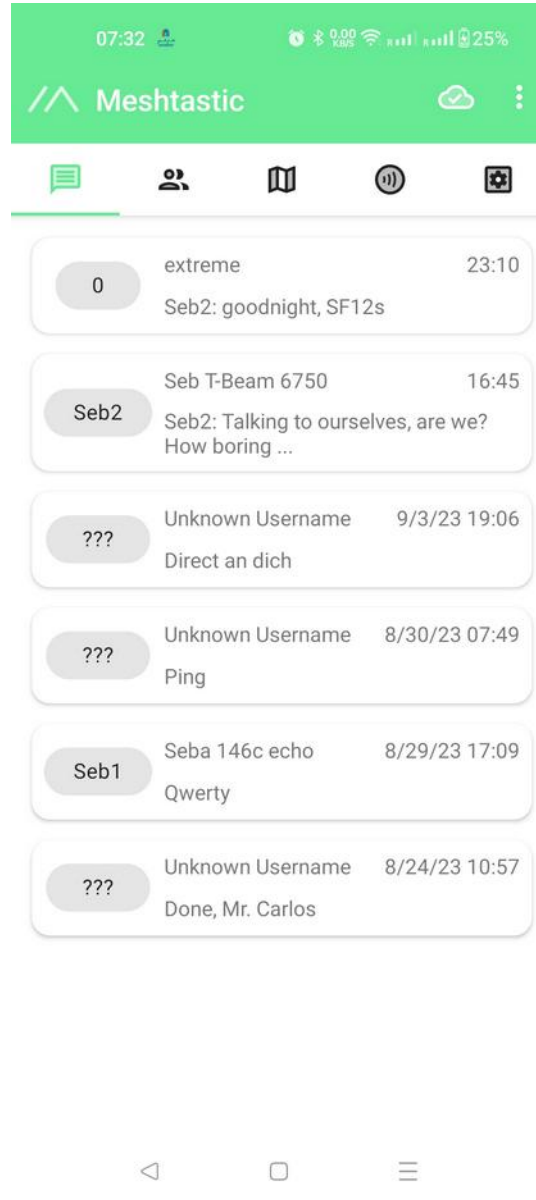
Default is *Long Range Fast*

Step 4

**Channels,
Chats,
Messages**

Here you can see

**Your channels
And direct chats**

Step 5

Inside a Channel

When you have found this

Please say hi!

And who you are!
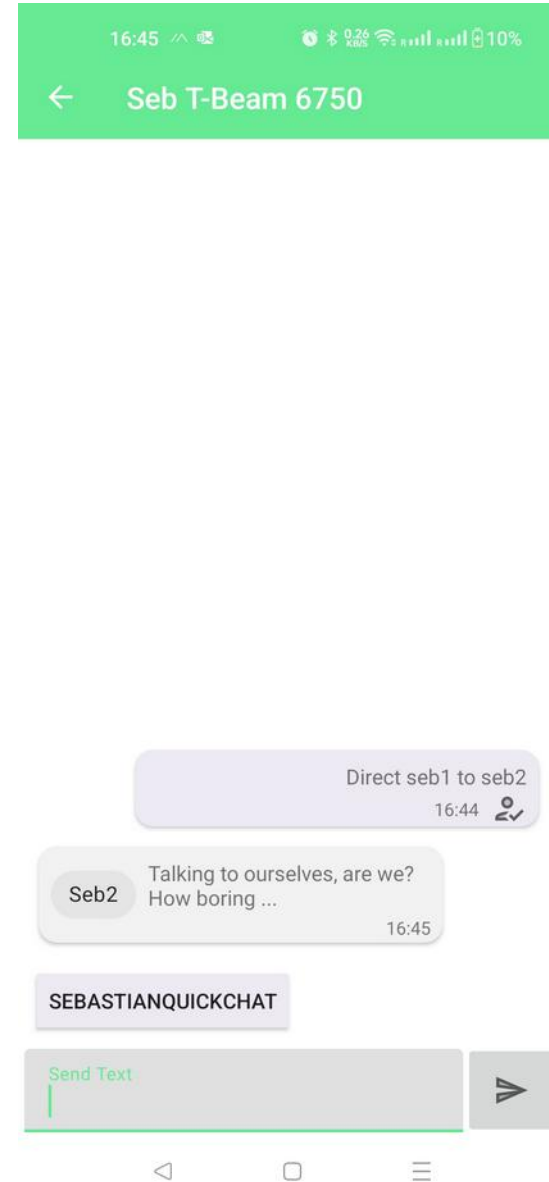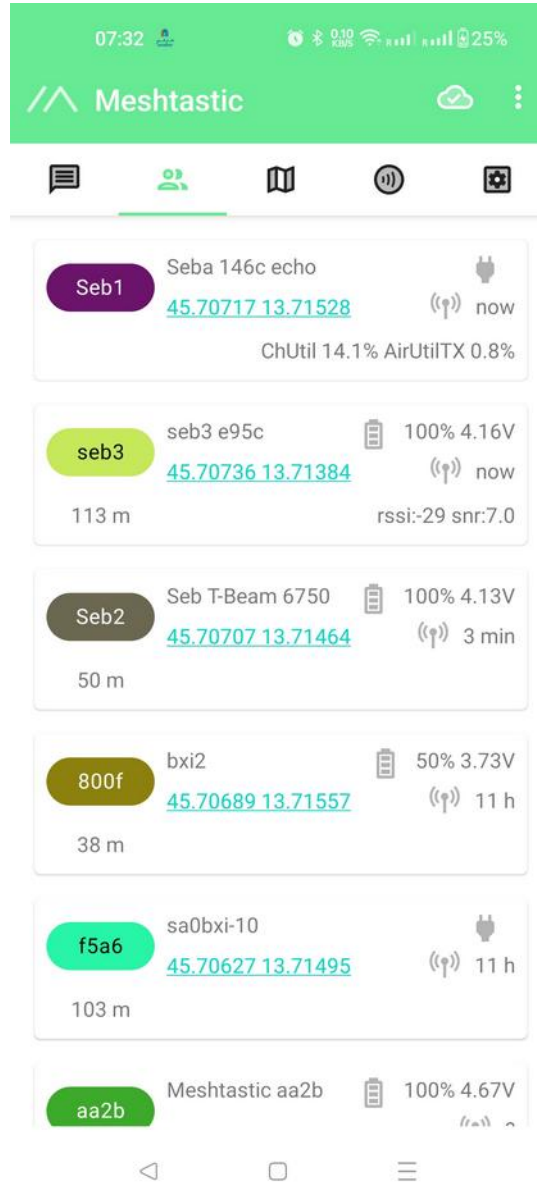
Step 6

Peers

With info on

Location,
Power,
Last Seeen

&

Direct messages

Step 7

Map view

Things we could talk more about

Internet integration – MQTT - Telegram integration

Configuration details

Use cases

Satellites and drones and mesh

Stay in touch via telegram group https://t.me/+CUPBrSbva-RiNTU0

or via email

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