Overview of IoT LPWAN technologies

(**L**ow **P**ower **W**ide **A**rea **N**etwork)

SIGFOX & LoRa

06/2016

- Overview
- The two main technologies
- Global comparison
- Our approach for LPWA

OVERVIEW - Characteritics

Long range

Long range communications even in dense urban areas.

Low data rate

< 10 Kb/s. De 8 à 256 bytes par message.

Low Power

Batteries last up to 10 years.

Star network

Unlike mesh networks (eg: Zigbee/802.15.4), star networks are more easily deployable and contribute to LPWA energy efficiency.

Low subscription cost

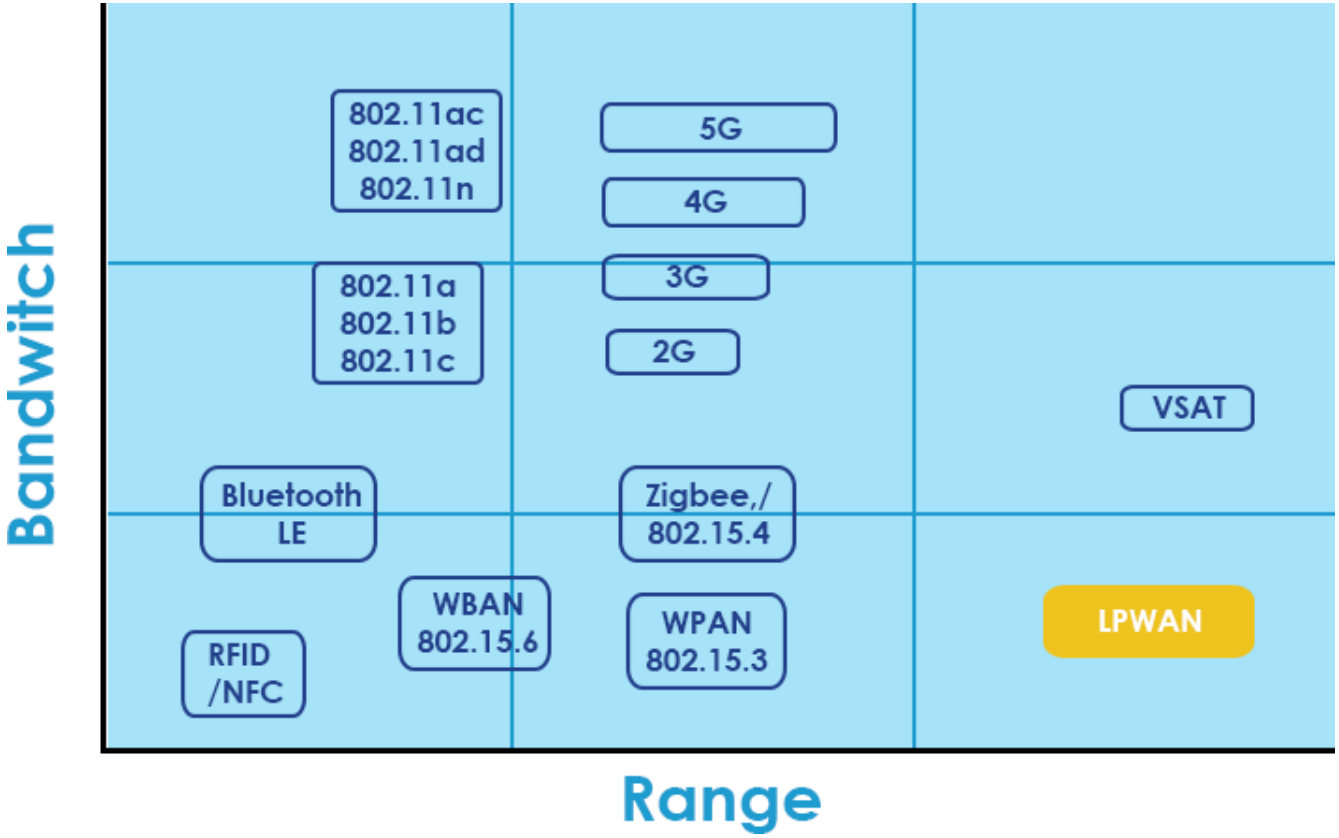
From less than 1€ per device per month.

Low number of required base stations

Several thousands of sensors managed by a single base station.

OVERVIEW - Positioning

A sweet spot for LPWAN that suits the Internet of Things usages.
Besides LPWAN, no other technologies fulfills the needs of IoT applications.



Source : Perter R. Egli (http://fr.slideshare.net/PeterREgli/lpwan)

OVERVIEW – Usages

Long rage communications even in dense urban areas

Smart City: smart grid, metering, lighting, structural health monitoring…
Smart Industry: predictive maintenance…

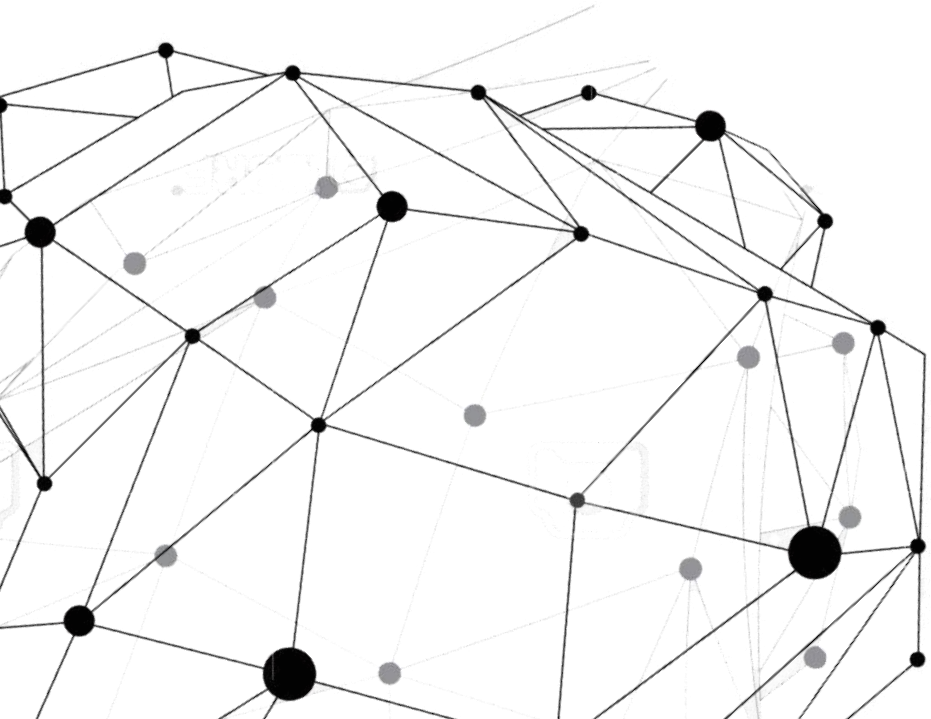
Isolated assets for applications requiring long life battery

Smart Agriculture: irrigation systems, …
Smart Grid / Water: metering

The two main LPWAN technologies

SIGFOX
One network A billion dreams

LoRa™



1. About
2. General points and data transmission
3. Architecture principles
4. Business model

1. About

SIGFOX is a French start-up company founded in 2009 and based in Toulouse.

Deploy long range infrastructure worldwide (visit: http://www.sigfox.com/coverage)

SIGFOX technology features modules able to send messages of **12 octets** maximum, with a maximum frequency of **140 transmissions per day**, and a datarate of **100 bits/s.**

- Network operator model only (annual subscriptions/connected object)
- Deployment outside France by selected SNOs (Sigfox Network Operator). Eg: Arqiva in the UK, Aerea in the Netherlands, Abertis Telecom in Spain, EI Towers in Italy…)
- Integration to its capital of telecomunication operators and equipment manufacturer to influence normalization of the Narrow-Band IoT.

2. General points

- The transmission uses public, open but regulated ISM radio band (ISM 868 MHz in Europe, 902 MHz in the US/FCC).
- Within an actual bandwidth of 48 KHz and soon of 192 KHz, centred on the 862 MHz frequency, in France and Europe, each device transmits on a bandwidth of 100 Hz. **A Sigfox modem cannot transmit more than overall 30s / hour** (1% of time, i.e. roughly 6 messages max/hour).
- The base frequency and authorised bandwidth are set in accordance with each country's regulations. This frequency range is public and can be shared with others users.

2. Transmission of the messages over the network

- Each device and each station have a unique Sigfox ID. The message are transmitted and signed with this ID. This signature authenticate the Sigfox device.
- Transmission mode is *fire and forget*: the modem does not wait for any acknowledgement from the base stations receiving the message. The modem has no awereness of the base station within its reach. Its missions are:
  - Multiple times transmission of messages (3 transmissions of the same message on 3 different canals)
  - The choice of transmission frequencies.
  - The choice of reception frequency which is calculated according to the frequency used for the last transmission

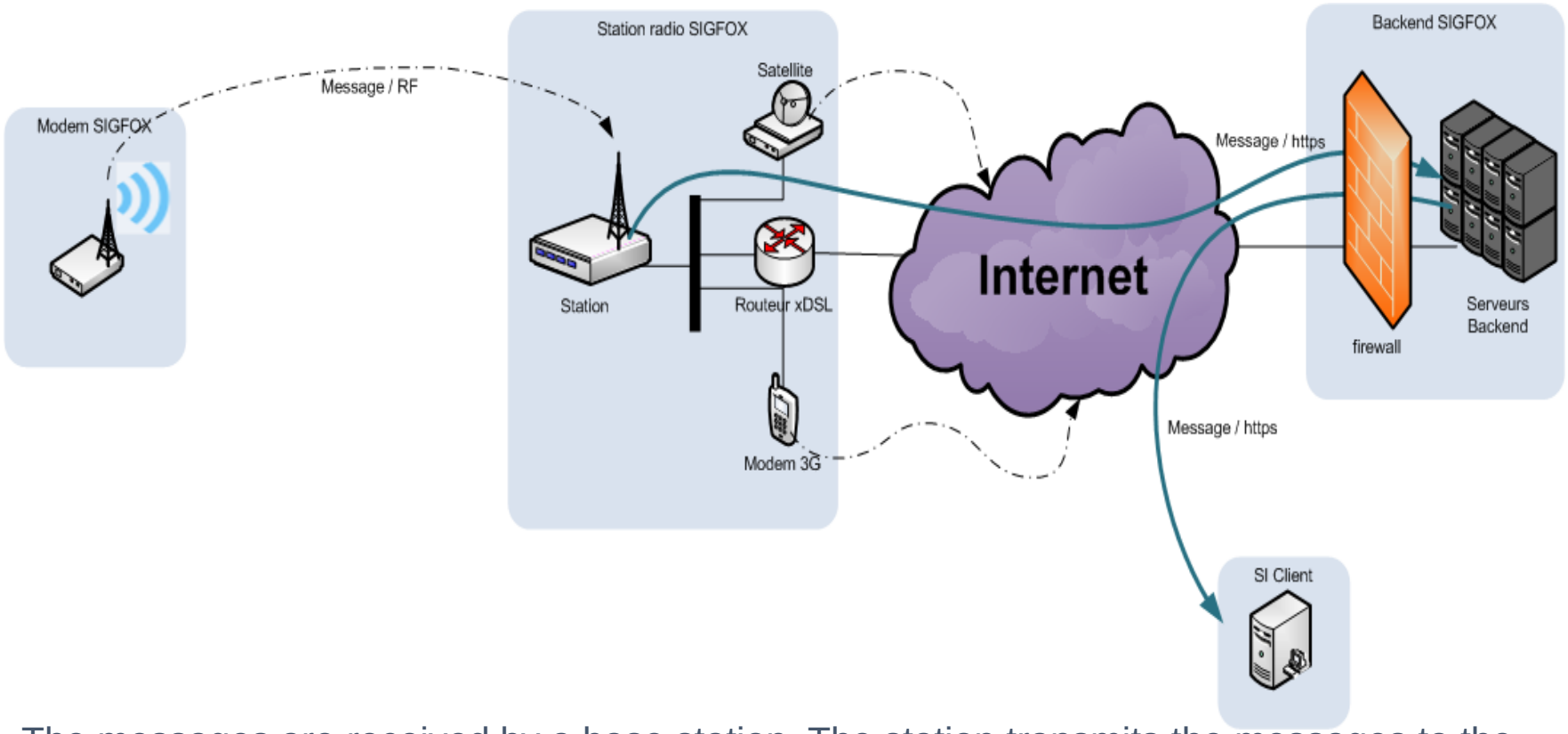
3. Bidirectional communication in Sigfox

- Uplink transmission (UL)

- Downlink transmission (DL)

1. The user sends to the back-end the demand for control
2. At the following UL connection of the Sigfox device, it is informed of the demand
3. Transmission by a single Base station
4. Delay in operation of transmission (asynchronous)
5. Up to 4 messages downlink per day per device (« platinum » subscription)

3. Architecture principles



The messages are received by a base station. The station transmits the messages to the Backend (BE) through IP connectivity. The BE stores and sends the messages to the client Information System.
The BE can send messages to the base station and connect to it. Nonetheless neither the BE nor the base station can connect to the device.

4. Business model

- An economic model based on subscription per connected devices (4 levels)
  - Royalties from telecom operators offering the Sigfox network
  - Network operator model (in France and the USA)
- Key variables for current Sigfox pricing model:
  - Total volume of connected devices (different price ranges)
  - Trafic profile / device (maximum number of uplink / downlink messages)
  - Duration of the subscription contract (impact = action fee for each single contract)
  - From < 1 € excl. tax/year/object to 7 € excl. tax/year/object + action fee/device/contract

1. About

- Technology and protocol engineered by SEMTECH (www.semtech.com) from a French technology (purchase of Cycleo in 2012)
- LoRa = Long Range => sturdy and increased range
- LoRa Alliance (founded at the end of 2014, > 200 members in February 2016 to support technical specifications)
- 2 successive versions of the protocol, LoRAMAC & LoRAWAN 1.0 (release January 2015)
- 3 classes of devices LoRAWan: A, B, C*
  - Classe A: **Bi-directional end-devices**
  - Classe B: **Bi-directional end-devices with scheduled receive slots**
  - Classe C: **Bi-directional end-devices with maximal receive slots**
- Chipsets exist in unidirectional (860 – 1020 MHz band) or bidirectional (High Band – 860-960MHz & Low Band – 169-510MHz) and for the moment are provided only by Semtech.
- End devices identification: IEEE EUI64 format

2. General points - LoRAWan Specification 1.0

- Datarate of 0,3 to 50 Kb/s
- Encryption AES128 device – server & end-node – user app
- Stars of stars architecture
- 3 classes of devices (bidirectionnal communication)
  - A Class
  - B Class (beacon)
  - C Class (continuous)
- Uplink messages format

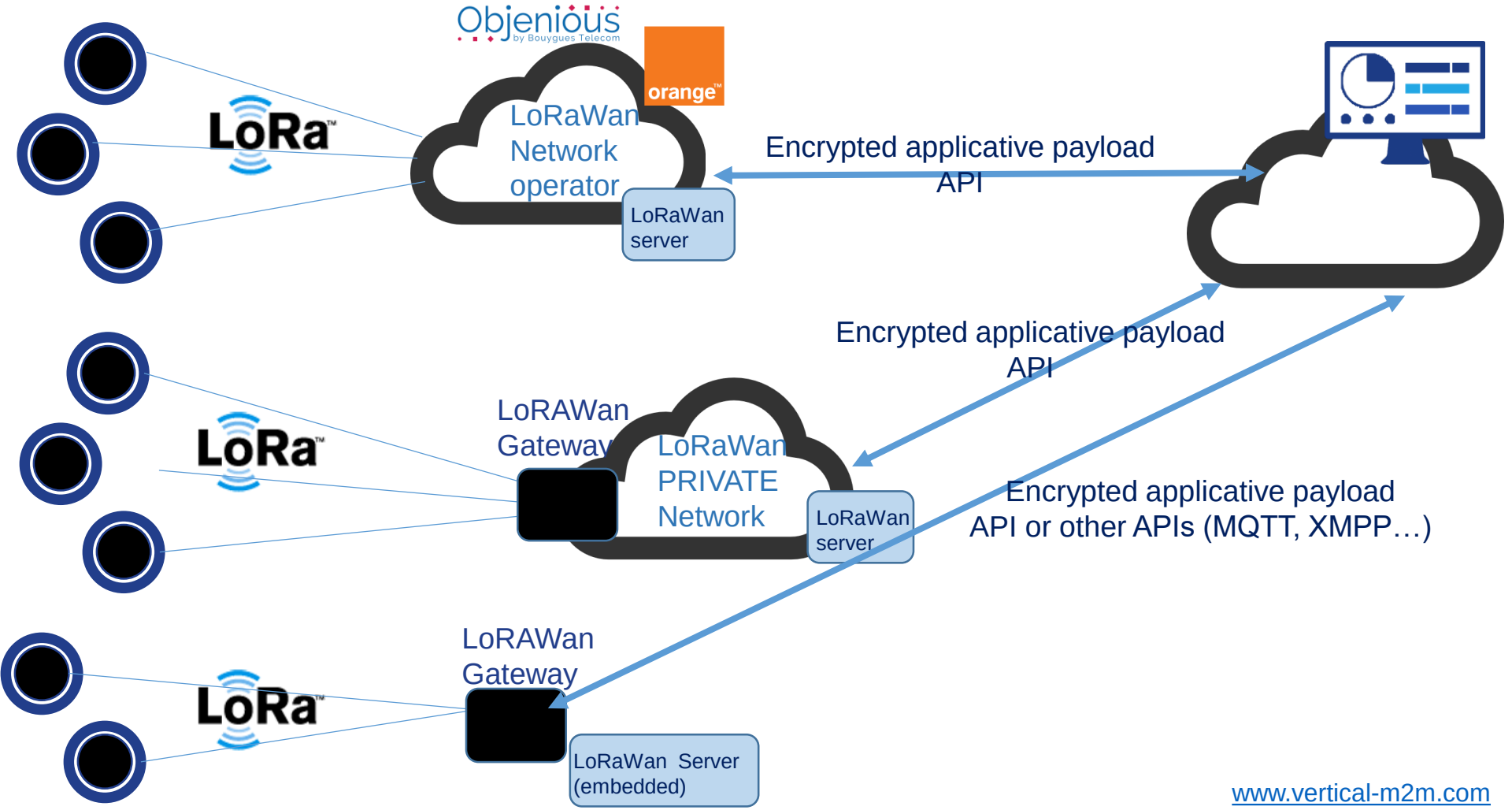
Preamble	PHDR	PHDR_CRC	PHYPayload	CRC

- Downlink messages format

Preamble	PHDR	PHDR_CRC	PHYPayload

3. Architecture principles

Review of technical architectures with LoRa



COMPARISON - SigFox or LoRA ?

Advantages of each technologies

SIGFOX
One network A billion dreams

- LoRa requires more base stations than Sigfox for the same communication capability. I**nfrastructures cost less** to Sigfox that will be able to lower its prices.

- Already **91% of the french population covered and several deployments worldwide.** LoRa coverage in France is at pilot stage: national coverage expected at the end of 2016 which prevent from tracking assets for instance which is a frequent usage on the Sigfox network.

LoRa™

- The content of **each message can reach 242 octets in** in comparison with 12 for Sigfox. LoRa suits better with applications requiring higher data rates (protocol based on spread spectrum).
- The technology **better penetrates buildings**
- **Better bidirectional support** owing to the symetric link. Example: if you are looking to perform control-command operations over your equipments.
- Adaptable data rate according to the object's environment
- LoRa is **backed by several telecom operators in France** (Orange, Bouygues)

Conclusion

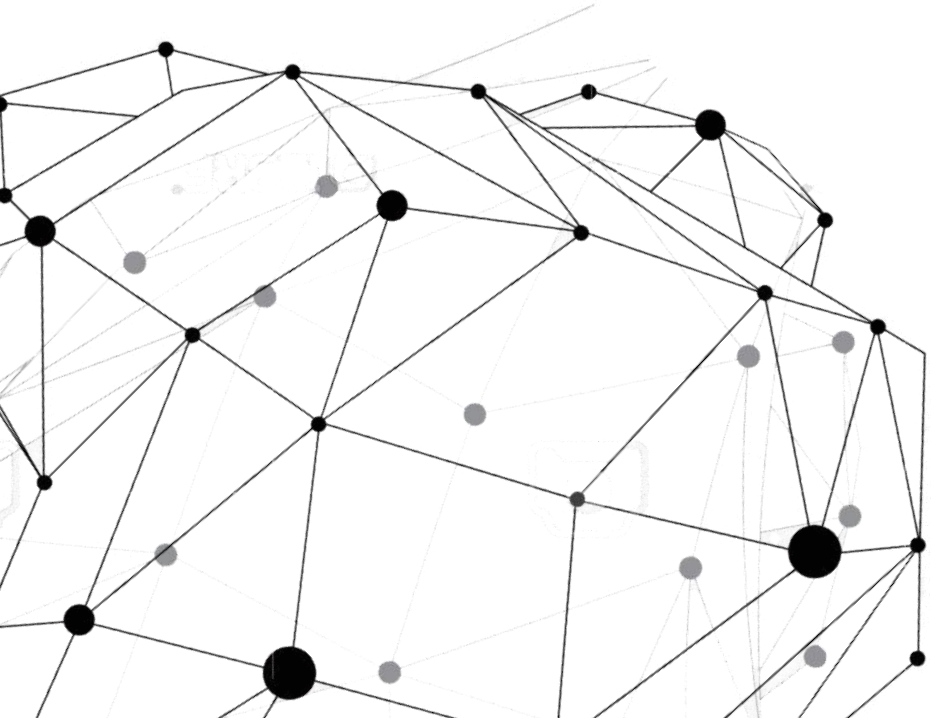
- A battle for the normalization of the two LPWA technologies with the support on both sides of telecom operators (SFR/NC for Sigfox, Orange & Bouygues Telecom for LoRA in France for example)
- Both technologies will coexist for the next years. They answer different needs !

COMPARISON – main LPWAN technologies

Feature	LORAWAN	SIGFOX	LTE Cat 1	LTE M	NB - LTE
Modulation	SS chip	UNB / GFSK / BPSK	OFDMA	OFDMA	OFDMA
Rx Bandwith	500 – 125 KHz	100 Hz	20 MHz	20 – 1.4 MHz	200 KHz
Data Rate	290bps – 50Kbps	100 bit / sec 12 / 8 bytes Max	10 Mbit /sec	200 kbps – 1 Mbps	Average 20K bit / sec
Max. # Msgs/day	Unlimited	UL: 140 msgs / day	Unlimited	Unlimited	Unlimited
Max Outpu Power	20 dBm	20 dBm	23 – 46 dBm	23/30 dBm	20 dBm
Link Budget	154 dB	151 dB	130 dB+	146 dB	150 dB
Battery lifetime – 2000 mAh	105 months	90 months		18 months	
Power Efficiency	Very High	Very High	Low	Medium	Med high
Interference immunity	Very High	Low	Medium	Medium	Low
Coexistence	Yes	No	Yes	Yes	No
Security	Yes	No	Yes Oui	Yes	Yes
Mobility / localization	Yes	Limited mobility, No localization	Mobility	Mobility	Limited mobility, No localization

Source: LoRAWAN Alliance, 2015

The approach of Vertical M2M for LPWAN



Our consulting for your LPWAN projects

- Professional services and LPWAN expertise
- Embbeded development and LPWA sensors / products design in the framework of solutions
- Management of heterogenous LPWAN sensors networks infrastructures (public LoRA, private LoRA, Sigfox…)
- Development of bespoke IoT applications featuring LPWAN through CommonSense IoT platform
- End-to-end solution design

Professional services and expertise on LPWAN / IoT connectivity solutions

- **Recognized experts** in multiple IoT technologies & technical training sessions since 2014

- **Unique expertise** of the whole LPWA spectrum

OneM2M Workshop, ETSI's headquarters, December 2016 with MULTITECH & SIERRA WIRELESS

Showcase G: Turnkey Smart city service platform using LPWAN (LoRa) and oneM2M API

http://www.etsi.org/news-events/events/966-2015-12-etsi-m2m-workshop-2015-featuring-onem2m

SIGFOX Partner
IoT platform provider
since april 2016.

https://partners.**sigfox**.com/companies/**vertical-m2m**

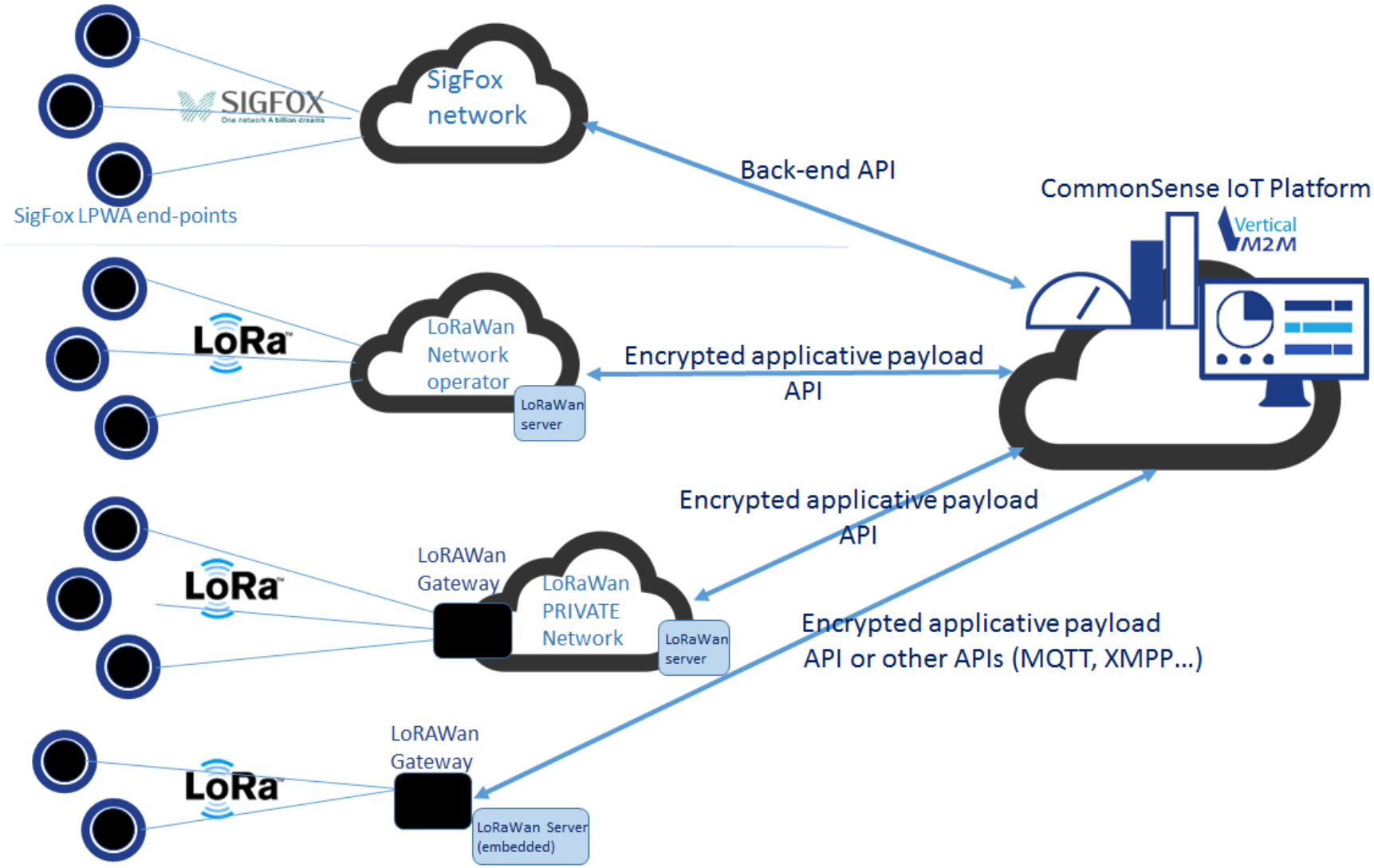
Administrator of the Paris *The Things Network* community

- **IoT technologies agnostic**

Embbeded developments and multiple platforms integration

- Multiple environnements of development: Python, Java, C/C++, OpenAT…
- Multiple telecom protocols: GSM/SMS/GPRS/3G/4G/broadband IP filaire (adsl, fiber…)
- Multiple data formats: Modbus, M-Bus, radio (Bluetooth, Wifi, Zigbee/802.15.4/ 6lowpan, Zwave, Sigfox, Semtech Lora…)

Management of heterogeneous LPWAN infrastructures with CommonSense IoT platform



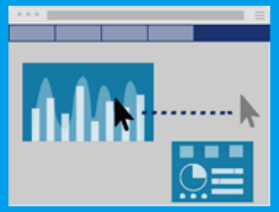
The CommonSense software infrastructure

Vertical M2M

CommonSense

Device management

Open infrastructure, can be easily integrated to external systems (IS, ERP, CRM...)



Application development module

On-the-shelves applications

OPEN DATA / IS / ERP

Smart City information system

MODBUS, M-BUS, Wavenis, Enocean, 802.15.4, Zigbee Zwave, BUS (KNX...), LoRa, Sigfox, OPC, Bluetooth, GSM,/SMS/2G/3G/4G

IoT telecom infrastructure

Infrastructures & Utilities

Smartbuildings & Homes

City equipments

Instrumentation & industrial equipments

Development of IoT/M2M applications

- CommonSense software architecture
- Application development module and API to design IoT applications
- On-the-shelves applications

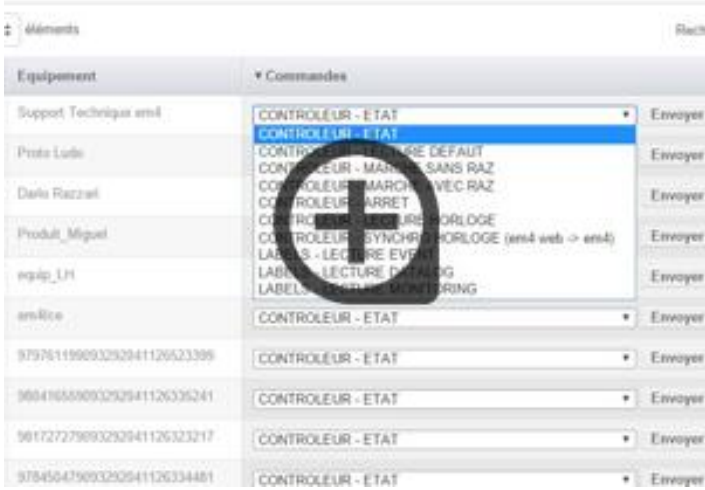
Monitor and ensure operations' performance

▲
Examples
▼

Remotely manage your equipments

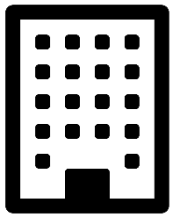
For more details visit: http://www.vertical-m2m.com/fr/commonsense-plateforme-iot

http://www.vertical-m2m.net/emailing/video/kfa-data-and-statistics.mp4



http://www.vertical-m2m.net/emailing/video/cst-equipements_maintenance_commandes.mp4

End-to-end solution design – examples: SmartEnergy, SmartBuilding & SmartHome



SmartBuilding solutions:

OneSense Energy

& U-shine (Renewable energy) since 2012

SmartHome solution since 2014

Several projects in the energy sector:

Les Champs du Soleil

FEDA

GazdeBordeaux

integra

SPIE

TERAO

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