Mexico City
Sigfox Makers Tour #21

Introduction

The first IoT network in Mexico

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About Sigfox

IoT Communication Service

Available in 32 countries right now

Low Energy + Simplicity

Chipsets from several major silicon vendors

sigfox


Iceland
Sweden
Norway
Russia
Canada
Belarus
Germany
Ukraine
Kazakhstan
Mongolia
North Atlantic Ocean
United States
Spain
Italy
Uzbekistan
Turkey
China
Japan
Tunisia
Iraq
Iran
Algeria
Libya
Egypt
Saudi Arabia
Pakistan
India
Mexico
Cuba
Laos
Mali
Niger
Senegal
Sudan
Philippines
Sri Lanka
Colombia
Malaysia
Democratic Republic of the Congo
Indonesia
Papua New Guinea
Peru
Brazil
Bolivia
Madagascar
Paraguay
South Atlantic Ocean
Indian Ocean
Australia
South Africa
Argentina
New Zealand

Online resources

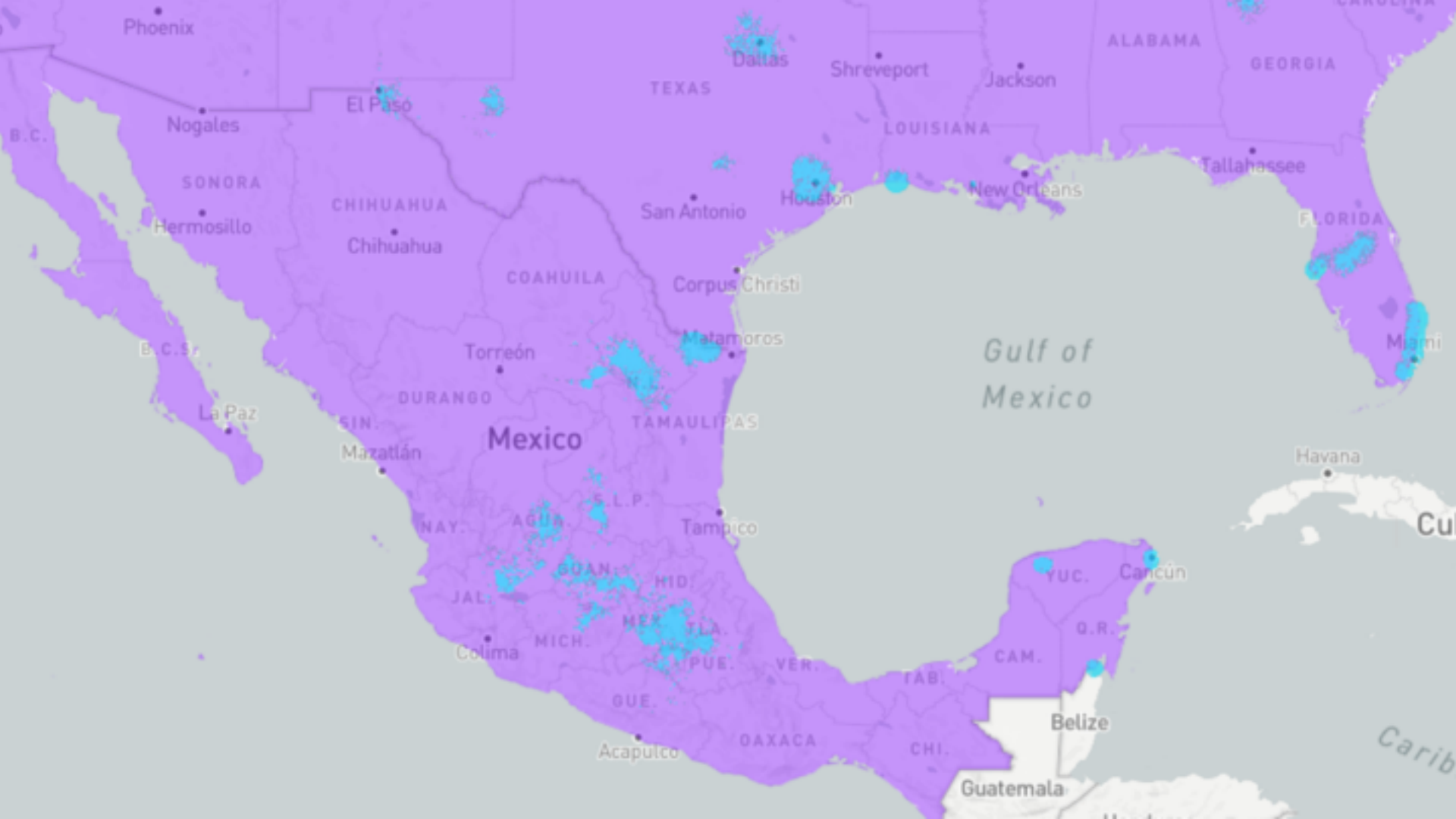
Technical information : http://makers.sigfox.com

Videos : http://youtube.com/sigfox

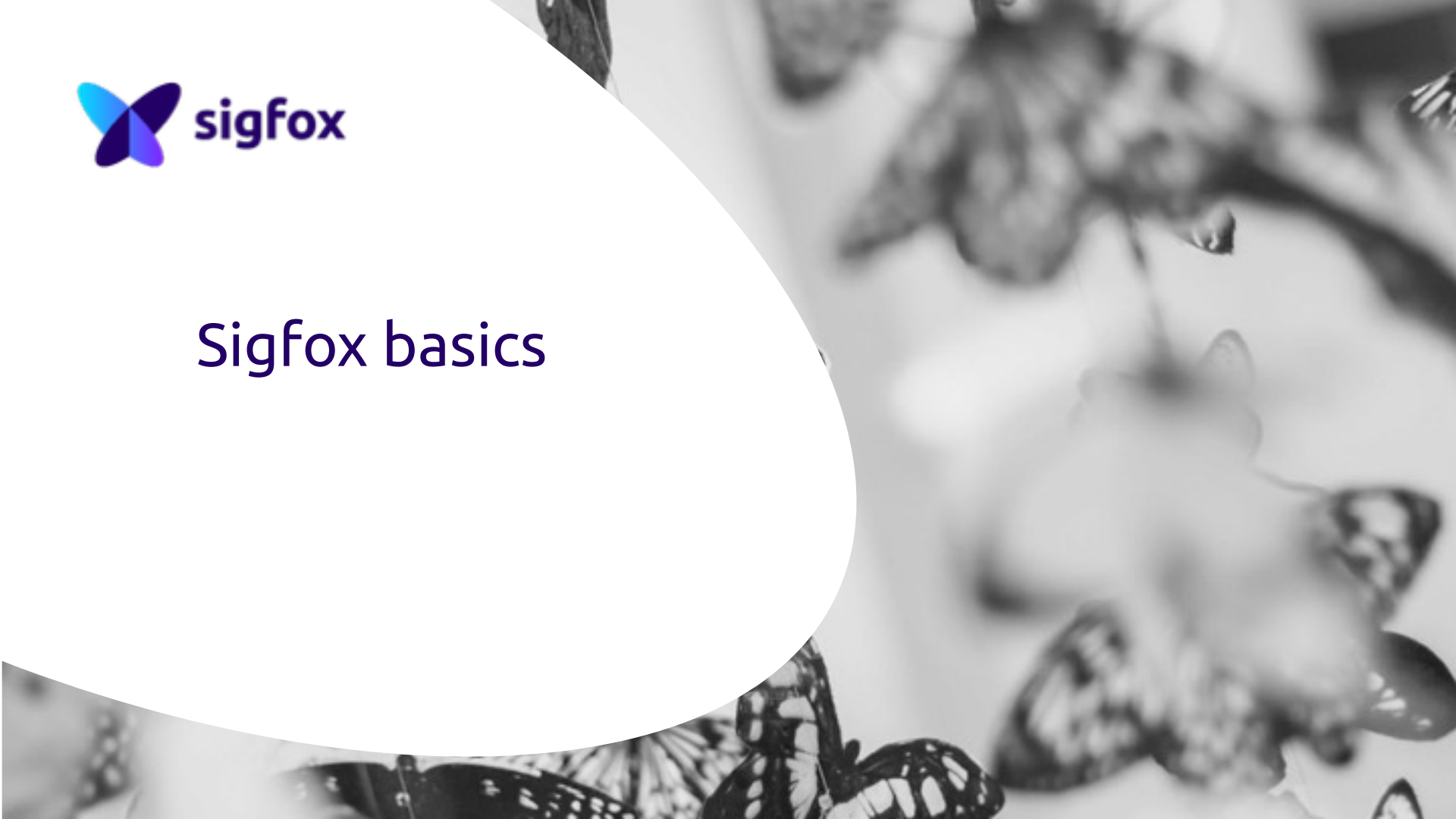
Q&A : http://ask.sigfox.com

Github: http://github.com/sigfox

sigfox


Phoenix
Nogales
B.C.
SONORA
Hermosillo
El Paso
CHIHUAHUA
Chihuahua
TEXAS
Dallas
Shreveport
Jackson
LOUISIANA
ALABAMA
GEORGIA
Tallahassee
FLORIDA
Miami
New Orleans
Houston
San Antonio
Corpus Christi
COAHUILA
Matamoros
Torreón
N.L.
DURANGO
TAMAULIPAS
Mexico
B.C.S.
La Paz
SIN.
Mazatlán
Gulf of Mexico
Havana
S.L.P.
NAY.
AGUA.
Tampico
GUAN.
HID.
JAL.
YUC.
Cancún
Q.R.
MEX.
TLA.
MICH.
Colima
PUE.
VER.
CAM.
TAB.
GUE.
Belize
OAXACA
CHI.
Acapulco
Guatemala

Sigfox basics



About Sigfox

Sigfox is **not selling chips**

Sigfox is **not building connected solutions**

Sigfox has invented a **radio protocol**

Sigfox operates a **global network**

sigfox

Why Sigfox ?

Need for a solution dedicated to the IoT, not an existing one tweaked for it.

We only serve the IoT, that’s why we’re doing it efficiently

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FIRE STARTING

MY BATTERY IS LOW

I'M FULL

I'M LOST

I AM AT
THE WAREHOUSE

I NEED
TO BE REPLACED

I NEED
REPAIR

PRESS
TO ORDER

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New possibilities

Existing solutions: Cheaper connection & extended battery life

Enables totally new IoT applications

Backup connectivity for higher bandwidth devices

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How to sigfox

Detect something to send (that’s the hard part)

Power on the communication module

Send

Message is picked up by the network

Data is received on your server

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Core concepts

Simplicity

No connection

No configuration

No pairing

No signaling

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Low Energy

Years of battery life

Independent solutions

Reduce maintenance & TCO

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Low Energy

Tx: ~200mA during a couple of seconds (@22dBm)

Key factor: idle consumption (99.x% of the time)

Idle consumption: µA range

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Very Long Range

Best case scenario

- +100km between transmitter & receiver (base station)

Real life

- A few kms (city) to tens of kms (countryside), depending on the topography

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Outdoor & Indoor

Good indoor propagation properties

Of course, you need to consider signal attenuation (~20dB)

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Two-way communication

Devices can receive updates sent from your application server

Each communication is instigated by the device

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Small messages

Useful payload: up to 12 bytes

Up to 140 times each day (contract)

600 bits/s

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Less is more !

GPS coordinates (lat x lng) : 6 bytes

Temperature: 2 bytes

State reporting : 1 byte

Heartbeat, update request : 0 byte

Keep it as simple as possible

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Example: Sensit

816b1954 | 10000001 01101011 00011001 01010100

10000001 01101011 00011001 01010100 Active mode (Temp)

10000001 01101011 00011001 01010100 Temp. MSB & LSB

10000001 01101011 00011001 01010100 Humidity x2

Temp : 0110011001 = 409 . (409-200) / 8 = 26.125°C

Humidity: 01010100 = 84. 84/2 = 42%

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Security

Security

No keys exchanged over the network, no handshake

Messages can be encrypted or scrambled

Each message is signed with a key unique to the device

Message signature

With each message, a hash is calculated & sent; using:

Device ID

Secret key, unique to the device. Never transmitted OTA

Payload

Internal increment

sigfox

Radio properties

Great tolerance to interferors

Jamming resistant

Interception is hard: UNB & frequency diversity

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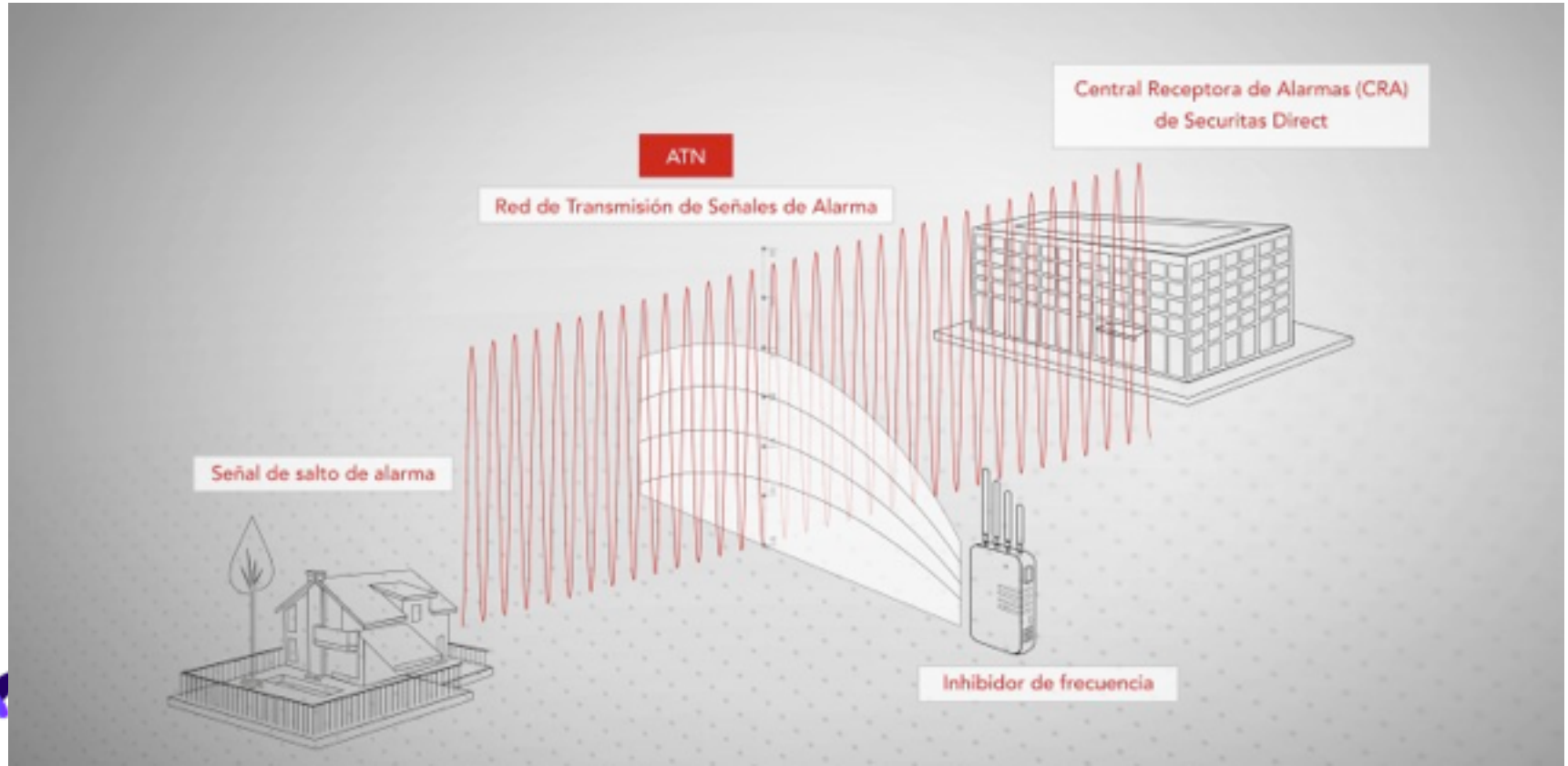
Jammers


Central Receptora de Alarmas (CRA)
de Securitas Direct
ATN
Red de Transmisión de Señales de Alarma
Señal de salto de alarma
Inhibidor de frecuencia

Radio
Ultra Narrow Band

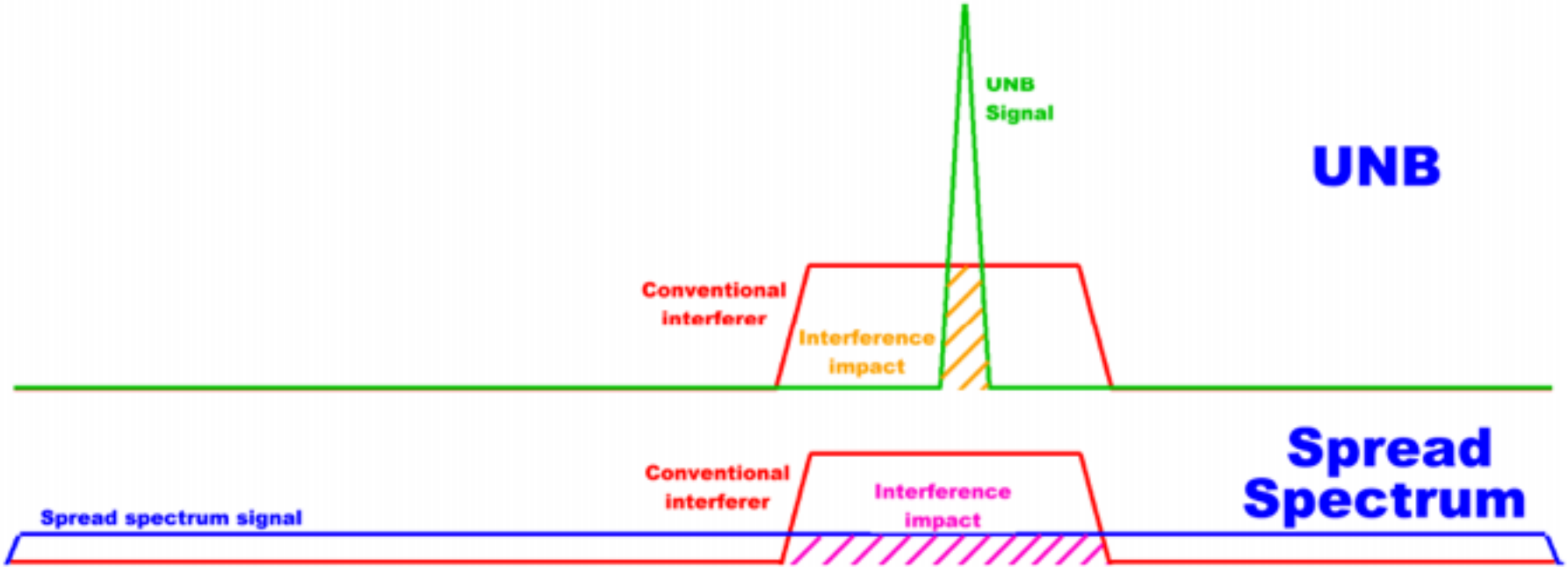
Sigfox use

The network currently monitors a 192KHz part of the spectrum

Each message is ~600Hz wide

sigfox

Interferors



Ultra Narrow Band channel occupation + light protocol = Bigger capacity !

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12 messages

Conventional

6 messages

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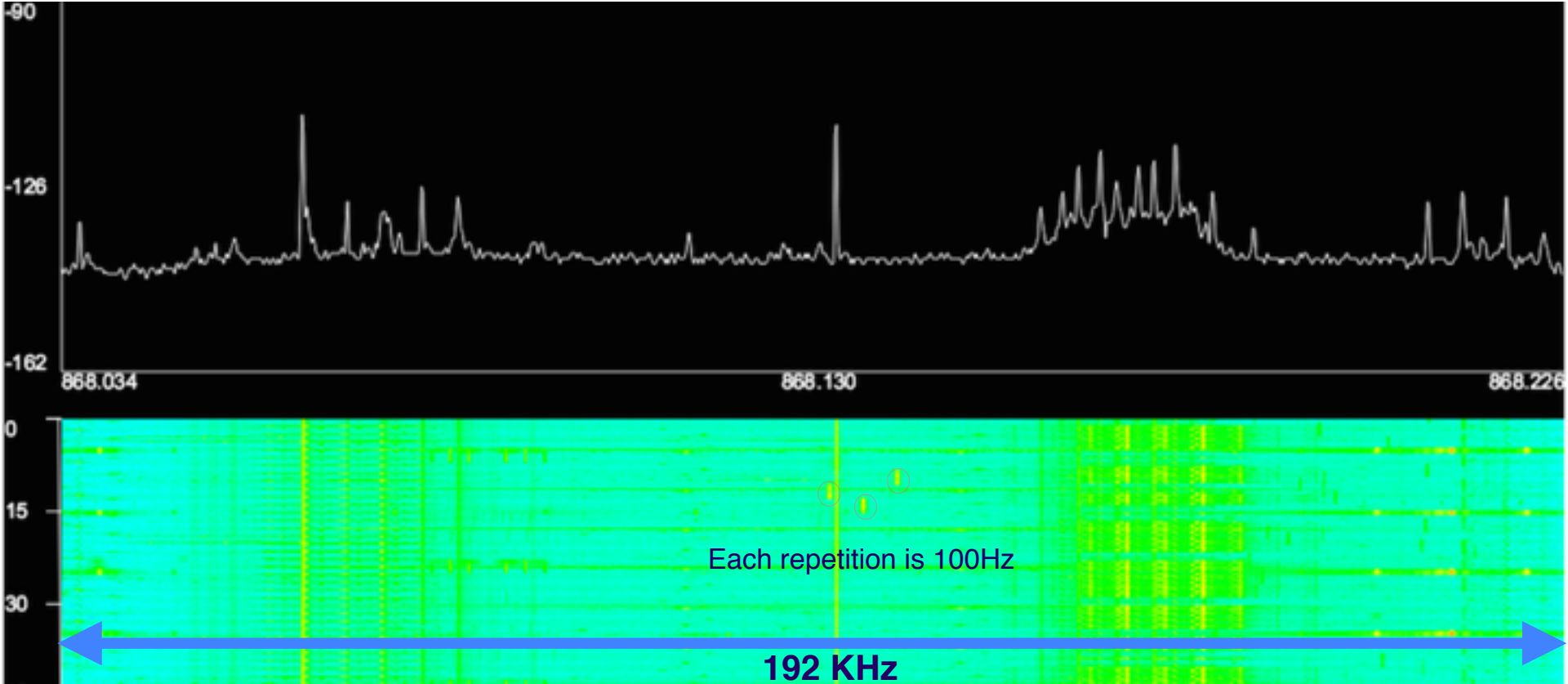
Sigfox messages



Regulations

Regulations

Sigfox is operating on unlicensed Sub-GHz frequency bands all over the world

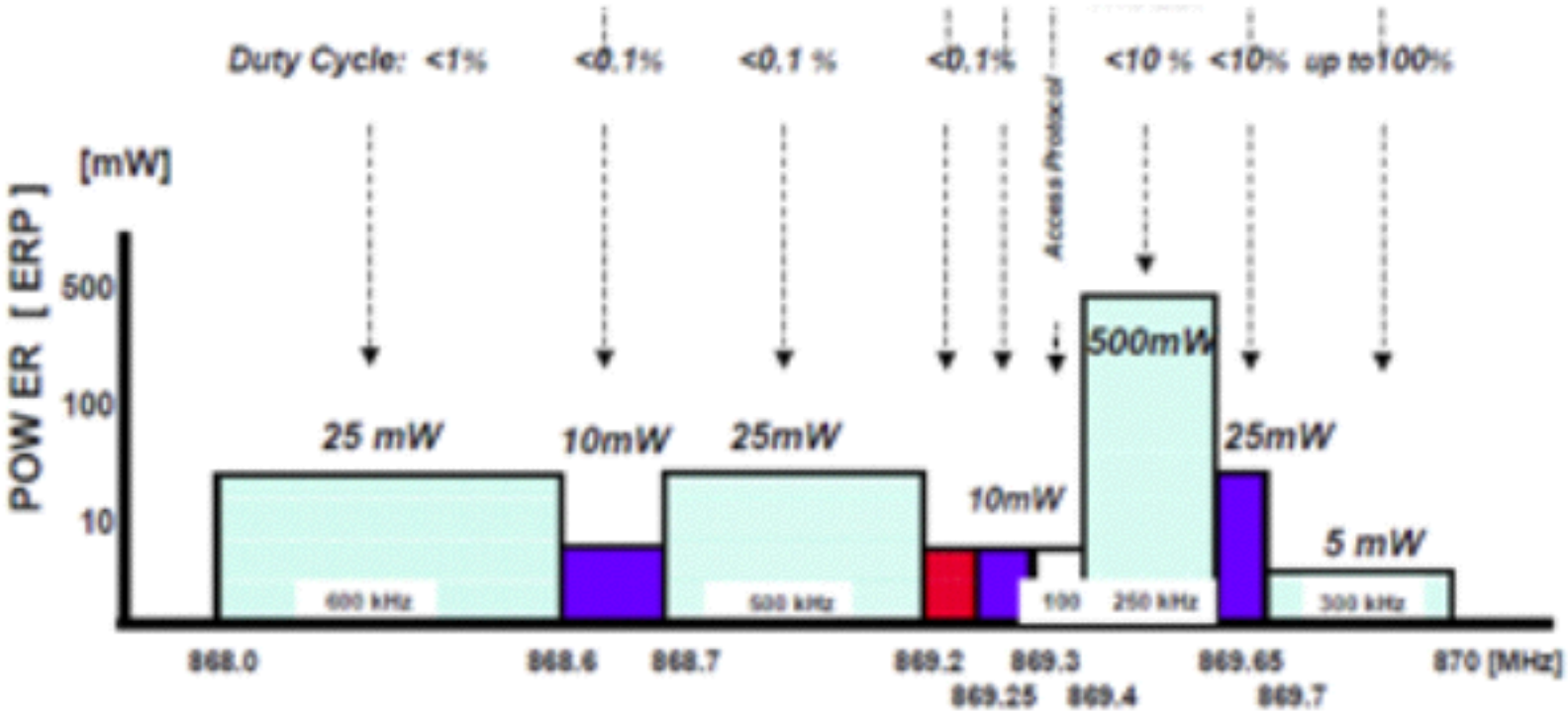
We just have to pick the right central frequency

Easy, right ?

UNITED STATES FREQUENCY ALLOCATIONS

THE RADIO SPECTRUM

ETSI Duty cycle



Unlicensed bands

Compliant with regulations

ETSI 300-220

FCC Part 15

ANATEL 506

AS/NZS 4268

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Different Radio Configuration Zones

Regional regulations affect

Central frequency

Power Output / Data Rate

Spectrum access

Handled by the Sigfox stack

Same hardware can be used, with software switches

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Sigfox Radio Configuration Zones

	RCZ1	RCZ2	RCZ3	RCZ4
Frequency	868 MHz	902 MHz	923 MHz	920 MHz
Power output	14 dBm	22 dBm	14 dBm	22 dBm
Where	Europe/MEA	N.America & Brasil	East Asia	Asia & Pacific & S.America

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Coverage


Wolcott
Avon
Vail
Minturn
Silverthorne
Frisco
NATIONAL
FOREST
ARAPAHO

Global network

Sigfox is offering a global network, not a solution to build private networks

Roaming is included is the standard service

Devices will work the same all over the network

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Svalbard
Greenland
Iceland
Sweden
Norway
Russia
Canada
Belarus
Germany
Ukraine
Kazakhstan
Mongolia
North Atlantic Ocean
United States
Spain
Italy
Uzbekistan
Turkey
China
Japan
Tunisia
Iraq
Iran
Algeria
Libya
Egypt
Pakistan
Mexico
Cuba
India
Laos
Mali
Niger
Senegal
Sudan
Yemen
Philippines
Sri Lanka
Colombia
Malaysia
Democratic Republic of the Congo
Indonesia
Papua New Guinea
Peru
Brazil
Bolivia
Madagascar
Indian Ocean
Paraguay
South Atlantic Ocean
South Africa
Australia
South Pacific Ocean
Argentina
New Zealan

Sigfox Radio Configuration Zones

	RCZ1	RCZ2	RCZ3	RCZ4
Frequency	868 MHz	902 MHz	923 MHz	920 MHz
Countries	🇩🇪 🇧🇪 🇨🇿 🇩🇰 🇪🇪 🇪🇸 🇫🇮 🇫🇷 🇳🇱 🇬🇧 🇮🇪 🇮🇹 🇱🇺 🇲🇨 🇵🇹 🇸🇪 🇸🇰 🇮🇷 🇲🇺 🇳🇿 🇿🇦 🇬🇫 🇬🇾 🇲🇶 🇳🇨	🇧🇷 🇺🇸 🇲🇽	🇯🇵	🇭🇰 🇸🇬 🇹🇼 🇦🇺 🇳🇿 🇦🇷 🇨🇴

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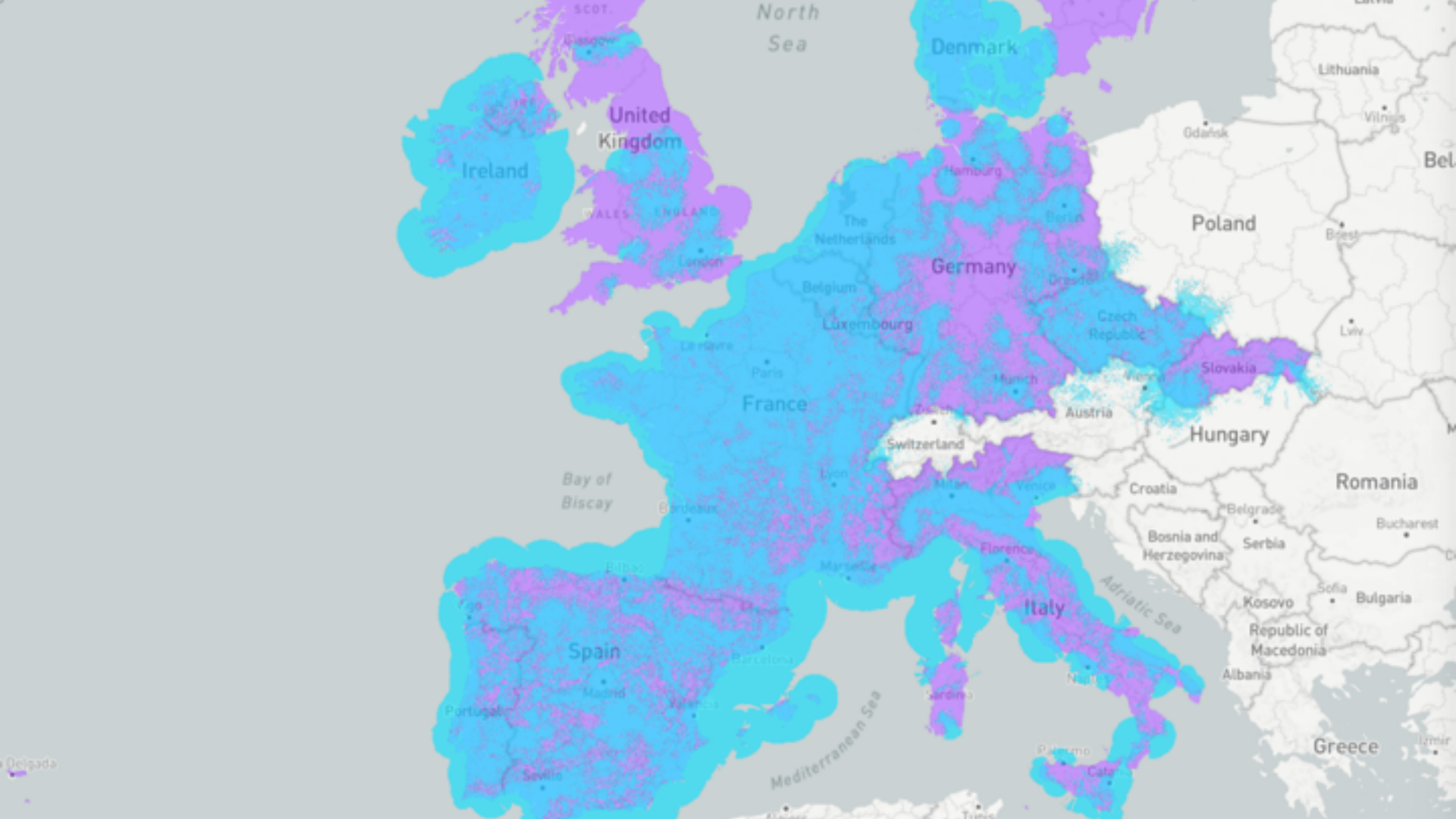
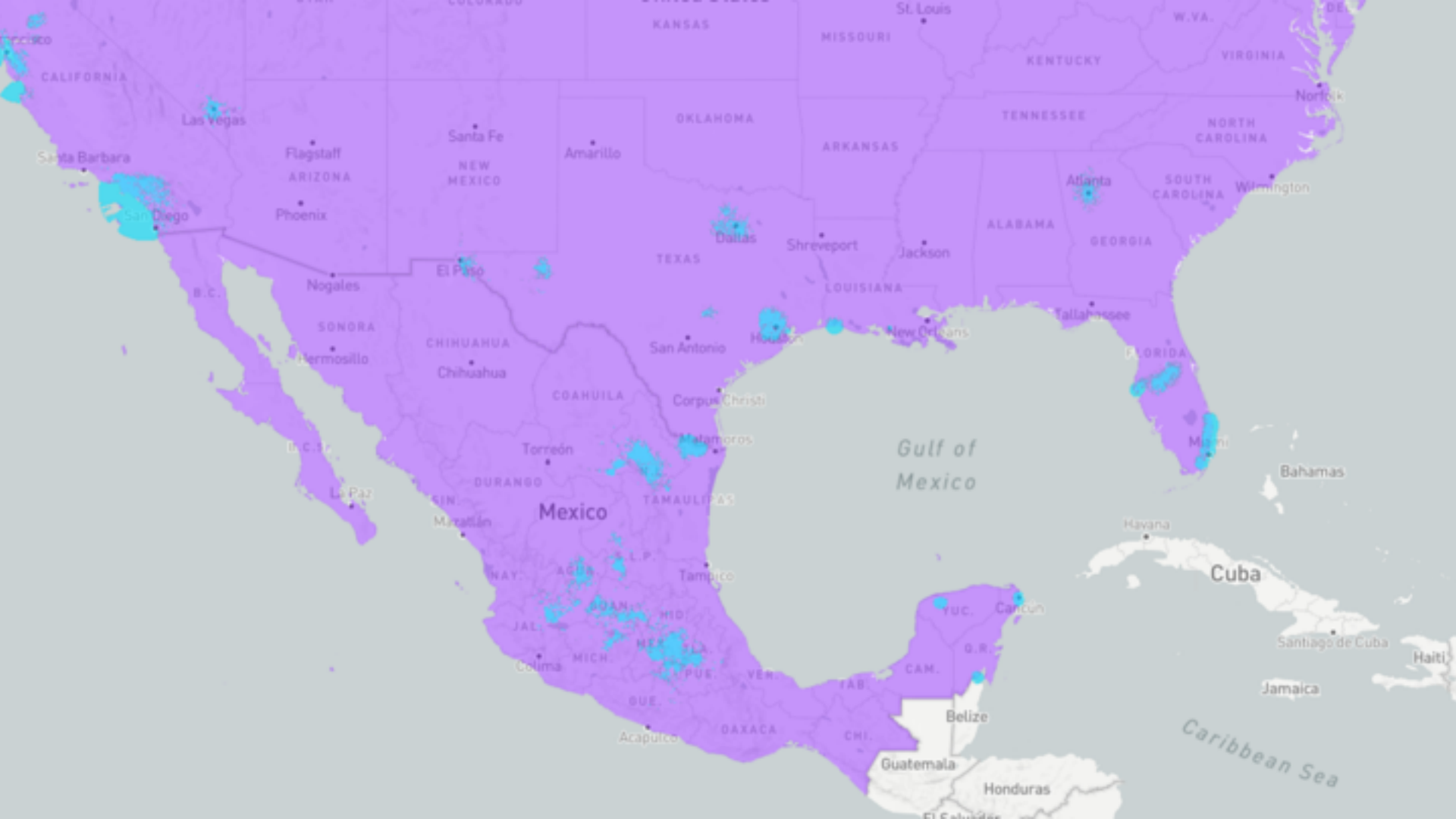

North Sea
Denmark
United Kingdom
Ireland
Glasgow
London
Hamburg
Berlin
The Netherlands
Germany
Dresden
Belgium
Luxembourg
Czech Republic
Slovakia
Le Havre
Paris
Munich
Vienna
France
Austria
Switzerland
Hungary
Bay of Biscay
Lyon
Milan
Venice
Croatia
Romania
Bordeaux
Belgrade
Bucharest
Bosnia and Herzegovina
Serbia
Florence
Bilbao
Marseille
Adriatic Sea
Kosovo
Sofia
Bulgaria
Vigo
Italy
Republic of Macedonia
Spain
Barcelona
Albania
Madrid
Portugal
Valencia
Sardinia
Mediterranean Sea
Greece
Palermo
Sevilla
Lithuania
Vilnius
Gdańsk
Poland
Brest
Lviv


KANSAS
MISSOURI
St. Louis
W.VA.
KENTUCKY
VIRGINIA
CALIFORNIA
Las Vegas
Santa Barbara
Flagstaff
ARIZONA
Santa Fe
NEW MEXICO
Amarillo
OKLAHOMA
ARKANSAS
TENNESSEE
NORTH CAROLINA
Norfolk
Atlanta
SOUTH CAROLINA
Wilmington
San Diego
Phoenix
Dallas
Shreveport
Jackson
ALABAMA
GEORGIA
TEXAS
LOUISIANA
Nogales
El Paso
B.C.
SONORA
Hermosillo
CHIHUAHUA
Chihuahua
San Antonio
Houston
New Orleans
Tallahassee
FLORIDA
Miami
COAHUILA
Corpus Christi
Matamoros
Torreón
DURANGO
TAMAULIPAS
Mexico
Gulf of Mexico
Bahamas
Havana
Cuba
Tampico
Cancún
YUC.
Santiago de Cuba
Haiti
Jamaica
Colima
MICH.
CAM.
Belize
Caribbean Sea
Acapulco
OAXACA
Guatemala
Honduras

Break

Current use cases

Examples of solutions already in production

Internet of Things ?

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Perfect Sigfox use cases

Independent solutions

no user, no power socket, no local network

Shy devices

Doesn’t speak much, but only useful data

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Asset tracking & Security

Asset tracking

Shipment / Pallet tracking

Valuable assets

Post-theft recovery

GPS or pure network geolocalisation

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Home Alarm System

Backup connectivity for GSM solution

Jamming resistant

Continuity of service

Self deployment

High capacity network

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Smoke detector

Easy install

Fault detection

Remote alert

sigfox

sigfox

Industry

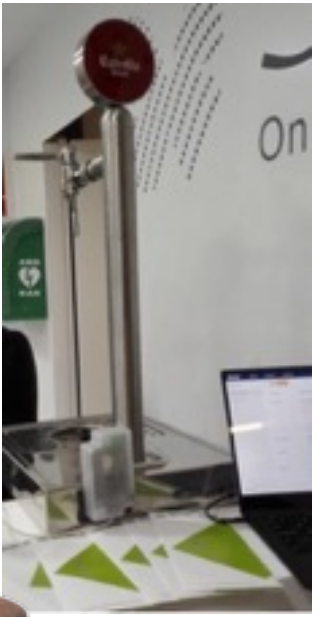
Predictive maintenance

Optimize & anticipate maintenance

Alerts when customer needs support

Lower operation costs

Increased safety and/or customer satisfaction



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Maintenance

Connected boilers

Remote sites intrusion detection

Industrial equipments

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Health & Assisted living

Assisted Living Box

Elderly people benefiting from home services

Monitor carers come & go

NFC badge reader

ROI : 6 months

Increased service quality

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Fall Detector

Send an alert when the bearer falls

Panic button

No set up

Long battery life

No « locked in » effect ; works everywhere

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Public sector

Metering

Different solutions

Smart or add-on to existing meters

Low cost of installation & operation

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Smart parking

Parking spots monitoring

Real time guidance for users

Traffic optimization

Local enforcement optimization

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Waste management

Optimize costs of collection

Plug & play

Years of battery life

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Street lighting

Save Energy & Costs

Improved maintenance

Light intensity management

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Agriculture

« Smart Agriculture » ?

Crop sensors to optimise yield

Livestock « predictive maintenance »

Beehives monitoring

Weather monitoring

Cattle tracking

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Retail & other services

Button

Simplest interface possible

Press a button ; trigger a service

No installation

Cloud-based services

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Customer Satisfaction

Effortless customer feedback

No wiring

No pairing

Long battery life

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Sigfox foundation

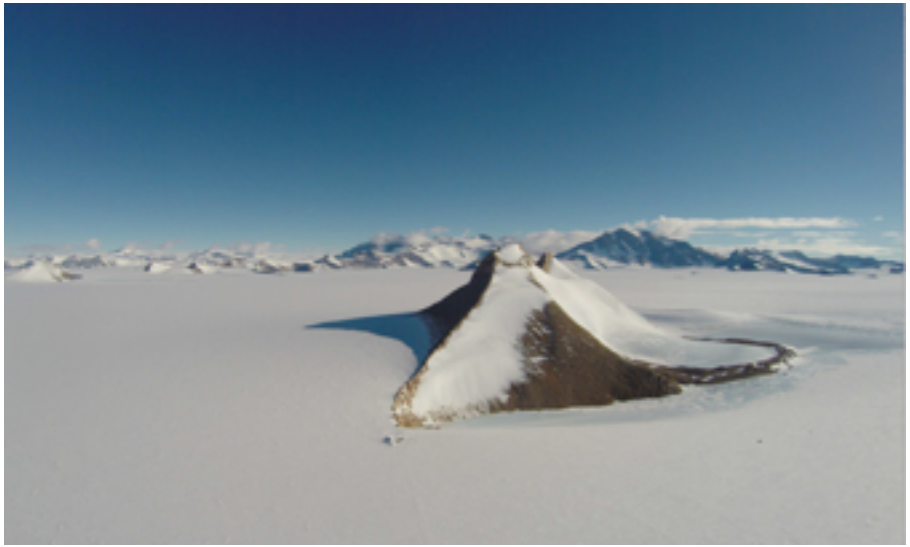
Antarctica

Tracking scientists & assets

Long reach

Ease of use

Robust trackers



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Wildlife

Rhinos tracking & monitoring

Anti poaching operation

Implant & play

Long reach

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Hardware solutions

Hardware

Sigfox is not a hardware vendor

Ecosystem of established partners

Modules

Starting from $2

Offers combining Sigfox with Wifi , BLE, GPS

Fast track for product certification

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Building your own

You can build your own, using one of the compatible RF transceivers (NXP, STMicro, TI, Semtech, SiLabs)

Only interesting for huge volumes, retrofit or special requirements

Will need full Sigfox certification program

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Antenna

Best way to ruin a great device is to mess the antenna integration

Balance between design & performance

Take into account from the early days of your project

We’re here to help with experts !

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Prototyping

Arduino & Raspberry Pi kits available from various partners

RCZ2 (Americas) solutions ecosystem starting to grow

Check out http://partners.sigfox.com for the full details

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Cloud

Get your data

View messages : Sigfox web platform

Get messages : REST API (pull)

Receive new messages : HTTP Callbacks (push)

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Callbacks

Each message received from your devices will be forwarded to your application server

Customisable headers & body

You can set more than one callback

Used to send data back to the device as well

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3rd party platforms

You can easily push your data to a 3rd party platform :

AWS, Azure, Telefonica, thethings.iO, IBM, Samsung…

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Downlink messages

A downlink message can be

Semi automatic : sent directly by the network

Customised : sent by your own application server

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Workshop session

Using Thinxtra Xkit boards

Sigfox Workshop

Using Thinxtra Xkit

Contribute back

Don’t forget to publish your experiments

Code Samples, HW design, fails … will be useful to other people

We all start by copy/pasting ;)

Your own website, github, hackster.io, instructables … your call!

Useful Resources

Session resources http://bit.ly/SMTSaoPaulo

XKit http://thinxtra.com/xkit

Questions ? http://ask.sigfox.com

Github

http://github.com/sigfox

http://github.com/nicolsc

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Contact info

Nicolas Lesconnec

nicolas.lesconnec@sigfox.com

twitter: @nlesconnec

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Register

http://backend.sigfox.com/activate

Provider: Thinxtra

Country : Choose yours. (Default: France)

ID/PAC : Check sticker

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Hello World

Arduino Setup

Open the Arduino IDE

Select the board (COM port)

Board type : `Arduino Uno`

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Sketch Tools Help

Auto Format ⌘T
Archive Sketch
Fix Encoding & Reload
Serial Monitor ⇧⌘M
Serial Plotter ⇧⌘L

WiFi101 Firmware Updater

Board: "Arduino/Genuino Uno" ▶
Port: "/dev/cu.wchusbserial1420" ▶
Get Board Info

Programmer: "USBasp" ▶
Burn Bootloader

Serial ports
✓ /dev/cu.wchusbserial1420
/dev/cu.Bluetooth-Incoming-Port
/dev/cu.BoseAE2SoundLink-SPPDev
/dev/cu.BoseAE2SoundLink-SPPDev-1

| Arduino 1.8.0

ch_apr06a | Arduino 1.8.0

```
}

void loop() {


}
```

Hello world sketch

```
void setup() {
  Serial.begin(9600);
  Serial.print("AT$RC\n");
  delay(100);
  Serial.print("AT$SF=0123CAFE\n");
}
void loop() {}
```

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Upload to the board

Remove the shield first

Then click Upload / Descargar

Upload Using Programmer

sketch_apr06a

```
1 void setup() {
2   // put your setup code here, to run once:
3   Serial.begin(9600);
4   Serial.print("AT$RC\n");
5   delay(100);
6   Serial.println("AT$SF=0123CAFE\n");
7 }
8
```

Message received ?

Navigate to the *devices* menu in the top bar

Click on the ID of your device

Enter the *messages menu* from the left navigation column

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SITE | BASE STATION | DEVICE | DEVICE TYPE | USER | GROUP | RADIO PLANNING | BILLING | PARTNE

- INFORMATION
- LOCATION
- ASSOCIATED DEVICES
- DEVICES BEING TRANSFERRED
- STATISTICS
- EVENT CONFIGURATION
- CALLBACKS
- BULK CREATIONS

Device type 'Thinxtra Solutions RCZ2 kit' - Associated devices

Export devices Id/Pac

Id

State All

Average SNR (all) 5 dB 50 dB

Last seen from date

RESET FILTER

Count : 1 / 1

page 1

Average Rssi	Average SNR	Communication status	Device type	Id	Last seen	Name	Token state
-85.06	58.49		Thinxtra Solutions RCZ2 kit	2C0694	2017-04-06 18:20:56	Device 2C0694	

page 1

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First callback

Callback setup

Device Type menu

Click on your *device type* name

Enter the *Callbacks* menu

Select *new default callback*

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INFORMATION

LOCATION

ASSOCIATED DEVICES

DEVICES BEING TRANSFERRED

STATISTICS

EVENT CONFIGURATION

CALLBACKS

BULK CREATIONS

Device type 'Thinxtra Solutions RCZ2 kit' - Information

Id: 58e4135d3c8789274562f9e5

Name: Thinxtra Solutions RCZ2 kit

Description: Auto created device type for EVK user : Nicolas Lesconnec

Keep alive: N/A

Group: Nicolas Lesconnec EVK

Payload display: None

Contract: Free eval board contract

Alert Email:

Downlink data hexa: {tapid}0000{rssi}

Creation date: 2017-04-04 23:42:53

Created by: Nicolas Lesconnec

Last edition date: 2017-04-04 23:43:11

Last edited by: Nicolas Lesconnec

INFORMATION
LOCATION
ASSOCIATED DEVICES
DEVICES BEING TRANSFERRED
STATISTICS
EVENT CONFIGURATION
CALLBACKS
BULK CREATIONS

Device type 'Thinxtra Solutions RCZ2 kit' - Callbacks

New

These callbacks transfer data received from the devices associated to this device type to your infrastructure. For more informations, please refer to the Callback documentation

SERVICE callbacks

Enable	Channel	Subtype	Duplicate	Batch	Information	Edit	Errors	Delete
☑		GEOLOC	☐	☐	[POST] https://boiling-cove-96312.herokuapp.com/locations/spotit			✖

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INFORMATION

LOCATION

ASSOCIATED DEVICES

DEVICES BEING TRANSFERRED

STATISTICS

EVENT CONFIGURATION

CALLBACKS

BULK CREATIONS

Device type 'Thinxtra Solutions RCZ2 kit' - New Callback

Create callbacks to connect Sigfox cloud to your server/platform.
A callback is a custom http request containing your device(s) data, along with other variables, sent to a given server/platform when the aforesaid device(s) message is received by Sigfox cloud.

Custom callback

Creates a new callback from Sigfox cloud to your own server. This is the "default" callback type.
You can create a full custom request (http method, content type, headers, etc).

AWS IoT

AWS IoT is a managed cloud platform that lets connected devices easily and securely interact with cloud applications and other devices. AWS IoT can support billions of devices and trillions of messages, and can process and route those messages to AWS endpoints and to other devices reliably and securely.

AWS Kinesis

Amazon Kinesis is a platform for streaming data on AWS, offering powerful services to make it easy to load and analyze streaming data, and also providing the ability for you to build custom streaming data applications for specialized needs.

Microsoft Azure™ Event hub

Event Hubs is an event processing service that provides event and telemetry ingress to the cloud at massive scale, with

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Callback setup

TYPE : DATA UPLINK

Choose a *CHANNEL* : URL (EMAIL for a quick test)

Url pattern: URL of your own server

Use HTTP method: GET/POST/PUT

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INFORMATION

LOCATION

ASSOCIATED DEVICES

DEVICES BEING TRANSFERRED

STATISTICS

EVENT CONFIGURATION

CALLBACKS

BULK CREATIONS

Device type Thinxtra Solutions RCZ2 kit - Callback new

Callbacks

Type DATA UPLINK

Channel ✓ URL
BATCH_URL
EMAIL

Send duplicate

Custom payload config

URL syntax: http://host/path?id={device}&time={time}&key1={var1}&key2={var2}...
Available variables: device, time, duplicate, snr, station, data, avgSnr, lat, lng, rssi, seqNumber
Custom variables:

Url pattern

Use HTTP Method GET

Send SNI (Server Name Indication) for SSL/TLS connections

Headers header value

Ok Cancel

Callback status

In the *Devices > Messages* panel, you have a indicator of the callback status (an arrow)

Black : in progress

Green : Callback OK

Red : Callback KO (at least one of the callbacks failed)

Click the arrow to display details.

INFORMATION
LOCATION
MESSAGES
TRASH MESSAGES
EVENTS
STATISTICS
EVENT CONFIGURATION

Device 2C0694 - Messages

From date
To date
Type All

RESET FILTER

page 1

Time	Delay (s)	Header	Data / Decoding	Location	Base station	RSSI (dBm)	SNR (dB)	Freq (MHz)	Rep	Callbacks
2017-04-06 20:23:17	1.3	0000	0123cafe		232D	-68.00	75.96	902.2018	1	

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Downlink

How does it work ?

Send a message, with a *downlink* flag

Once message is sent, the module gets back to sleep

After 20s, it will wake up automatically, in Rx mode

It will wait 20s for a *downlink* message

Afterwards it will get back to sleep

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Downlink setup

To setup an automatic callback :

Device Type > Info > Edit

In the *Downlink data* settings, set the following :

Downlink Mode : DIRECT

Set the following value : 123400000BADCAFE

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SITE | BASE STATION | DEVICE | DEVICE TYPE | USER | GROUP | RADIO PLANNING | BILLING | PARTNER

- INFORMATION
- LOCATION
- ASSOCIATED DEVICES
- DEVICES BEING TRANSFERRED
- STATISTICS
- EVENT CONFIGURATION
- CALLBACKS
- BULK CREATIONS

Device type 'Thinxtra Solutions RCZ2 kit' - Information

Disengage sequence number | Edit | Delete

Id: 58e4135d3c8789274562f9e5

Name: Thinxtra Solutions RCZ2 kit

Description: Auto created device type for EVK user : Nicolas Lesconnec

Keep alive: N/A

Group: Nicolas Lesconnec EVK

Payload display: None

Contract: Free eval board contract

Alert Email:

Downlink data hexa: {tapid}0000{rssi}

Creation date: 2017-04-04 23:42:53

Created by: Nicolas Lesconnec

Last edition date: 2017-04-04 23:43:11

Last edited by: Nicolas Lesconnec

sigfox

Device type Thinxtra Solutions RCZ2 kit - Edition

Device type information

Name: Thinxtra Solutions RCZ2 I

Description: Auto created device type for EVK user : Nicolas

Keep-alive (in minutes): 0

If we fail to call one of your callbacks, an email will be sent to the address below so that you can take action to fix the problem.

Alert email:

Downlink data

Downlink mode: ✓ DIRECT / CALLBACK

Expression must either include hexadecimal encoded bytes (ex: deadbeefcafebabe) or the following variables: - {time} 4 bytes - {tapId} 4 bytes - {rssi} 2 bytes

Downlink data in hexa: {tapId}0000{rssi}

Payload display

Select below the most suitable parsing mode for the display of your payloads in the backend (mostly appropriate for debugging and development)

Payload parsing: Regular (raw payload)

Ok Cancel

How to request a downlink

Same AT command, with additional parameters

```
AT$SF=[hex byte]*, 1
```

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Handle the response

When entering Rx mode, the module will display

```
+RX BEGIN
```

Received frame (if any) will be displayed as:

End of Rx mode

```
+RX END
```

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Downlink callback

In *Device Type > Info > Edit*

change *Downlink mode* to CALLBACK

Create a new default callback, with TYPE : DATA | BIDIR

Then set up your URL

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Sample input output

```
AT$SF=55 50 4C 49 4E 4B,1

OK

+RX BEGIN

+RX=44 4F 57 4E 4C 49 4E 4B

+RX END
```

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XKit - demo app

Copy the source code from github

https://github.com/aureleq/Xkit-Sample

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Geolocation

Geoloc callback

Simply create a SERVICE > GEOLOC callback, and receive latitude + longitude + accuracy

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NFORMATION

LOCATION

ASSOCIATED DEVICES

DEVICES BEING TRANSFERRED

STATISTICS

EVENT CONFIGURATION

CALLBACKS

BULK CREATIONS

Device type Thinxtra Solutions RCZ2 kit - Callback new

Callbacks

Type SERVICE

- STATUS
- ✓ GEOLOC
- ACKNOWLEDGE
- REPEATER

Channel URL

URL syntax: http://host/path?id={device}&time={time}&key1={var1}&key2={var2}...
Available variables: device, time, duplicate, snr, rssi, station, avgSnr, lat, lng, radius, seqNum
Info: lat, lng and radius variables are provided by the GPS data or the Sigfox Spot'It service

Url pattern

Use HTTP Method GET

Send SNI ☐ (Server Name Indication) for SSL/TLS connections

Headers header value

Ok Cancel