



# LoRa

- LoRa is a wireless Radio frequency technology used to **transmit bi-directional information to a long-distance without consuming much power.**
- Developed by Semtech
- **LoRa stands for Long Range Radio**
- Transmits over license-free sub-gigahertz radio frequency bands like 169 MHz, 433 MHz, 868 MHz (Europe) and 915 MHz (North America).
- **Enables very-long-range transmissions (more than 10 km in rural areas) with low power consumption**
- Based on spread-spectrum modulation techniques derived from **chirp spread spectrum (CSS) technology**





- Each region have different LoRaWAN Frequency allocations:

| Region        | Frequency    |
|---------------|--------------|
| Europe        | 867 - 869MHz |
| North America | 902 - 928MHz |
| China         | 470 - 510MHz |
| Korea/Japan   | 920 - 925MHz |
| India         | 865 - 867MHz |



# Advantages of LoRa

Long range: Many miles on line-of-sight links.

Low power: Can run on battery for years.

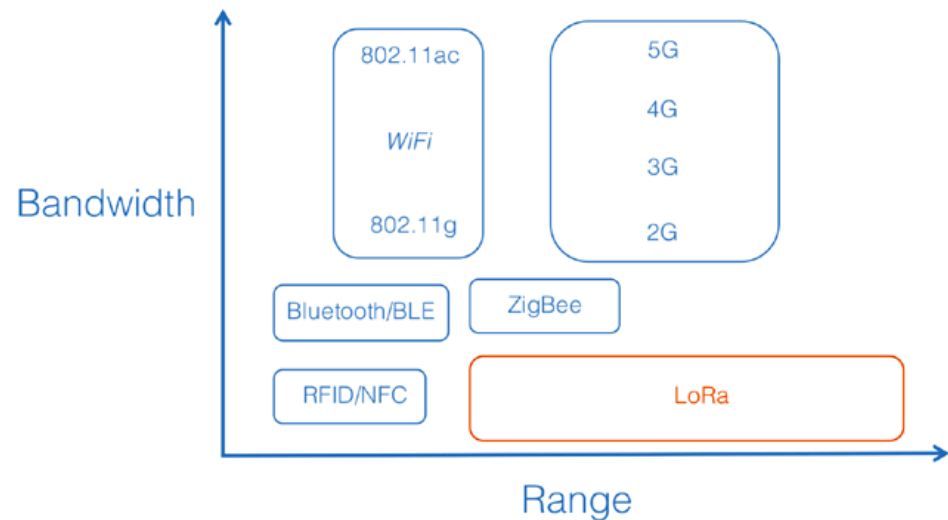
Low cost: LoRa modules are pocket-friendly. It uses constant envelope modulation that brings lower cost and higher efficiency to the power amplifier.

Universal: Uses unlicensed bands that are globally available.

Bi-directional: Can send and receive data.

## Disadvantages of LoRa

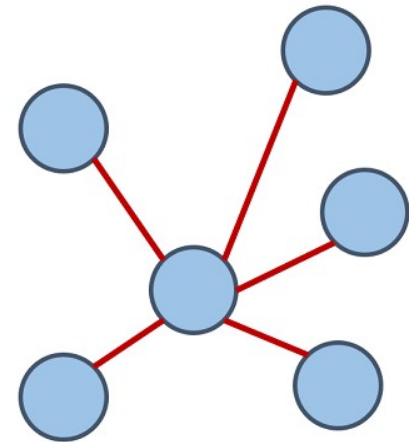
- With a maximum data rate of around 50kb/s.
- **LoRa has the lowest of data rates** when compared with most of the other technology which makes it not ideal for certain applications where high data rates are required.



# LoRa Topologies



Point to point  
communication



Network

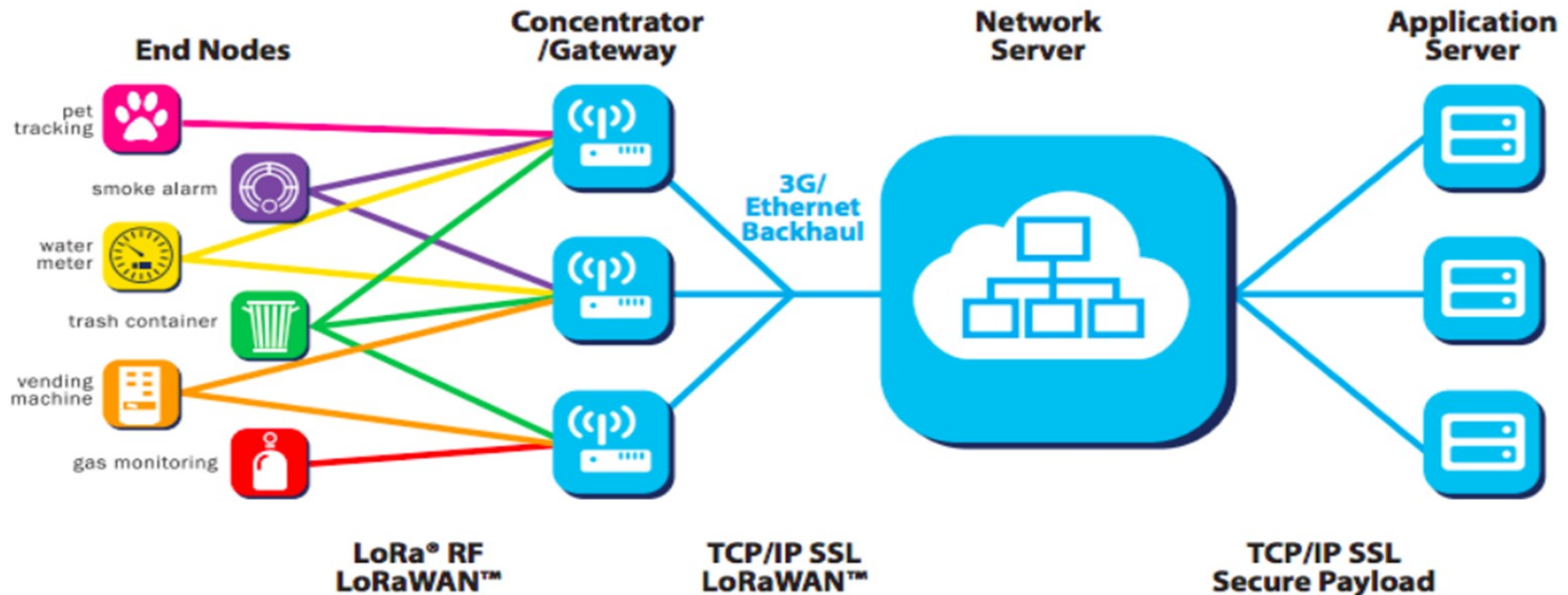
## •Point to Point Communication

- In point to point communication, two LoRa enabled devices talk with each other using RF signals.
- For example, this is useful to exchange data between two **ESP32** boards equipped with LoRa transceiver chips that are relatively far from each other or in environments without Wi-Fi coverage.
- Unlike Wi-Fi or Bluetooth that only support short distance communication, **two LoRa devices with a proper antenna can exchange data over a long distance.**

# LPWAN

- Deployed in a star topology
- LoRaWAN defines the communication protocol and system architecture for the network while the LoRa physical layer enables the long-range communication link
- Communication between sensor nodes & BS goes over the wireless channel utilizing LoRa physical layer and the connection between gateways & central server are over IP-based network
- **End Nodes** transmit directly to all gateways within range, using LoRa
- **Gateways** relay messages between end-devices & central network server using IP

# LoRaWAN network architecture



- An end node broadcast its data to every gateway in its vicinity.
- The gateways forward this packet to the network server.
- The network server collects the messages from all gateways and filters out the duplicate data and determines the gateway that has the best reception.
- The network server forwards the packet to the correct application server where the end user can process the sensor data.
- Optionally the application server can send a response back to the end node.
- When a response is send, the network server receives the response and determines which gateway to use to broadcast the response back to the end node.