



# Sigfox



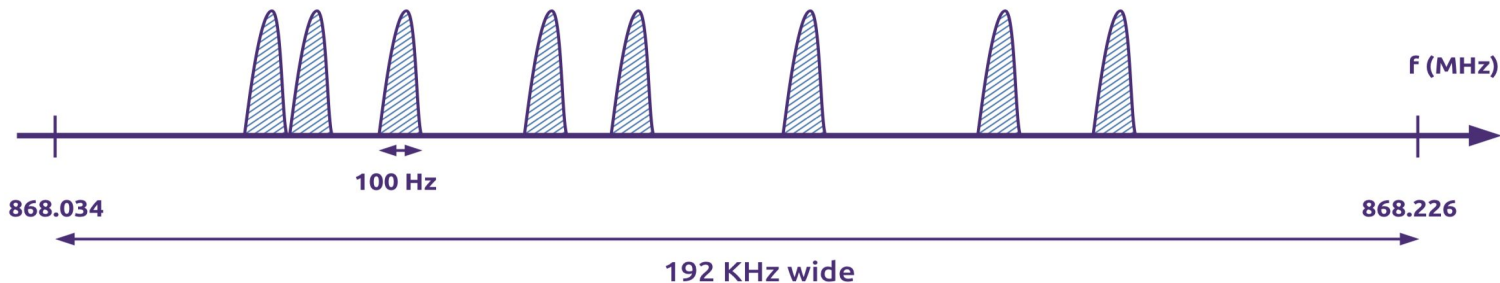
Mathilde Cornille, Clément Delobel, Jeremy Vincent

# Physical layer

## 1. Frequency & Bandwidth

- **Ultra-Narrow Band (UNB)**
- Message range : **100 Hz** wide
- Data rate : **100 to 600 bits per sec** depending on the regions
- Bandwidth : **192KHz** of the publicly available band
  - between 868 and 868.2 MHz in Europe
  - between 902 and 928 MHz in the rest of the world

Advantage : long distances and very robust against noise



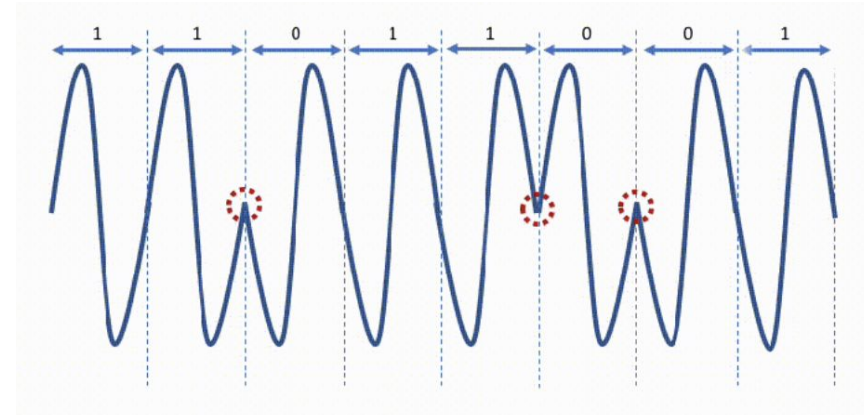
# Physical layer

## 2. Modulation

### Differential Binary Phase Shift-Keying (DBPSK)

Use the **phase changes** to encode 0 or 1

- 1 when no change
- 0 when change in phase occur

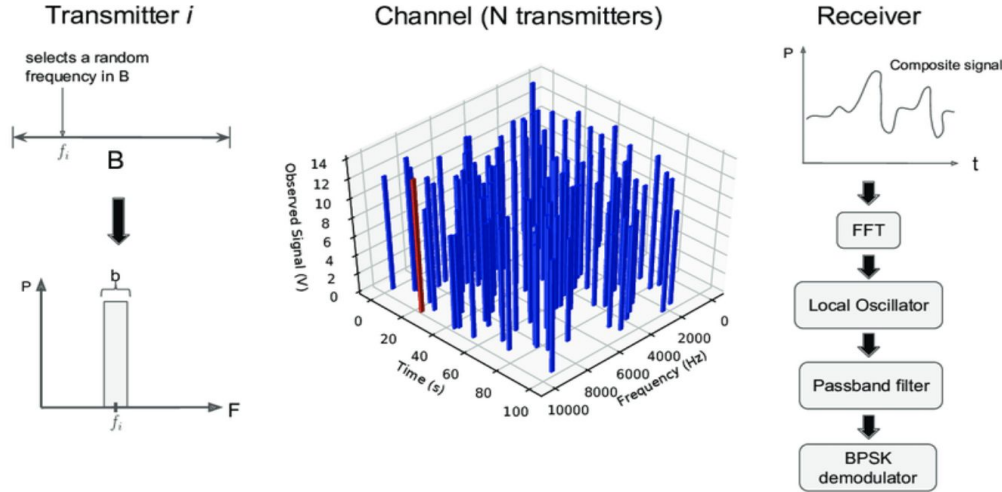


→ In contrary of simple BPSK do not need a reference of phase

# MAC layer



## Random Frequency Time Division Multiple Access (RFTDMA)



**Transmitter** : active nodes access randomly in time and frequency to the wireless medium without any contention-based protocol.

Time and frequency diversity : 2 replicas are sent on different frequency and time to increase QoS

**Receiver** : composite signal to demodulate

Advantage : protecting devices from interferences and limiting energy consumption

# Security



## 1. Build-in Firewall

- Sigfox **devices** (excluding IoT objects) are **not connected directly** to any network
- **built-in behavior** : messages are delivered to predefined destination (IoT applications)
- **Devices are shielded** : they do not have the ability to send data to arbitrary entity

## 2. Security of data in motion

- **A unique** symmetrical authentication **key** : provides the **integrity** of the sender and ce transmitted message.
- **Anti-replay** : a sequence **counter** is verified to detect and discard replay attempts.
- **Anti-eavesdropping** : possibility to **encrypt** sensitive data.

# Security



## 3. Security of data at rest

- **Sigfox devices** : authentication key storage.
- **Base stations** : credentials storage (communicate with the Sigfox Core Network)
- **Sigfox Core Network** : → authentication key & traffic metadata storage  
→ ensure the integrity, availability and confidentiality

# Power Consumption

- Many value **depending on use cases**: device, bitrate, directionality, distance, etc
- Table below based on **experimental** values of researchers :

Model	Payload	Consumption (mJ)	Energy (mJ/bit)
Simplified	12-byte	400	4.17
Sigfox based localization	12-byte	1 470	15.3
Based on energy harvesting	12-byte	4.56	0.0475

*Energy consumption analysis of one Sigfox transmission*

- **Usual autonomy** between **1 to 5 years** depending on the transmission period, data rate, etc
- **Theoretical asymptotic** device lifetime with 2400mAh battery : **14.6 years**

# Conclusion

## Advantages

- low power consumption
- works well for simple devices  
(transmits infrequently very small amounts of data, very slowly)
- wide coverage area where it is located

## Drawbacks

- not deployed everywhere
- less link budget going down than going up
- difficulties with mobility



# Sources



<https://www.disk91.com/wp-content/uploads/2017/05/4967675830228422064.pdf>

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Internet of Things for Architects : Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security