

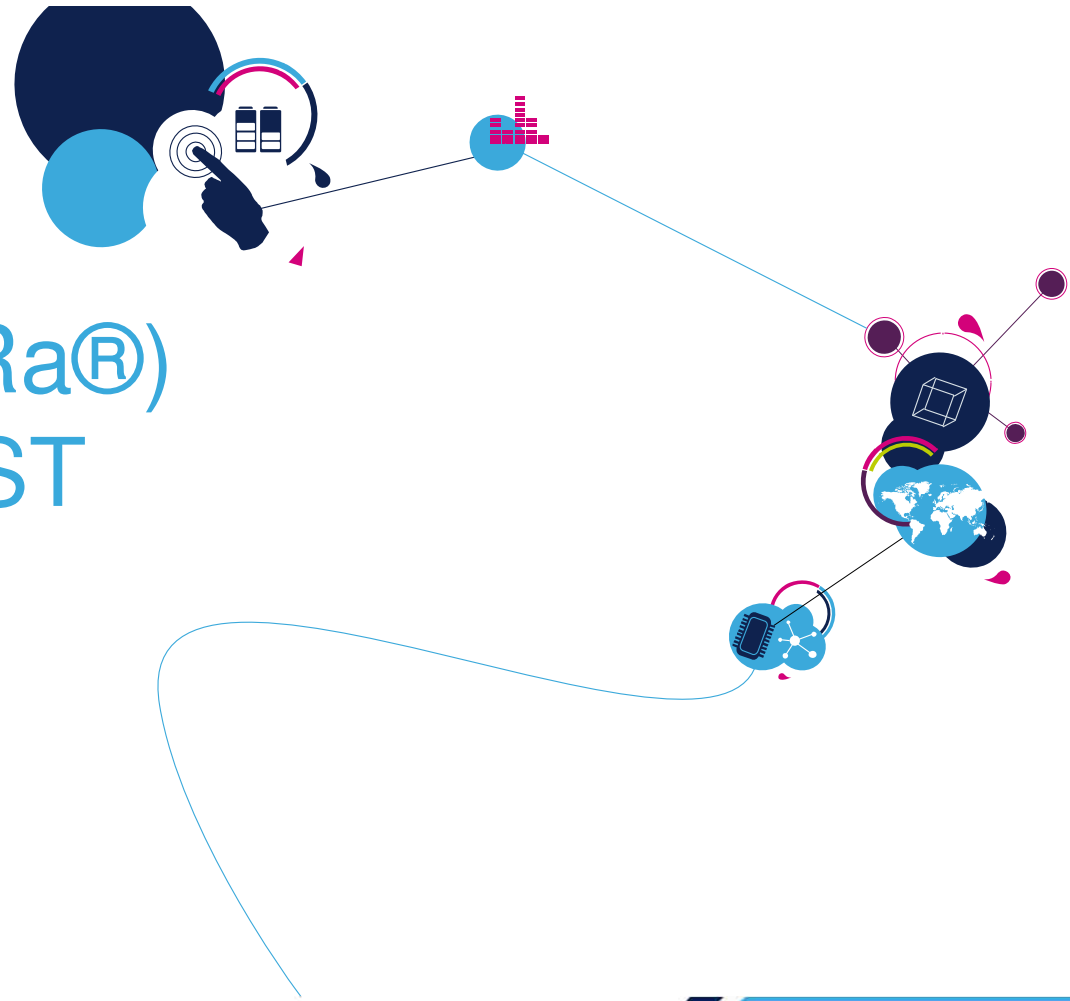
LPWAN (LTE & LoRa®) IoT Solutions from ST

Marc Hervieu
Marketing Manager



Technology Tour 2019

Anaheim, CA | March 26



Agenda

- LPWAN Market Overview
- ST IoT & Operator Strategy
- ST IoT LPWAN Cellular
 - AT&T, Verizon, Telus Dev-Kits
- ST IoT LPWAN LoRa®
 - MachineQ Dev-Kits
 - GNSS LoRa® Tracker Dev-Kits & Ref. Design
- ST IoT LPWAN Sigfox
- Wrap-Up

LPWAN

Low Power Wide Area Network

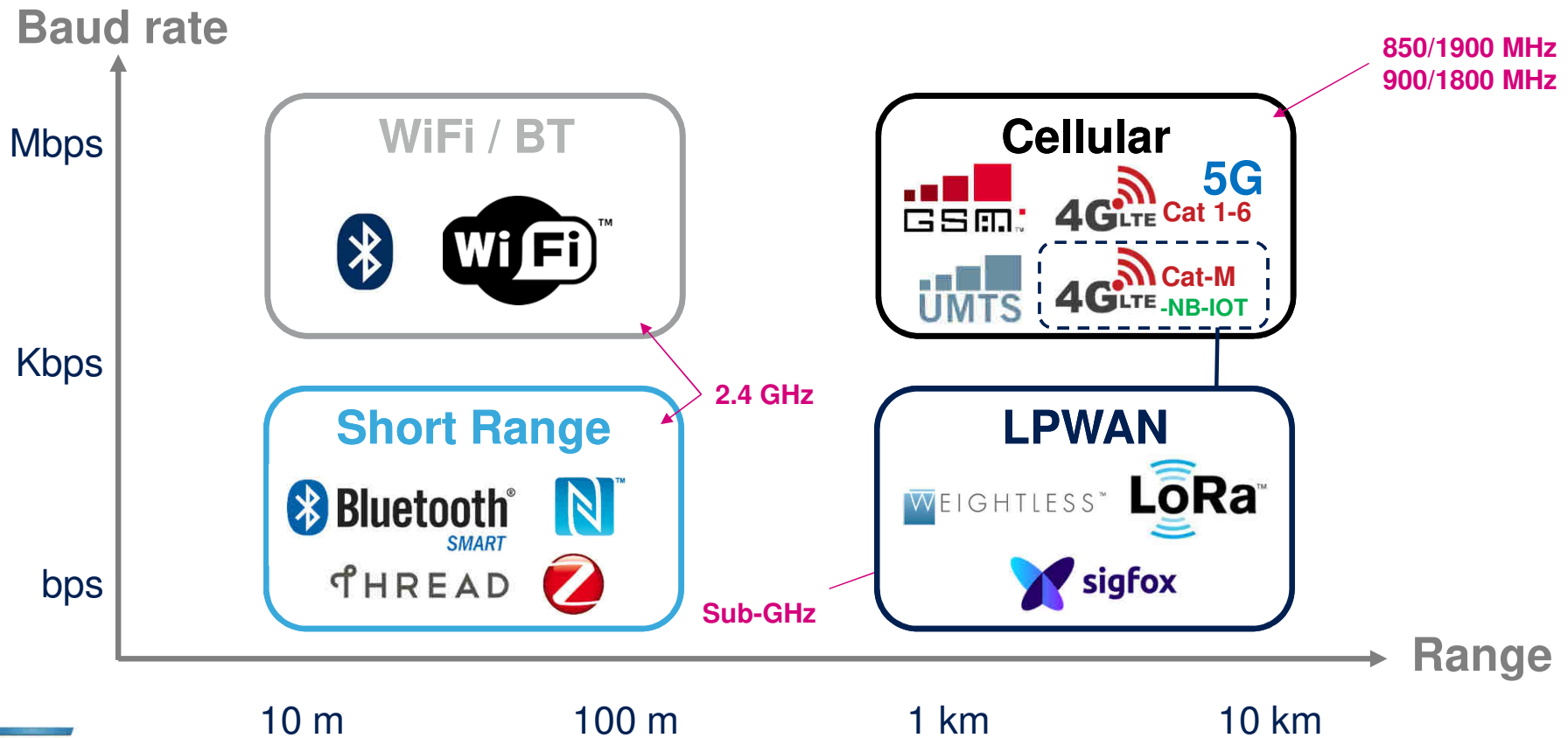
3



LPWAN Market Overview

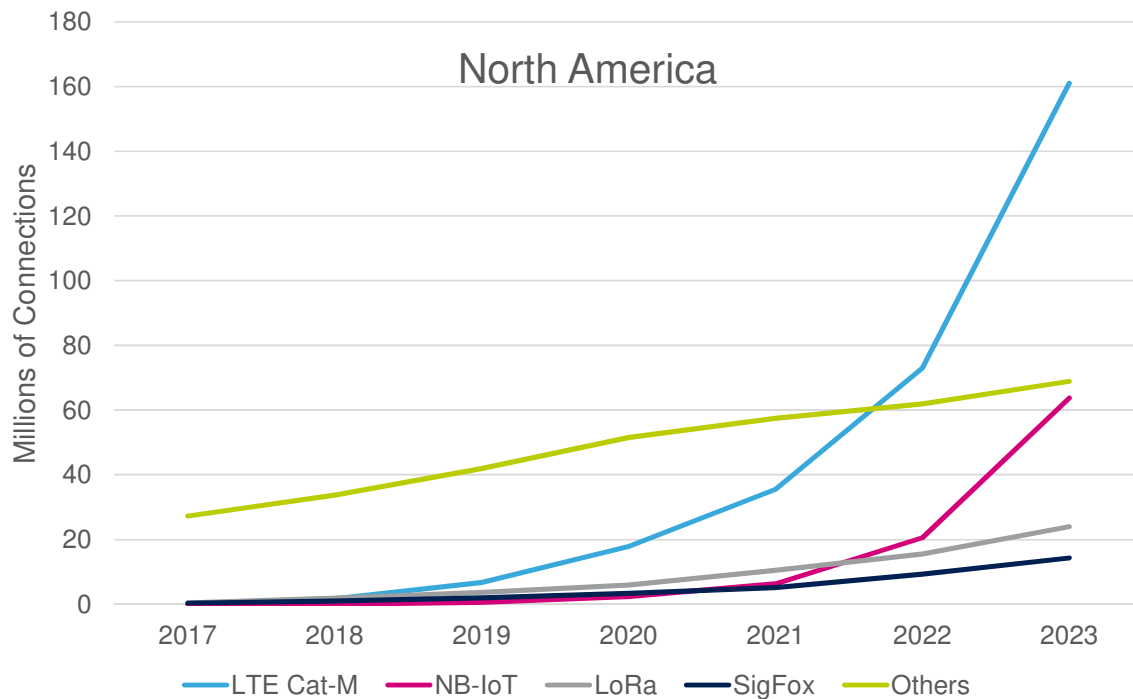
Communication Technologies - Overview

4



North America – LPWAN Market Trends

5



Applications driving LPWAN growth

LTE Cat-M

Asset Tracking

People / Pet Tracking

Home Auto.

Metering

Street Lighting

LoRa

Agriculture

Asset Tracking

Home Monitoring

Metering

Others

Home Auto.

NB-IoT

Asset Tracking

Metering

People / Pet Tracking

Sigfox

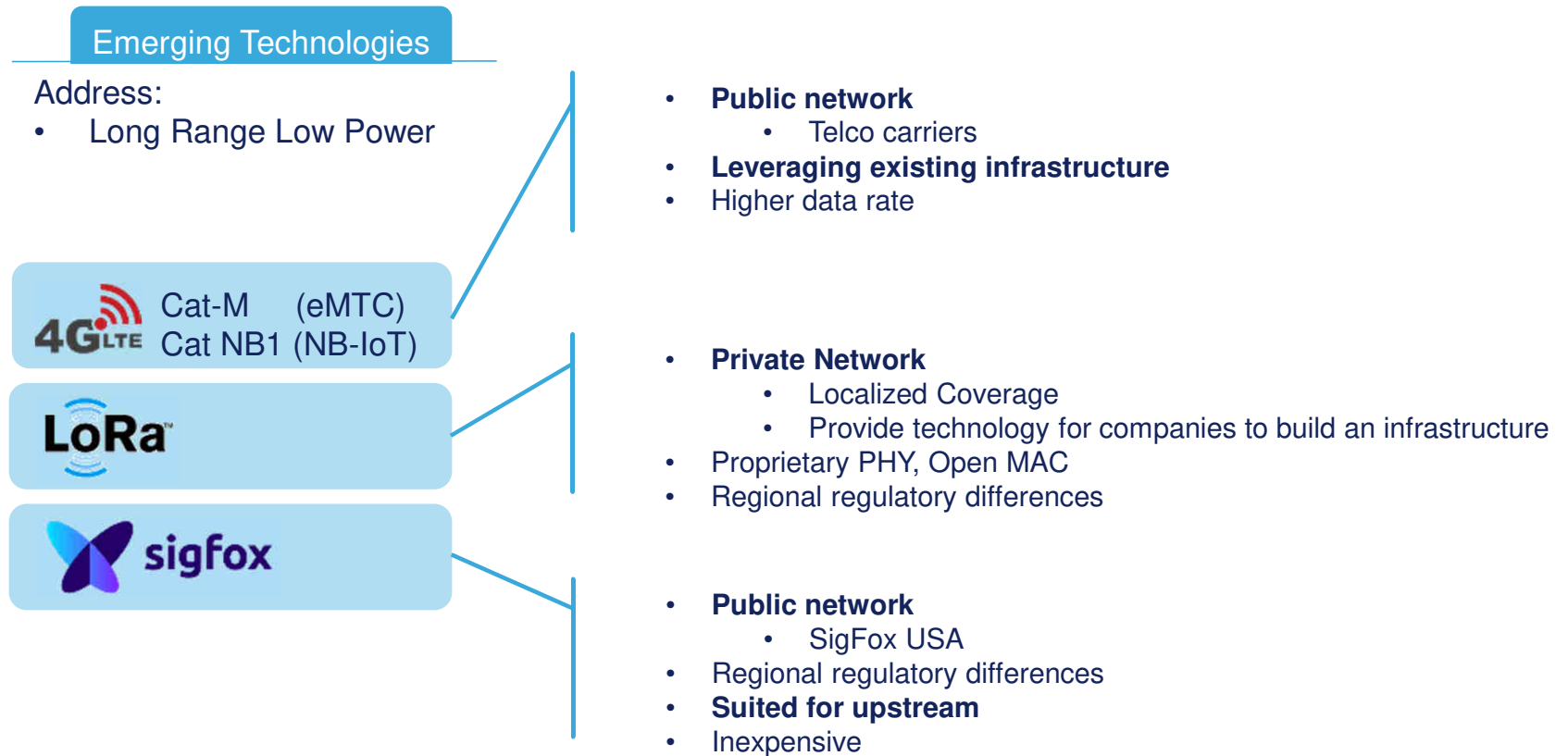
Agriculture

Asset Tracking

Home Monitoring

Communication Technologies - Overview

6



Technology Comparison

7



Coverage (BS Sensitivity)	-142 dBm	-138 dBm	-124 to -138 dBm	-142 dBm
Power Consumption	Low	Medium ⁴	Optimized for rich traffic Models (several K Bytes/day)	
Security	AES128 No IP	AES128	eSIM	eSIM
Bandwidth	0.1 - 0.6 kHz	0.3 - 50.0 kHz	10.0 - 100.0 kHz	0.2 - 10.0 kHz
2-Way	Device triggered	Class A only	Yes	Yes
Data Rate	100 - 600 bps	11 Kbps	300 Kbps	50 Kbps
Daily Traffic per device	1.6 Kbyte	10 Kbytes	Several 100 Kbytes	Several 100 Kbytes

Americas Operators – LPWAN Activity

8

 **Lte** Cat-M

verizon

 **at&t**

 **ROGERS**

 **TELUS**

américa
móvil

 **eseye**

 **Lte** NB-IoT

 **T-Mobile**

 **américa**
móvil

 **verizon**

 **at&t**

 **LoRa**

machineQ
A COMCAST SERVICE

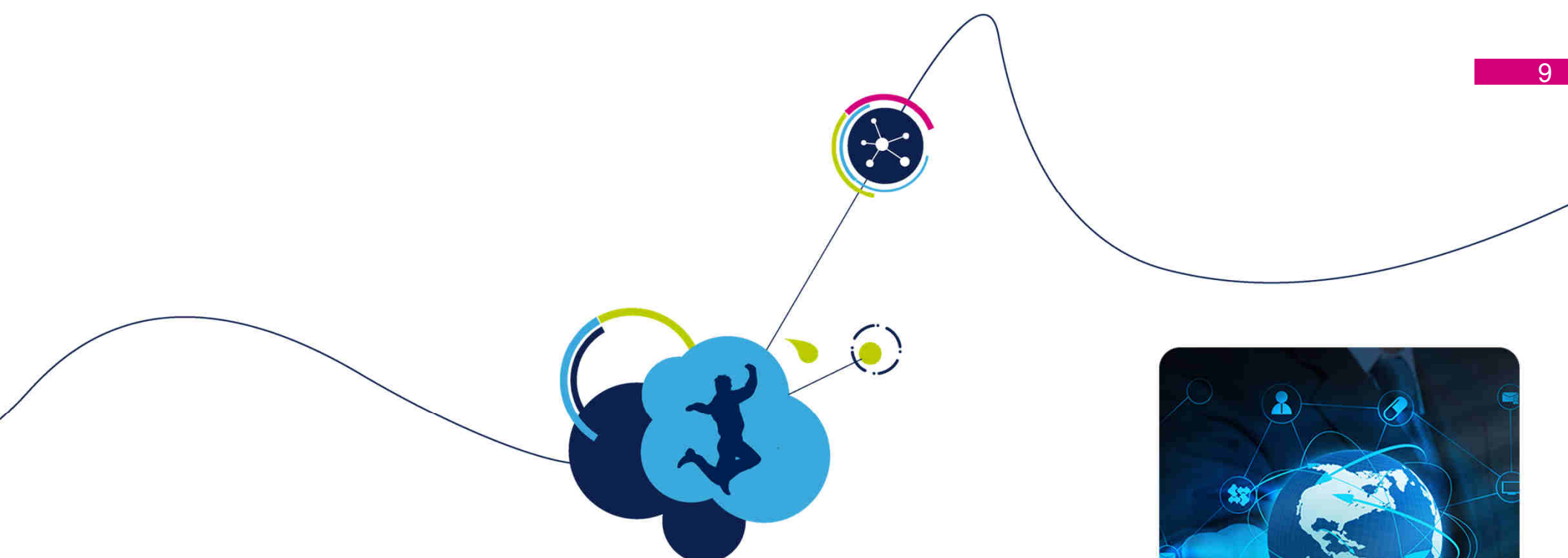
 **senet**

COX

Sprint

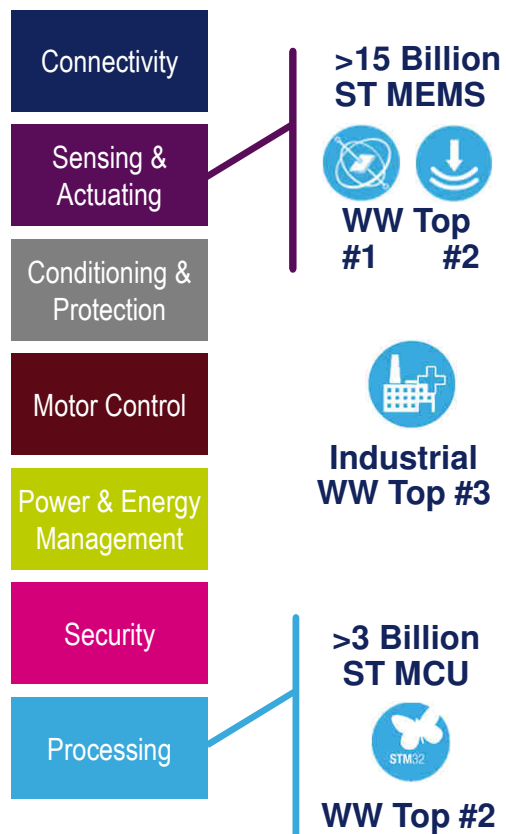
 **U.S. Cellular**

 **sigfox**



ST IoT & Operator Strategy





Pre-integrated SW for vertical applications



"Re-use the embedded code from prototype to product"

Development Ecosystem



STM32 portfolio positioning

11



14 product series / More than 50 product lines



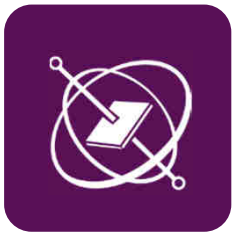
Note ● : Cortex-M0+ Radio Co-processor, ● : Cortex-M4 Co-processor

More than
40,000 customers



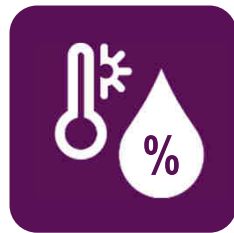
MEMS Sensors and Actuators

ST is the only company to offer the full range of Sensors & Micro-actuators



Motion

Gyroscope
Accelerometer
Magnetometer
6 & 9-axis inertial module
Optical image stabilization



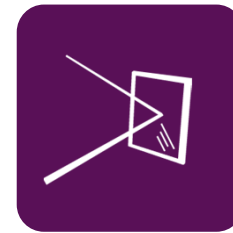
Environment

Temperature
Humidity
Pressure
VOC (Volatile Organic Compound)



Interactivity

MEMS microphone
Touchscreen controllers



Micro-Actuators

Micro-mirrors
Thin-film
Piezo-electric MEMS



Optical

FlightSense™
Time-of-Flight ranging sensors

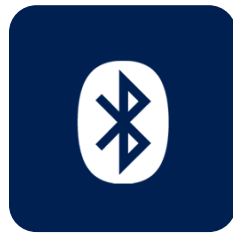
Connectivity

Low-power wireless connectivity solutions



NFC and RFID

NFC/RFID tags
Dynamic NFC/RFID tags
NFC transceivers



Bluetooth

Bluetooth 4.x single core
Network Processors and SoCs
Multiprotocol, multi core
(Bluetooth 5.0/802.15.4)
Wireless SoC



SubGHz

Transceivers
Modules
LoRa and SigFox
compatibility



Wi-Fi

Plug & Play Wi-Fi module
Pre-certified solutions



Cellular

LTE CatM
LTE NB-IoT
Partner Radio
Partner Modules

ST Operator LPWAN Strategy

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Packaged
Embedded
Solutions

HW, SW, Documentation...

Targets:

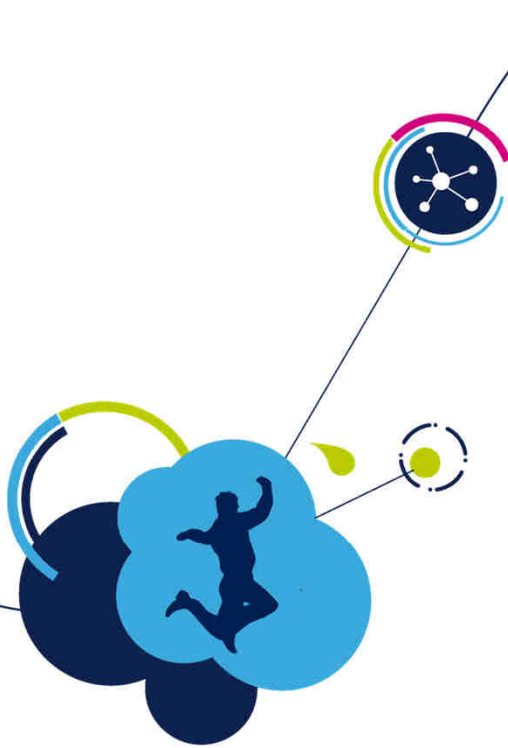
- Embedded Developers
- IoT evangelist
- OEMs
- Mass market

New Products on
the market

Return On Investment:

- Use ST products
- Use Operator service

- Faster Time to Market
- Easier development: Less cost/resources

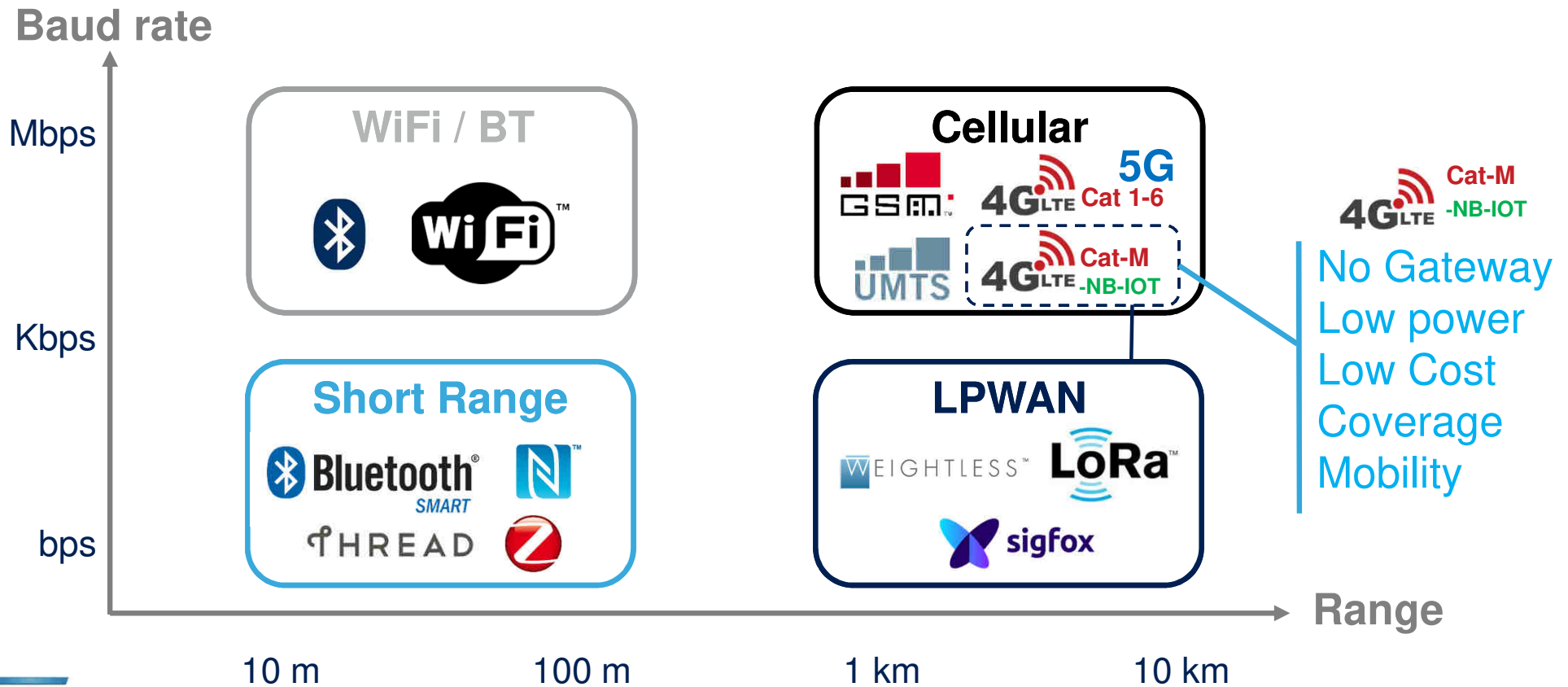


ST IoT LPWAN Cellular



Communication Technologies - Overview

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AT&T Starter Kit

17

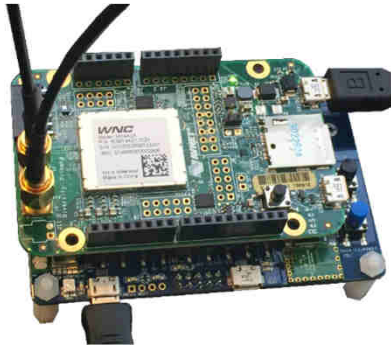
STM32 based Development Kits with AT&T





IoT STM32 LTE Starter Kit

18

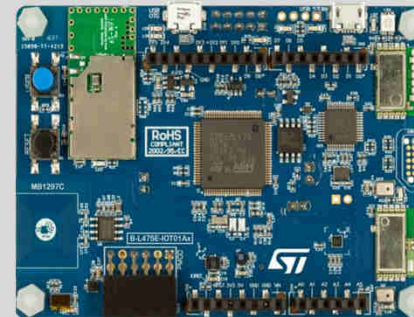


WNC Modem

- LTE Cat-1
- LTE Cat-M



Avnet – Modem Board



STM32L4 Discovery
Kit IoT Node



Bluetooth®
Low Energy



Sub GHz



LTE Cat-M
NB-IoT



Avnet- AT&T Solution

19

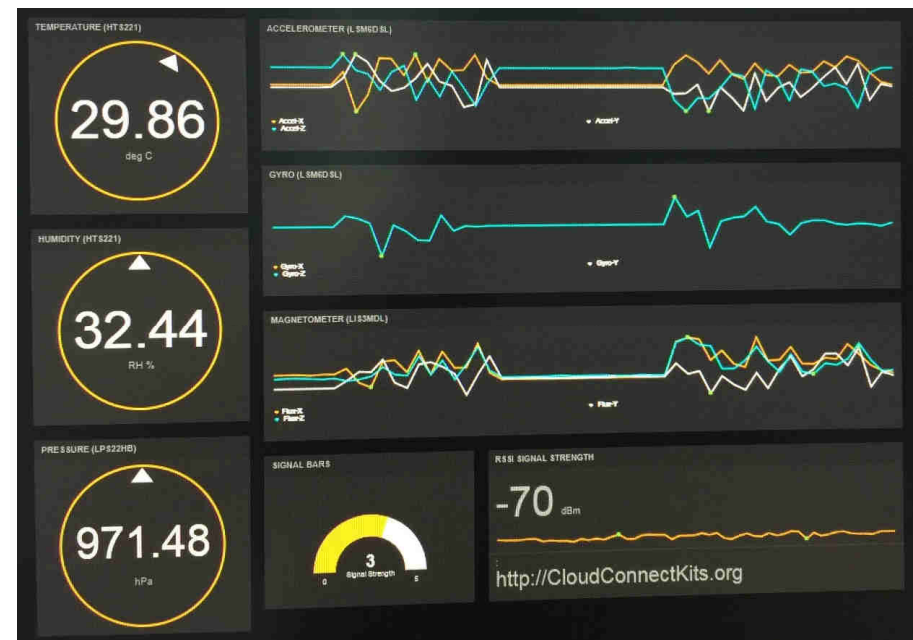
STM32 LTE Starter Kit



LTE Cat-M

AT&T Flows

Web Browser



STM32 AT&T – How to Get Access

20

- AT&T market place



<http://marketplace.att.com/products/att-iot-starter-kit-stm32-lte-m>

- Solution: \$139, 150 MB / 6 Months Per Device included, 90 Days



- Avnet resources



<http://cloudconnectkits.org/product/att-stm32-iot-starter-kit>

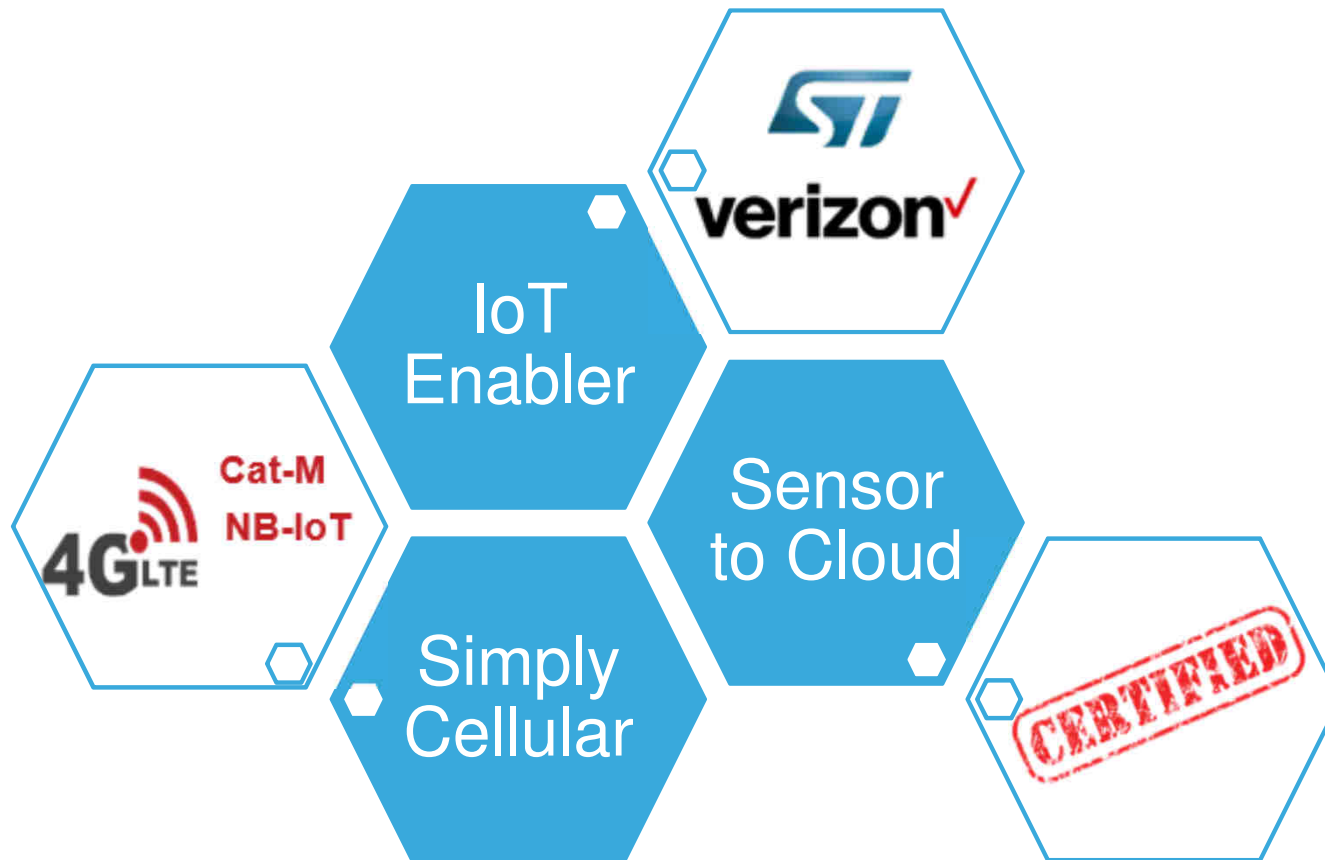




VERIZON LTE Starter Kit

Targets IoT Embedded Developers

21





IoT STM32 LTE Starter Kit

22



Quectel Modem

- LTE Cat-M
- LTE NB-IoT

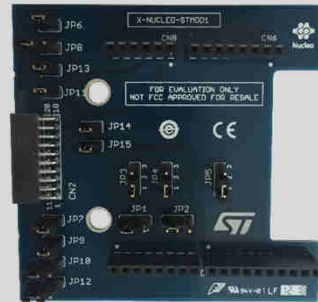


ST LTE Modem

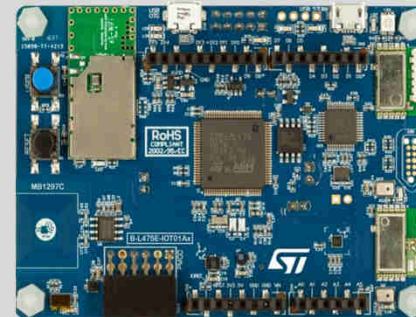


verizon

ST SIM-Card

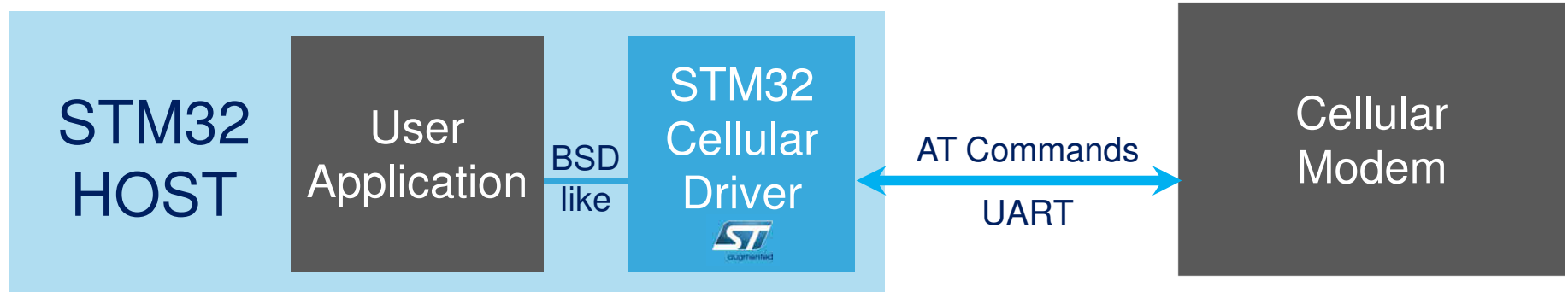


X-Nucleo
Expansion Board



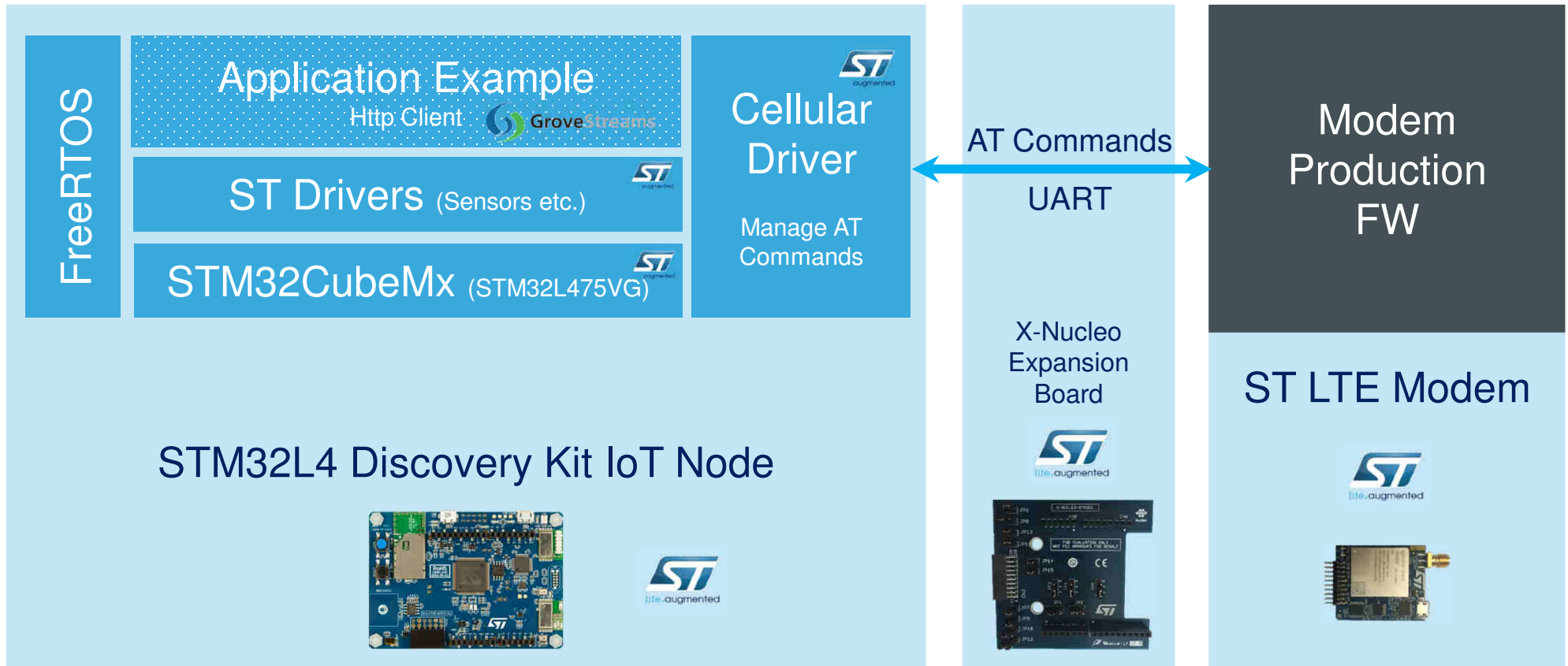
STM32L4 Discovery
Kit IoT Node





STM32 Cellular Driver Middleware

- No need to be a Cellular expert
- Simple Application
 - BSD like Socket APIs → Data Plane
 - HAL → Abstract all key Cellular AT commands
 - Control various modem vendors
 - Error Management (Device, Network)
- Certification added value
 - Partial GSMA TS34/35 compliance

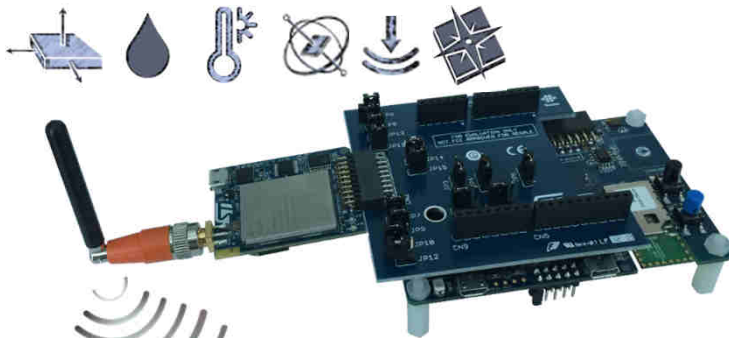




X-CUBE-CELLULAR

25

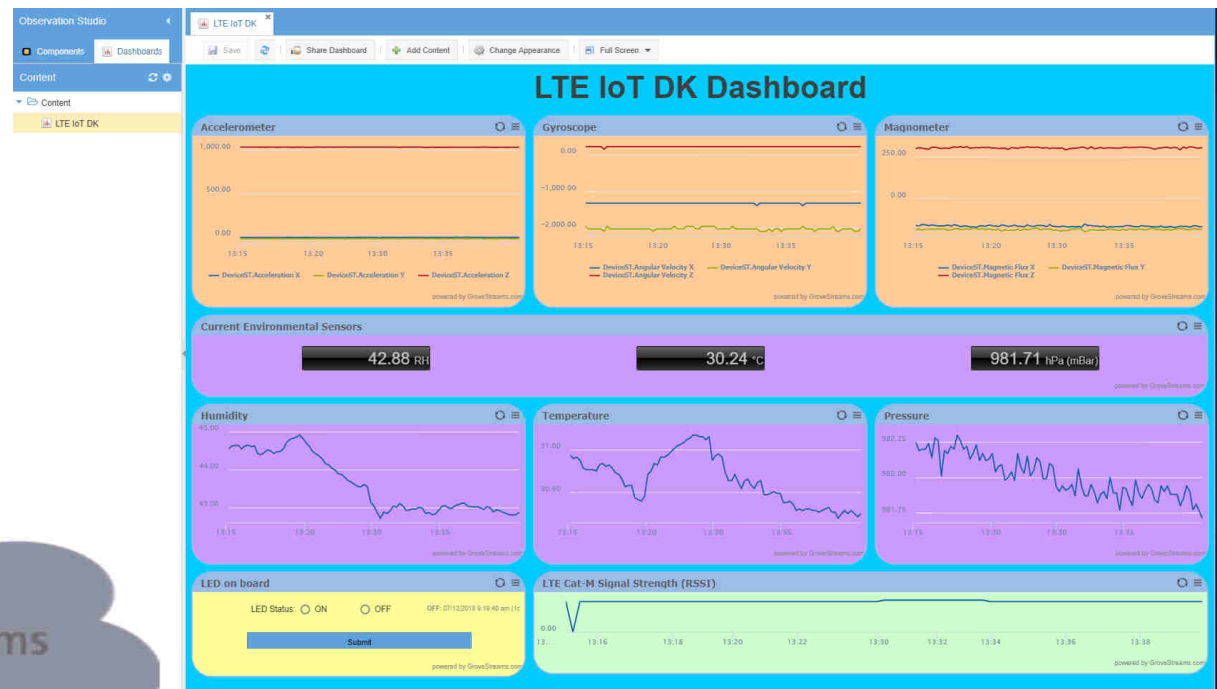
STM32 LTE Starter Kit x-cube-cellular

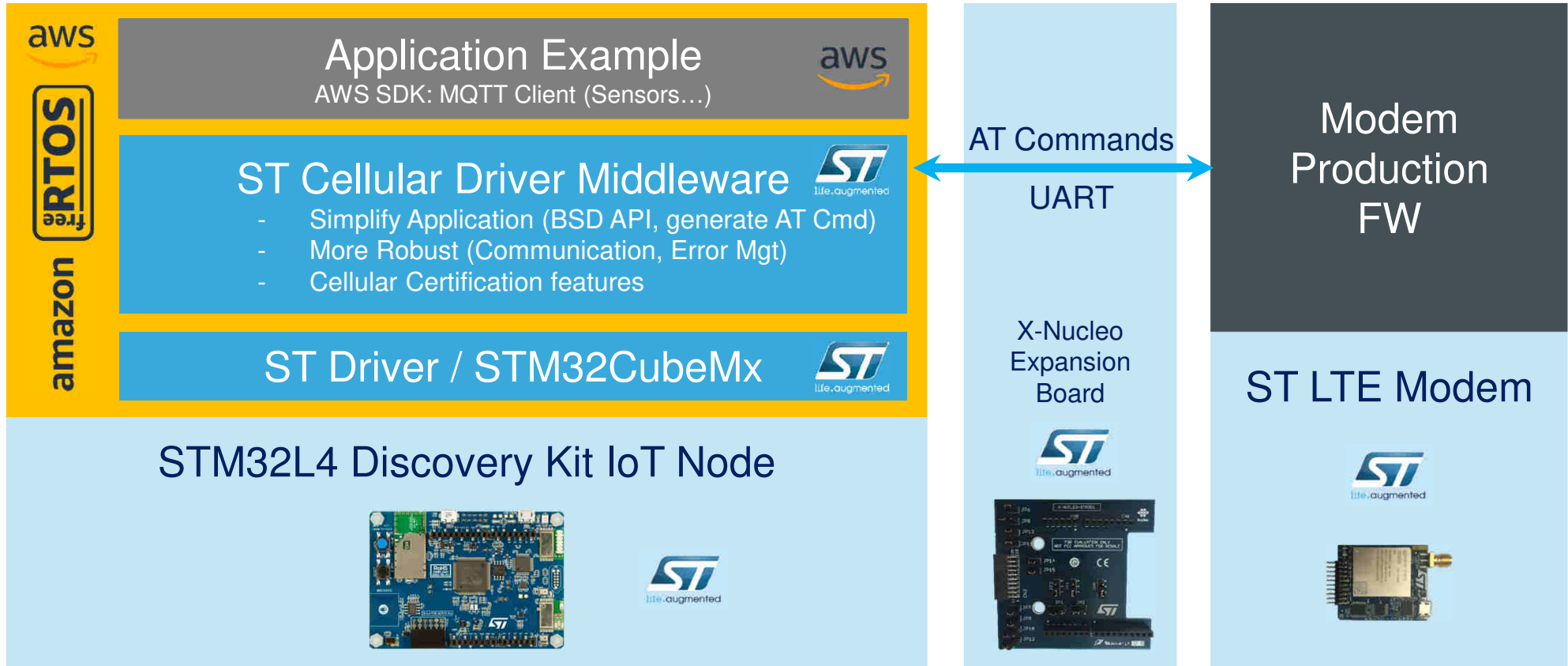


LTE Cat-M



Web Browser

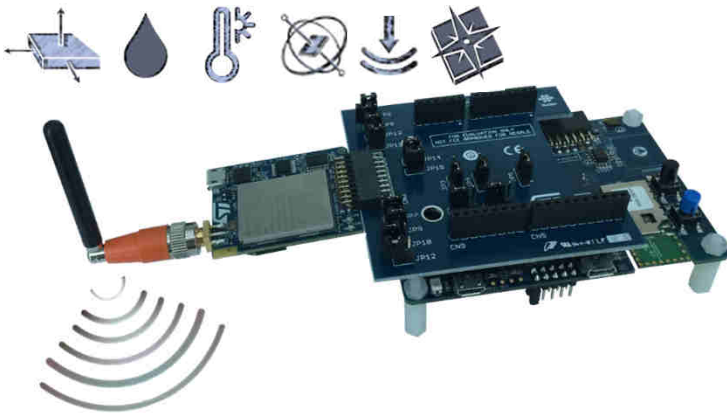




verizon[✓]

STM32 LTE Starter Kit

amazon **freeRTOS**



verizon[✓]

LTE Cat-M

ST
life.augmented



Amazon FreeRTOS

27

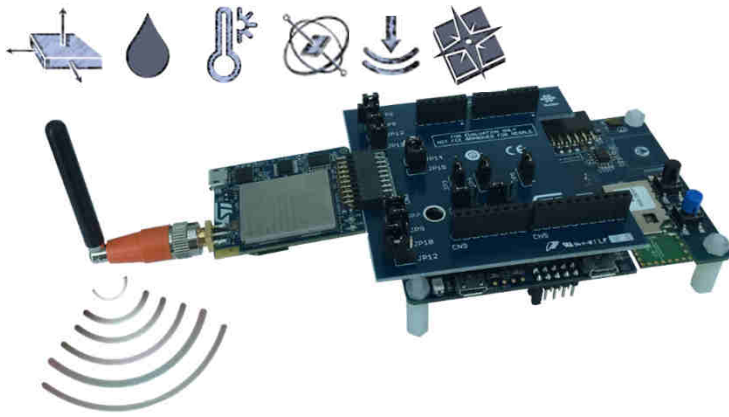
Web Browser
AWS – KIBANA Dashboard



verizon[✓]

STM32 LTE Starter Kit

amazon **freeRTOS**



verizon[✓]
LTE Cat-M

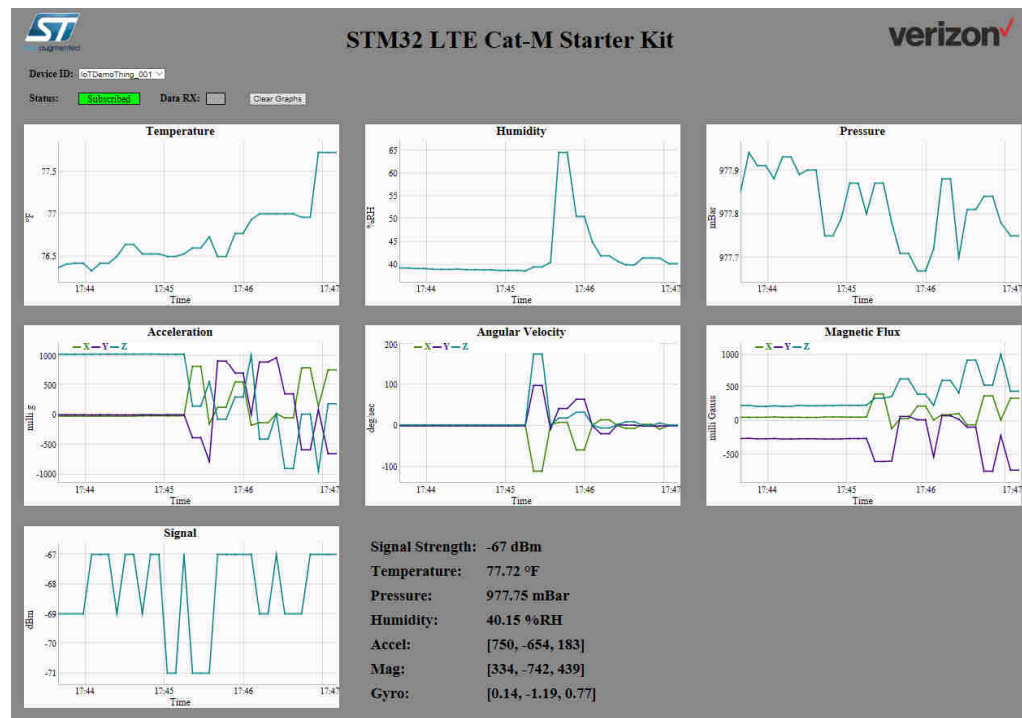


ST
life.augmented

Amazon FreeRTOS

28

Web Browser
ST JavaScript Dashboard



STM32 Verizon – How to Get Access

- Verizon ThingSpace Cloud connectors



<https://thingspace.verizon.com/connectors>

Click on “Learn more”

IoT Development Kit
Build, connect and stream to AWS

Learn more



- Amazon Marketplace

<https://devices.amazonaws.com/search?kw=thingspace&page=1>



Arrow → To buy the hardware

<https://www.arrow.com/en/products/vz-iot-dev-002/arrow-development-tools>

- Offer: Hardware \$125, Verizon plan: <https://thingspaceportal.verizon.com/ccapp/#/home>

- Software Resources



X-CUBE-CELLULAR

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Search for X-CUBE-CELLULAR



Amazon FreeRTOS – Verizon GitHub

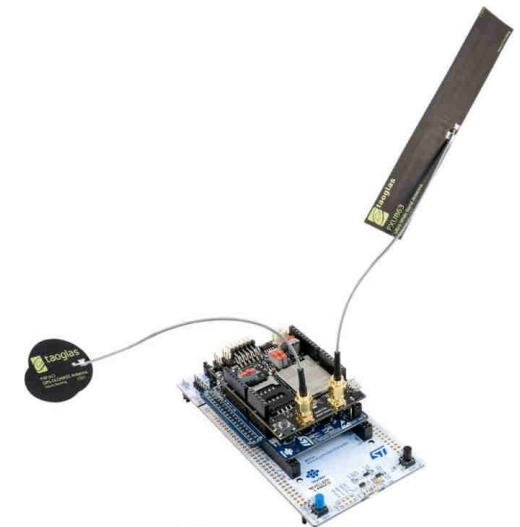
https://github.com/verizonlabs/vz_aws_st

Operator	Name	Dev-Kit	HW Kit	Cloud
	Avnet Nucleo		NucleoL496ZG X-Nucleo-IKS01A2 Avnet Modem (Quectel)	Microsoft Azure ARM mBed 5.0

Telus → <https://www.telus.com/lpwa>

Avnet → <http://cloudconnectkits.org/product/telus-lte-m-iot-starter-kit>

- LTE Cat-M
 - Quectel Modem LTE Cat-M / NB-IoT
- Distribution: Avnet – \$138.99
 - Data Plan – 150 MB / 6 Months
- Demo sensor to cloud
 - Sensor → **LTE-Cat-M** → Microsoft Azure

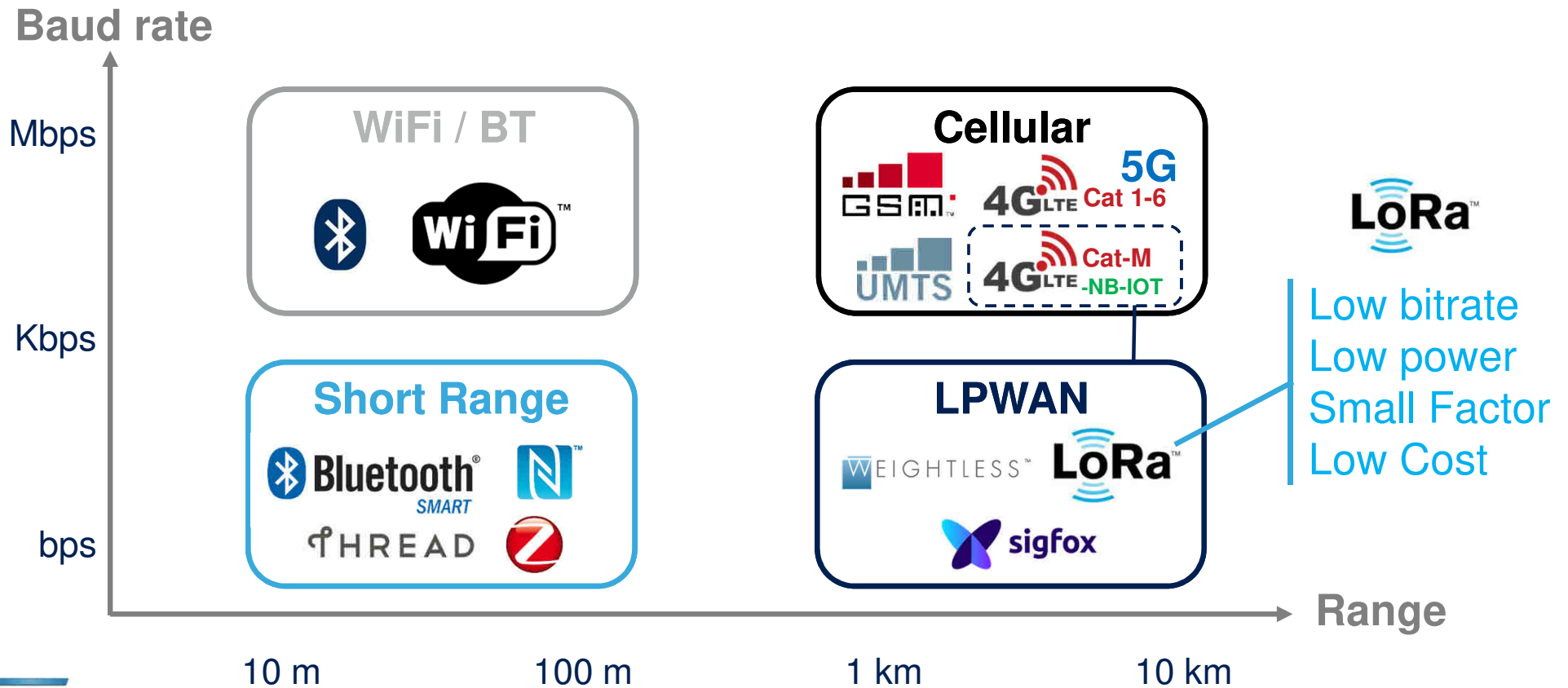




ST IoT LPWAN LoRa®

Communication Technologies - Overview

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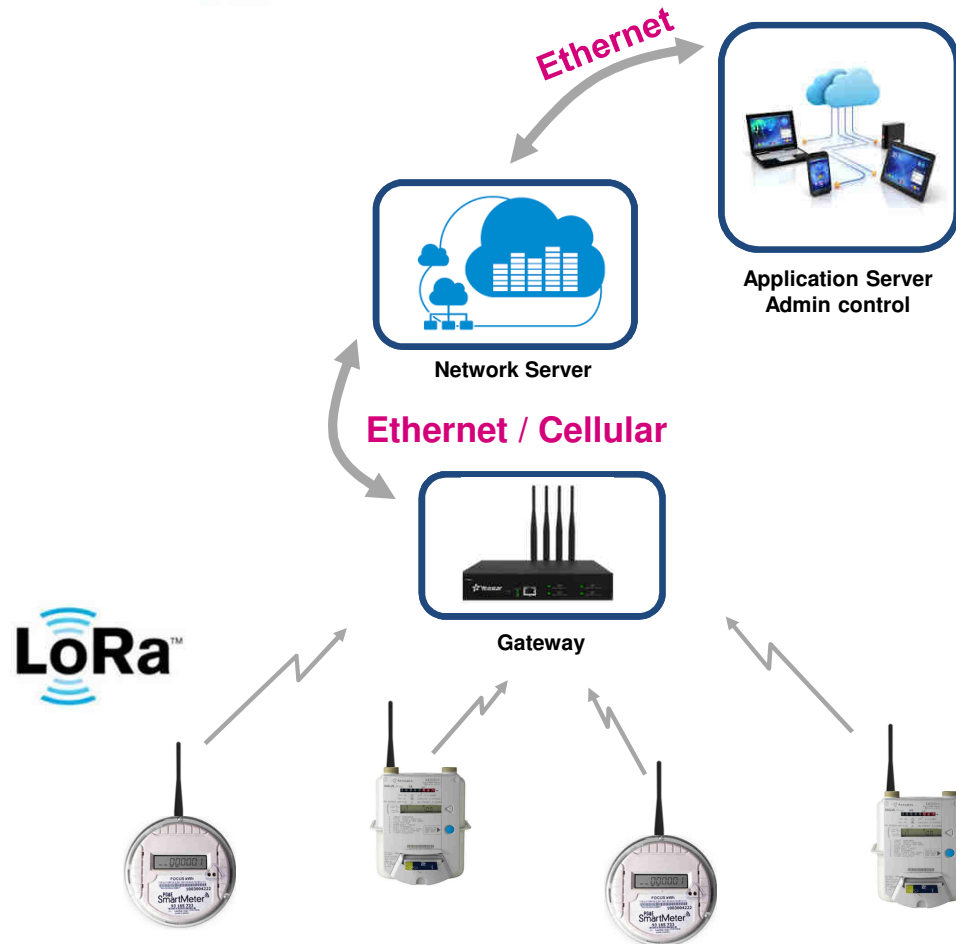
LoRa™ IoT use cases

33

Key Verticals

- Smart Industry
- Smart City
- Smart Metering
- Smart Agriculture
- Smart Building

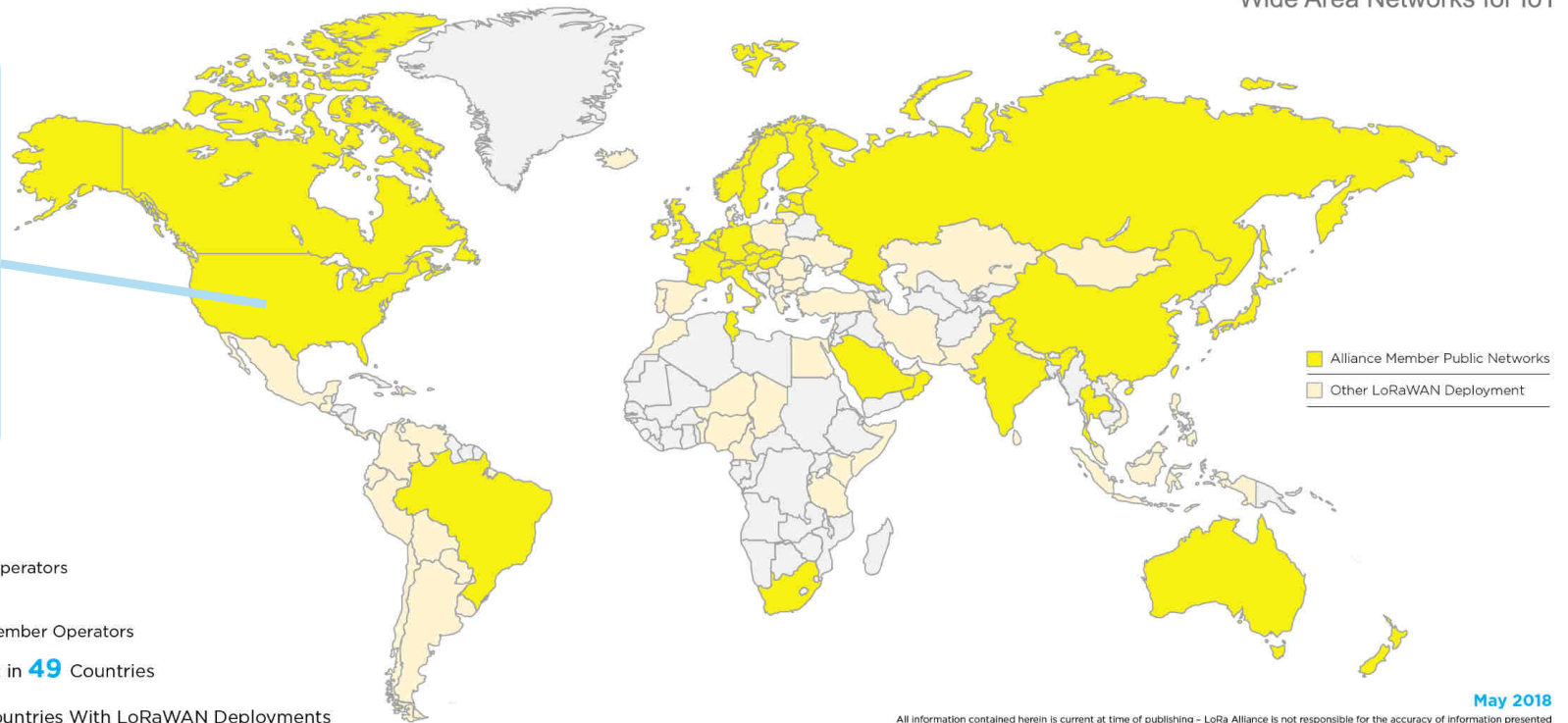
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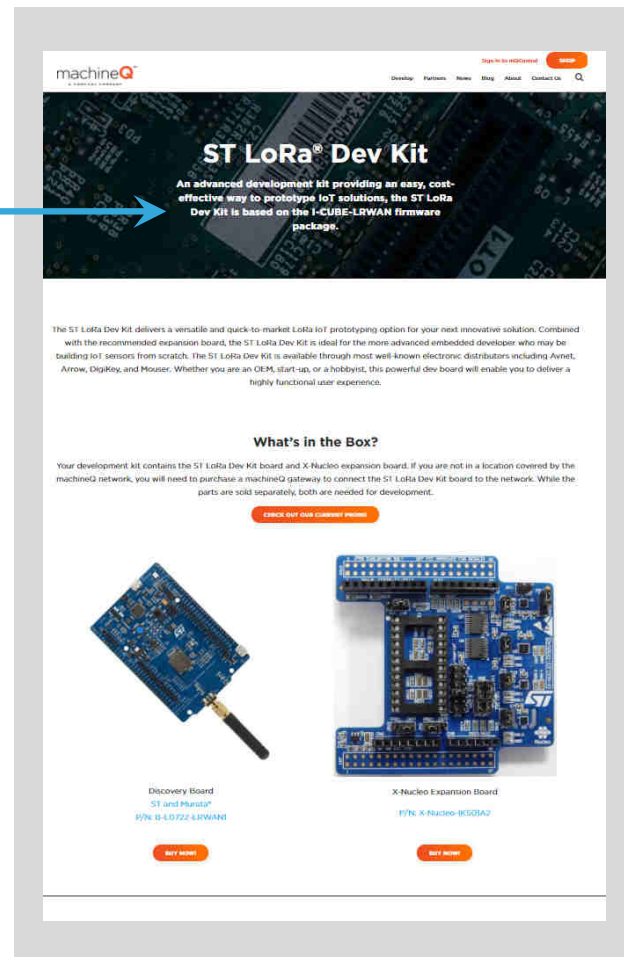
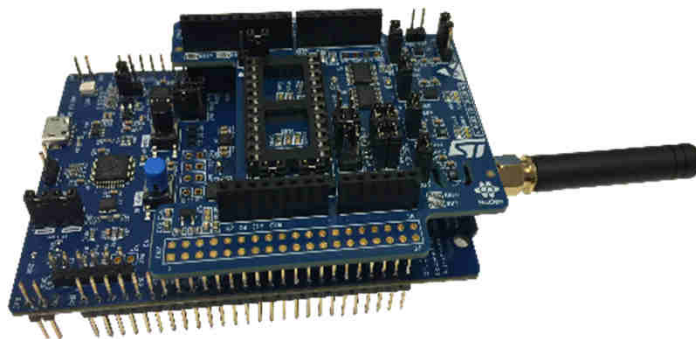
LoRa® Network Deployments

34

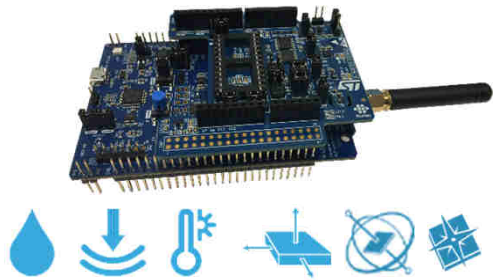
LoRaWAN™ NETWORKS



- Dev-kit based on STM32 & ST Sensors
 - MachineQ.com: <https://machineq.com/st-lora-dev-kit/>
 - Getting Started Guide
 - Binary & Keil project Source Code
 - HW available from Mouser
 - FW supported by MachineQ



ST LoRa[®] Dev Kit Solution



MACHINE QTM
IoT Gateway



MQcentral (SaaS)



<https://MachineQ.com/st-lora-dev-kit/>

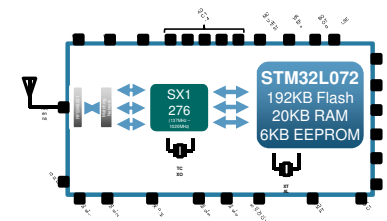
ST LoRa[®] Dev Kit Hardware

base board B-L072Z-LRWAN1

ST-Link
Debugger



Murata[®] Module
All-in-one Open



Arduino Connector

Published on www.st.com
Search for B-L072Z-LRWAN1



B-L072Z-LRWAN1

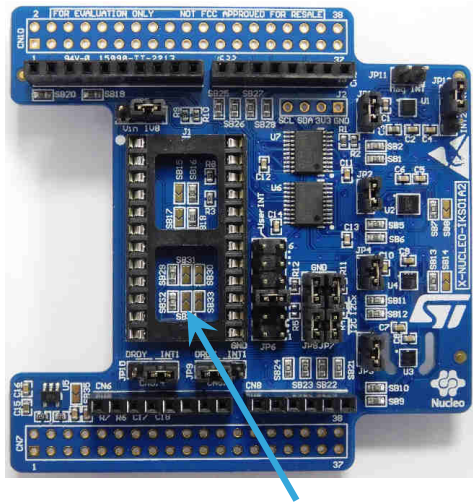
- Murata Module
 - Host: STM32L0
 - 20KB RAM, 192KB Flash, 6KB Eeprom
 - Radio: Semtech SX1276



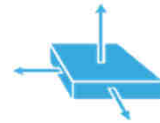
ST LoRa® Dev Kit Hardware

Sensor Shield X-NUCLEO-IKS01A2

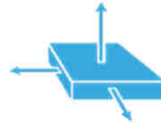
Published on www.st.com
Search for X-NUCLEO-IKS01A2



DIL-24 Extension



3D Accel. + 3D Gyro. (LSM6DSL)



3D Accel. + 3D Magno. (LSM303AGR)



Pressure (LPS22HB)



Temperature + Humidity (HTS221)

Published on www.st.com
Search for STEVAL-MK*



ST LoRa[®] Dev Kit Firmware

To download Binary & Source code
go to <https://MachineQ.com/st-lora-dev-kit/>

ST LoRaWAN stack → I-CUBE-LRWAN

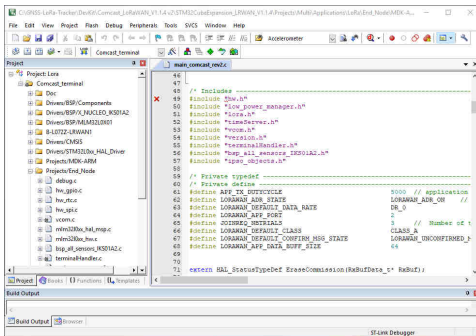
Published on www.st.com
Search for I-CUBE-LRWAN

+

Sensors → raw data to the cloud

+

Menu setup → Stores parameters in NVM
Credentials (DevEUI, AppEUI, AppKey), Duty Cycle



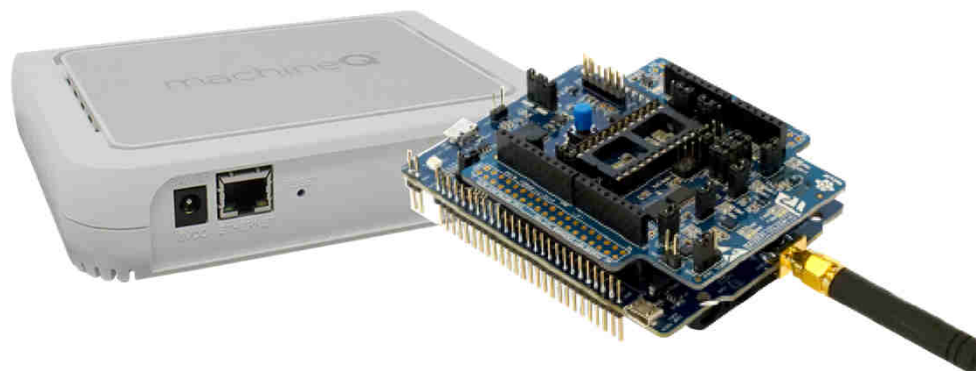
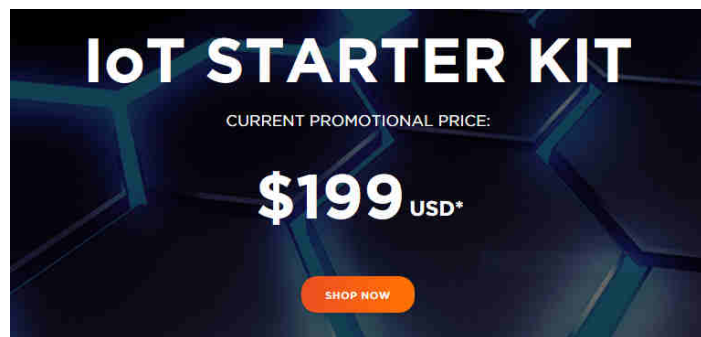
ARM[®] KEIL[®]
Microcontroller Tools

- Professional grade IDE
- Free for STM32L0
- Debugger / Program

<http://www2.keil.com/stmicro-electronics-stm32/mdk>



Starter Kit - Deal



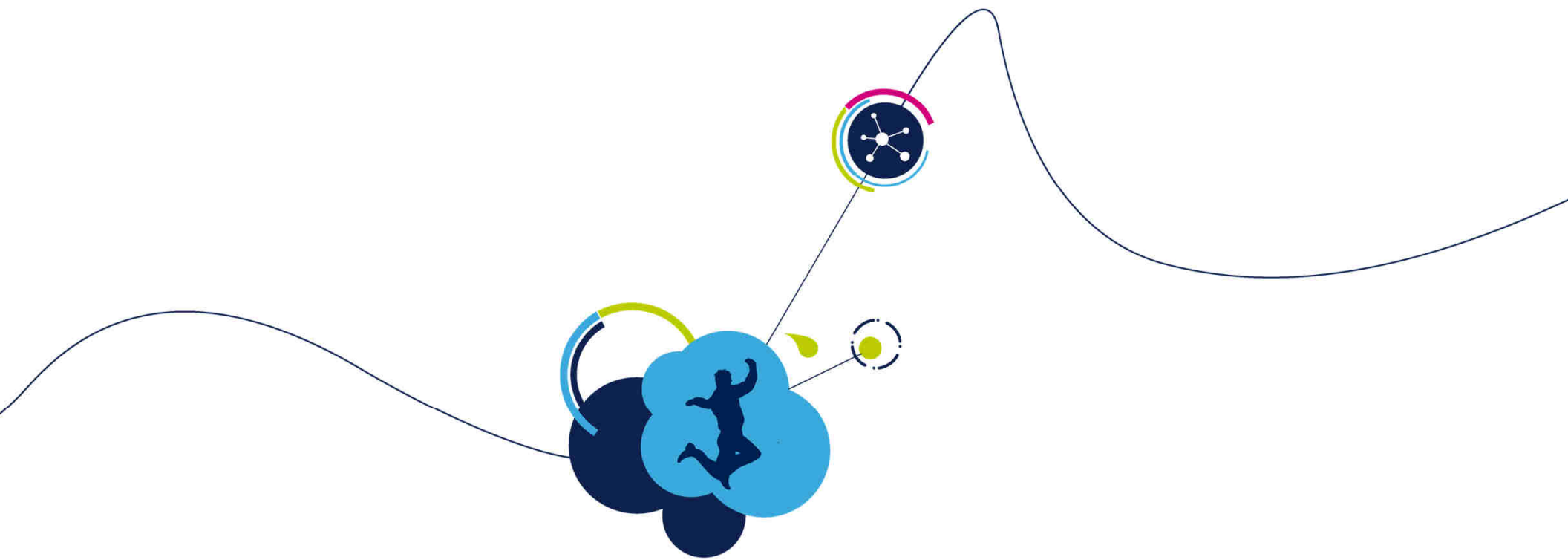
Offer Details

- Includes an ST LoRa® Development Kit
- MachineQ LoRa® Network Gateway (8 channel w/ ethernet or WiFi backhaul)
- Access to MachineQ Cloud Management Platform (90 days of use)
- Access to a library of useful dev tools and resources at MachineQ.com/develop

<https://store.machineq.com>

ST LORA DEV KIT

The STMicroelectronics LoRa® Dev Kit development board and sensor shield is an advanced development kit – optimized for engineers ready to prototype scalable solutions toward complete IoT implementation



LoRa® Asset Tracker

Asset Tracking Use Case

Being to locate an asset and its environmental



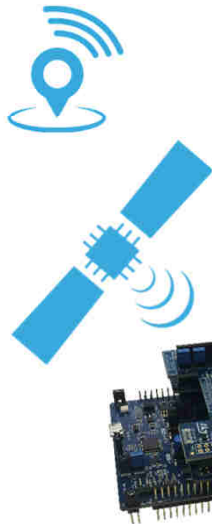
- Applications

- Fleet Management → For ex. Truck delivery
- Asset / Good Tracking
- Pet/Child tracker

- Use case scenarios

- On-line within LoRa® network
 - Real time location, Send notification when inside geo-fence
- Off-line not connected to any LoRa® network
 - Recreate the path history for post analysis

ST LoRa® Asset Tracking Dev-Kit

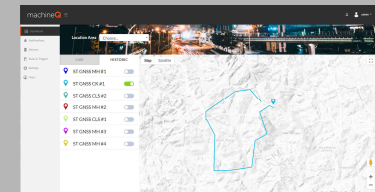


LoRa®

MACHINE Q™
IoT Gateway



mQPortal(SaaS)



<https://MachineQ.com/st-lora-dev-kit/>

+

ST GNSS Arduino Shield

- ST Teseo-LIV3F Module
- ST Teseo III
 - Multi-constellation:
 - Geo-Fencing...

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Search for X-NUCLEO-GNSS1A1



GPS



Galileo



GLONASS

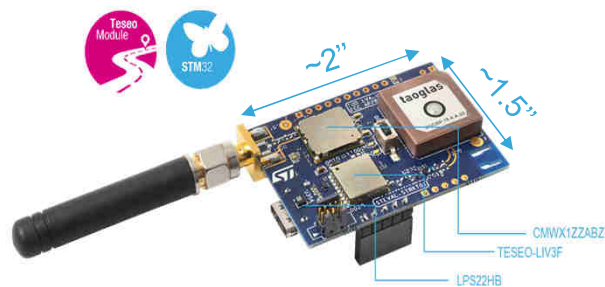


Beidou2



QZSS

ST LoRa® Asset Tracking Ref Design



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Search for STEVAL-STRKT01

LoRa® Asset Tracking Function Pack

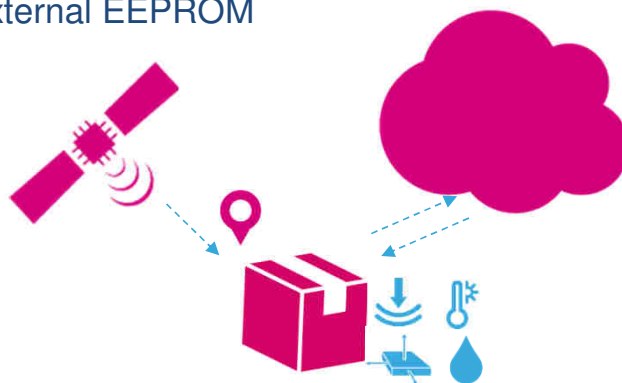
FP-ATR-LORA1

Published on www.st.com
Search for FP-ATR-LORA1



Key Features

- Complete firmware to connect an IoT node to a LoRaWAN network, sending geo-position coming from GNSS and environmental and sensor data
- Library supporting LoRaWAN 1.0.2 class A and USB
- Teseo-LIV3F based GNSS positioning and Geofencing.
- LoRaWAN keys provisioning via USB
- Power/Battery Management with low-power operating modes
- Data logging on external EEPROM



Application	Asset tracking Application		
Middleware	LoRaWAN Class A	USB	GNSS
Hardware Abstraction	STM32Cube Hardware Abstraction Layer (HAL)		
Hardware	STM32 Nucleo expansion boards X-NUCLEO-GNSSA1 (Connect) X-NUCLEO-IKS01A2 (Sense)		STEVAl-STRKT01 evaluation board
	B-L072Z-LRWAN1 development board		

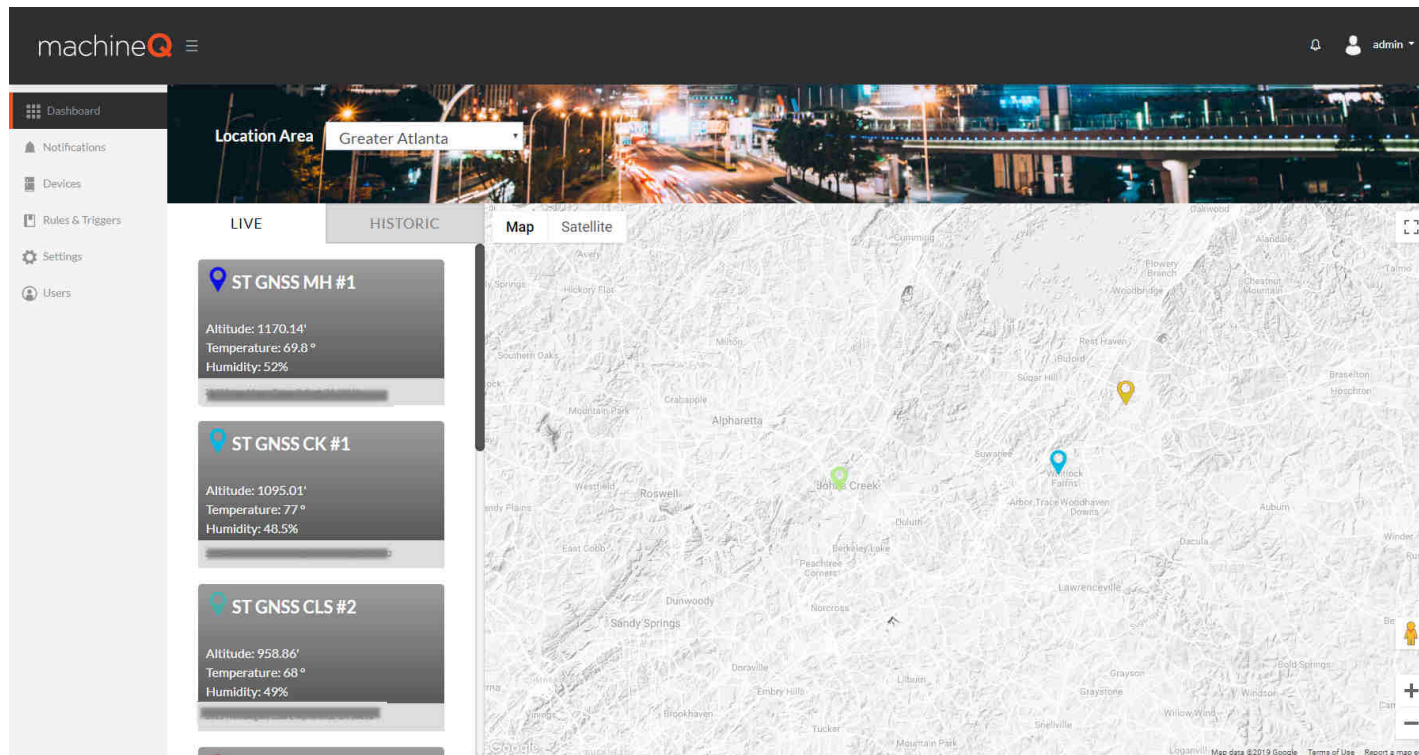


Asset Tracker – MQportal UI

Monitoring

Sensor Monitoring

- Reverse address discovery based on GNSS location
- Monitor sensors (Altitude, Temperature, Humidity)

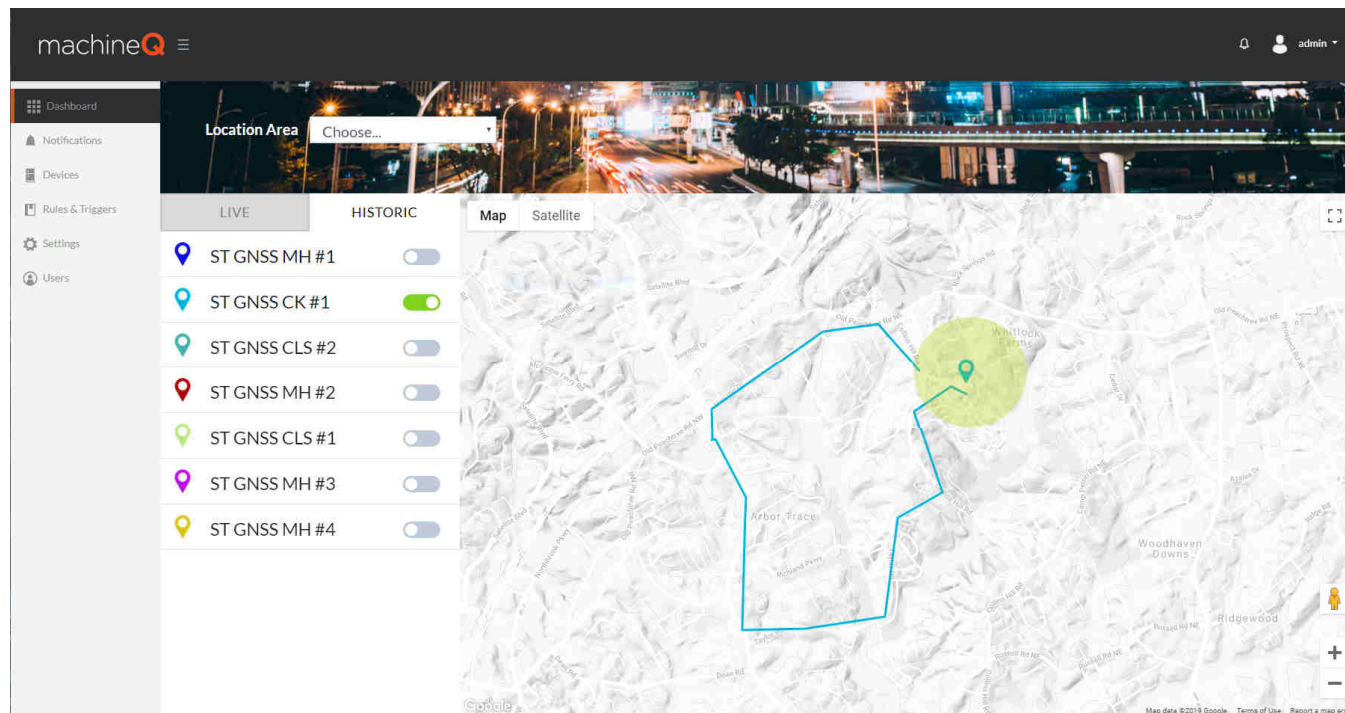


Asset Tracker – MQportal UI

Historic Path

Asset Tracking

- Inside LoRa Network → Track position near real time
- Outside LoRa Network → Store position & catch-up when connection restored
 - Keep track of the time to rebuild the path

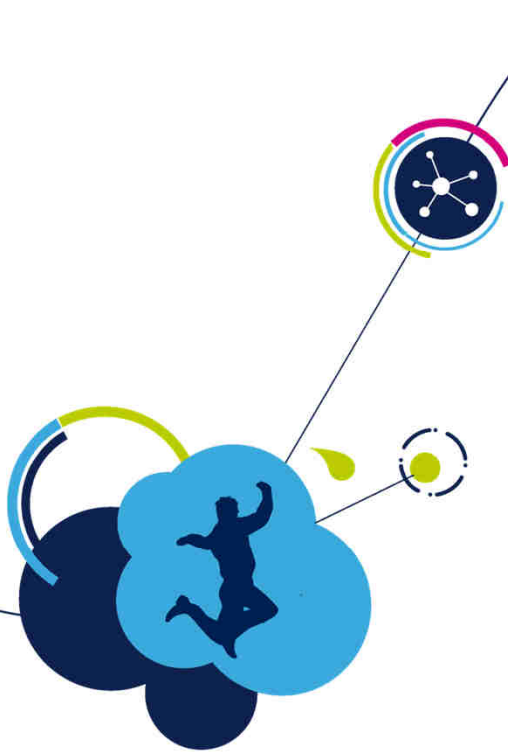




- **Getting it right the first time:
Accelerate your LoRa® Implementation**
 - ST Webinar Sponsored by MachineQ & Murata
 - Occurred on **Jan 30th 2019**

https://www.st.com/content/st_com/en/about/events/events.html/accelerate-your-lora-implementation-webinar.html

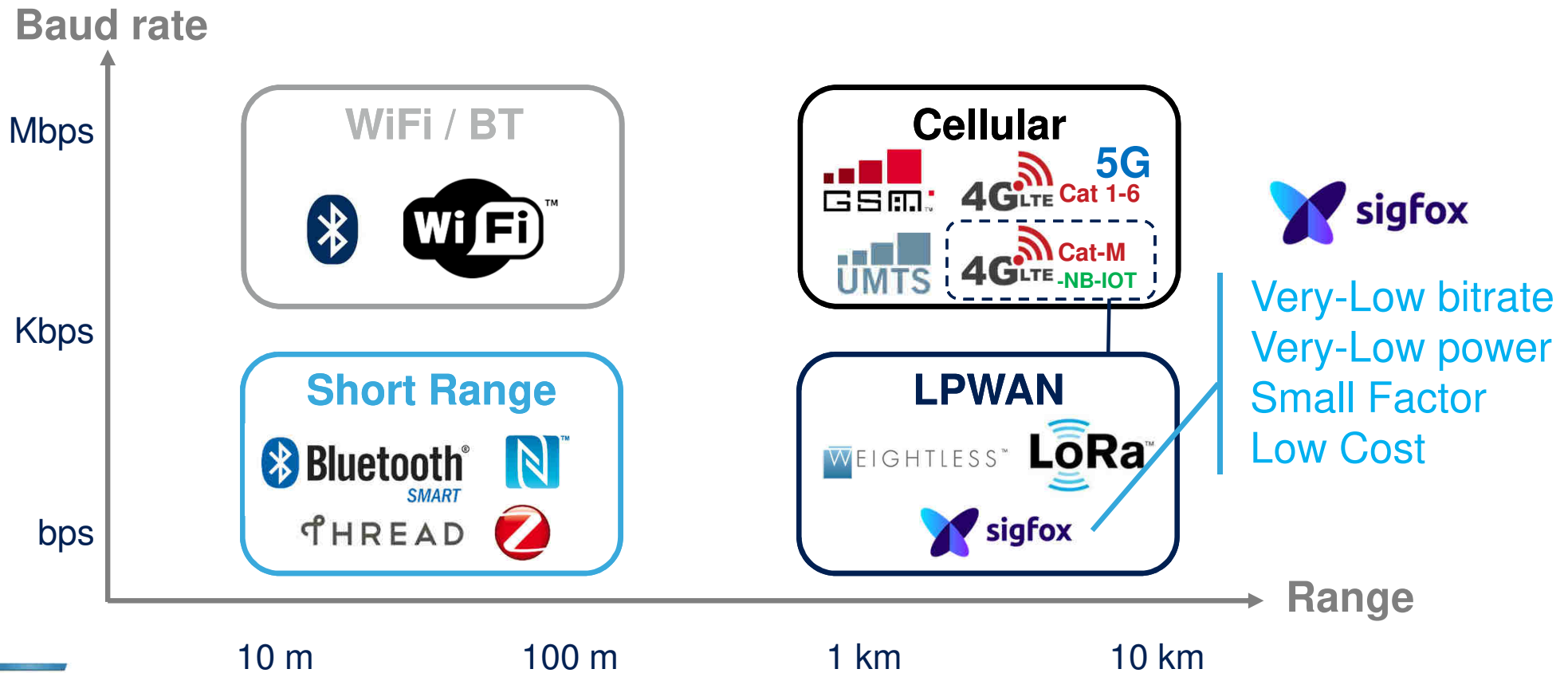
Video and Material available on line.



SigFox

Communication Technologies - Overview

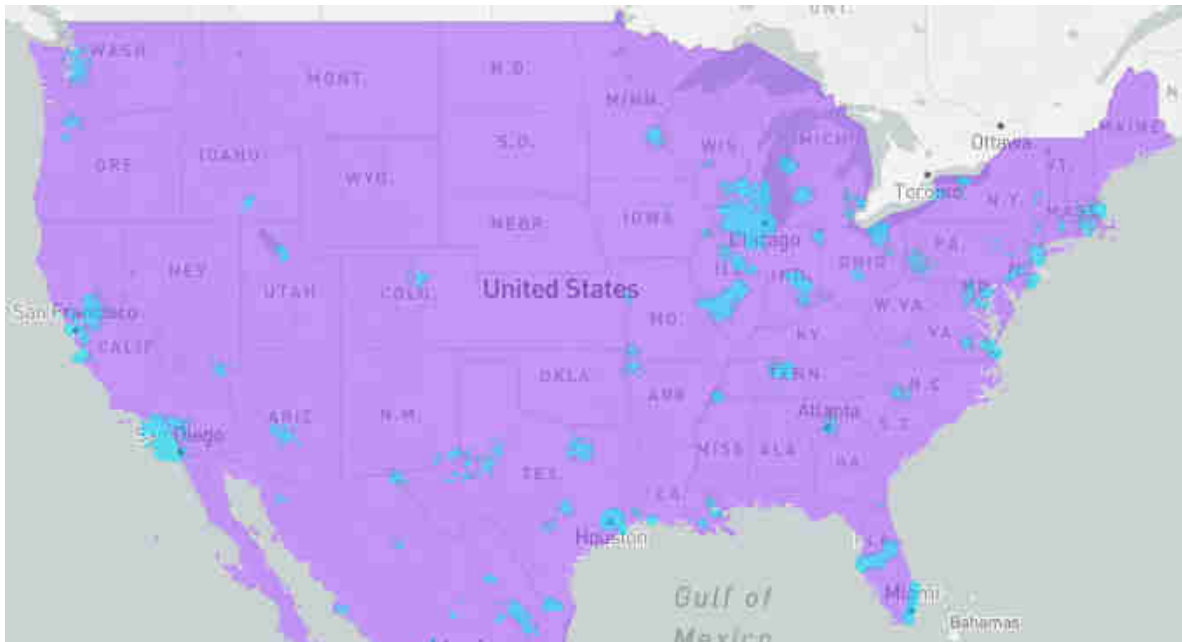
50





Sigfox USA Service

Feb 2019



- Use Cases

- Asset Tracking / Monitoring
- Predictive Maintenance
- Regulatory Compliance
- Operational Efficiency

SIGFOX certified tools

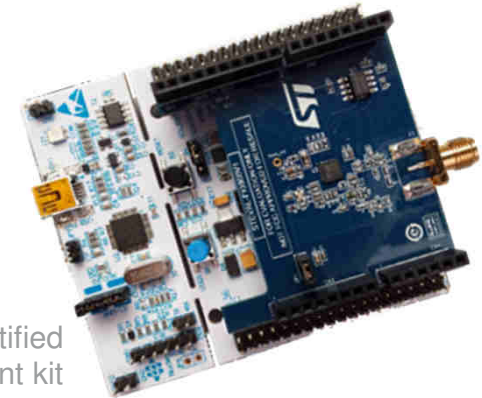
STEVAL-FKI868V1 / FKI915V1

52

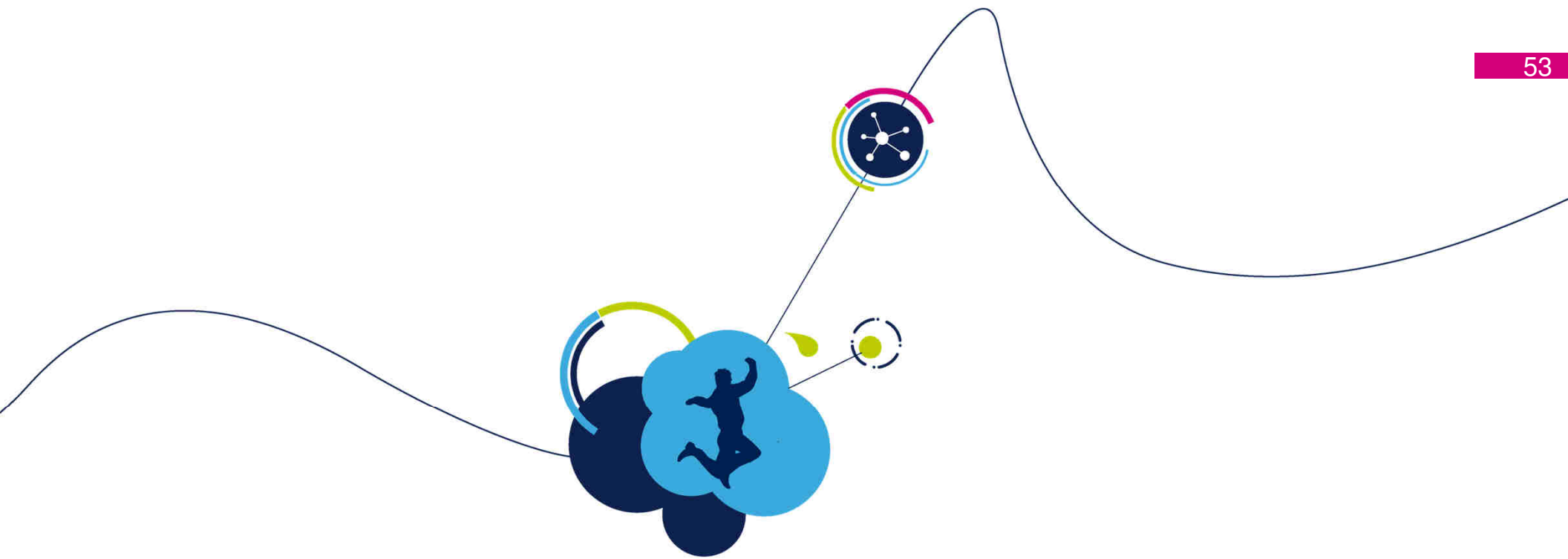
SIGFOX-ready sub-1GHz RF kits accelerate sensor-to-cloud IoT applications

- Development kit:
 - Region AME: [STEVAL-FKI915V1](#)
 - Region EMEA: [STEVAL-FKI868V1](#)
- Sigfox SDK:
 - [STSW-S2LP-SFX-DK](#)
- Based on STM32 Nucleo board
- no need for a local gateway or access point.

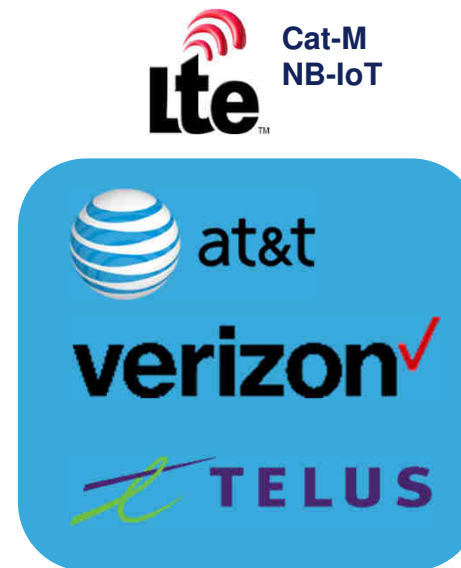
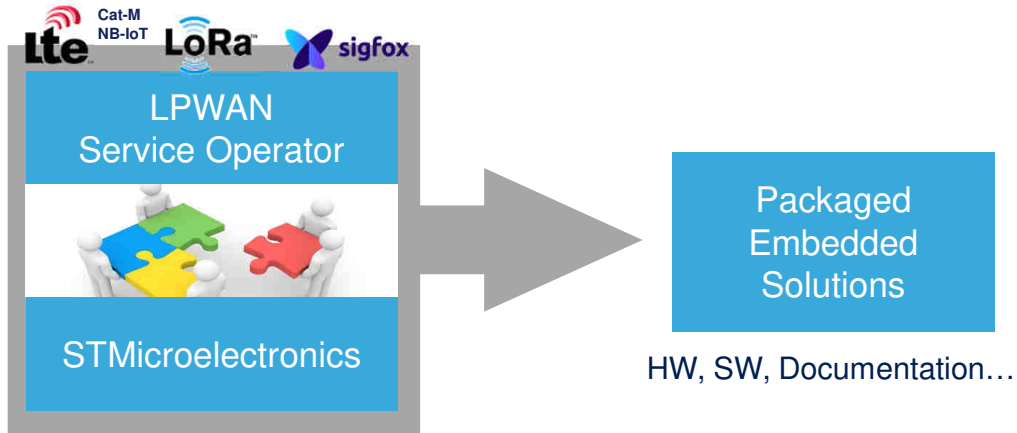
Development Kit for Out-of-the-box
Sensor-to-Cloud Connectivity



SIGFOX End Product certified
Development kit



Wrap-Up



- Come see the demos
- Contact: Marc.Hervieu@st.com

