LPWAN: SIGFOX, LoRa and Weightless

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Low Power Wide Area Networks

Precedent

• Late 80s - AlarmNet by ADEMCO\textsuperscript{[1]} and ARDIS by Motorola\textsuperscript{[2]}

Characteristics

• Long Range Communications
• Low Bit Rate
• Low Energy Consumption

Future

• GSMA Mobile IoT Initiative for standardization\textsuperscript{[3]}

\textsuperscript{[1]} http://www.link-labs.com/past-present-future-lpwan/
\textsuperscript{[2]} http://www.signalharbor.com/ardis.html
\textsuperscript{[3]} http://www.gsma.com/connectedliving/mobile-iot-initiative/
Sigfox. History

- French Startup. Founded in 2008
- First LPWAN technology proposed in the IoT market
- Goal: Build wireless network to connect low energy-objects
- Global Internet Of Things operator
- 2011: First large suscription signed
- 2013: France fully covered
Sigfox. Deployment (FRANCE)

Base stations deployed:

01/01/2013
57 units

31/08/2013
396 units

31/12/2013
770 units
Sigfox. Infrastructure

http://www.sigfox.com/
Sigfox. Specifications

• **Physical layer**: Ultra Narrow Band (UNB) wireless modulation \[1\]

• **Communication**:
  - First models: Uni-directional communication
  - Last releases: Bidirectional communication

• **Coverage areas**:
  - 30-50 km (rural areas)
  - 3-10 km (urban areas)

• **Network Topology**: Star cell infrastructure \[2\]
  - Low OPEX

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\[2\] Paper: Long-Range Communications in Unlicensed Bands: the rising stars in the IoT and Smart Cities scenarios
Sigfox. Specifications

- **Frequency band**: ISM bands: 868 MHz in Europe, 902 Mhz in US
- **Bandwidth**: Ultra narrow Bandwidth (UNB), 100 MHz
- **Number of channels**: 400
- **Data rate**: 100 bps
- **Coding scheme**: Random-FDMA
- **Receiver Sensitivity**: -120 dBm / -142 dBm
- **Max. Transmission Range**: 50 km
- **Frequency Hopping**: Yes
- **Size of data packets**: 12 bytes (96 bits) per message
- **Maximum number of messages**: 140 every day
- **Duty cycles**: 1% (6 messages/hour)

http://www.markers.sigfox.com/
LoRa

- Modulation at the physical layer by semtech corp
- Chirp spread spectrum (CSS) modulation to reach higher distances
- Legacy wireless-FSK
- LoRaWAN- MAC protocol (LoRa Alliance) mimics 802.15.4
- Star topology

LoRa

- Frequency band: 169, 433 & 915 MHz USA, 868 MHz Europe[1]
- Frequency hopping: Yes
- Number of channels: 10 EU, 64 USA[4]
- Channel Bandwidth: 125/250 kHz EU, 125/500 kHz USA[4]
- Transmit power: 14 dBm EU, 20-30 dBm USA[4]
- Receiver Sensitivity: -130 dBm[7]
- Max. Transmission Range: 10 km[2]
- Available Data bit rates: 0.3 to 50 kbps (ADR)[1]
- Max. Number of simultaneous devices: 62500 if 1 pack/hour[5]
- Size of data packets: max 256 bytes[5]
- Size of header: 1 byte[3]
- ACK transmissions: 64 default[3]
- Time Synchronization: slotted and asynchronous[6]

LoRa

Energy consumption:[1]

- Transmission: 125 mA
- Reception: 13 mA
- Sleep: 0.0025 mA

Use of this technology:

Pros:
- Low power consumption
- Low cost

Cons:
- Emerging standards
- Low data rate
- Actual range is lower than advertised

Use cases:

- Streetlight control solution in Szada, Hungary[^1]
- Hoosjebootje - flood control on boats in Amsterdam[^2]
- I want to ride my bicycle - tracking and alarm system in Amsterdam[^2]

[^1](https://www.lora-alliance.org/portals/0/documents/whitepapers/inteliLIGHT_LoRa_-_Szada_Case_Study.pdf)
Weightless

- Weightless-W was the first version of the LPWAN
- Designed to work in the TV white space spectrum
- Good idea in theory but quite complicated to implement
  
  * Appears Weightless-N

- Similar to Sigfox
- Instead of being an end-to-end system uses a network of partners

http://www.link-labs.com/what-is-weightless/
http://www.weightless.org/about/what-is-weightless
· N-wave is the leader company in weightless-n technology

· RPMA
WEIGHTLESS vs SIGFOX

- Similar from a technological point of view
- Sigfoz offers a complete solution
- Weightless is just a standard which needs a company to create a solution around it (n-wave)

WEIGHTLESS vs LORA

- Very similar
- Both are uplink-focused data systems
Weightless

- **Channels**: 12.5kHz
- **Bandwidth**: Ultra narrow Bandwidth (UNB), 100 MHz
- **Data Rate**: 200bps - 100kbps
- **Range**: 2km