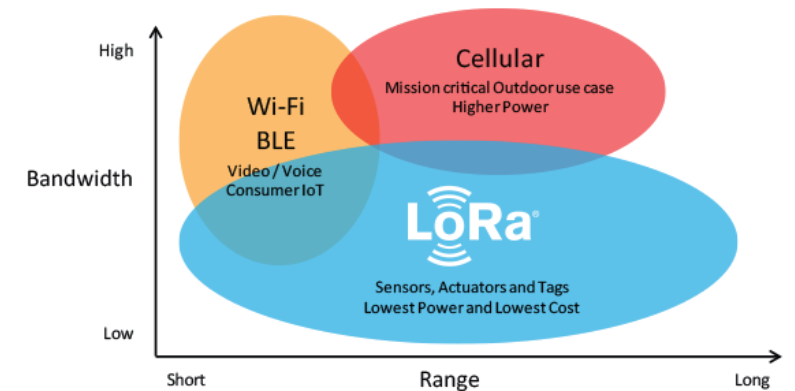# LoRa

Long range radio communication

Introduction

- Home Assistant is already in use for home automation

- Goal: Modular weather station with easy integration of additional sensors
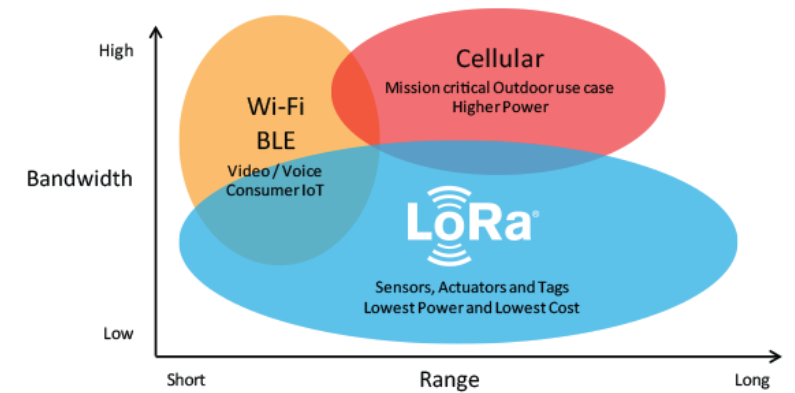
Radio Protocols

- WiFi, BLE, Zigbee

- Known standards

- Frequency: 2.4 GHz / 5 GHz

- Easy to integrate (ESP Home)

- Easy to integrate (Bluetooth)

- Easy to integrate (Zigbee2MQTT, ZHA, ...)

- Only short distance, for my case too short
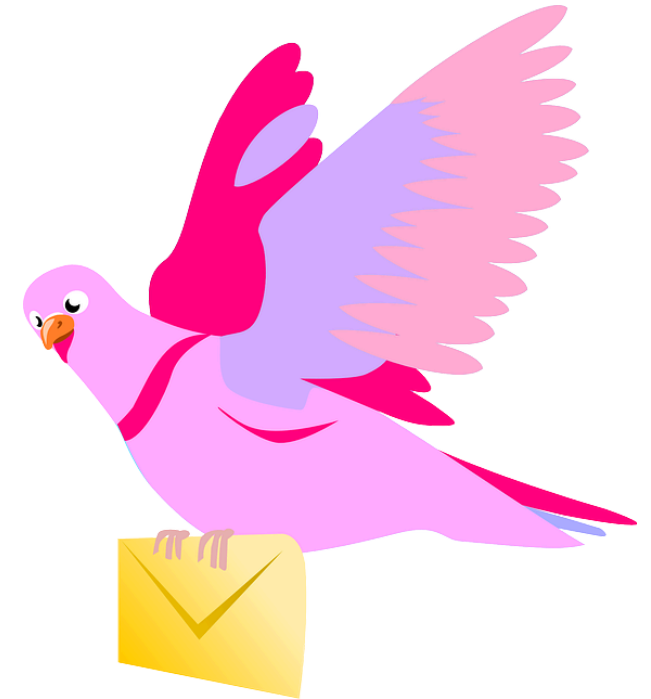
- Power Usage (WiFi)

Cellular

- 4G, 5G

- Known standards

- Integration unknown

- Long distance

- Power Usage

LoRa

- Known standard

- Harder to integrate (without LoRaWAN)

- Long distance, little data, little power

LoRa, LoRaWAN

- LoRa (from "long range")

    - Physical proprietary radio communication technique

    - Spread spectrum modulation

    - Patented in 2014 by Cycleo (later acquired by Semtech)

- LoRaWAN (wide area network)

    - Communication protocol and system architecture

    - Official standard: ITU-T Y.4480 (International Telecommunication Union)

   - Development managed by the non-profit LoRa Alliance (Semtech is a founding member)

https://en.wikipedia.org/wiki/LoRa

LoRa, LoRaWAN
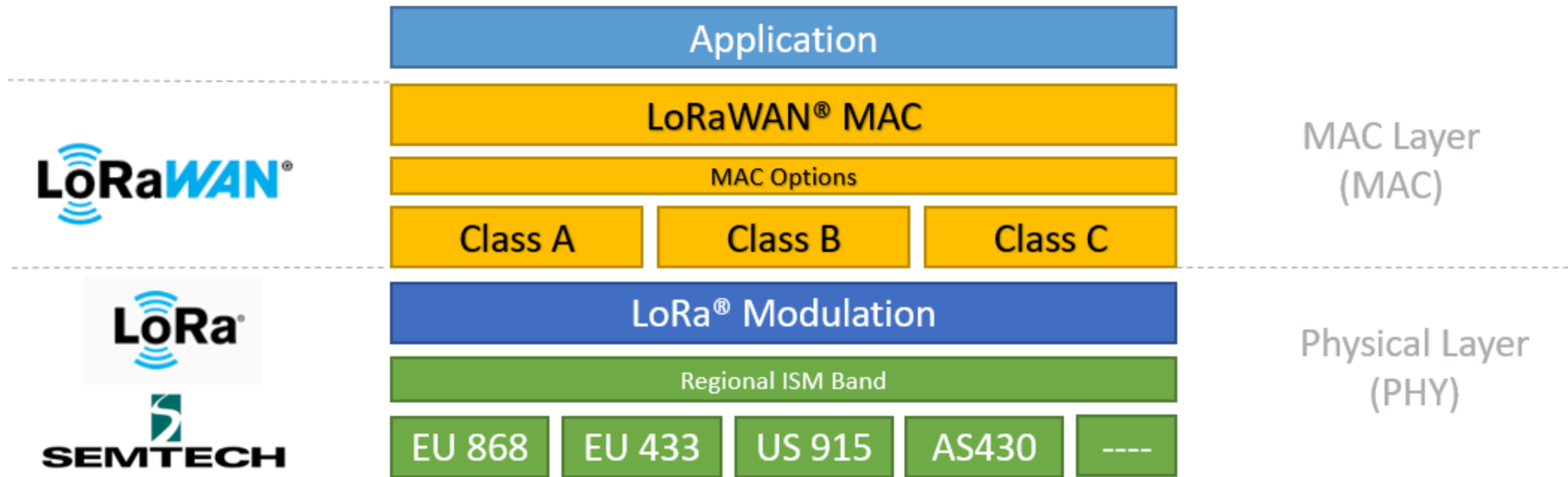
PHY

DEMODULATING THE PHY

1. Identify the beginning of a frame

2. Find the beginning of the PHY data unit

3. Extract data from instantaneous frequency transitions

‣ How? We need to quantify the frequency transitions

Source: https://devopedia.org/lora
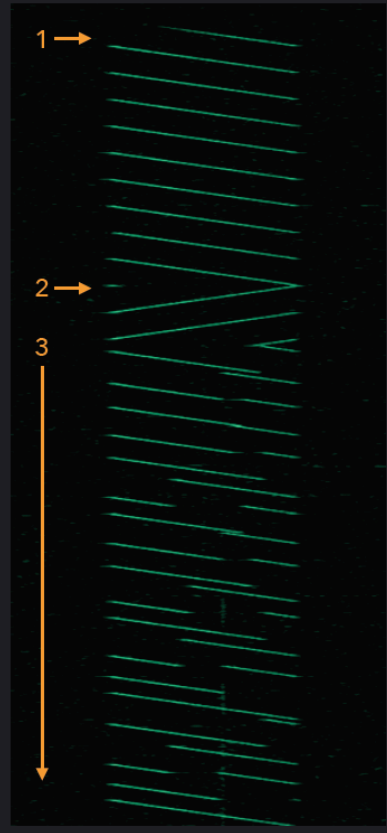
Chirps

A chirp is a radio signal pulse in which the frequency either increases (up-chirp) or decreases (down-chirp) in time. The increasing and decreasing of the frequency is linear.

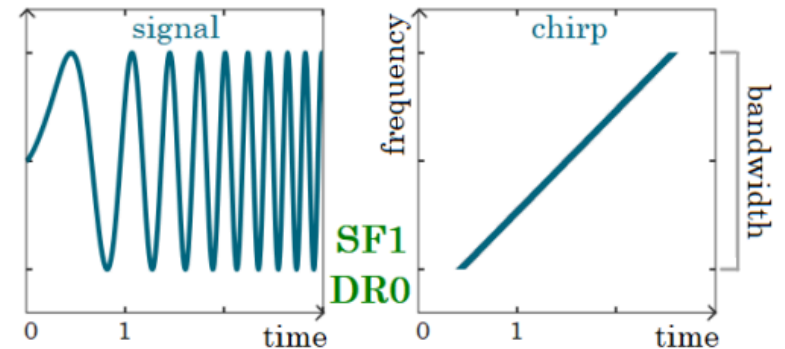Source: https://blog.ttulka.com/lora-spreading-factor-explained/
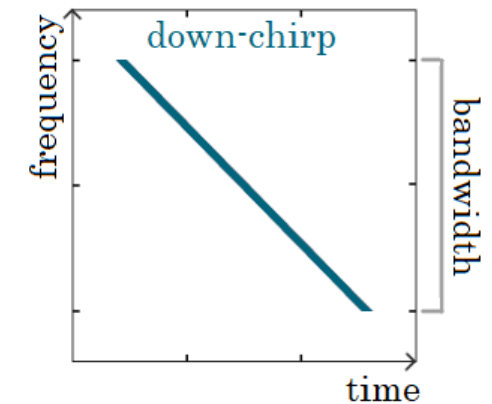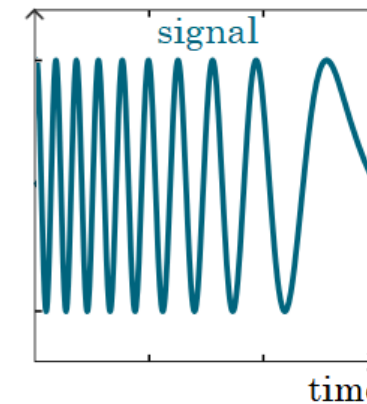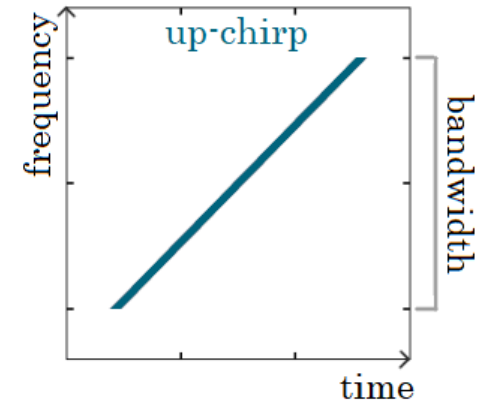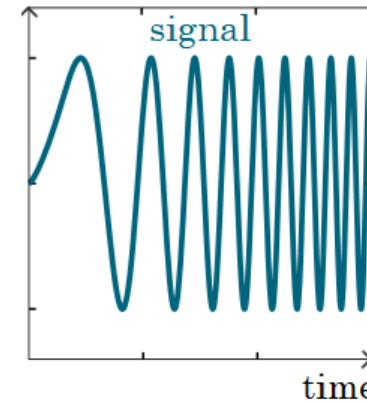
LoRa Parameters

Spreading Factor
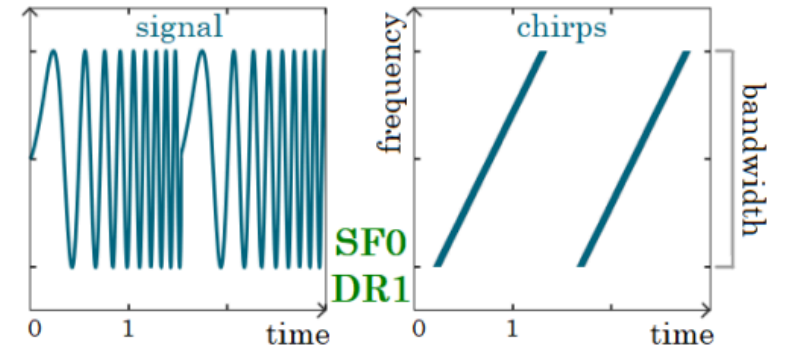
> Spreading factor (SF) is the speed at which the signal frequency changes across the bandwidth of a channel.

The lower SF, the higher data rate

Source: https://blog.ttulka.com/lora-spreading-factor-explained/

LoRa Parameters

Bandwidth

The bandwidth describes the frequency range from the lower to the upper end of the chirp signal.

Common values:

- 125 kHz
- 250 kHz
- 500 kHz

LoRa Parameters

Coding Rate

- Modulation adds a forward error correction (FEC) in every data transmission

- Encoding 4-bit data with redundancy

  - 5-bit (4/5)

  - 6-bit (4/6)

  - 7-bit (4/7)

  - 8-bit (4/8)

- Redundancy will allow the signal to endure short interferences

- The more interference in the channel, the higher the CR value

LoRa Parameters

Sync Word

Two well-known models: Semtech SX127x and SX126x

- SX1262 Sync Word: 2 Bytes (default 0x1424)
- SX1276/77/78/79 Sync Word: 1 Byte (default 0x12)

🤔

LoRa Parameters

Sync Word

Two well-known models: Semtech SX127x and SX126x

- SX1262 Sync Word: 2 Bytes (default 0x1424)
- SX1276/77/78/79 Sync Word: 1 Byte (default 0x12)

$$0xYZ = 0xY4Z4$$

where:

$$Y and Z = 1..7$$

Sync Word Compatibility
e.g. SyncWord: 0x1424 = 0x12

Law (Swiss)

- LoRa Funkverbindungen: Rechtliches
- Federal Office of Communications OFCOM - Non-specific SRDs (RIR1008)
- LoRa Air-Time Calculator

Law (Swiss)

RIR	Frequency Band [MHz]	Power [mW e.r.p.]	Duty Cycle [%]
RIR1008-06	868.0 - 868.6	25	1
RIR1008-09	869.4 - 868.65	500	10
RIR1008-40	915 - 918	25	1
RIR1008-41	916.1 - 917.7	100	1

LoRa2MQTT

- Read data from LoRa

- Feed them to MQTT

- Create Home Assistant device

- OpenMQTTGateway