

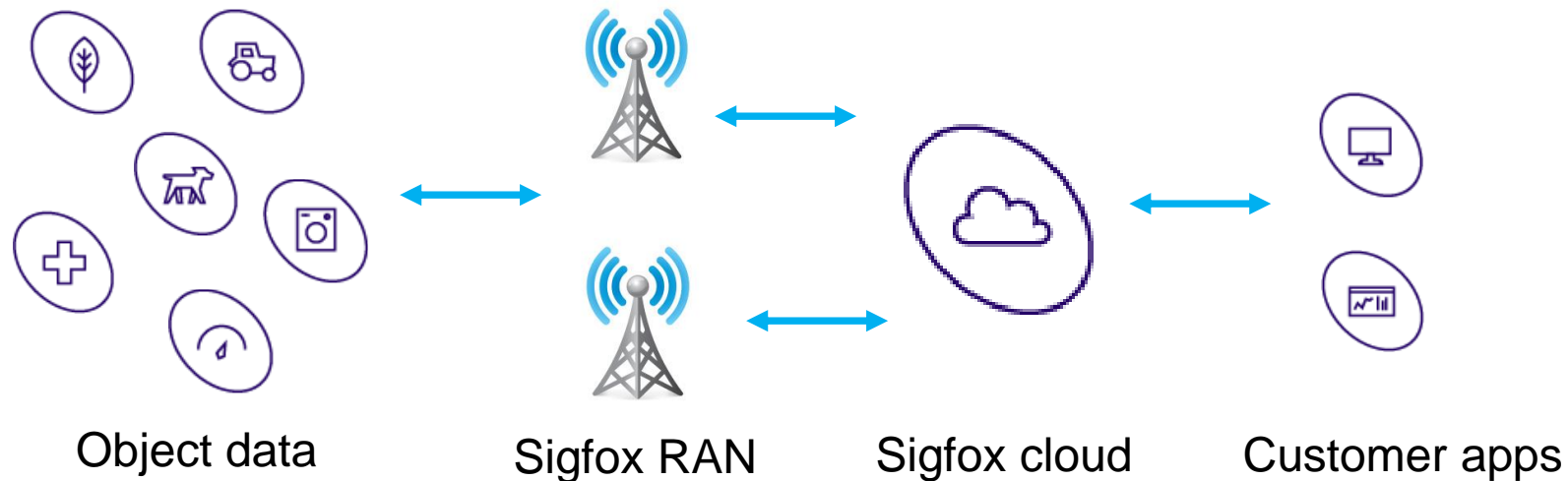
Sigfox System Description

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draft-zuniga-lpwan-sigfox-system-description-01

Architecture

- Central LPWA Gateway / Cloud-based (Service Center)
- Cooperative Radio Gateways (Base Stations) - MIMO
- Public network (like cellular)
- Central global authentication - no roaming requirements
- End-device application transparent to the network



Relevant L1 UL characteristics

- Channelization mask: 100 Hz ETSI / 600 Hz FCC
- Uplink baud rate: 100 baud ETSI / 600 baud FCC
- Modulation scheme: DBPSK
- Uplink transmission power: compliant with local regulation
- Link budget: 155 dB (or better = good indoor coverage)
- Central frequency accuracy: not relevant, provided there is no significant frequency drift within an uplink packet
- For ETSI-zones, UNB uplink frequency band limited to 868,00 to 868,60 MHz, with maximum output power of 25 mW and a maximum mean transmission time of 1%

Relevant L1 DL characteristics

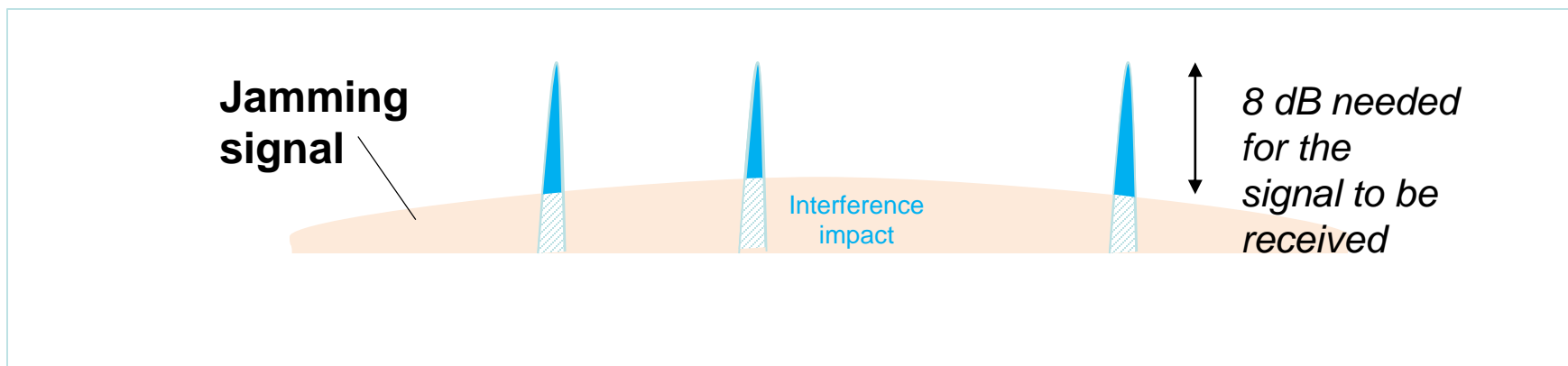
- Channelization mask: 1.5 kHz ETSI/FCC
- Downlink baud rate: 600 baud ETSI/FCC
- Modulation scheme: GFSK
- Downlink transmission power: 500 mW ETSI / 4W FCC
- Link budget: 153 dB (or better)
- Central frequency accuracy: Centre frequency of downlink transmission set by the network according to the corresponding uplink transmission
- For ETSI-zones, UNB downlink frequency band limited to 869,40 to 869,65 MHz, with maximum output power of 500 mW with 10% duty cycle

UNB – Overview

High resilience to interferers

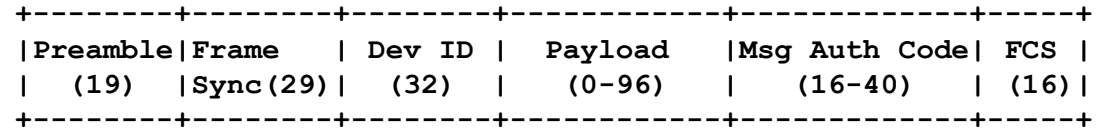
- Robust operation in ISM bands

Anti-jamming capabilities due to UNB intrinsic ruggedness coupled with spatial diversity of the base stations (+20dB)

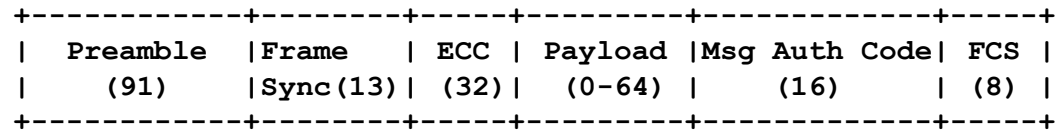


Relevant L2 characteristics

- Framing



Uplink Frame Format

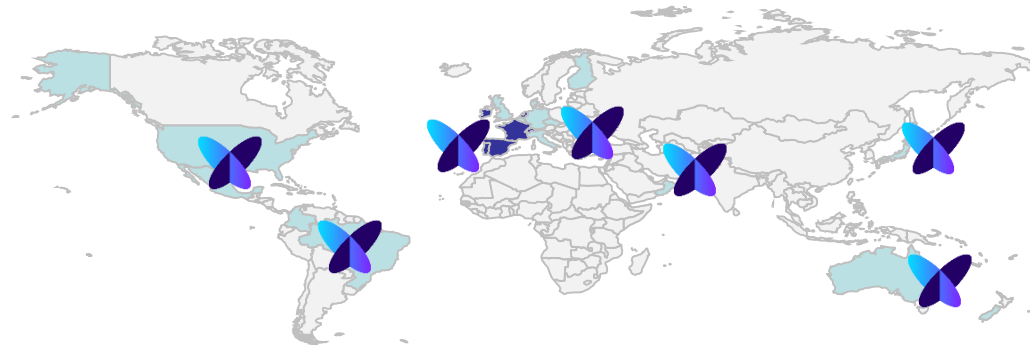


Downlink Frame Format

- Fragmentation and encryption at application layer
- Unicast asynchronous communications
 - 32-bit globally unique device ID
- Unbalanced UL/DL channels
 - Max. limitations: 140 Uplink vs 4 Downlink messages per day
 - Limitations can be slightly relaxed depending on system conditions
- L2 security
 - Message authentication code and unique device ID
 - Key management: pre-provisioned

Network deployment

- Current Network Deployment
 - Sigfox public LPWAN fully deployed in France, Spain, Portugal, Netherlands, Luxembourg, and Ireland
 - Being rolled out in Japan, Germany, UK, Belgium, Denmark, Czech Republic, Italy, Mauritius Island, Australia, New Zealand, Oman, Brazil, Finland, Malta, Mexico, Singapore and the USA
- Coverage
 - 1,3 million square kilometers / Population of 340 million people
 - Max cell size of 50 km



Examples of current applications

Public sector

- Connected waste bins and hydrants
- Air quality and water level monitoring
- Smart parking



Agriculture and environment

- Livestock management
- Smart irrigation
- Precision agriculture



Home and lifestyle

- Home alarm systems
- Smoke detectors
- Water quality and leak sensors
- Connected mailboxes



Utilities

- Water and electricity metering
- Smart building management
- Electricity microgeneration monitoring

Retail

- Smart buttons
- Customer satisfaction assessment

Payload size examples

- 6 bytes: GPS coordinates
- 2 bytes: temperature reporting
- 1 byte: speed reporting
- 1 byte: object state reporting
- 0 byte: heartbeat (demonstrate when an object is alive)

Health & assisted living

- Caregivers support and management
- Defibrillators
- Fall detectors



Industry

- Predictive maintenance
- Critical goods management
- Structural health monitoring



Fleet management

- Delivery truck tracking
- Stolen vehicle recovery



Sigfox Summary

- System tailored for low end, very low cost LPWAN devices
 - Complementing other networks to address the bulk of connected objects
 - Public network, multi-vendor support, university programs
 - Complex SDR BS, MIMO – simpler cert modules at about \$2-3
- Radio interface optimized for low power UL communications
 - Asynchronous channel
 - Unlimited sleep time
 - DL communication on demand by device application
- IETF LPWAN WG Interests
 - Definition of common LPWAN management features
 - Definition of common security features
 - Definition of common application profiles