

OFF-GRID COMMUNICATION TECHNOLOGIES



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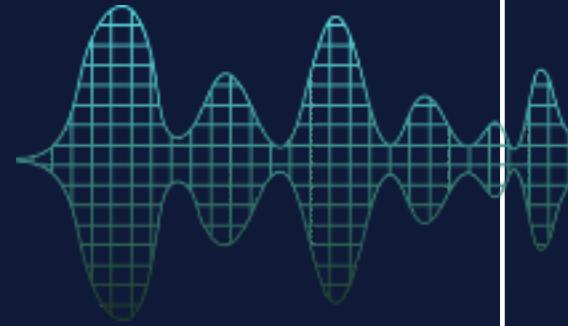
1. INTRODUCTION

2. METASTATIC

3. LORA DEVICES

4. RF DEVICES

5. PROPOSED SOLUTION



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01. introduction

Off-grid communication is data transfer service without internet

Key points of off-grid communication are:

- Independence from traditional Networks
- Uses Alternative Methods like radio waves, satellites, or direct device-to-device connections.
- Decentralized Communication
- Reliability in Remote Areas



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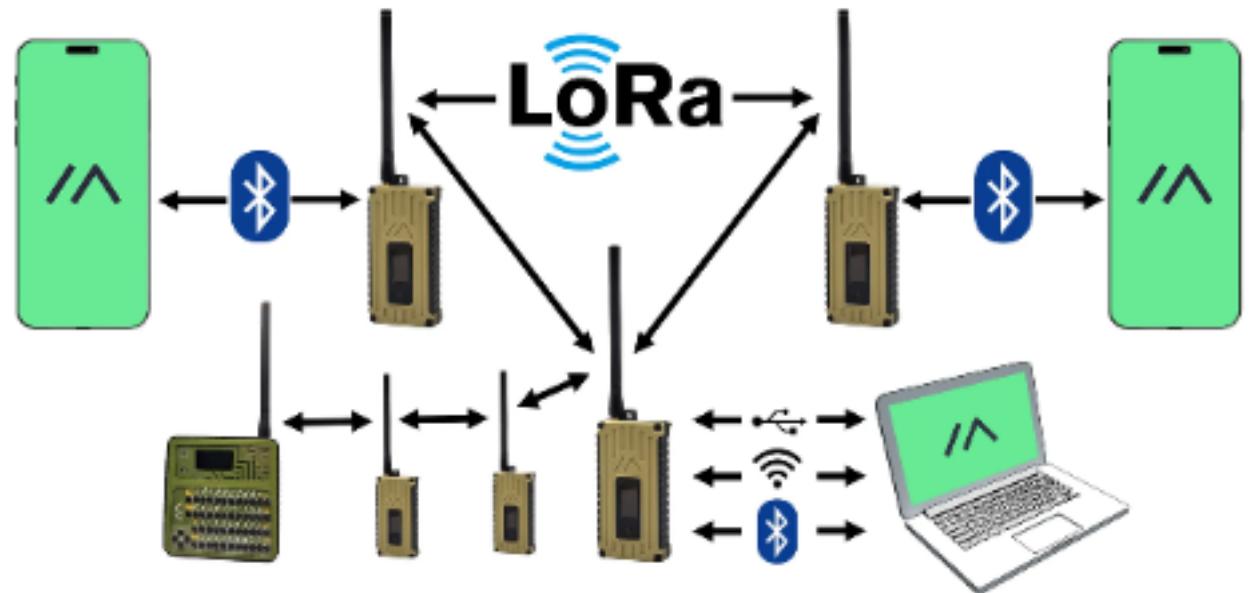
METASTATIC

Metastatic is a project that enables you to use inexpensive LoRa radios as a long range off-grid communication platform :

- Long range ([254km record by kboxlabs](#))
- No phone required for mesh communication
- Decentralized communication - no dedicated router required
- Encrypted communication
- Excellent battery life
- Send and receive text messages between members of the mesh
- Optional GPS based location features



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METASTATIC DEVICES OVERVIEW



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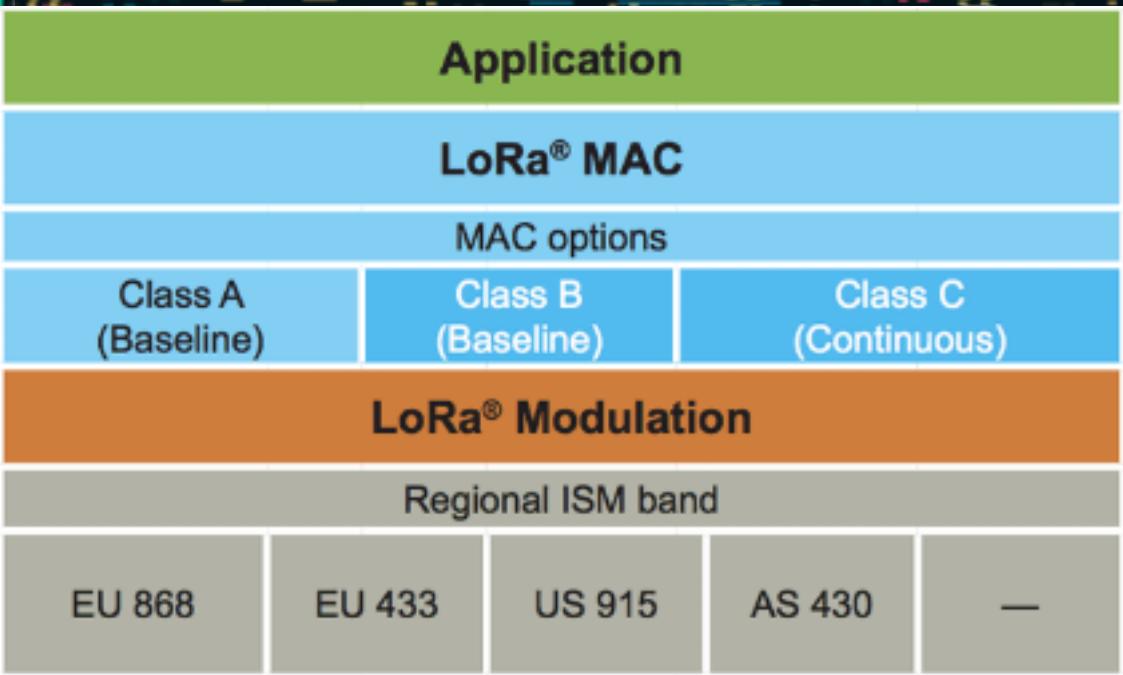
03. Lora devices

LoRa (Long Range) Communication Technology

- **Long Range:** LoRa can achieve communication distances of up to 10-15 kilometers in rural areas and up to 2-5 kilometers in urban environments.
- **Low Power Consumption:** Designed for battery-powered devices, LoRa enables years of operation on a single battery.
- **Low Data Rate:** LoRa supports data rates ranging from (0.3 - 50) kbps, suitable for transmitting small amounts of data.



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LORA AND LORA WAN OVERVIEW



03. Lora devices

Stand Alone LoRa Devices Are:

- **ESP32 Based**
 - Lilygo T-Beam
 - Lilygo T-Deck
 - Heltec LoRa 32
- **NRF52 Based**
 - Lilygo T-Echo
 - RAK Wireless WisBlock
- **Other Boards**
 - Raspberry pi pico + LoRa



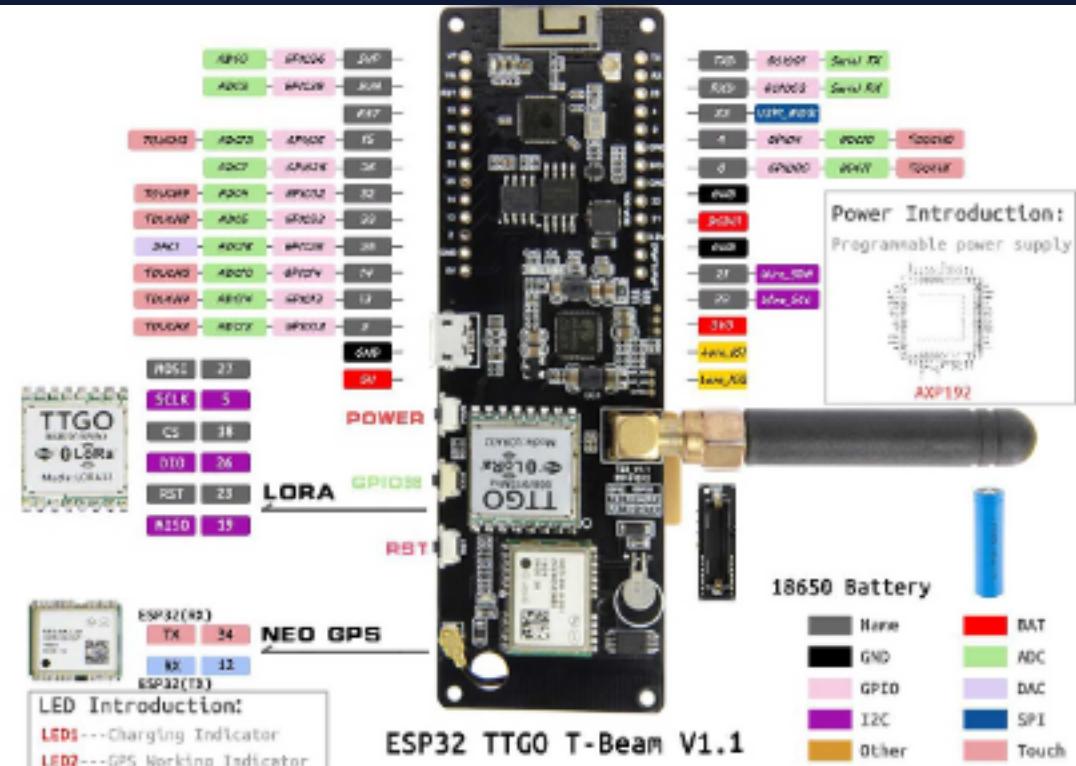
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03. Lora devices

Lilygo T-Beam:

- Based on ESP 32
- Have WiFi , Bluetooth and GPS built in
- Antenna should be based on frequency you are using

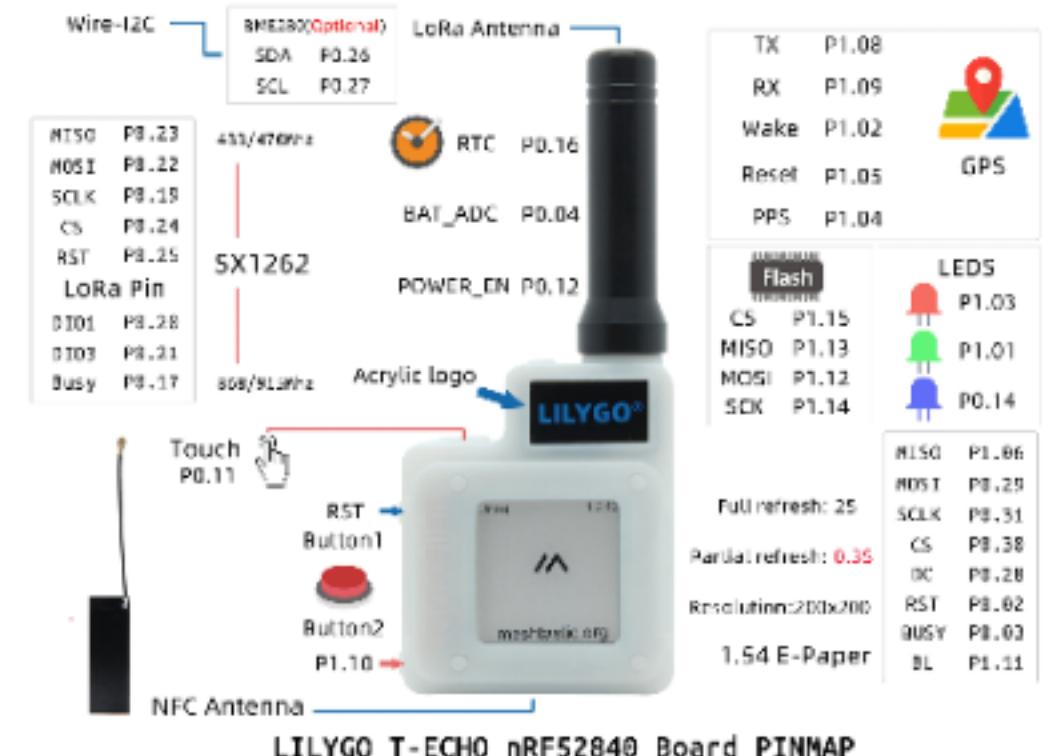
- Transceiver rate is 300kb



03. Lora devices

Lilygo T-Echo:

- Based on NRF52 (Low power consumption)
- Have Bluetooth and GPS built in
- Antenna Should be based on Frequency you are using
- Transceiver Rate is 300kb

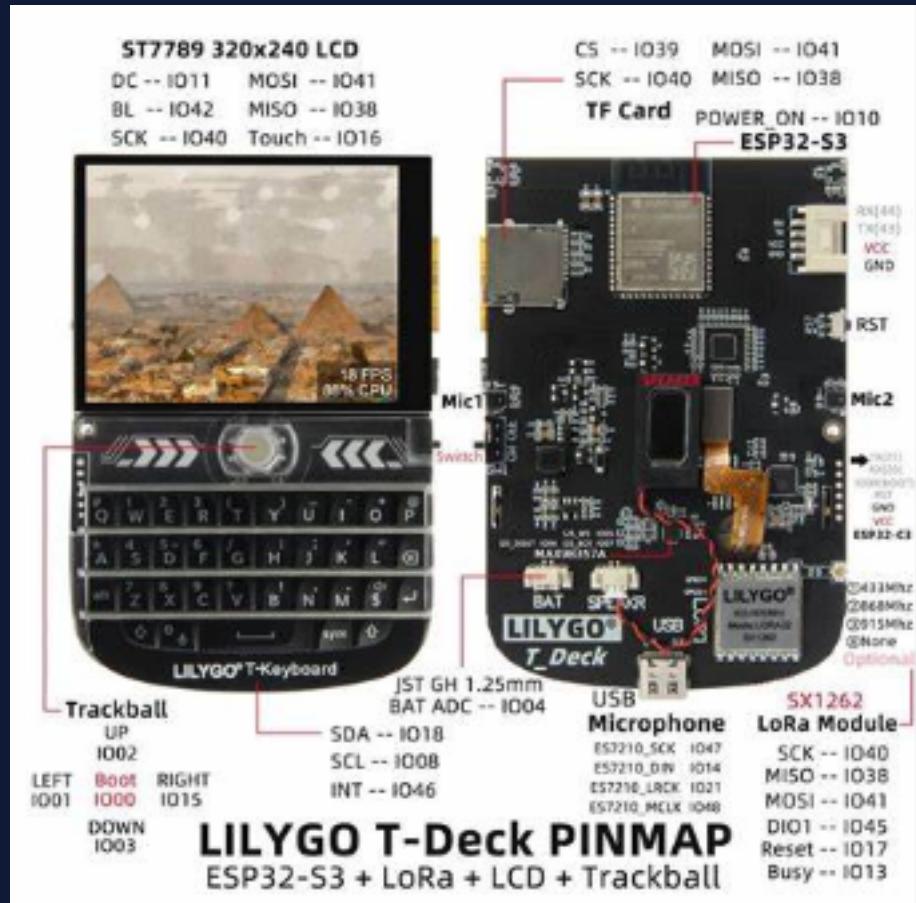


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03. Lora devices

Lilygo T-Deck:

- Based on ESP32 (High Power Consumption)
- Have Bluetooth, WiFi and GPS built in
- Antenna Should be based on Frequency you are using
- Transceiver Rate is 300kb
- Can type message on Device Screen



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03. Lora devices

RAK Wireless Wisblock:

- Nrf52
- Modular:
 - GPS
 - BME680 Environmental Sensor
 - Ethernet
- Low Power Consumption
- Transciever Rate 300kb

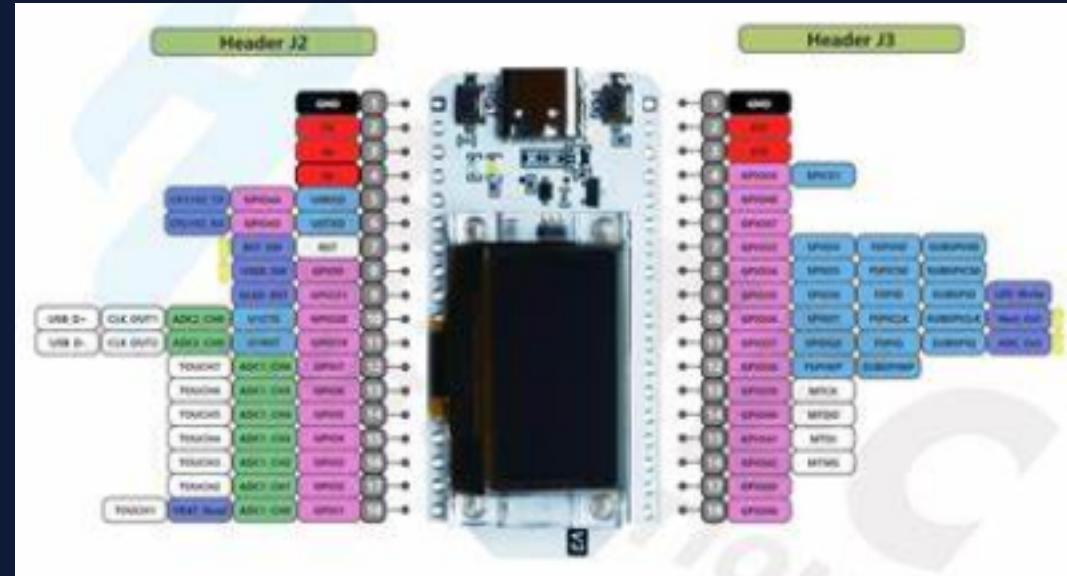


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03. Lora devices

Heltec LoRa 32:

- Based on ESP32 (High Power Consumption)
- Have Bluetooth. WiFi and GPS built in
- Antenna Should be based on Frequency you are using
- Transceiver Rate is 300kb

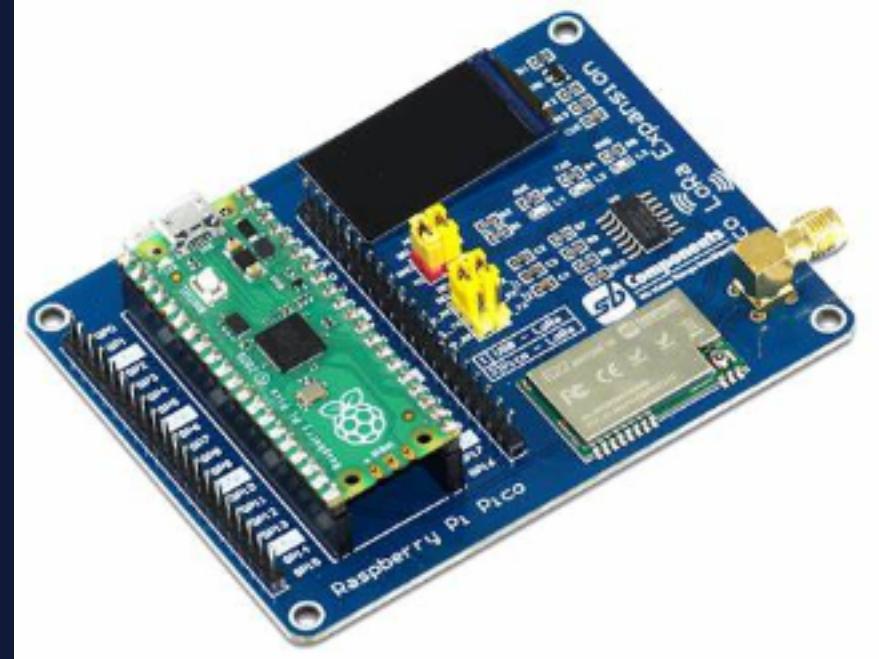


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03. Lora devices

Raspberry Pi Pico + LoRa :

- Raspberry Pi RP2040 with dual M0+ cores, 133MHz CPU clock.
- SX1262 supporting 410-525 MHz, 863-870 MHz, and 902-930 MHz frequencies.
- Micro-USB on Pico, U.FL/IPEX antenna, and 1.25mm 2-pin JST for battery on LoRa module.



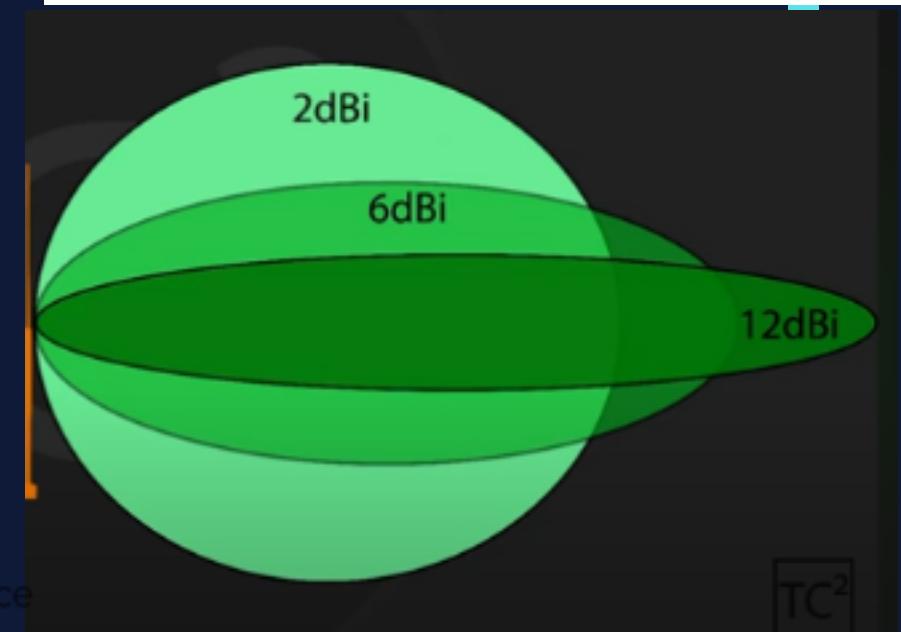
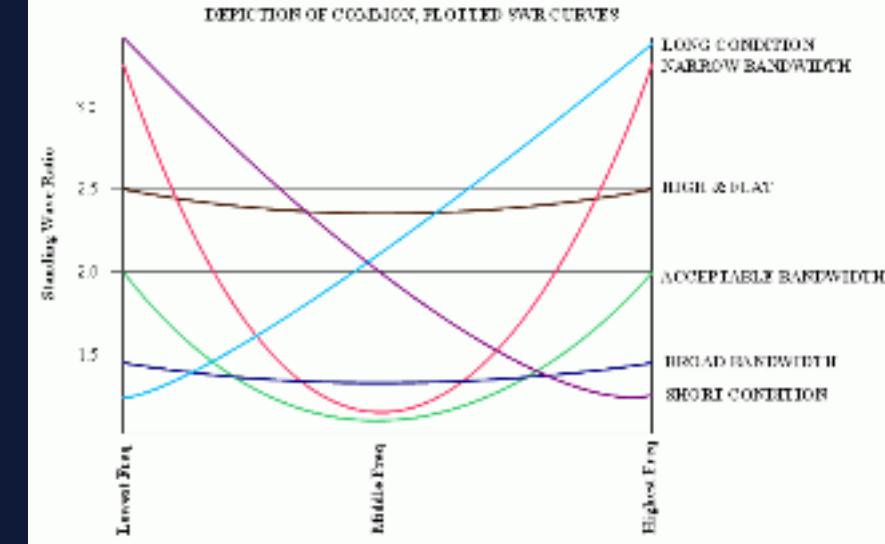
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03.

LORA DEVICES

Selecting the Antenna:

- Find the One Which match with the frequency you are operating
- look at SWR charts
- Use tested Antennas
- look At Antenna gain (Dbi value)



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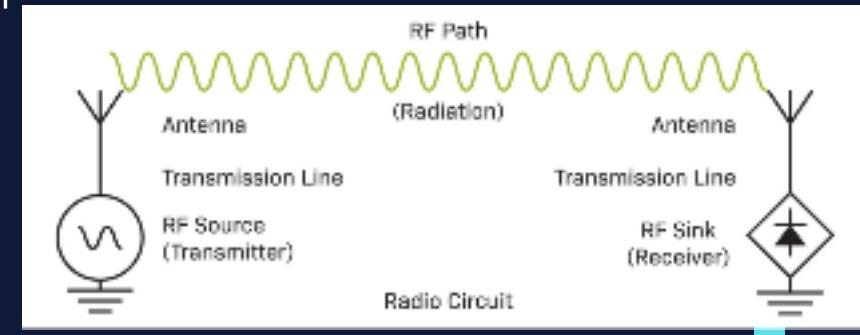
04. RF DEVICES

What is Radio Frequency?

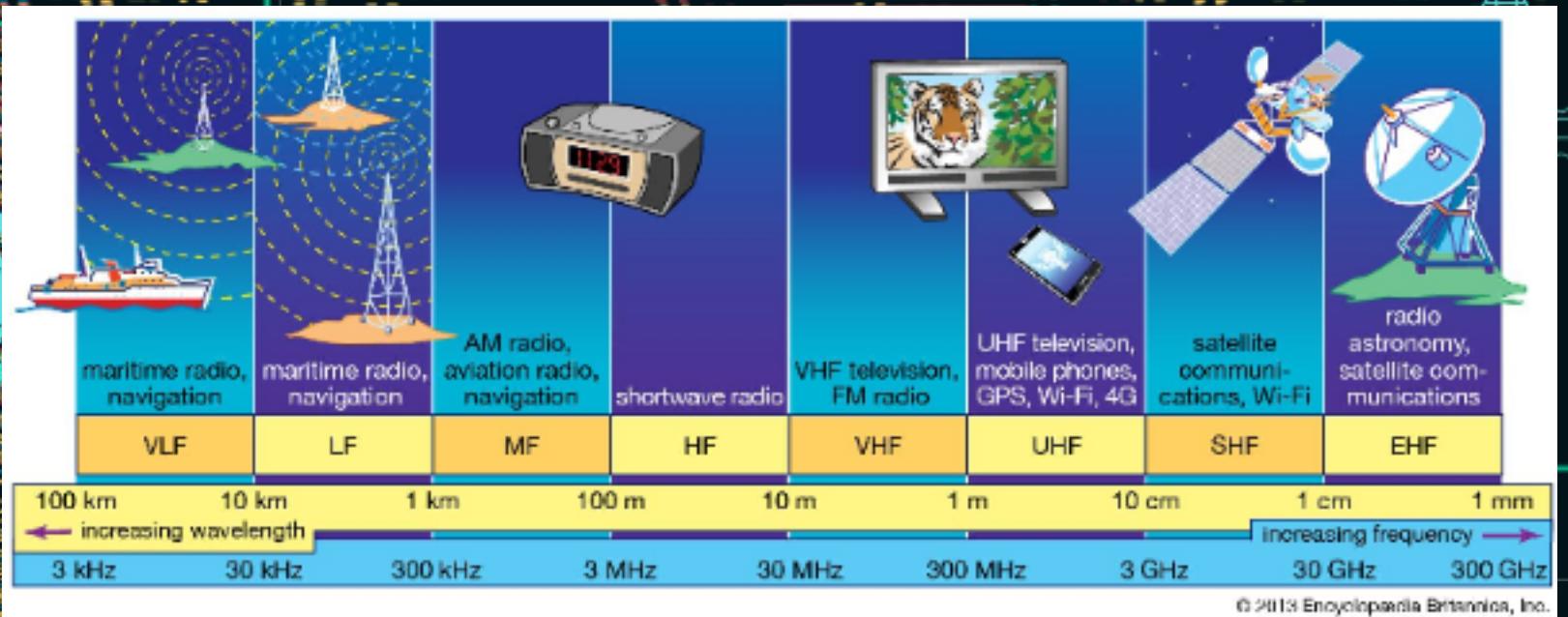
“RF” refers to the use of electromagnetic radiation for transferring information between two circuits that have no direct electrical connection.

Use of RF in communication :

- Cellular Networks: RF is used for voice and data transmission in mobile phones (e.g., 3G, 4G, 5G).
- Satellite Communications: RF is used for transmitting signals between satellites and ground stations.
- Wi-Fi: Wireless networking uses RF to connect devices within a local area network.
- Bluetooth: Short-range communication between devices like headphones, keyboards, and smartphones.
- Walkie-Talkies and Two-Way Radios: RF is used for short-distance voice communication.



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RF SPECTRUM



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04. RF DEVICES

BaoFeng UV-5R

- Supports both VHF (136-174 MHz) and UHF (400-520 MHz) frequencies, providing reliable communication over distances up to 5 km in optimal conditions.
- Equipped with a large inverted LCD display, LED flashlight, FM radio (65.0MHz-108.0MHz), and a high/low RF power switchable function, making it a versatile tool for off-grid communication.
- Comes with a 1500mAh battery, ensuring extended usage for long-range communication without frequent recharging.



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04. RF DEVICES

Motorola T600 H2O Talkabout Radio

- Up to 35-mile range with 22 channels and 121 privacy codes, compatible with any FRS or GMRS radio.
- IP67 waterproof rating and built-in water-activated flashlight, ensuring durability in harsh conditions
- Dual power options: 9 hours with rechargeable NiMH battery and 23 hours with 3 AA batteries, plus push-to-talk power boost for extended range.



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04. RF DEVICES

BEARTOOTH

- 3.7V, 3000 mAh battery, offering a robust two-day battery life for extended use.
- Ensures secure communication with AES-256 encryption and features low probability of detect and intercept.
- Operates on the 902-928 MHz ISM band with frequency hopping, supports a line of sight range of 30 miles, more than 100 meshed nodes, and up to 6 hops. Transmit power is 1W (30 dBm).



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04. RF DEVICES

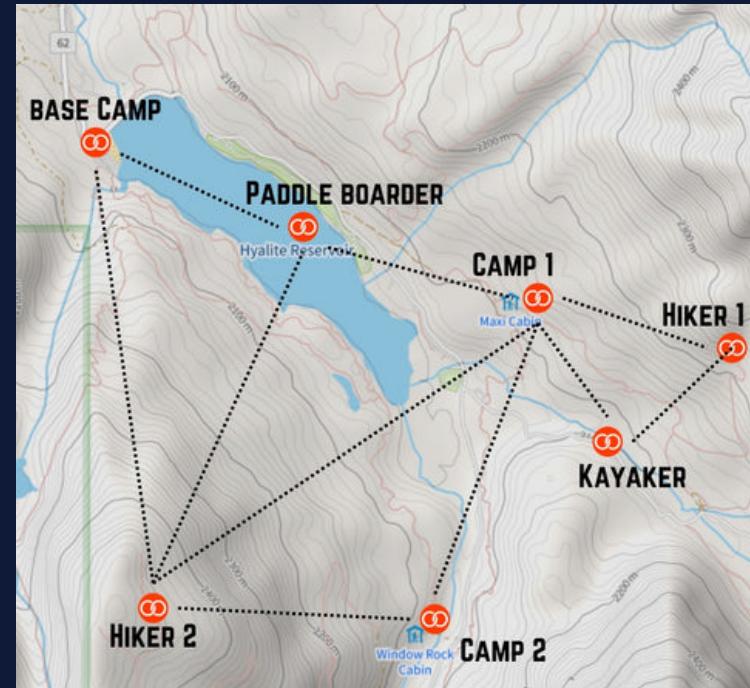
How Do BearTooth Work ?

- **BearTooth Relay Protocol (BRP):**

- Enhanced LoRa: Utilizes an advanced version of LoRa for improved real-time communication capabilities.
- Configurable Link Layer: Adapts to various communication scenarios to optimize performance.

- **Range Extension:**

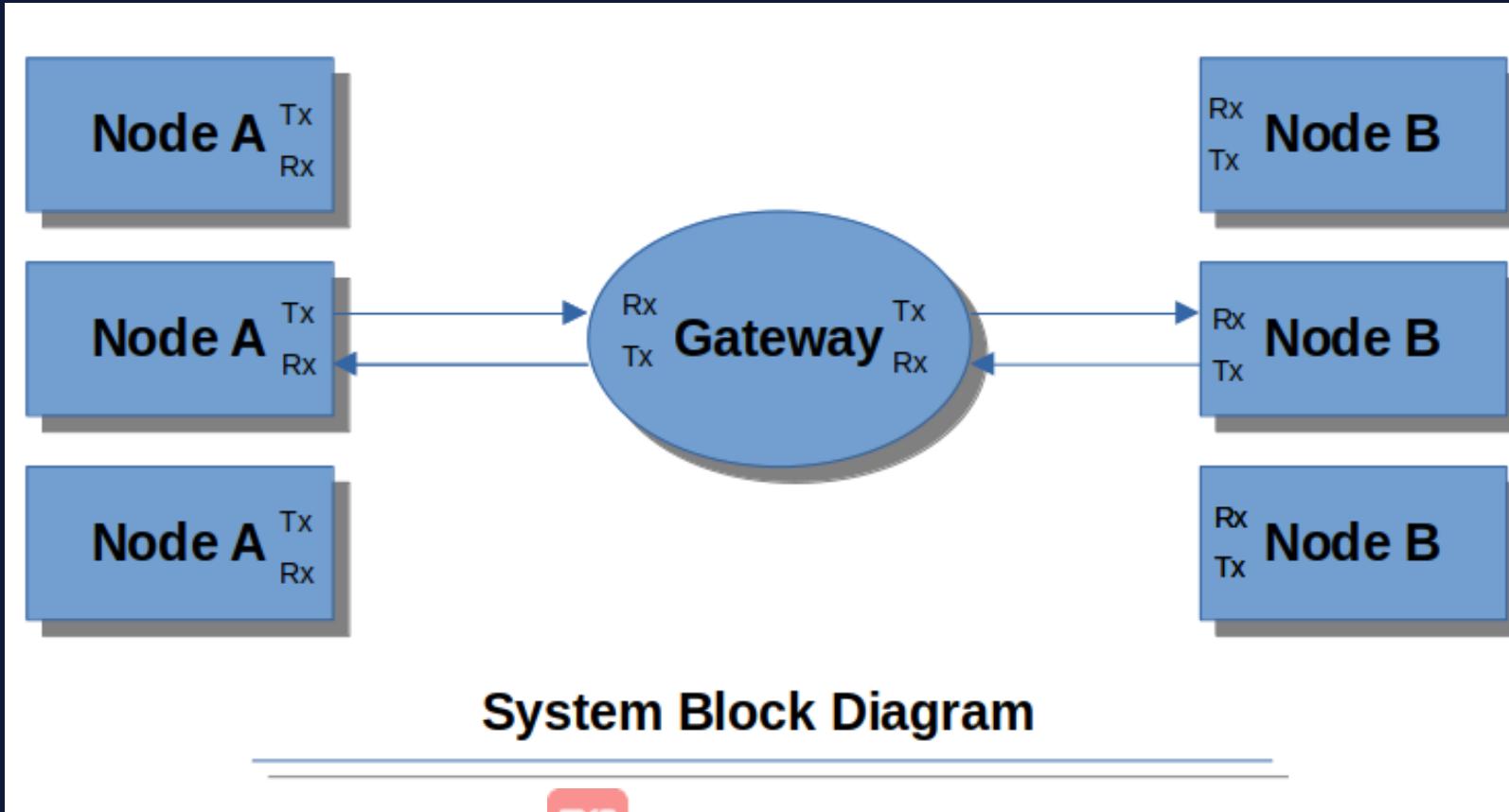
- Peer-to-Peer Communication: Devices communicate directly with each other, bypassing the need for centralized infrastructure.
- Relay Mechanism: Data is relayed through intermediate nodes, allowing for extended communication ranges. A message can be sent from one node to another and then to a third node, significantly increasing the effective range.



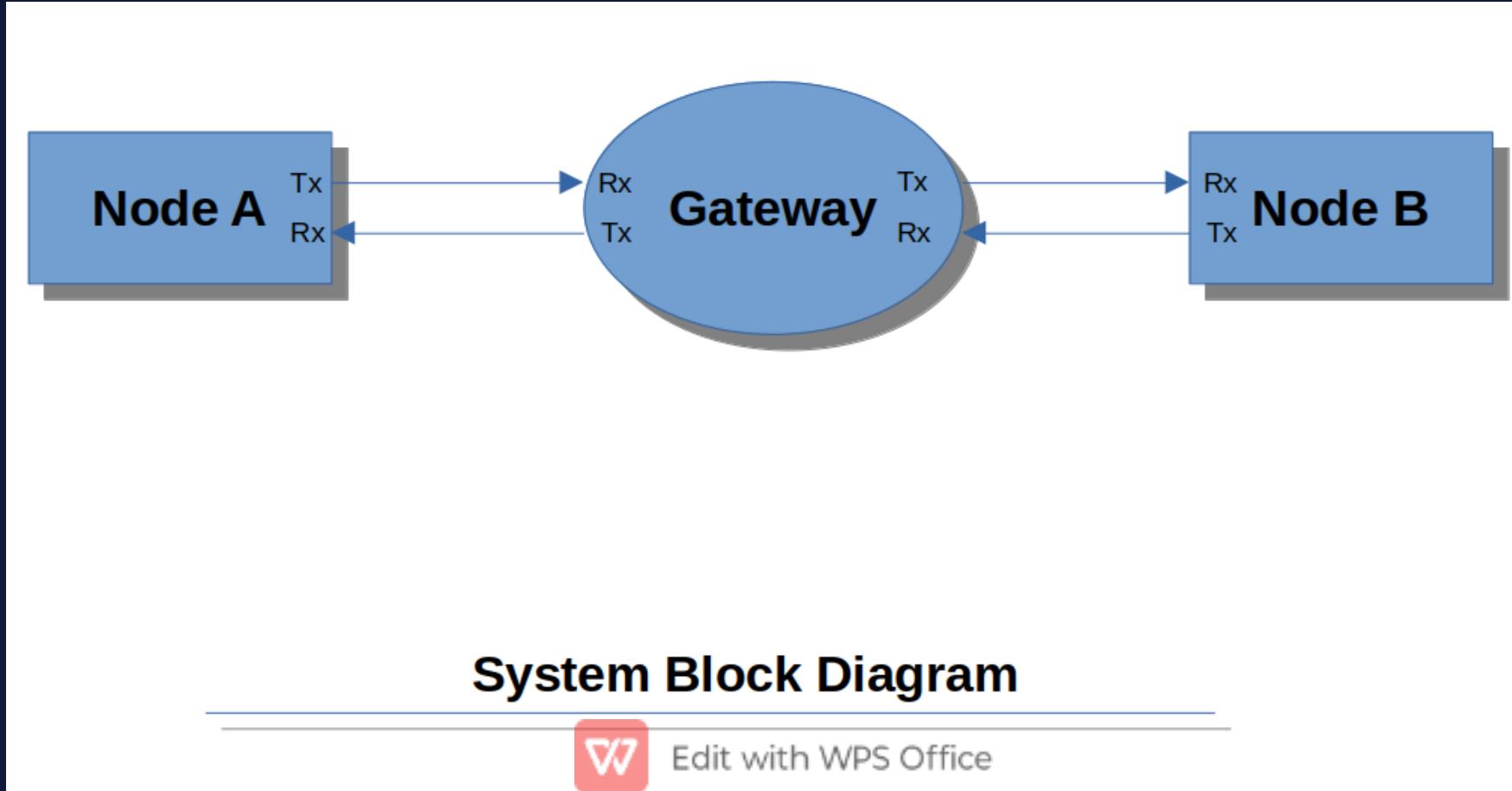
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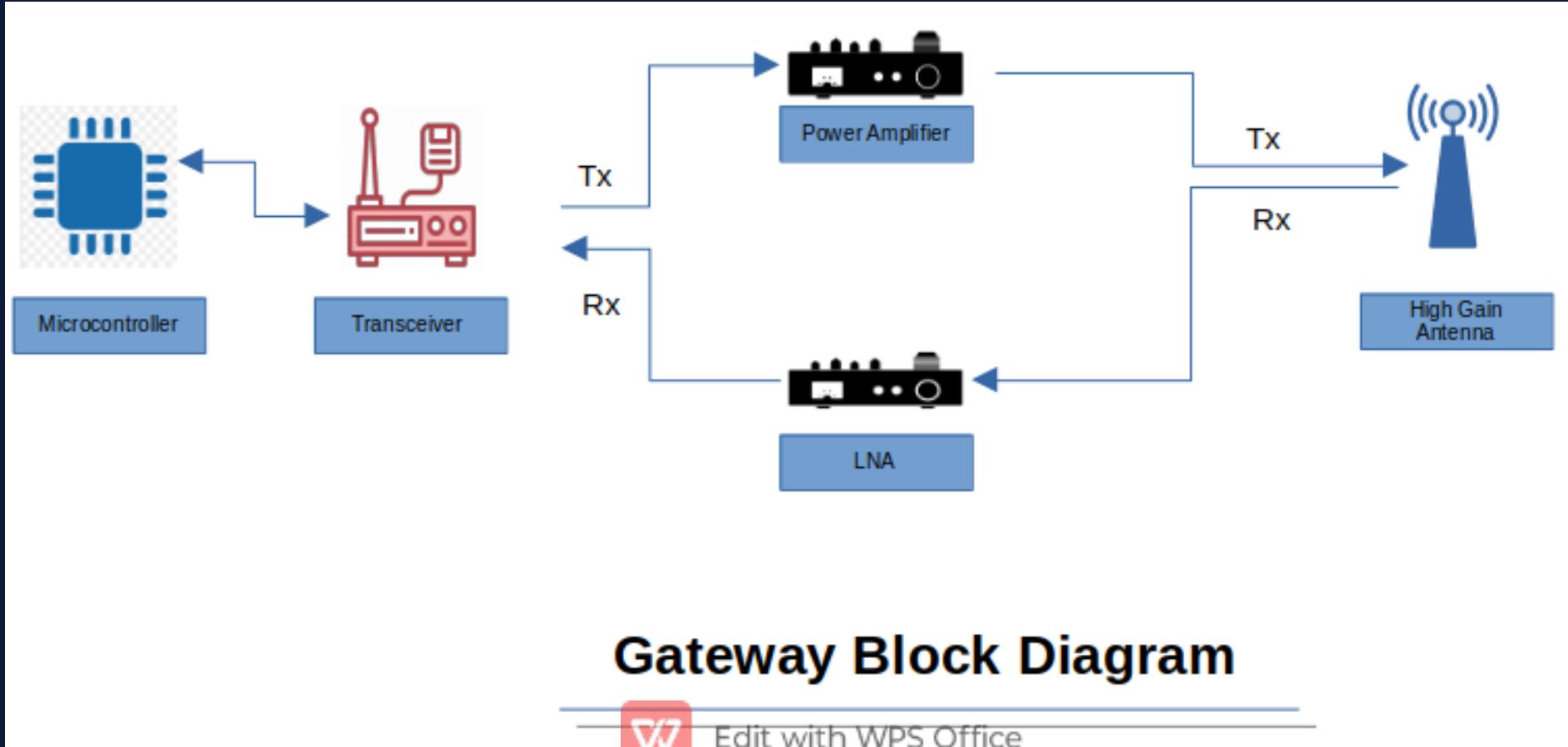
Proposed Solution



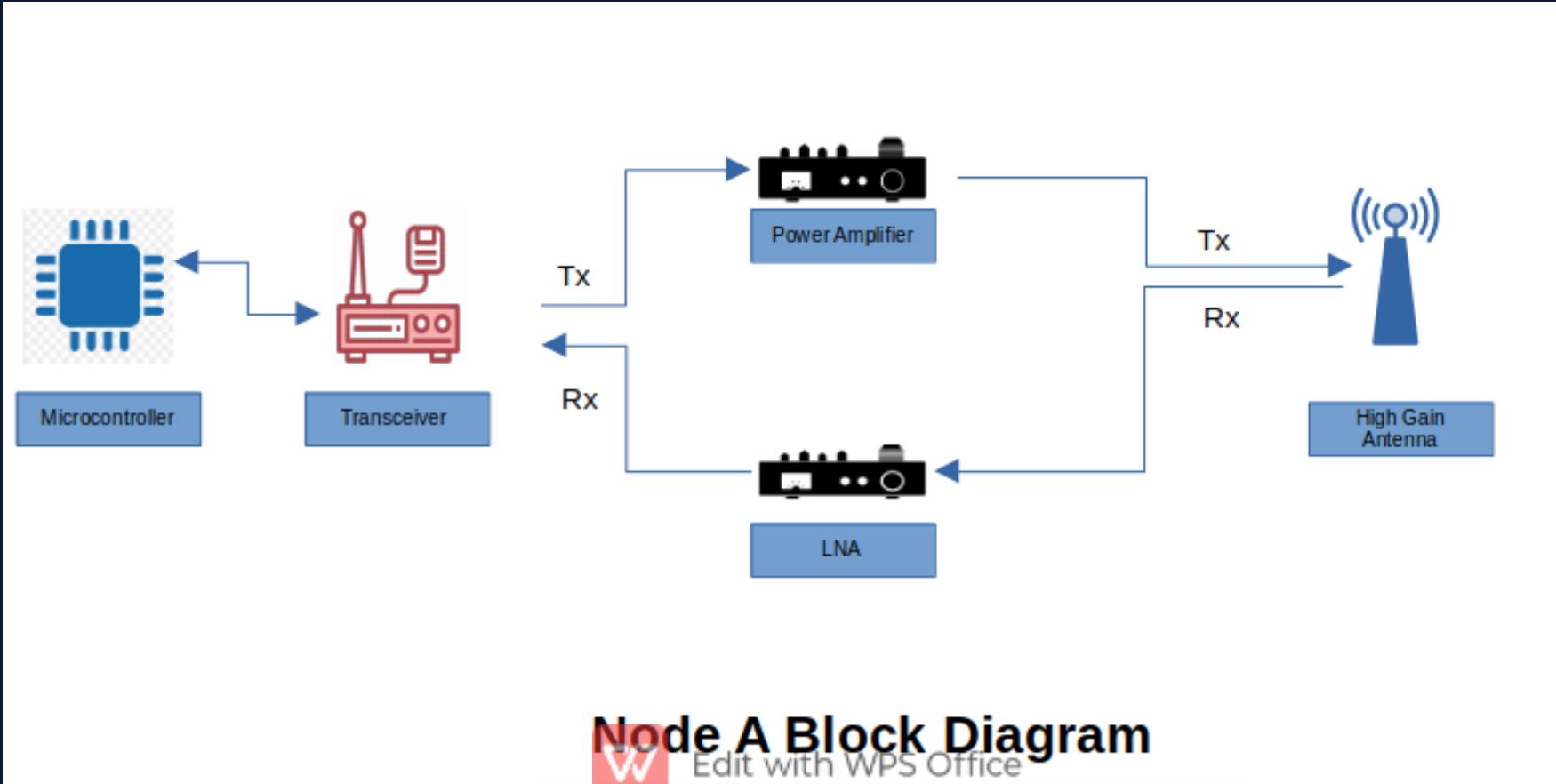
5. In Progress



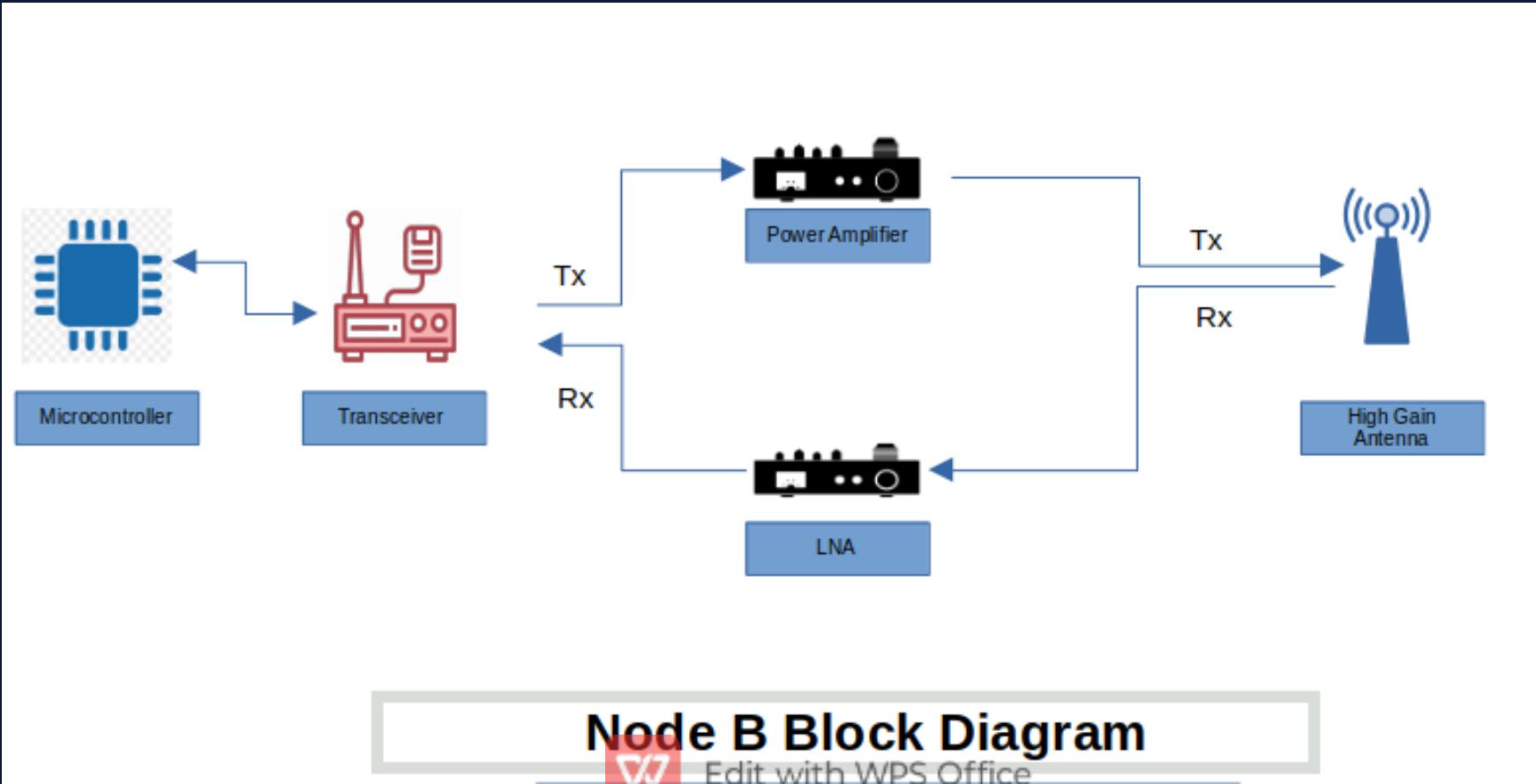
5. Gateway Block Diagram



5. Node A Block Diagram



5. Node B Block Diagram



5. Proposed Solution

Different Components that require research according to market

- **Gateway (Transmission Side)**
 - Microcontroller → Transceiver → Power Amplifier (PA) → High Gain Directional Yagi Antenna
- **Gateway (Receiver Side)**
 - Microcontroller ← Transceiver ← Low Noise Amplifier (LNA) ← High Gain Directional Yagi Antenna



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5. Proposed Solution

Different Components that require research according to market

- Node A (Tx)
 - Microcontroller → Transceiver → Power Amplifier (PA) → High Gain Directional Yagi Antenna → Battery
- Node A (Rx)
 - Microcontroller ← Transceiver ← Low Noise Amplifier (LNA) ← High Gain Directional Yagi Antenna



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5. Proposed Solution

Different Components that require research according to market

- Node B (Tx)
 - Microcontroller → Transceiver → Power Amplifier (PA) → High Gain Directional Yagi Antenna → Battery
- Node B (Rx)
 - Microcontroller ← Transceiver ← Low Noise Amplifier (LNA) ← High Gain Directional Yagi Antenna



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5. Proposed Solution

Different Components that require research according to market

- Node B (Tx)
 - Microcontroller → Transceiver → Power Amplifier (PA) → High Gain Directional Yagi Antenna → Battery
- Node B (Rx)
 - Microcontroller ← Transceiver ← Low Noise Amplifier (LNA) ← High Gain Directional Yagi Antenna



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THANKS A LOT.
FEEL FREE TO ASK QUESTIONS



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