

**Intent:** The purpose of this document is to examine the role of the LoRa/Meshtastic (LoRa) technology in our emergency comms network (Uhuru).

**Background:** We are in the process of examining the LoRa technology, focused on 3 tangible real-world undertakings, including:

- a small working network in Sarnia
- a network in development in Niagara
- a start-up tech research group

LoRa technology uses radio signals on a license-free frequency (915 kHz) to communicate short text messages by line-of-sight over distances of 4-5 kms (although there are claims of up to 200+ kms in ideal ‘mountain top-to-mountain top’ conditions). The range can be increased within a community by increasing the number of devices within the network which then act as repeaters, including stand-alone ‘unsupervised units’. In most instances, sending and retrieving messages is done through your smartphone using bluetooth and an app called Meshtastic. (<https://meshtastic.org/>)

The message is encrypted to only be visible on a pre-programmed channel so your comms are totally private. Devices, or nodes, that are not on your channel can pass on your message as part of the Network but are not be able see it. Becoming a member of a channel requires a direct exchange between two devices. (to be verified)

The devices range widely in terms of capability and price. While we are developing a list of recommended units, you are invited to have a look at some of the options (see Exhibits). At one end of the spectrum are very bare-bones units that look like a circuit board with an antenna (where you have to solder on a screen, add a battery and 3D print the case) to units that combine everything into one, including keyboard and screen (no need for your smartphone) as well as a solar power source. We intend to develop a range of suggested units/packages.

These units are available through a variety of vendors, including Amazon and AliExpress as well as direct from the manufacturer in some instances.

The potential exists to manufacture the devices provided one can procure the required components and skills.

**Findings:**

- LoRa technology appears to be a viable alternative to short range ham radio or CB, although, to the best of our knowledge, it hasn't yet been implemented on a large scale.
- We are confident in saying that the devices will achieve a point-to-point (P2P) connection of 4.5 kms in an urban setting.
- There are claims that the devices can achieve a P2P connection of 200 km+, mountain top to mountain top, although we have not yet tested this ourselves.
- Long Range HF Ham radio will continue to be required for truly long range comms (country-wide, world-wide).
- Non-technical people might find obtaining and using the technology a bit of a challenge.
- Availability and pricing present a problem as well.
- It is important for Uhuru to develop some expertise and support in this area.

**Recommendations:**

- Uhuru is establishing a LoRa Team so that we can better share intelligence and best practises
- Groups should invest some time and money into the technology in order to gain a first hand understanding of its capabilities and limitations
  - this involves having at least one person in your group acquire a few units (ideally 3) to play with, in concert with our team
- it is too early to provide a blanket recommendation for groups to use this technology as the foundation of their emergency comms network
  - limited number of real world examples vs ham radio
  - limited experience with acquiring the technology (what to buy, where to buy it, etc.)
  - limited experience with training and adoption of the tech by non-techie
  - issues with availability and price

**Exhibit 1 - Intro Videos**

License Free Off-Grid Comms (LoRa Meshtastic)

Ham Radio Crash Course

<https://youtu.be/DumgHz56IjI?si=gI4JBYY5NzsRxXn>

My Top Pick for LoRa Mesh Devices

Ravenwood Acres

[https://youtu.be/7hDmwc\\_xlAY?si=jT65I11MKAN3CZJb](https://youtu.be/7hDmwc_xlAY?si=jT65I11MKAN3CZJb)

## Exhibit 2 – Product Information

Following is information on various aspects of the LoRa products and technology

### Products:

Following are some of the more popular LoRa models

LilyGo T-Beam: (\$50-\$70)

- appears to be the mostly commonly purchased unit which is very bare-bones requiring the additional purchase of a screen and battery as well as a case, which can be 3D-printed or acquired on Etsi

LilyGo T-Echo: (\$100-\$200)

- a self-contained, robust unit which includes case, screen and battery

3D Security MIL-Mesh: (\$65.00)

- a self-contained, robust unit which includes case, screen and battery
- <https://3d-security-llc.ueniweb.com/products/off-grid-lora-915mhz-radios-programmed-with-meshtastic-r/mil-mesh-52308581>

3D Security Solar "SunPeater": (\$180.00)

- a robust, self-contained unit that includes a solar panel – ideal for use as an unsupervised unit
- <https://3d-security-llc.ueniweb.com/products/meshtastic-radios/solar-sunpeater-w-mag-mesh-magnetic-switch-and-mil-mesh-52308578>

### Manufacturers:

3D Security LLC; American company located in Connecticut

<https://3d-security-llc.ueniweb.com/>

Heltec Automation; Chinese company

<https://heltec.org/>

LilyGo; Chinese company (Shenzhen Xinyuan Electronic Technology Co., Ltd) located in Shenzhen

<https://www.lilygo.cc/en-ca>

GoTenna; Based in New Jersey, they design and manufacture durable, hi-end military-grade devices

<https://gotennapro.com>

**Vendors:**

AliExpress:

<https://www.aliexpress.com/w/wholesale-lora-devices.html?spm=a2g0o.productlist.search.0>

Amazon:

[https://www.amazon.ca/s?k=lora+devices&crd=EFC5ZAINDWK9&sprefix=lora+devices%2Caps%2C103&ref=nb\\_sb\\_noss\\_1](https://www.amazon.ca/s?k=lora+devices&crd=EFC5ZAINDWK9&sprefix=lora+devices%2Caps%2C103&ref=nb_sb_noss_1)

Walmart

[https://www.walmart.ca/en/ip/Hilitand-For-TTGO-T-Beam-ESP32-LoRa-Wireless-REV1-WiFi-GPS-Module-Board-With-Battery-Base/5FWC2O8DDP9D?offerId=FECE05021019409F812B0617BFBB027B&cmpid=SEM\\_CA\\_33355\\_HQH88E2IHJ&utm\\_id=SEM\\_CA\\_33355\\_HQH88E2IHJ&utm\\_medium=paid\\_search&utm\\_source=google&utm\\_campaign=always\\_on&gad\\_source=1&gclid=Cj0KCQjwztOwBhD7ARIsAPDKnkCxepxfJwi0sFDoF2Vj9opajm8n1Wuvv2Rz9BIfEBZkDRa6C-FZ6ScaAu2cEALw\\_wcB&gclsrc=aw.ds](https://www.walmart.ca/en/ip/Hilitand-For-TTGO-T-Beam-ESP32-LoRa-Wireless-REV1-WiFi-GPS-Module-Board-With-Battery-Base/5FWC2O8DDP9D?offerId=FECE05021019409F812B0617BFBB027B&cmpid=SEM_CA_33355_HQH88E2IHJ&utm_id=SEM_CA_33355_HQH88E2IHJ&utm_medium=paid_search&utm_source=google&utm_campaign=always_on&gad_source=1&gclid=Cj0KCQjwztOwBhD7ARIsAPDKnkCxepxfJwi0sFDoF2Vj9opajm8n1Wuvv2Rz9BIfEBZkDRa6C-FZ6ScaAu2cEALw_wcB&gclsrc=aw.ds)

### Exhibit 3 - Summary of LoRa Technology from Chat GPT:

LoRa (Long Range) technology is a wireless communication protocol designed for long-range, low-power communication between IoT (Internet of Things) devices. It operates on unlicensed radio bands and is characterized by its ability to transmit data over several kilometers while consuming minimal power. LoRa uses spread spectrum modulation techniques to achieve this, allowing it to penetrate obstacles and provide reliable communication in urban and rural environments.

Key components of LoRa technology include:

1. **LoRaWAN**: This is the networking protocol built on top of LoRa technology. LoRaWAN defines the communication protocol and system architecture for the network, allowing devices to communicate with gateways and the internet.
2. **LoRa Devices**: These are the physical devices equipped with LoRa transceivers that transmit and receive data. They can be sensors, actuators, or any other IoT devices.
3. **LoRa Gateways**: These act as intermediaries between LoRa devices and the internet. They receive data from nearby LoRa devices and forward it to a network server, typically through an Ethernet or cellular connection.
4. **Network Server**: The network server manages the communication between LoRa gateways and LoRa devices. It handles device authentication, data encryption, and routing of messages to the appropriate applications or servers.
5. **Applications**: These are the end-user applications or backend systems that interact with the data collected from LoRa devices. They analyze the data, generate insights, and trigger actions based on the information received.

LoRa technology is widely used in various IoT applications such as smart cities, agriculture, industrial automation, environmental monitoring, and asset tracking. Its long-range capabilities, low power consumption, and scalability make it a popular choice for IoT deployments where devices are spread over large geographic areas and need to operate on battery power for extended periods.

#### Exhibit 4 - Chat GPT recommendations on most economical LoRa units to buy:

The most economical LoRa devices to buy can vary depending on your specific requirements, including range, data rate, power consumption, and additional features. However, some popular and cost-effective options for LoRa devices include:

1. **Semtech SX1276/SX1278**: These are commonly used LoRa transceiver chips that can be integrated into custom IoT devices. They offer good performance and are widely available from various manufacturers.
2. **Dragino LoRa IoT Development Kit**: Dragino offers a range of LoRa development kits that include both LoRa devices and gateway solutions. These kits are relatively affordable and suitable for prototyping and small-scale deployments.
3. **Heltec ESP32 LoRa Development Boards**: These development boards combine an ESP32 microcontroller with a LoRa transceiver, providing a low-cost solution for building IoT devices with both Wi-Fi and LoRa connectivity.
4. **Pycom LoPy4**: The Pycom LoPy4 is a versatile development board that supports multiple wireless technologies, including LoRa. It's a bit pricier than some other options, but its capabilities and flexibility make it a cost-effective choice for certain applications.
5. **Arduino MKR WAN 1300**: Arduino offers LoRa-enabled development boards like the MKR WAN 1300, which provides an easy-to-use platform for building LoRa-based IoT applications. While slightly more expensive than some alternatives, its compatibility with the Arduino ecosystem may reduce development time and costs.

When considering the most economical option, it's essential to factor in not just the upfront cost of the device but also the overall cost of your IoT deployment, including gateway infrastructure, network server setup, and any additional hardware or software requirements. Additionally, evaluating factors such as power consumption, range, and compatibility with existing systems can help ensure that you select the most cost-effective LoRa solution for your specific needs.