Mesh networks over LoRa

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Who am I

- `https://f.erethon.com/mesh2023.pdf`
- dgrig/Erethon
- Infrastructure / Automation / Security / Tinkering
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We're gonna speedrun over these topics

- Mesh networks
- LoRa and modulation schemes
- LoRa over "cheap" ESP32 based boards
- Software to create mesh networks over LoRa
  - Meshtastic
  - Reticulum

Mesh Networks
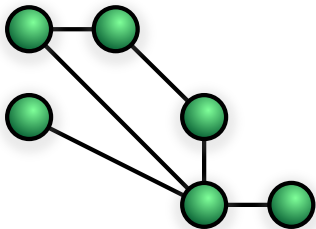
Mesh Networks

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- Internet of Things depends on meshing

LoRa

LoRa (Long Range)

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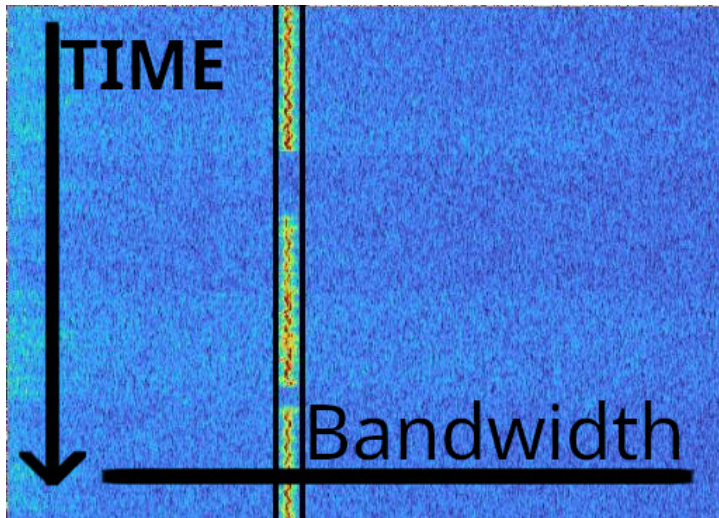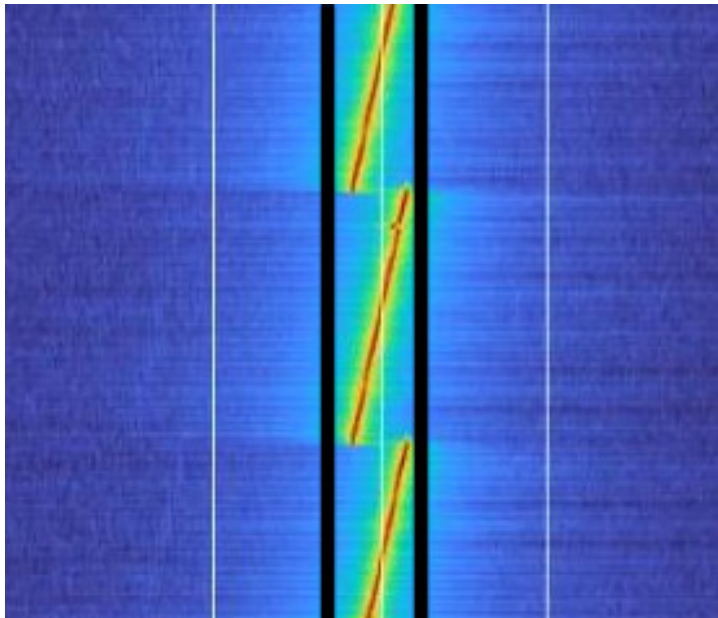- These two together define the low power wide area network (LPWAN) LoRa

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- Legislation is a bit weird (power, duty cycle)

Video

Video

How to transmit/receive LoRa

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- SDR (Software Defined Radio)!

LoRa Boards
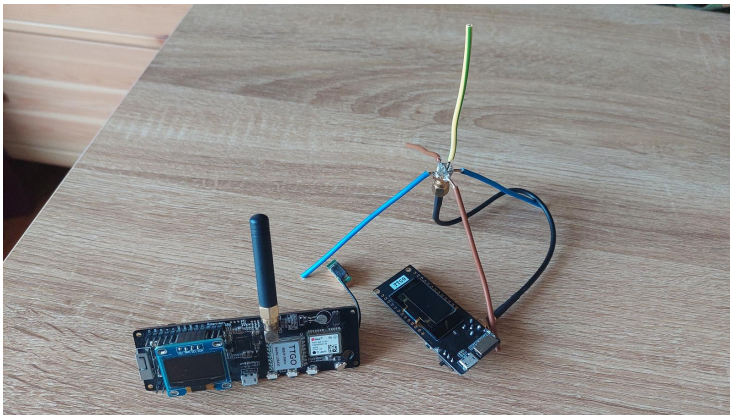
Mesh networks over LoRa

LoRa Boards

Meshtastic

An open source, off-grid, decentralized, mesh network built to run on affordable, low-power devices

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- Firmware
- Apps that consume these ProtoBuff definitions
  - Mobile applications
  - Python CLI
  - Web

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- Single "channel" for all devices in a mesh
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  - Chat room with all participants
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- Longest range contact 254km!

Meshtastic

- Networks
  - Canadian Network
  - Austin Mesh
- Map of nodes (1540 entries)
- Simple routing protocol, 3 hops by default
- GitHub & Discord

Meshtastic
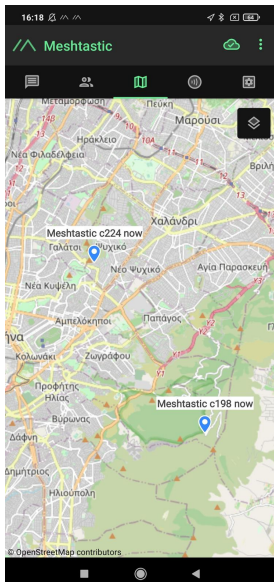
Meshtastic

Reticulum
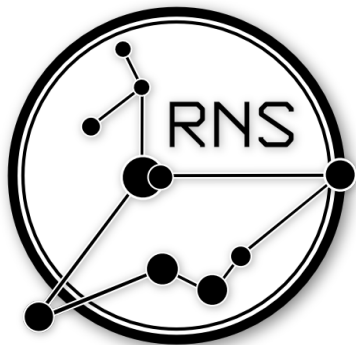
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- MIT Licensed

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- It's not based on TCP/IP, it's using its own lower-bw protocol. Lightweight Extensible Message Format (LXMF) based on msgpack
- Docs are amazing

Reticulum software

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- Mesh with nodes that have no line of sight
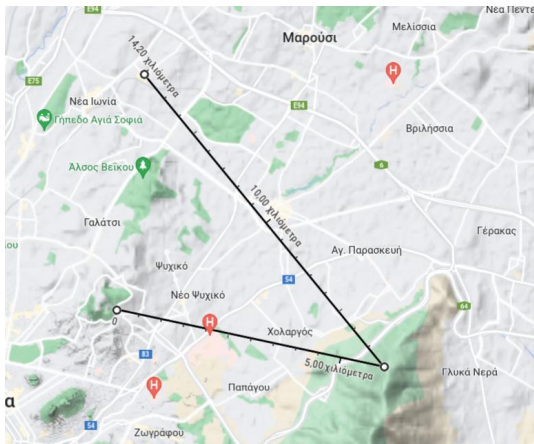
Reticulum software

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- tncattach, allows one to attach KISS TNC devices as network interfaces

Reticulum Community

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- There's also a Public Testnet over TCP/IP and I2P for running experiments

Contribute!

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- ProtoBuffs make it easy to update the protocol and extend it, also porting to new devices

Other meshes over LoRa?

- Ripple

Questions?

- Feel free to ask me in the corridor sessions ;)

Links

- https://unsigned.io/
  understanding-lora-parameters/
- https://wirelesspi.com/
  understanding-lora-phy-long-range-phys
- https:
  //github.com/GUVWAF/Meshtasticator
- https://meshtastic.org/

Links

- https://reticulum.network/
- https://github.com/markqvist/RNode_Firmware
- https://github.com/markqvist/tncattach

Bonus Slides

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Notable mesh networks

- AWMN
- Freifunk (~1750 routers, ~4k clients)
- guifi.net (~38k nodes)
- AREDNet (~7k nodes)

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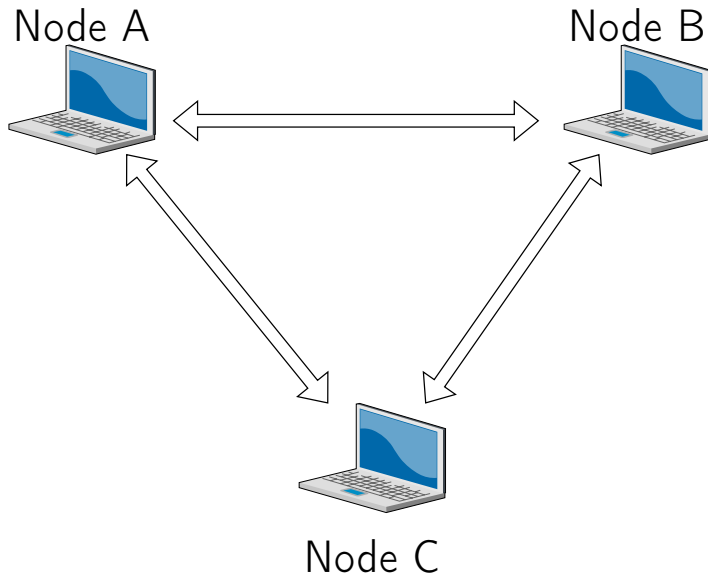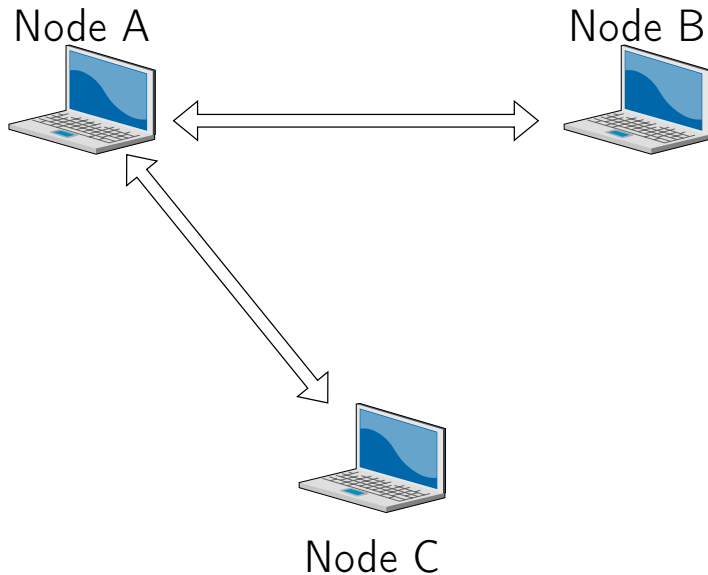 ○ Power hungry as well

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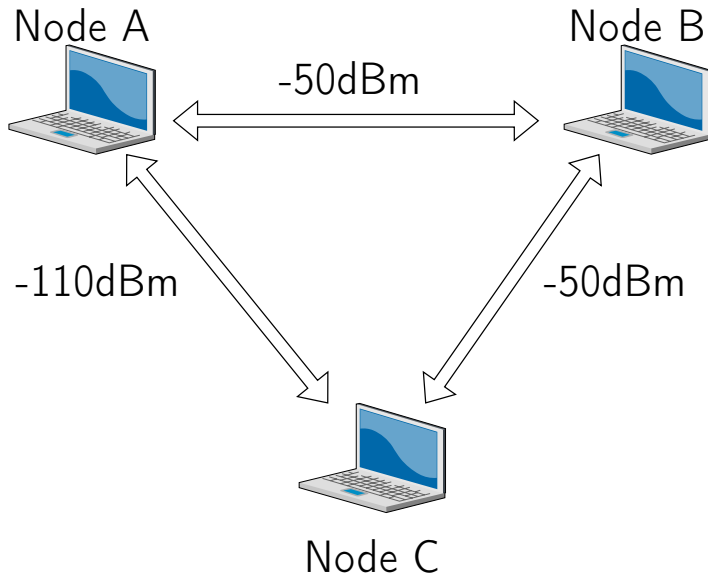
- Nodes might not be stationary

Routing loops and other issues

Node A

Node B

Node C

Routing loops and other issues

Node A

Node B

Node C

Routing loops and other issues

Node A

Node B

-50dBm

-110dBm

-50dBm

Node C

Routing on Mesh networks

- Routing schemes:
  - DVR (Distance (hops) Vector Routing)
  - DSDV (Destination Sequenced Distance-Vector Routing)
  - DSR (Dynamic Source Routing)