LoRa Radio

Long Range

Low Power

MeshTastic Data Communication Part I

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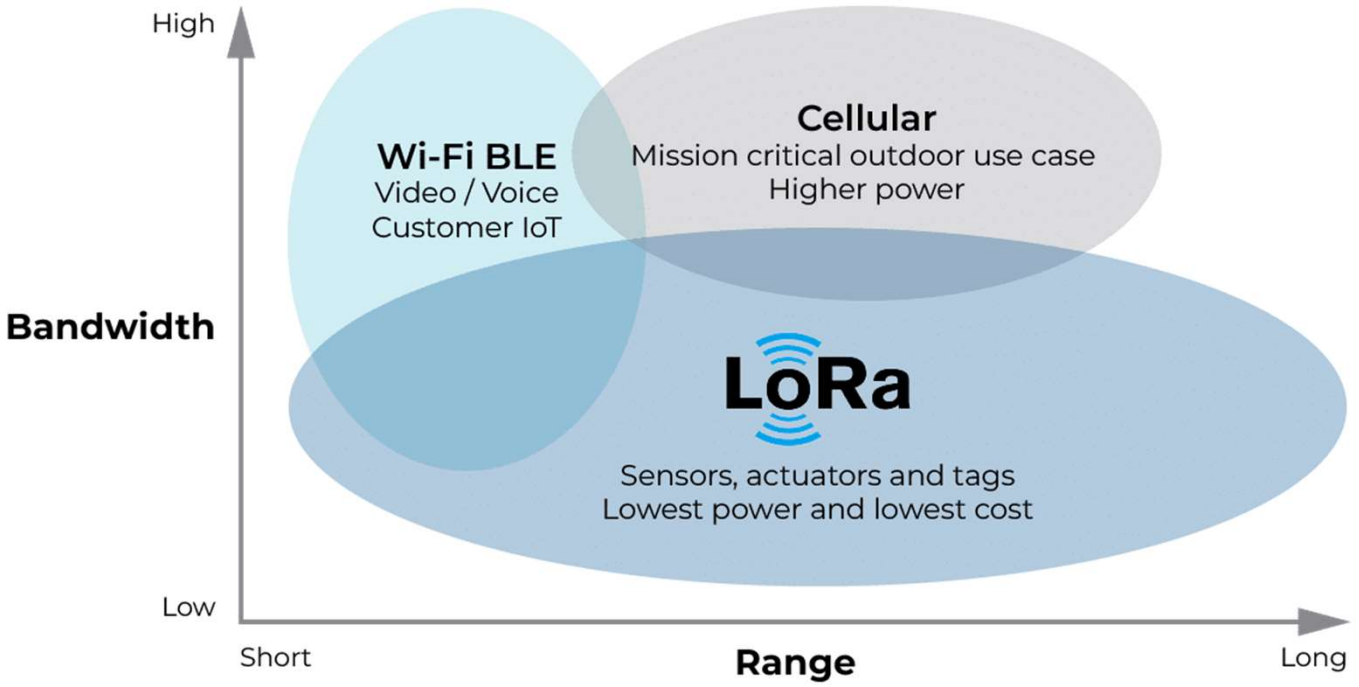
LoRa = Long Range



Long Range

- **Urban areas**: LoRa can reach up to 3 miles (4.8 km)
- **Rural areas**: LoRa can reach up to 10 miles (16 km) or more
- **Ideal conditions**: LoRa can reach up to 15 km
- **World record**: LoRa can reach up to 832 km (517 miles)

Long battery life – 1 Week to 1 Year

- Low Power: 30 dBm Max
  - 20dBm is typical ~ 100 mW

- The system “sleeps”, leaving only the LoRa Radio on
  - Draws less than 10mw in receive mode.
  - Wakes up the CPU when it receives a message
    - Processes the message
    - May relay message to next hop

Long battery life – 1 Week to 1 Year

- The system also wakes up periodically to send telemetry

- Modular builds and optional feature are only used as needed.
  - Wi-Fi / Bluetooth / Display

Band Information

- 915 MHz band in United States (open to public use)
  - Channels: 64 – Half Duplex
- Typical channel width is 125k
- Typical Data-Rate 980 bps – 21.9 kbps

- 915 MHz in primarily line of site. A good antenna, and clear line of sight is more important than radio power.

Applications

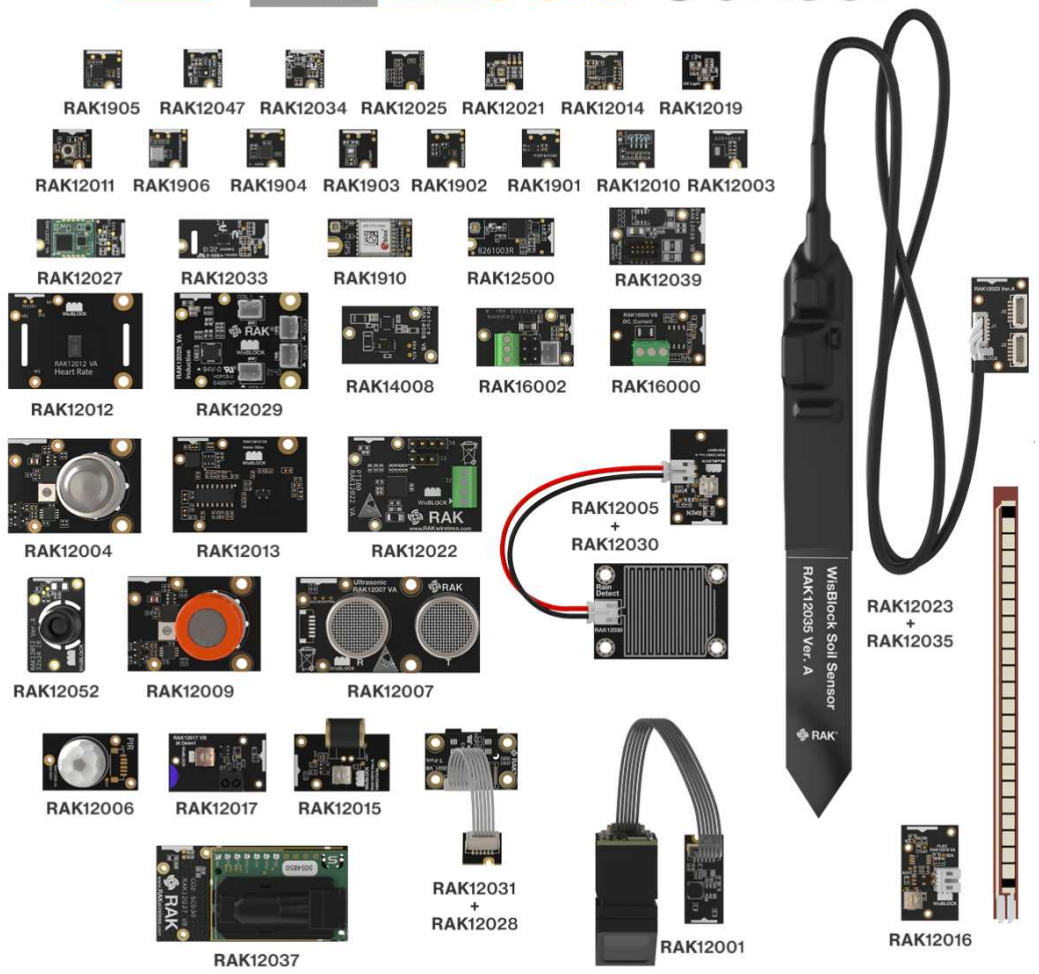
- LoRa was designed to provide inexpensive radio transmission of remote sensor data for agriculture.

- Remote control
  - Lights, pumps, etc.
  - Home automation
  - DYI Projects: LoRa Radio integrations with Arduinos

Applications

- Add a display, Bluetooth, and a display and. . .
  - GPS Tracking and Messaging
    - Hunting, hiking, camping parties, etc.
  - Meshtastic
    - A mesh network for text messaging

WisBLOCK Sensor

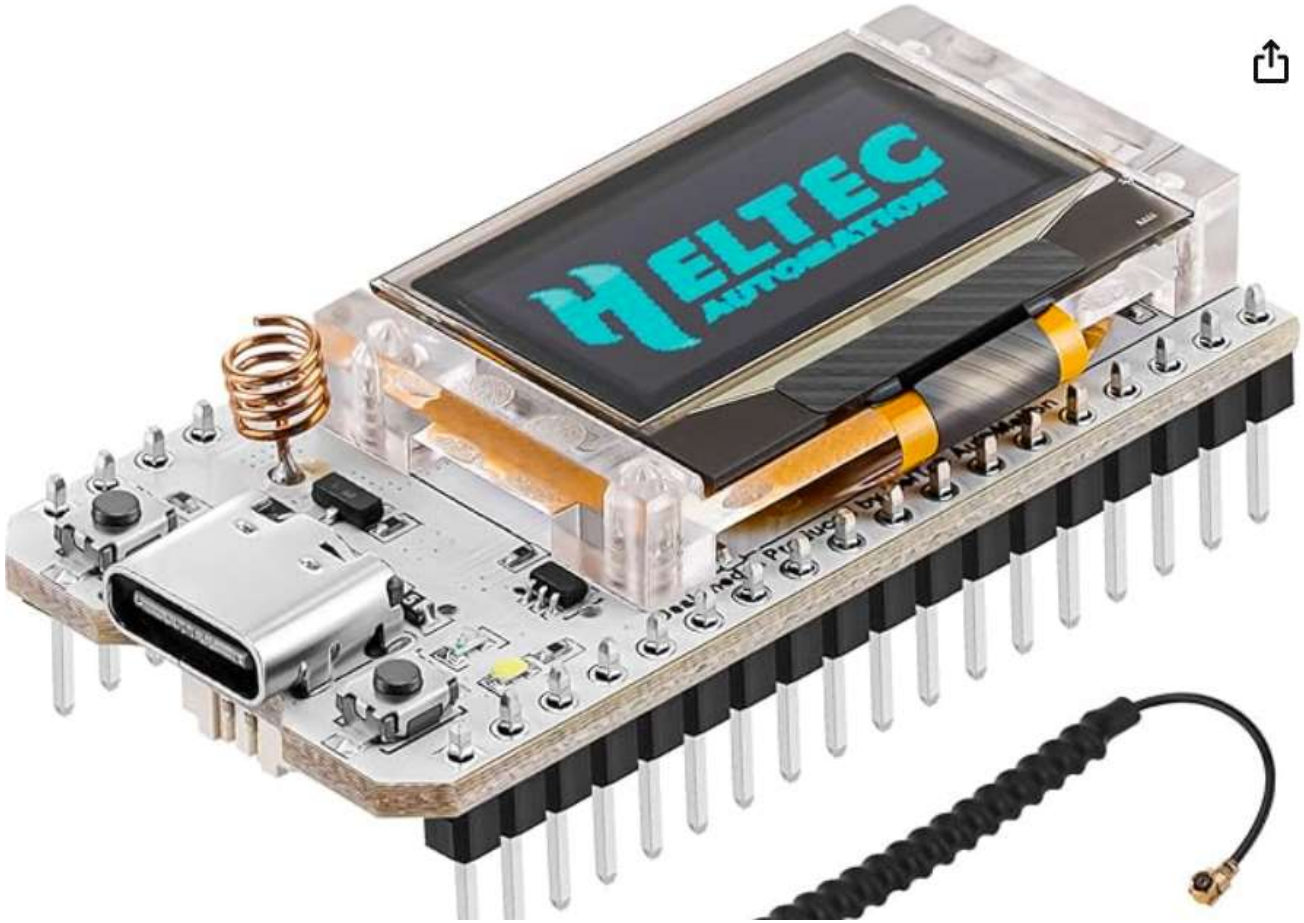


Some WisBlock Sensor Modules

- Earthquake Sensor
- Air Particle Matter Sensor
- CO2 Sensor
- Proximity Sensor
- Heart Rate Sensor
- UV Sensor
- Soil Moisture Sensor
- Barometer Pressure Sensor
- Ambient Light Sensor
- Temperature and Humidity Sensor

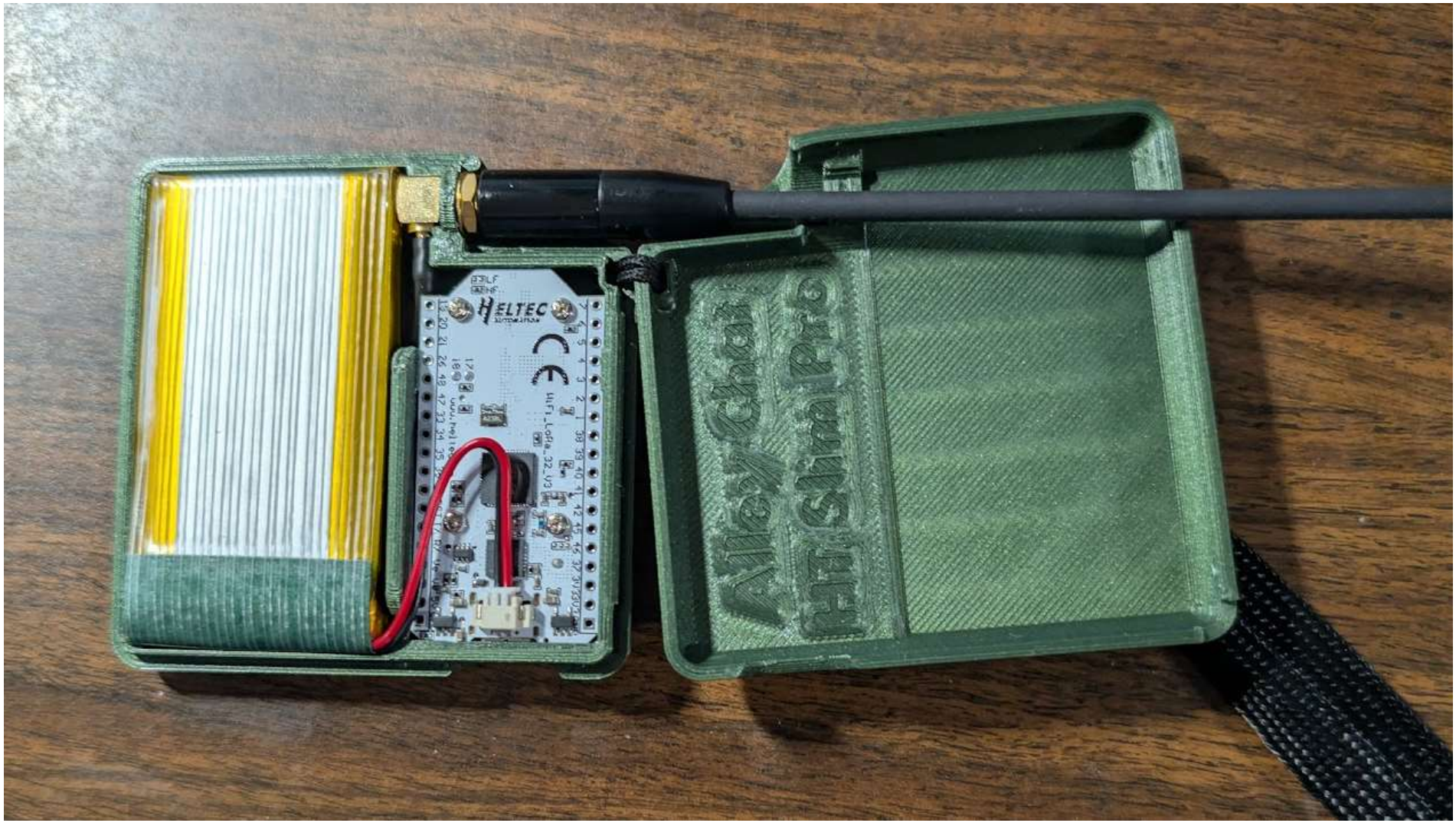
WisBlock Various I/O modules

- Motor Control
- Display
- Wireless Modules
  - LoRa
  - WiFe
  - BLE
- Storage Modules
- Keypads
- Barcode Scanners


HELTEC
AUTOMATION

A Meshtastic Radio

(Banana for scale)

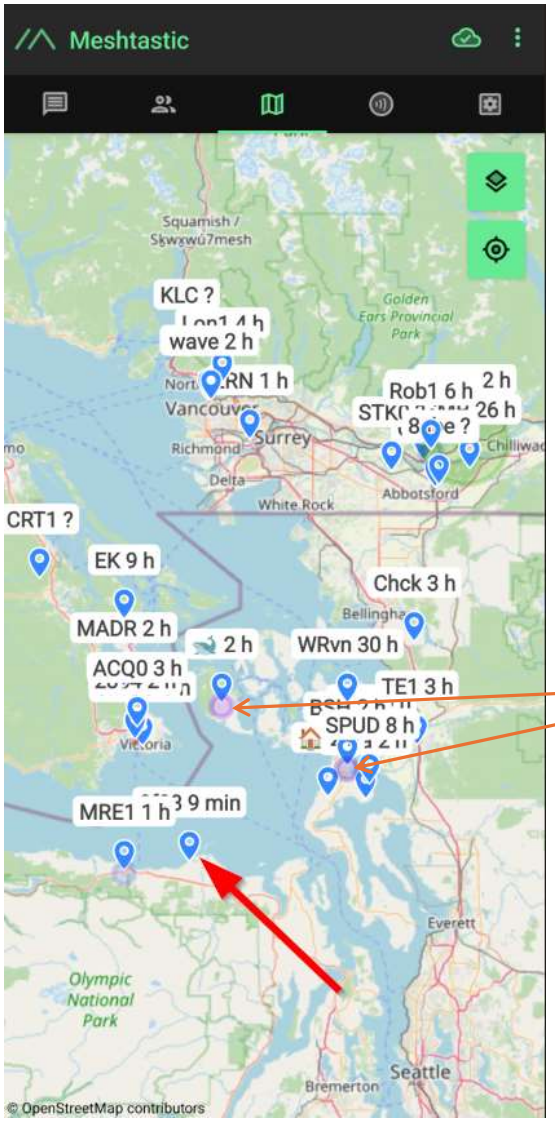

HELTEC
WiFi_LoRa_32_V3

Meshtastic - an off-grid message texting application

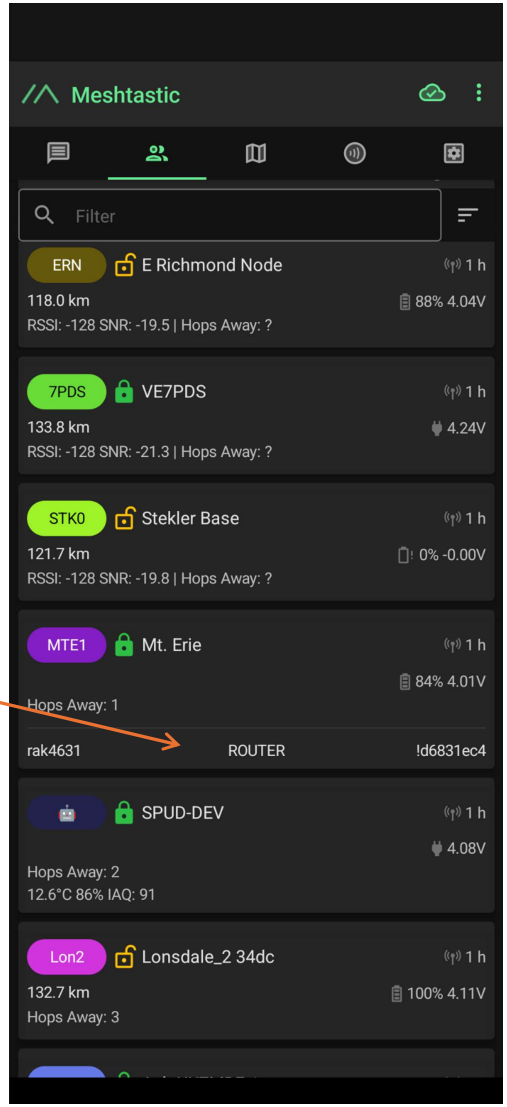
- A meshtastic app for Android of Apple allows you to interface to the meshtastic application through Bluetooth or Wi-Fi
- A web app can connect to the radio using Google Chrome that accesses a virtual serial port using the USB interface on the radio
- The Meshtastic device can connect to the internet and pass messages to other internet connected devices through the MQTT Protocol.

Often you phone connects to the radio with Bluetooth, then an application provides the user interface.

This device (a board without a case) adds a keyboard and display so a phone is not needed.


Meshtastic
Squamish / Sḵwx̱wú7mesh
KLC ?
wave 2 h
Golden Ears Provincial Park
Vancouver
Surrey
Richmond
Delta
White Rock
Abbotsford
Rob1 6 h
2 h
26 h
CRT1 ?
EK 9 h
Chck 3 h
MADR 2 h
WRvn 30 h
ACQ0 3 h
TE1 3 h
SPUD 8 h
Victoria
MRE1 1 h
9 min
Everett
Olympic National Park
Seattle
Bremerton
© OpenStreetMap contributors

Routers


Meshtastic
Filter
ERN
E Richmond Node
1 h
118.0 km
88% 4.04V
RSSI: -128 SNR: -19.5 | Hops Away: ?
7PDS
VE7PDS
1 h
133.8 km
4.24V
RSSI: -128 SNR: -21.3 | Hops Away: ?
STK0
Stekler Base
1 h
121.7 km
0% -0.00V
RSSI: -128 SNR: -19.8 | Hops Away: ?
MTE1
Mt. Erie
1 h
84% 4.01V
Hops Away: 1
rak4631
ROUTER
!d6831ec4
SPUD-DEV
1 h
4.08V
Hops Away: 2
12.6°C 86% IAQ: 91
Lon2
Lonsdale_2 34dc
1 h
132.7 km
100% 4.11V
Hops Away: 3

Costs of Radio

- **Radio (Heltec Wi-Fi LoRa 32 V3) - $20**
- **3000 ma Battery - $13**
- **Better Antenna $8**
- **Case – 3D printed**

- **Available from Amazon, Rokland**

Devices

- EP 32 V3 such as the Heltek V3 is a good choice
- nRF52840 such as RAK radio and the WisBlock system
- T-Deck

- Get a good antenna. The ones that come with the devices are not well tuned to 915 MHz and are small.
  - Make sure it is a 915 MHz antenna. Some antennas are more designed for the 830 MHz band and have a SWR of 4.0 on the 915 MHz Band
    - Meshtastic in other countries may use the 830 MHz Band. The U.S. uses the 915 Band.

Meshtastic Roles

- Client – Talk with others. Rebroadcases all messages
  - RoofTop that relay messages to others or to indoor nodes
  - Mobile nodes that relay to on location nodes
- Client_Mute: Talk with others, Does not rebroadcast messages
  - Reduces network noise
  - Indoor nodes or aras with unlikely neighbors
  - Vehicles (Mobile use) that do not relay messages
- Tracker (When paired with a GPS or a Phone with GPS)

Meshtastic Roles

- **Router**
- **Repeater**

- **Don’t use the Router or Repeater mode unless you really understand how it works and what it’s impact will be to the rest of the mesh.**

- **All nodes pass messages to neighboring nodes.**

Hops

- Each node (Clients, Routers and repeaters) decrements the hop count.

- When the count reaches zero, the message is no longer propagated.
  - If it takes 5 hops to get to the destination, the destination has to be set to five hops to reply back to you.

  - Hop count limit is set to 3 by default. Setting it higher can flood the mesh.

Issues – Unreliable?

- Implementation is still Beta?
- Understanding?
  - Learning Curve
  - Signal Path - Mostly line of sight, and can be affected by bad weather
  - Routing algorithm – Router first, farthest first
  - Hop Count Limit – Default is 3
    - Node Density
  - Timing – Devices sleep between transmissions
  - Configuration – Quality of Service setting (Message retries)
  - Bluetooth or Wi-Fi congestion
  - LoRa congestion. Collision Avoidance / Collision Detection
    - Throughput on CSMA/CA & /CD maxes out at 30% band use

Links and information

- https://meshtastic.org
- YouTube: The Comms Channel - Meshtastic

  This guy does a pretty good job of exploring meshtastic with a lots of videos.
- YouTube: Geerling Engineering - Meshtastic
  - Jeff Geerling has lots of Meshtastic videos
    - Meshtastic off-grid radio: Fantastic? Waste of Plastic? Or...
      - https://www.youtube.com/watch?v=0A7A-CSd3e4
- YouTube: Richard Wenner – LoRa CHIRP Spread Spectrum Animated
  - https://www.youtube.com/watch?v=dxYY097QNs0

- The Puget Sound Mesh Group runs a weekly net on Meshtastic
  - https://pugetmesh.org

LoRa and Meshtastic Part II

- **CCARC Monthly Membership Meeting: Jan. 8, 2025**

- **LoRa – CHIRP Modulation**
- **Heltec EP32 radio**
  - **GPIO interface**
  - **Arduino Development Environment**
- **Meshtastic**
  - **Setup and initialization**
  - **Web interface**
  - **Python CLI interface**
  - **Messaging**
  - **Routing**
  - **MQTT message broker**