



Technology Overview for W3C WoT Group

Juan Carlos ZUNIGA

Senior Standardization Expert – Sigfox

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- 1 INTRODUCTION
- 2 USE CASES AND DEPLOYMENTS
- 3 TECHNOLOGY
- 4 KEY FEATURES
- 5 IoT: CONNECTING THE “I” WITH THE “T”

1

INTRODUCTION

- Sigfox, Low Power Wide Area Networks (LPWAN) and Massive IoT



A dream of disruption to make things come alive

“Time flies! It’s already been more than five years that we have been chasing our dream to change the world with a crazy idea to connect the physical world to the Internet, consuming as little energy as possible and as simply as possible.

Today we are making it a reality, with hundreds of millions of messages already transmitted and received via the Sigfox Network, which continues to deploy around the globe.

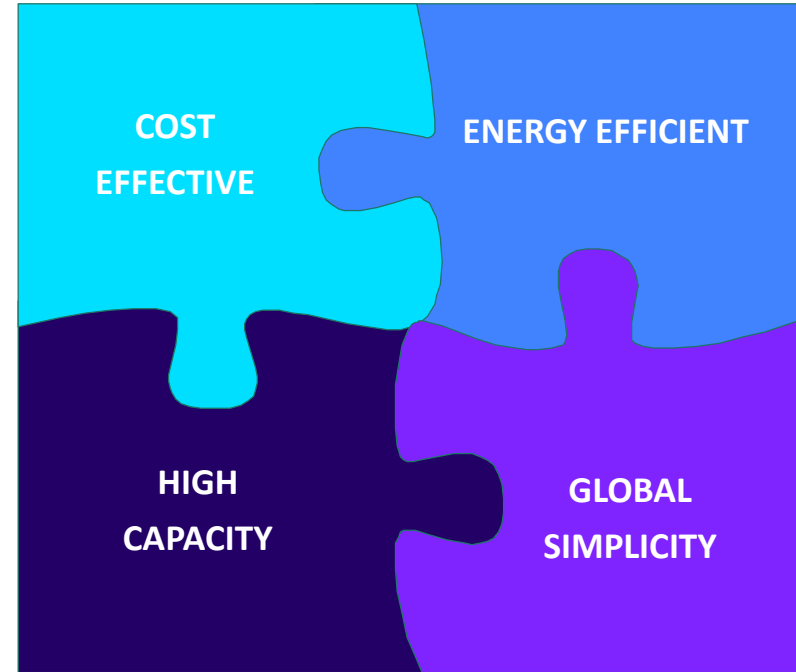
This is what we like to call the “Power of Low,” which fully embodies the meaning of the Internet of Things – a huge revolution without precedent. We’re excited about where all this is headed, and we hope you’re excited about it too!”

Christophe Fournet
CSO Sigfox

Ludovic Le Moan
CEO Sigfox

KEY GOALS FOR MASSIVE IoT

- € Ultra Low Cost (Devices and Network)
- ⚡ Ultra Low Current Drain
- 📶 Ultra High Capacity – Scalability
- ✂️ Global Simplicity

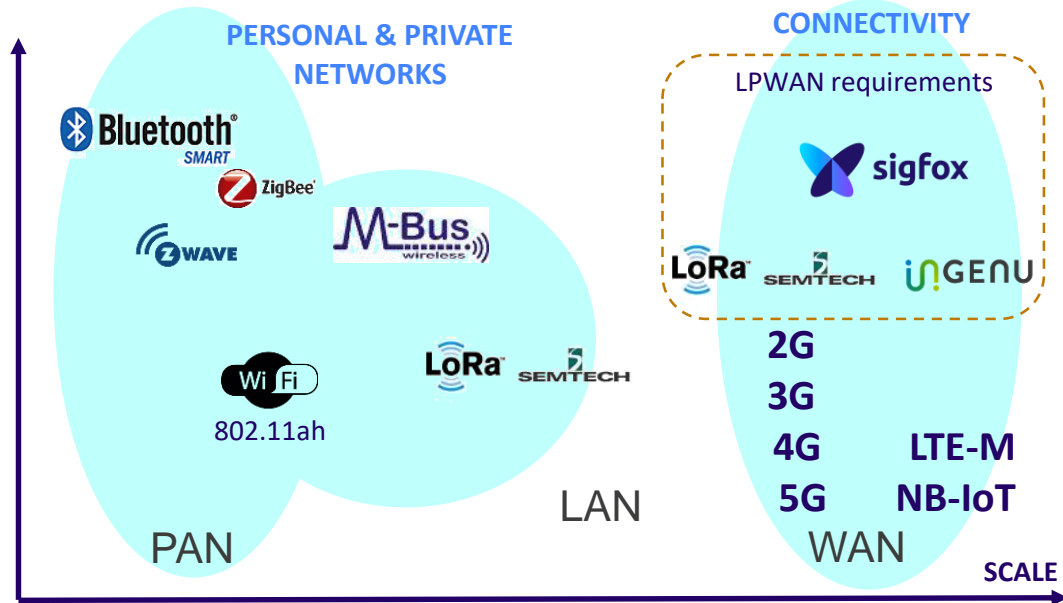


SIGFOX IS A LOW POWER WIDE AREA NETWORK

complementing existing networks to address the bulk of connected objects

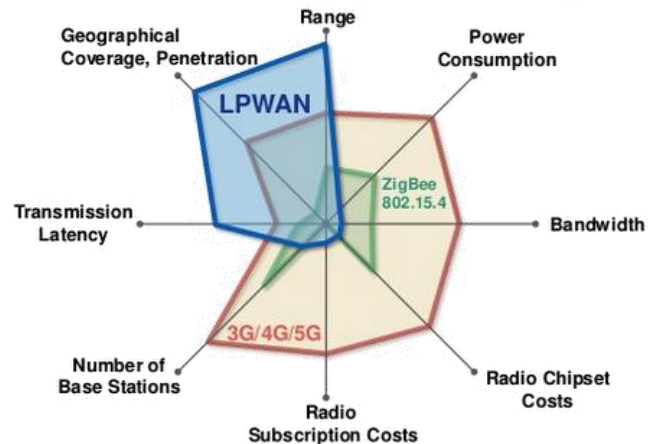
ENERGY & COST
EFFICIENCY

PERSONAL & PRIVATE
NETWORKS



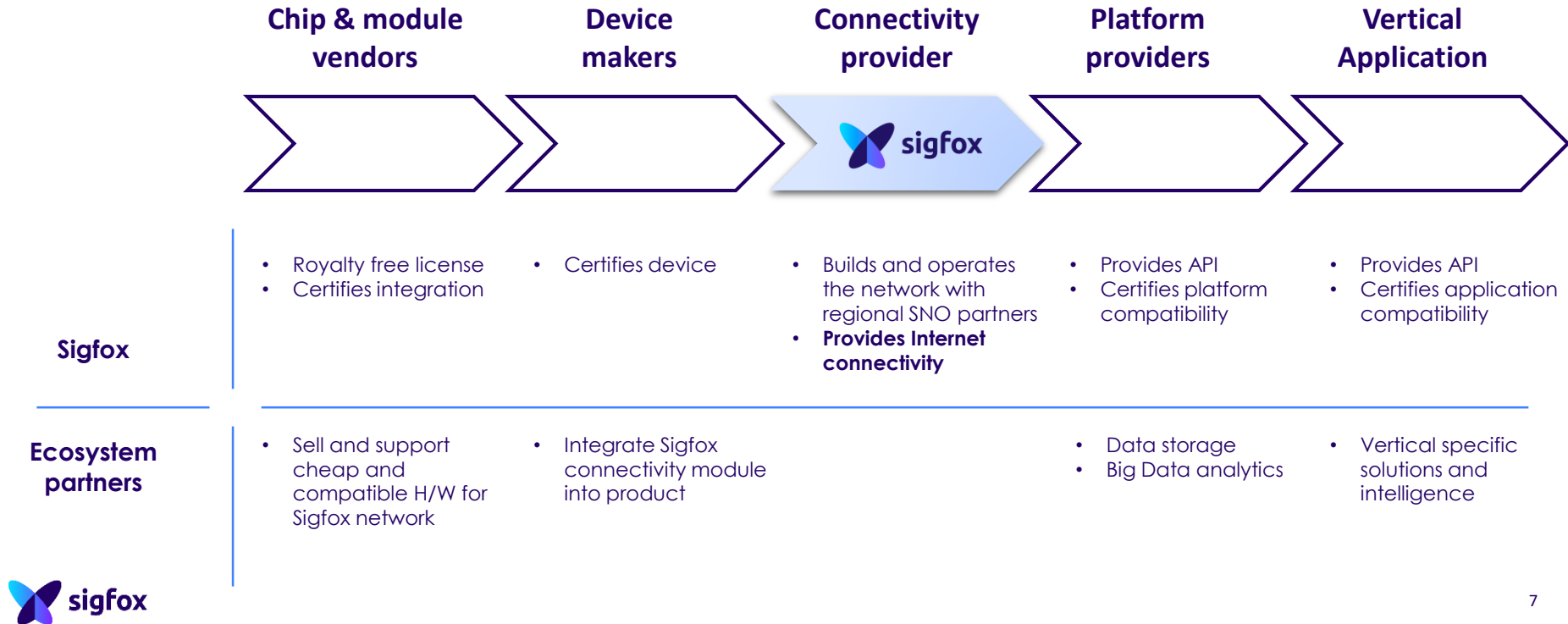
LPWAN definition

- High density of objects
- Reduced H/W cost
- Reduced connectivity cost
- Low data rates
- Constrained latency



WHERE WE ARE IN THE IoT CHAIN

A network to transport data from connected objects to the customer IT systems



3

USE CASES AND DEPLOYMENTS

- Customer stories
- Country deployments
- Sigfox Foundation

Assisted Living Box



Z#BRE

MANAGE PEOPLE REMOTLY

Challenge

The city council of Loiret in France, which supports financially medical cares for seniors, was regularly overcharged by care service providers. With the ageing population, there is a need for solutions to help seniors staying at home longer without their relatives worrying too much.

Solution

The Lysbox helps monitoring service providers and automate the billing based on the actual time spent with the seniors. It also sends alerts to neighbors or families in case of a heat wave or cold spell detected through the temperature sensor of the device.

Finally, seniors can also call for help thanks to the emergency button on the device.

Benefits

- ✧ The ROI was reached within the first 6 months thanks to the savings of 3 million € per year, which represent 10% of their budget. The total cost of the project was 1.5 million €.
- ✧ The adoption rate was 97% among the seniors.
- ✧ The social isolation broke down and services quality went up.



Home Alarm System



Challenge

Alarms are traditionally connected through GSM to central system and burglar intrusion can be facilitated by GSM jammers. There is a need for effective backup connectivity to ensure more robust alarm transmissions.

Solution

Sigfox has upgraded Securitas Direct's alarm systems to provide a back-up connectivity in case jamming is detected.

The upgrade was possible over the air as a Sub-GHz chip was already inside.

Benefits

- ✧ Robustness of solution is a commercial differentiator
- ✧ Continuity of service
- ✧ Soft deployment via over the air update - no HW swap. No user impact
- ✧ Network available to handle millions of devices

SECURE BETTER



Alternative partners for this application

SMACT

 MCS 360

Smoke Detector



Challenge

Alarms are traditionally connected through GSM to central system and burglar intrusion can be facilitated by GSM jammers. There is a need for effective backup connectivity to ensure more robust alarm transmissions.

Solution

Connected smoke detectors to increase safety

Regular status (heartbeat) monitors check sensors are functioning correctly

Real time alerts through phone calls, SMS, and emails

Distribution through retail and insurance companies



Benefits

✧ A Unique Selling Proposition:

- Easy to install
- Secure data transmission
- Proof of function
- 5+ year battery life

✧ TAM: 12 million policy holders

SECURE BETTER



Alternative partners for this application



MCS 360

SMACT

Precision Agriculture



Challenge

Irrigation & usage of fertilizers are based on the intuition of the farmer and represent a big part of its operating costs.

Solution

GreenCityZen offers the HummBox, a continuous measurement solution for the monitoring of environmental data. Hummbox is an energy and communication means stand-alone solutions, very simple to deploy and interoperable. The HummBox brings immediate benefits such as reduced costs of field trips, improved process performance and help to enrich service offerings ect leaks and water waste.

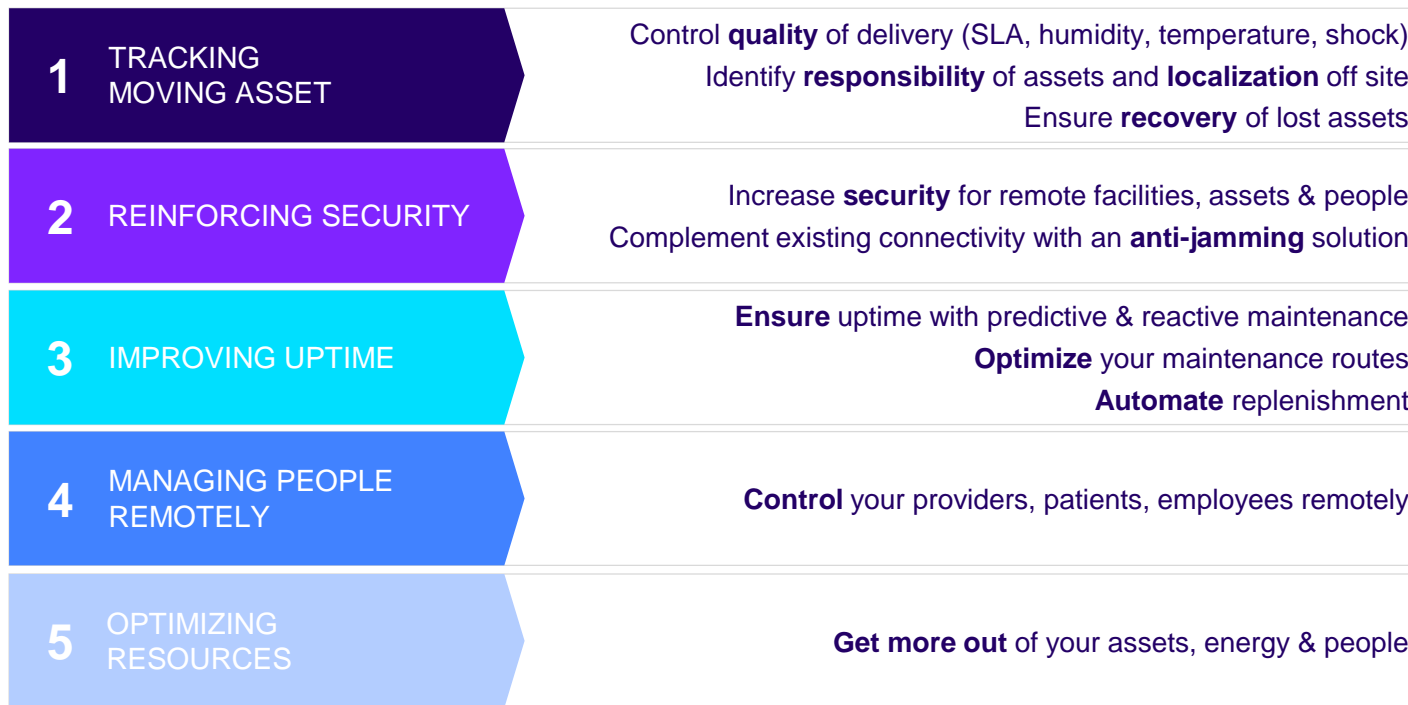
Benefits

- ✧ Save water resources
- ✧ Decrease operating cost by using no more water and fertilizers than what is actually needed
- ✧ Micromanagement of the parcel
- ✧ Improve production quantity and quality

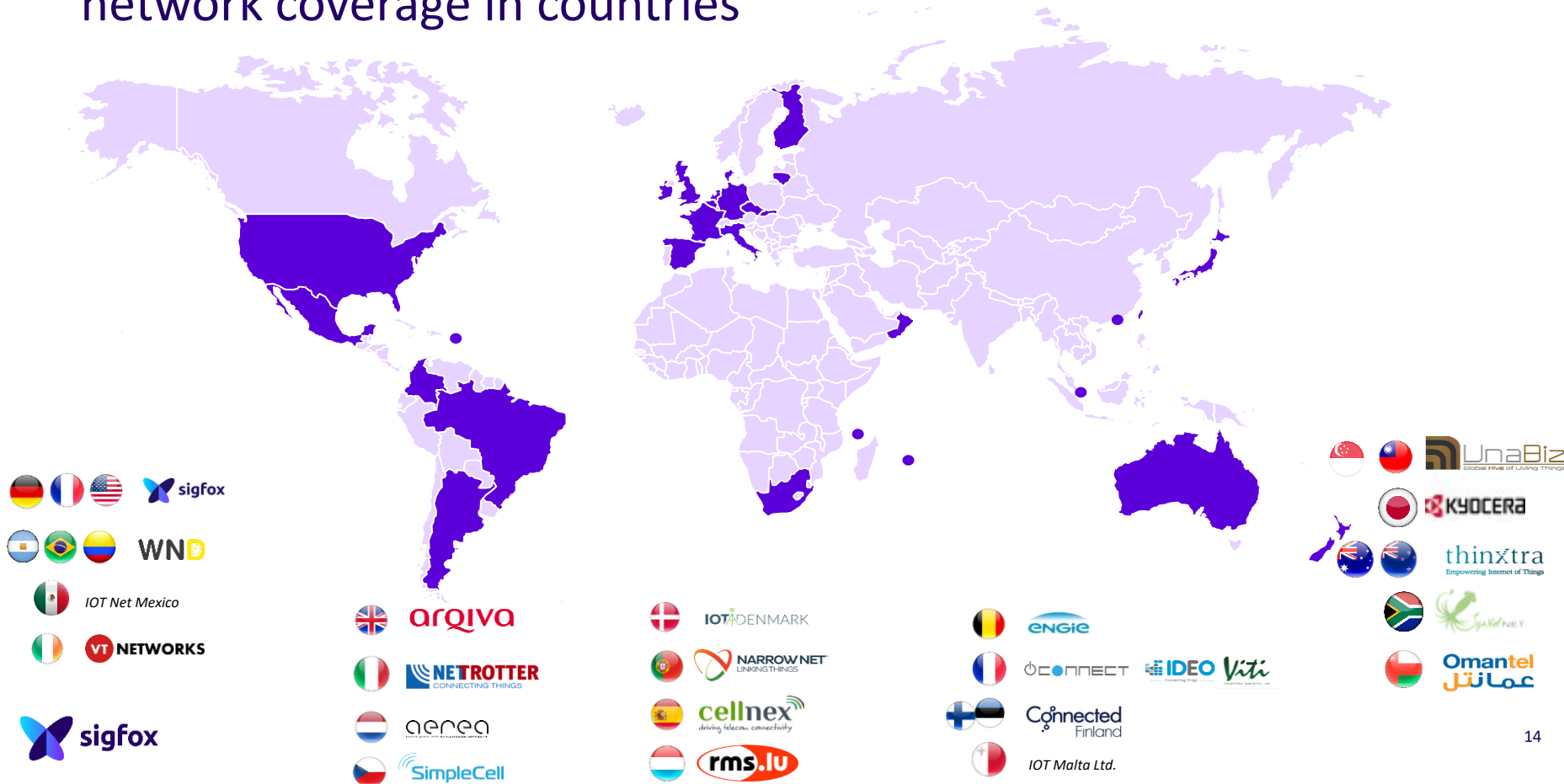
OPTIMIZE YOUR RESSOURCES



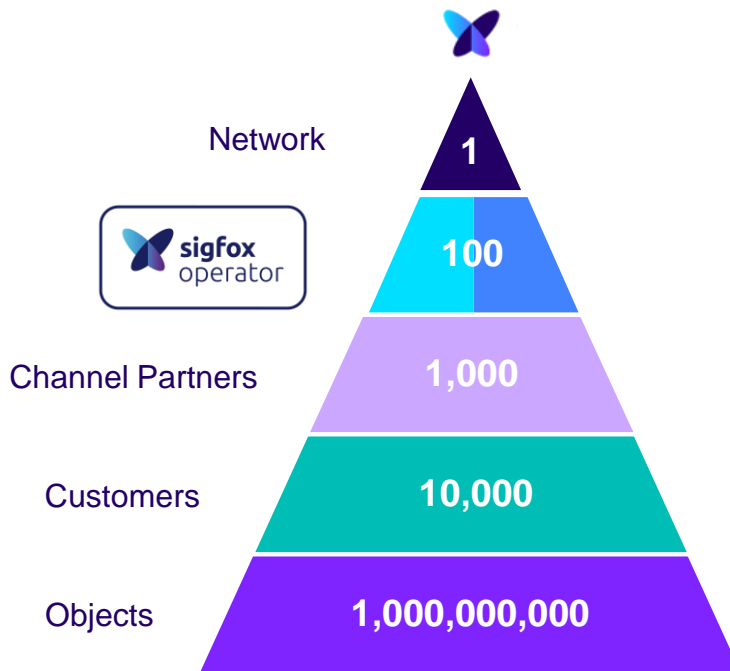
Thanks to our IoT solutions, we enable to unlock **5** main business benefits...



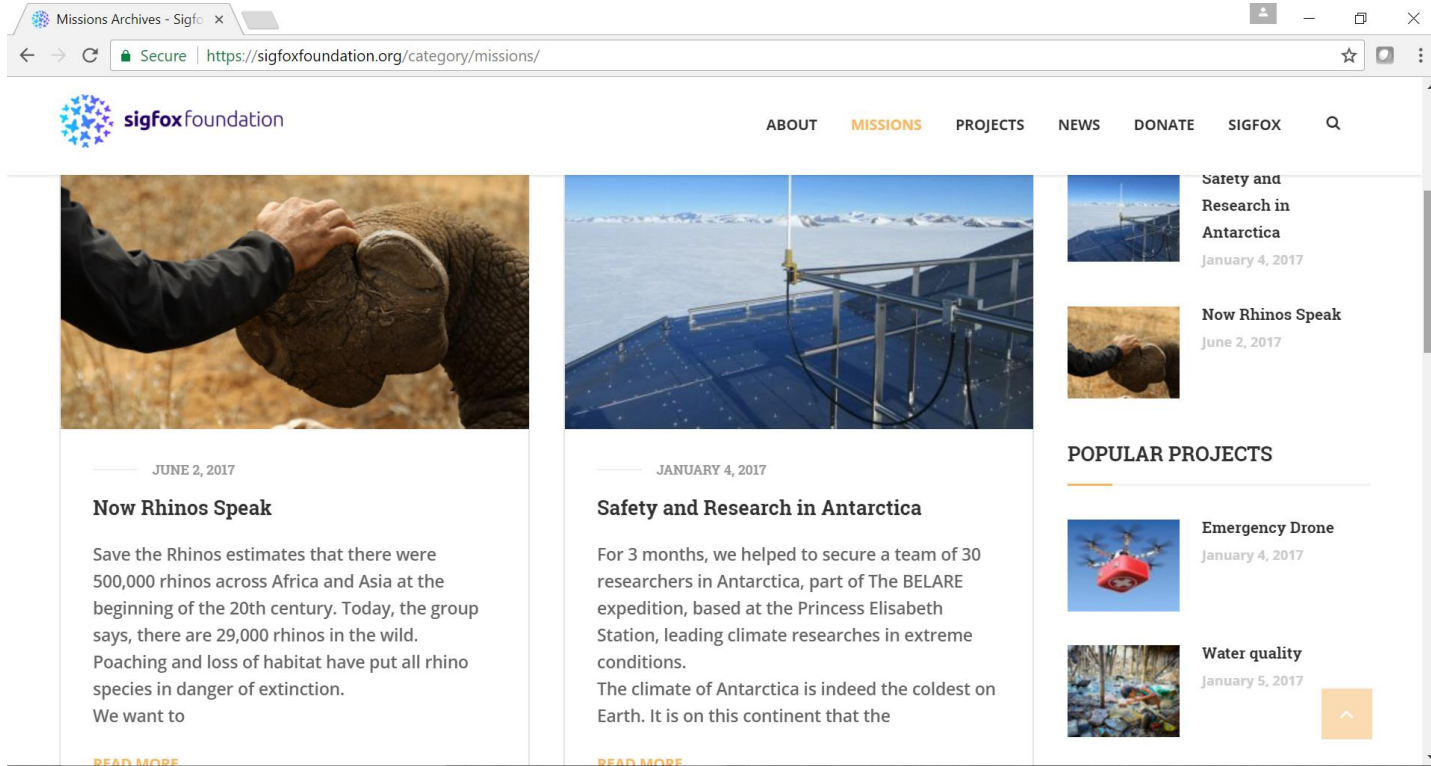
Sigfox network relies on Sigfox Operators that provide the network coverage in countries



Sigfox and Operators offer to customers an ecosystem on which all objects can be connected




Sigfox Foundation



The screenshot shows a web browser window with the address bar displaying "https://sigfoxfoundation.org/category/missions/". The website header features the Sigfox Foundation logo on the left and a navigation menu with links for ABOUT, MISSIONS, PROJECTS, NEWS, DONATE, and SIGFOX on the right. Below the header, the page is divided into three main columns. The left column features a large image of a person's hand touching a rhino's head, with the date "JUNE 2, 2017" and the title "Now Rhinos Speak". The middle column features a large image of a blue tent structure in a snowy landscape, with the date "JANUARY 4, 2017" and the title "Safety and Research in Antarctica". The right column features a list of articles, including "Safety and Research in Antarctica" (January 4, 2017) and "Now Rhinos Speak" (June 2, 2017), followed by a section titled "POPULAR PROJECTS" with articles like "Emergency Drone" (January 4, 2017) and "Water quality" (January 5, 2017). Each article has a small thumbnail image and a "READ MORE" link at the bottom.

Missions Archives - Sigfox

Secure | <https://sigfoxfoundation.org/category/missions/>

 sigfox foundation

ABOUT MISSIONS PROJECTS NEWS DONATE SIGFOX

Now Rhinos Speak
JUNE 2, 2017

Save the Rhinos estimates that there were 500,000 rhinos across Africa and Asia at the beginning of the 20th century. Today, the group says, there are 29,000 rhinos in the wild. Poaching and loss of habitat have put all rhino species in danger of extinction. We want to

[READ MORE](#)

Safety and Research in Antarctica
JANUARY 4, 2017

For 3 months, we helped to secure a team of 30 researchers in Antarctica, part of The BELARE expedition, based at the Princess Elisabeth Station, leading climate researches in extreme conditions. The climate of Antarctica is indeed the coldest on Earth. It is on this continent that the

[READ MORE](#)

Safety and Research in Antarctica
January 4, 2017

Now Rhinos Speak
June 2, 2017

POPULAR PROJECTS

Emergency Drone
January 4, 2017

Water quality
January 5, 2017

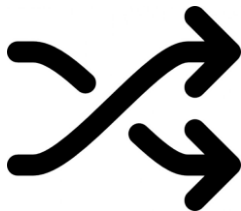
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TECHNOLOGY

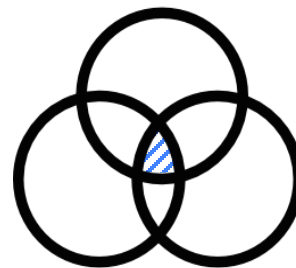
- Ultra narrow band
- Random access
- Cooperative reception
- Small messages
- Bi-directional
- Cloud-based Core Network



ULTRA NARROW BAND



RANDOM ACCESS



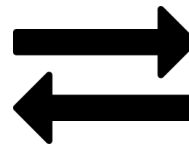
COOPERATIVE RECEPTION



SMALL MESSAGES



SIGFOX CLOUD
CORE



PIGGYBACK BI-DIR

ULTRA NARROW BAND (EU)



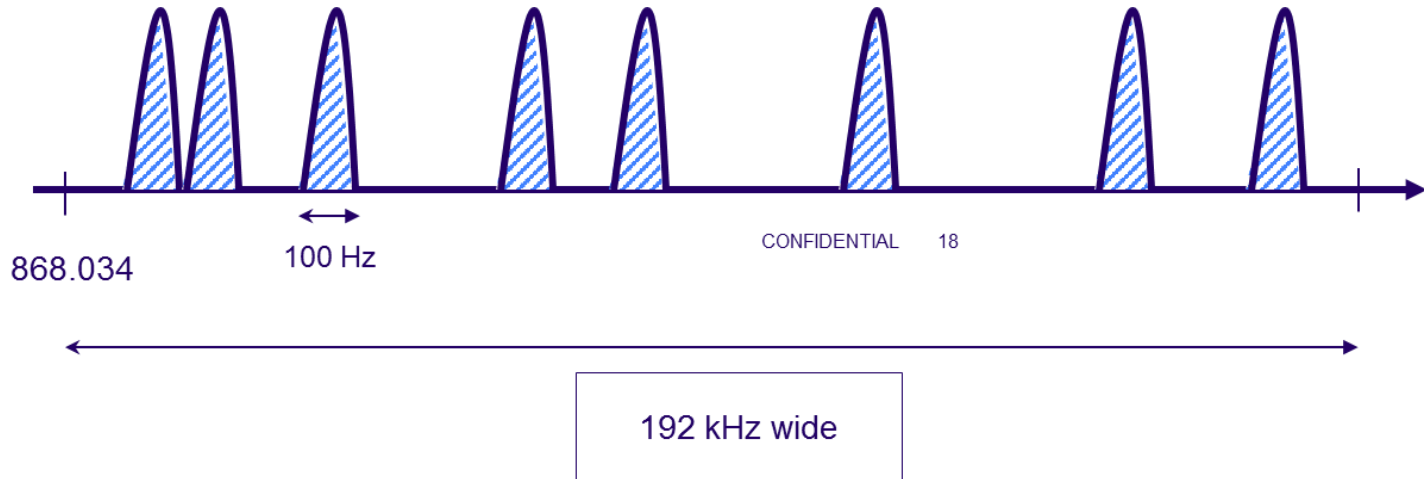
100Hz wide in a 200 kHz band



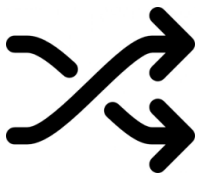
DBPSK



High spectrum efficiency 1bit/s = 1Hz of bandwidth



RANDOM ACCESS



Unsynchronized transmission



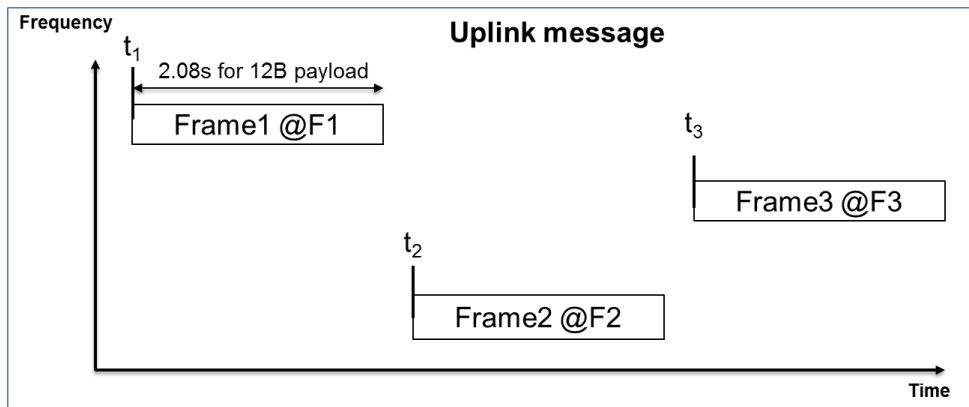
Random frequency



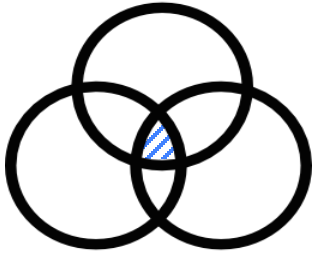
SIGFOX Base stations permanently listen to the spectrum



3 replicas of the same frame @ 3 frequencies



COOPERATIVE RECEPTION



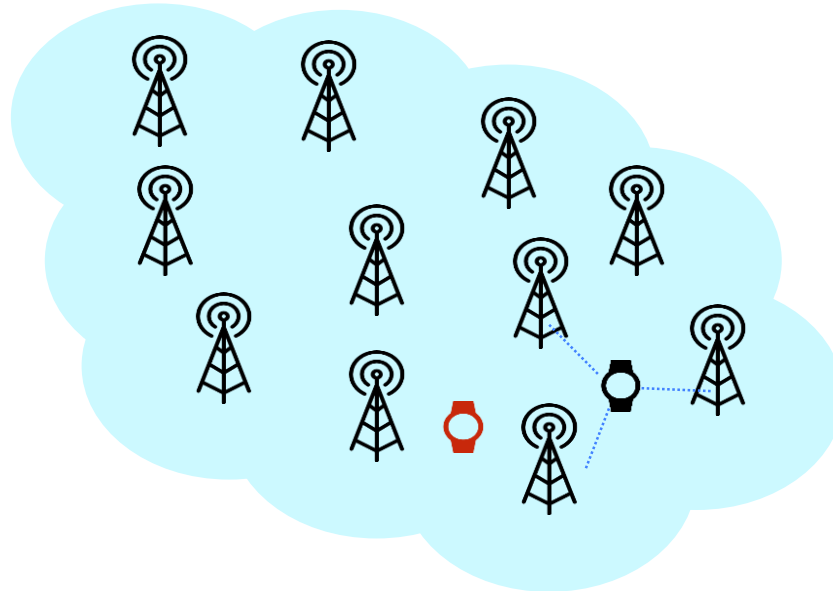
Message received by 3 Base Stations in average



Spatial diversity decreases collision probability



MIMO like Approach



SMALL MESSAGES

to answer the cost & autonomy constraints of remote objects

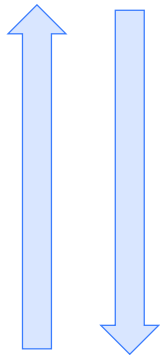


UPLINK

12-byte payload

- Sensor data
- Event status
- GPS fix
- Application data

1 % duty cycle for Objects
Up to 6 messages/hour



DOWNLINK

8-byte payload

- Action / actuator trigger
- Device management
- Application parameter setting

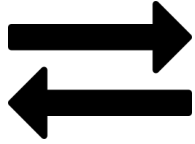
10 % duty cycle for Base Stations
4 guaranteed downlink msg/day



Payload size examples

- ❑ 6 bytes: GPS coordinates
- ❑ 2 bytes: temperature reporting
- ❑ 1 byte: speed reporting
- ❑ 1 byte: object state reporting
- ❑ 0 byte: heartbeat (object keepalive)

DEVICE DRIVEN BI-DIRECTIONAL



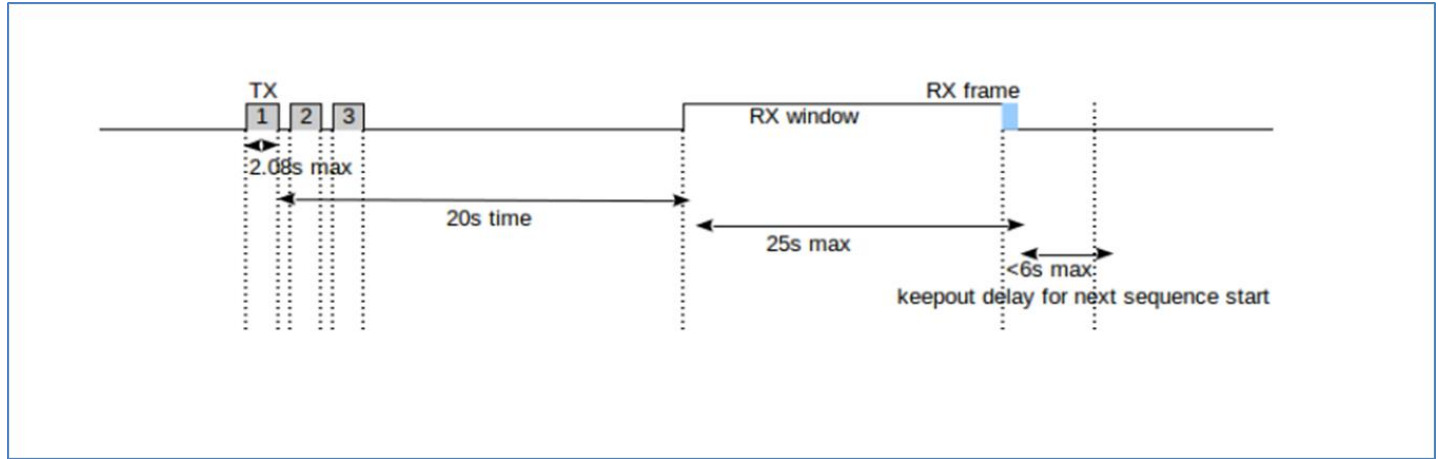
Downlink requested by the device to the network



Delay of 20 seconds – 25 seconds downlink window



Downlink frequency derived from uplink frequency



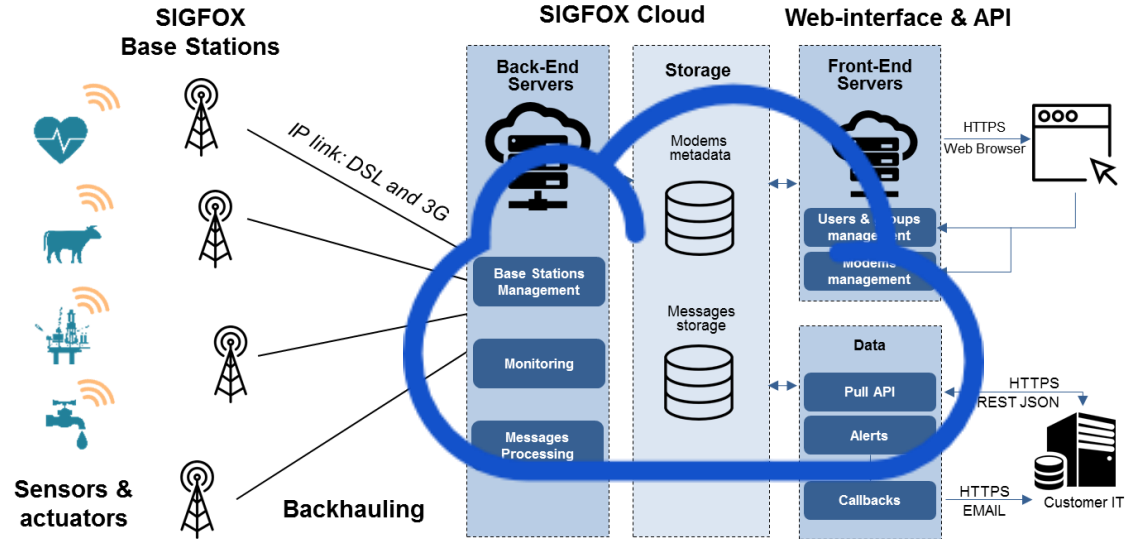
SIGFOX CLOUD-BASED CORE



Centralized Authentication & Message Forwarding



Flat RAN Architecture



3

KEY FEATURES

- High energy efficiency
- Long range
- Simple connectivity
- Secure



HIGH ENERGY EFFICIENCY

to offer maximum autonomy to remote objects



Designed to maximize energy efficiency



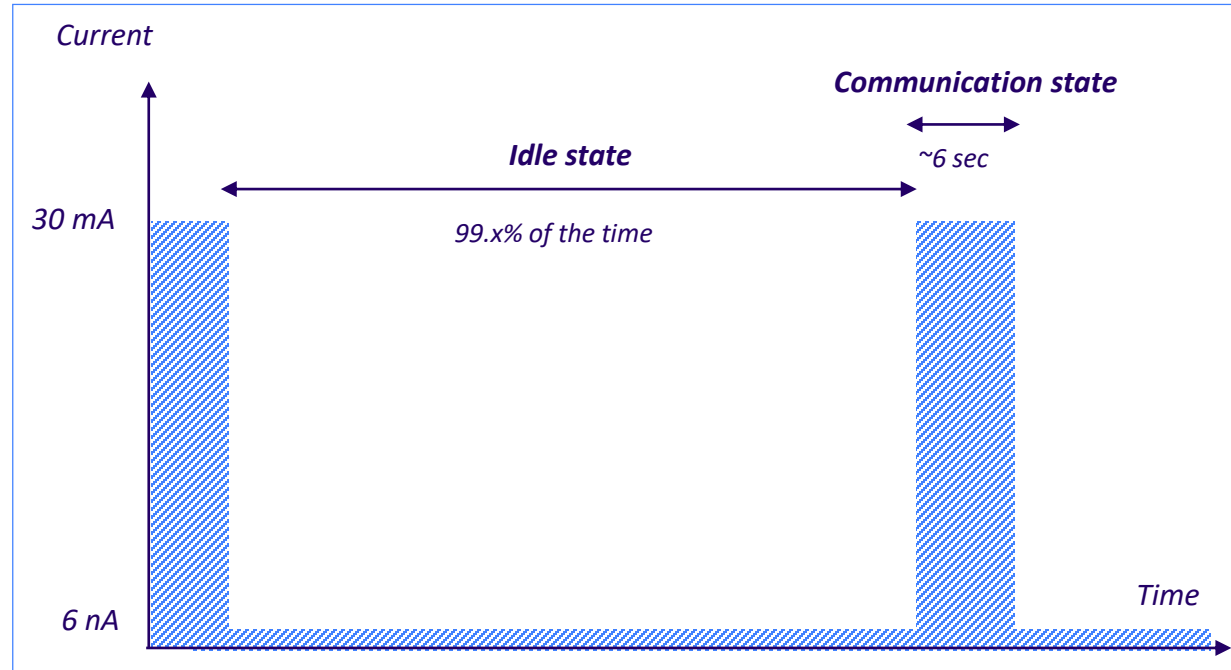
No pairing / network attachment required



15 to 45 mA during a few seconds (25mW; 14dB) depending on the chip and the size of the payload



Idle consumption: negligible





VERY LONG RANGE

to quickly offer great coverage at minimum cost



Constant output power and low data rate provide comfortable link budget and long range

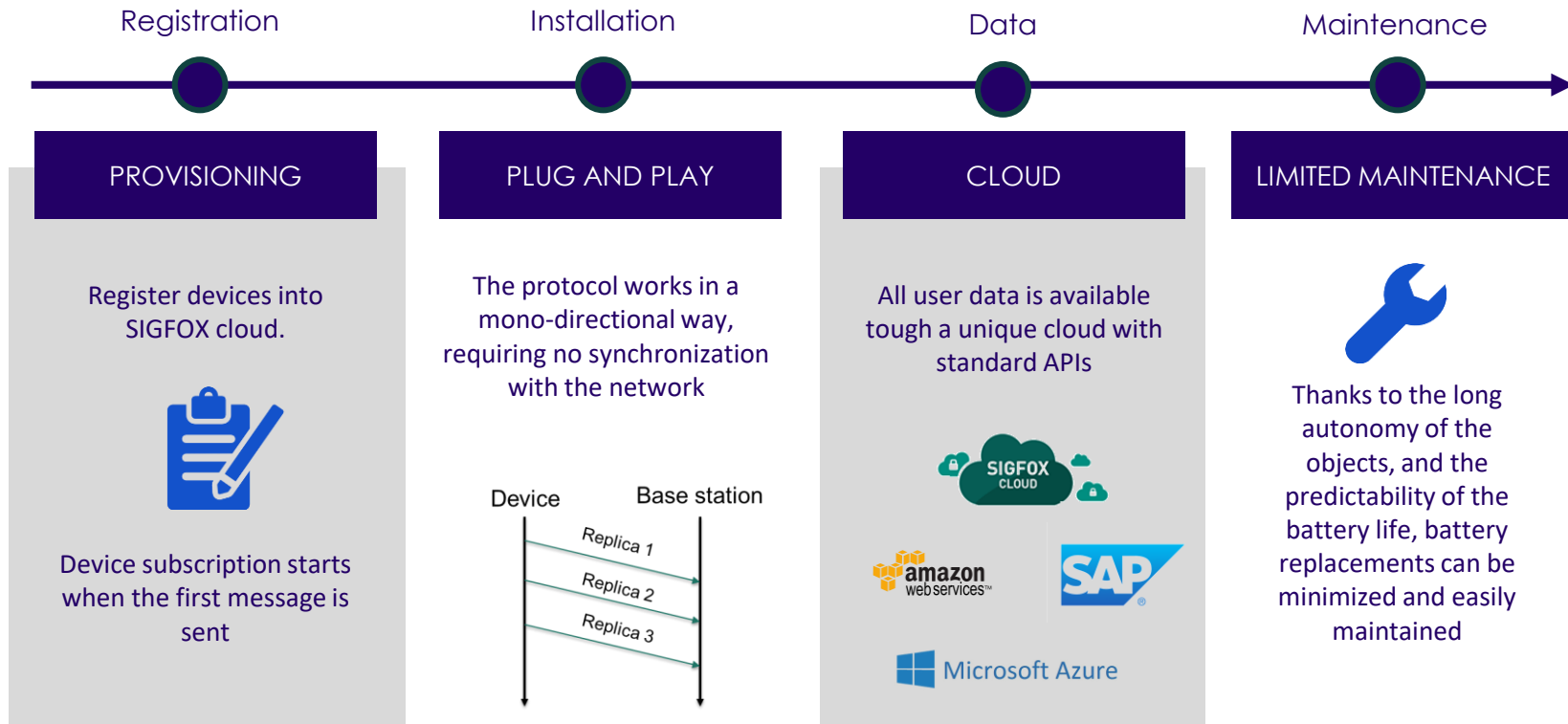


Good coverage due to the use of sub-1GHz bands

	Modulation	Data-rate (bps)	Tx Power	Compound TX Antenna Gain	Compound RX Antenna Gain	RX sensitivity	Link Budget
Uplink (ETSI)	DBPSK	100	+14 dBm	0dB	+6dB	-142dBm	+162dB
Downlink (ETSI)	GFSK	600	+27 dBm	+6dB	0dB	-130dBm	+163dB
Uplink (FCC)	DBPSK	600	+22 dBm	0dB	0dB	-134 dBm	+156dB
Downlink (FCC)	GFSK	600	+30 dBm	0dB	0dB	-129 dBm	+159dB



OUT OF THE BOX CONNECTIVITY



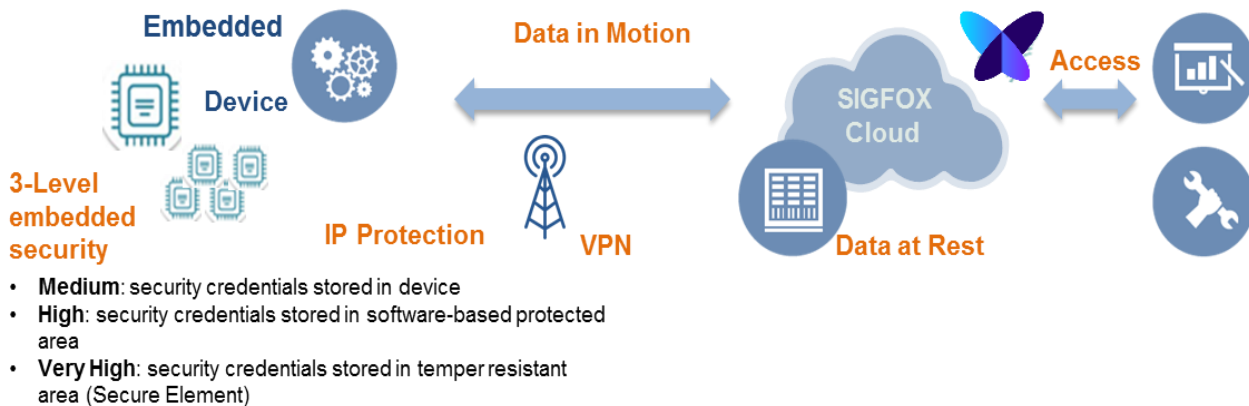
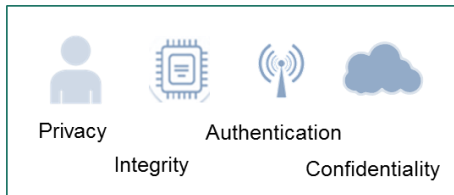


THE RIGHT LEVEL OF SECURITY

to protect what matters, where it matters

SIGFOX SECURITY IS A PROCESS – **SECURITY BY DEFAULT**

AUTHENTICATION
INTEGRITY
ITY
PRIVACY



STRONG SECURITY MECHANISMS AT THE HEART OF THE COMMUNICATION SOLUTION

4

CONNECTING THE 'I' WITH THE 'T'

- Standards and interoperability at application level
- Privacy and security-by-design
- Collaborative security
- Multi-stakeholder policy approach

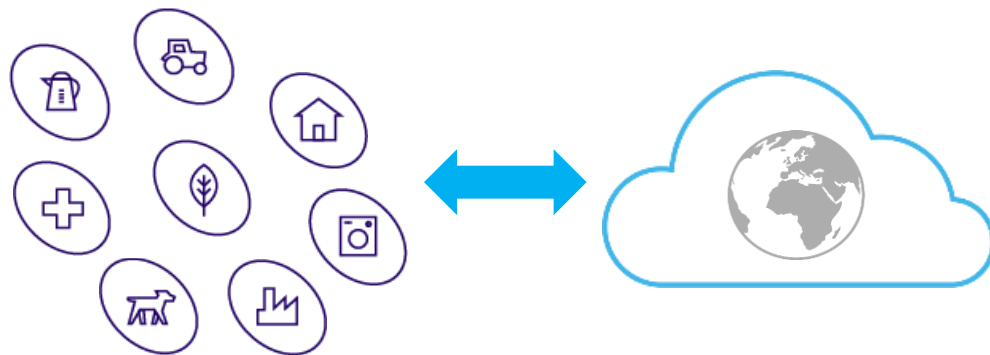
KEY ENABLERS TO LINK THE “T” AND THE “I”

✓ Standards-based application-level interoperability

✓ Collaborative approach to security

✓ Multi-stakeholder policy development

✓ Privacy-by-design practices



INTEROPERABILITY AT APPLICATION LEVEL



IETF

- Developing Internet protocols, from Layer 3 (IPv6) up to Application Layer (HTTP, CoAP)
- Full set of protocols for the IoT, including data representations, interaction models, security, etc.



LPWAN WG

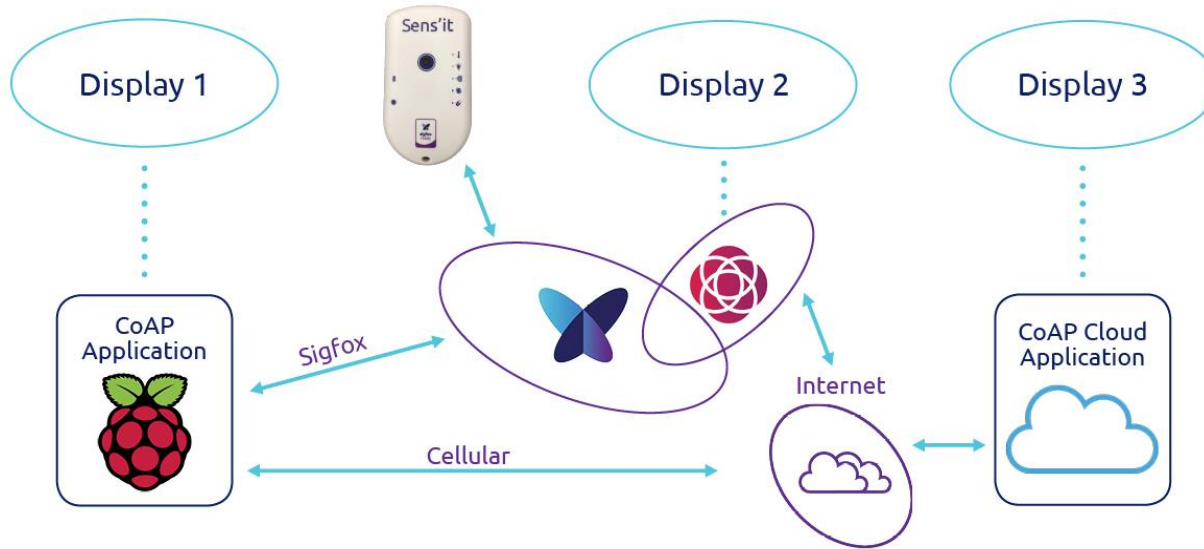
- Defining interworking functions such as:
 - common network layer,
 - management features,
 - security features, and
 - application profiles



BnB Demonstration at IETF 98 Chicago and Hackathon at IETF 99 Prague

- IPv6/CoAP over LPWAN demonstration
 - <https://www.sigfox.com/en/news/sigfox-pioneers-internet-things-interoperability-further-accelerate-mass-market-adoption>
- Interoperability of SCHC implementations over Sigfox and LoRa
 - <https://www.ietf.org/registration/MeetingWiki/wiki/99hackathon>

INTEROPERABILITY AT APPLICATION LEVEL



PRIVACY

Scope

Narrow: focused on individuals

Broad: any information related to an individual that can identify him/her, directly or indirectly, may be relevant

Note that standards are limited to what can be addressed in protocol design - vs. deployment and operation

Threats

Identification

Surveillance

Correlation

Stored data
compromise

Secondary use

Disclosure

Intrusion

Exclusion

Misattribution



PIIs IN THE INTERNET OF “THINGS”

Personally Identifiable Information (PII)



PRIVACY BY DESIGN (PbD)

Need to embrace PbD principles:

- **Proactive** not reactive
- Privacy as the **default setting**
- Privacy **embedded into design**
- Full functionality – **positive-sum**, not zero-sum
- End-to-end security – **full lifecycle protection**
- Visibility and **transparency** – keep it open
- Respect for user privacy – keep it **user-centric**





SIGFOX'S APPROACH TO SECURITY AND PRIVACY



Certification programs

- Applied to modules, devices and cloud platforms



Resiliency to botnets and tempered-with devices

- Blocking and blacklisting capabilities at the cloud



Privacy-friendly practices

- Anonymization of data collected and retained



Strong security features

- Authentication, data integrity and ity
- Secure APIs
- Different levels of security available depending on the criticality and type of application



CONSIDERATIONS FOR IoT DEVELOPMENT

fostering potential economic and societal benefits, while addressing associated challenges

Promotion of Internet and data-infrastructure growth

- Refrain from mandating technical approaches to IoT – Instead encourage open, voluntary IoT standards to support innovation
- Promote efficient and very low cost use of wireless spectrum to allow for economy of scale, e.g. licensed-exempt, technology neutral, and harmonized over several regions

Multi-stakeholder approach to policy discussions

- Including policy makers, standards bodies, service providers, network operators, infrastructure manufacturers, device manufacturers, and end users



Collaborative approach to security

- Empower players to address security issues close to where they occur, instead of centralizing responsibility amongst a few
- Promote inclusiveness/transparency, collective responsibility, effective decision-making /implementation, collaboration

Promote responsible design practices

- Encourage security-by-design and privacy-by-design practices to maintain user's trust in technology



Thank You

Juan-Carlos Zúñiga

JuanCarlos.Zuniga@sigfox.com