

LPWAN (LTE & LoRa®) IoT Solutions from ST

Marc Hervieu
Marketing Manager



Technology Tour 2019

Dallas-Richardson, TX | March 7



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

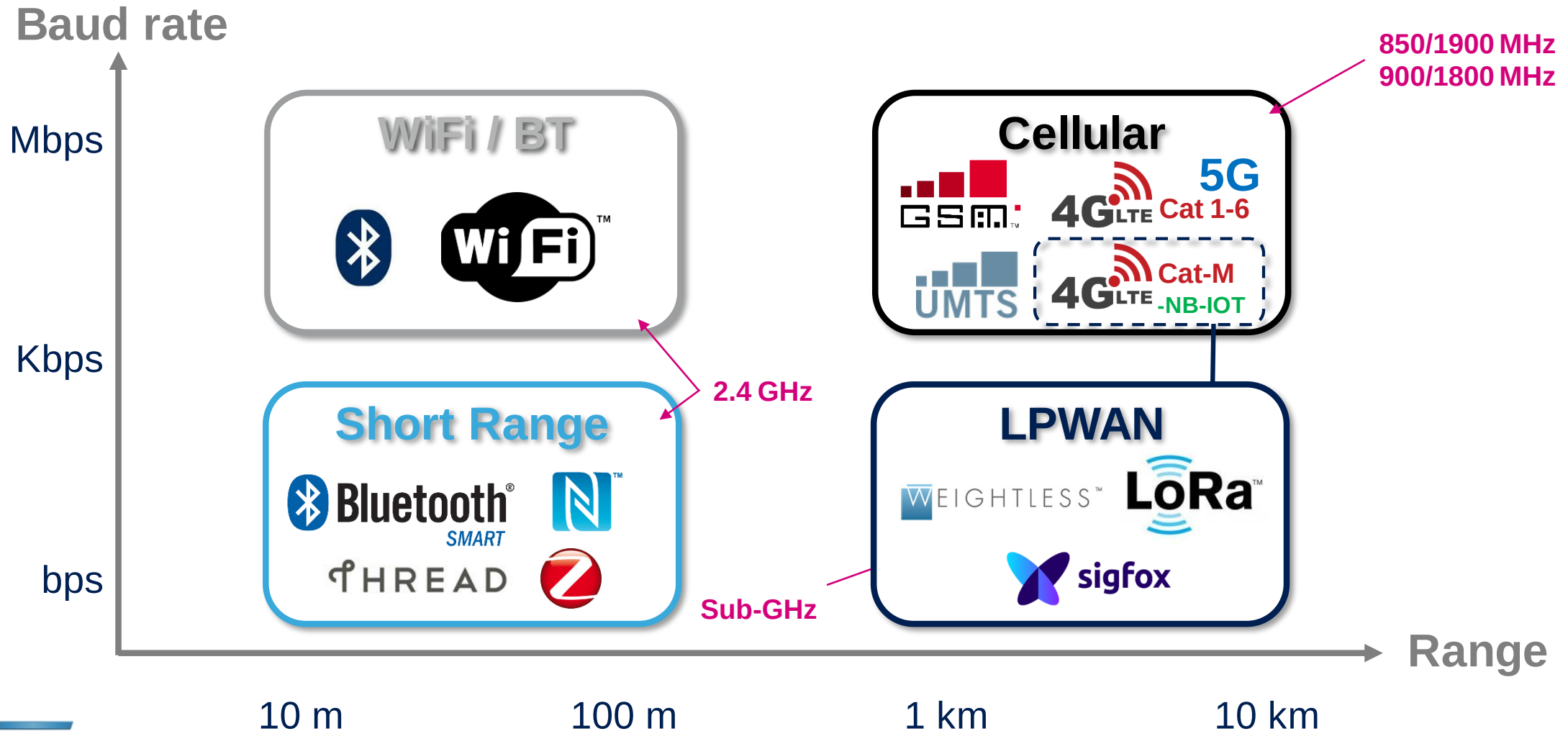
3



LPWAN Market Overview

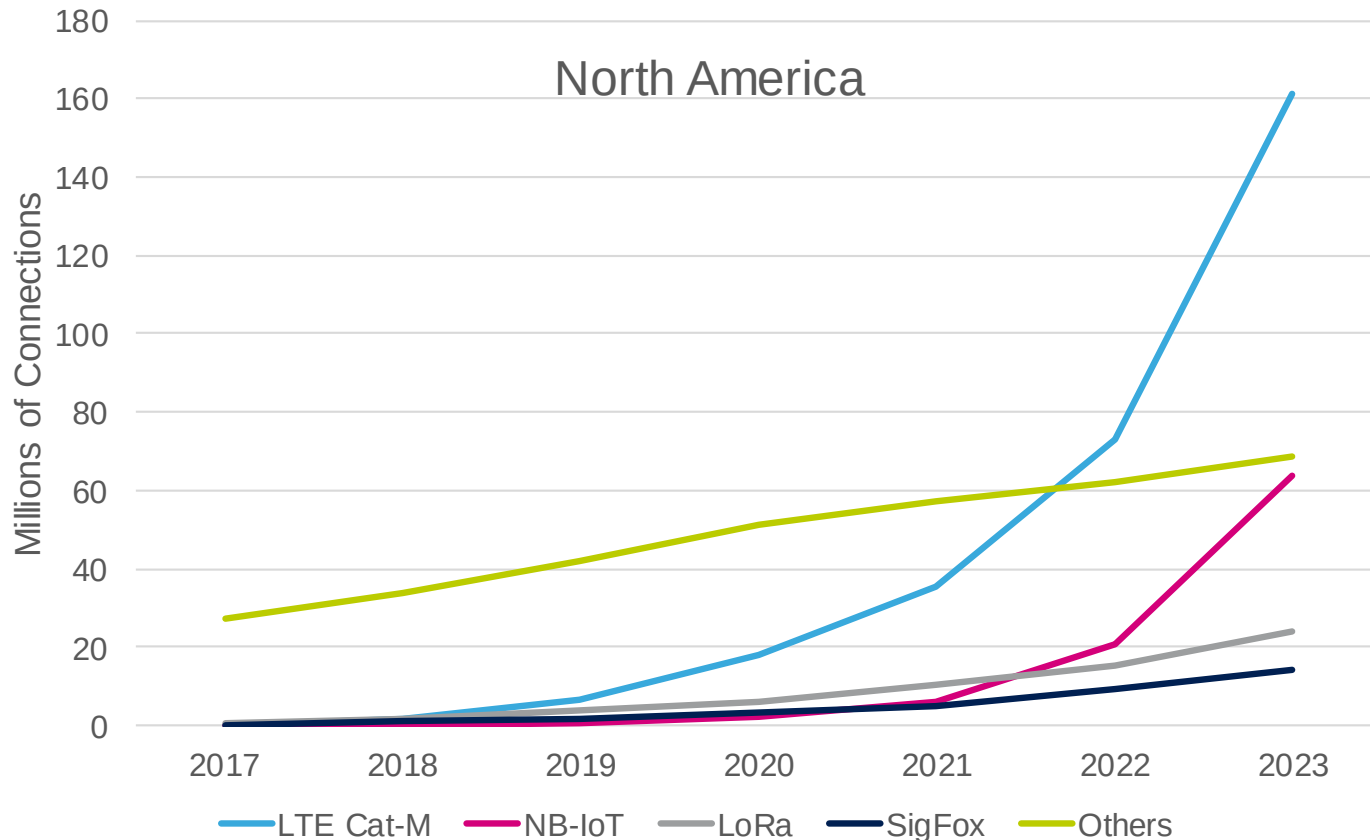
Communication Technologies - Overview

4



North America – LPWAN Market Trends

5



Applications driving LPWAN growth

LTE Cat-M

Asset Tracking

People / Pet Tracking
Home Auto.

Metering

Street Lighting

NB-IoT

Asset Tracking

Metering

People / Pet Tracking

LoRa

Agriculture

Asset Tracking

Home Monitoring

Metering

Sigfox

Agriculture

Asset Tracking

Home Monitoring

Others

Home Auto.

Communication Technologies - Overview

6

Emerging Technologies

Address:

- Long Range Low Power



Cat-M (eMTC)
Cat NB1 (NB-IoT)



sigfox

- **Public network**
 - Telco carriers
 - **Leveraging existing infrastructure**
 - Higher data rate
-
- **Private Network**
 - Localized Coverage
 - Provide technology for companies to build an infrastructure
 - Proprietary PHY, Open MAC
 - Regional regulatory differences
-
- **Public network**
 - SigFox USA
 - Regional regulatory differences
 - **Suited for upstream**
 - Inexpensive

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

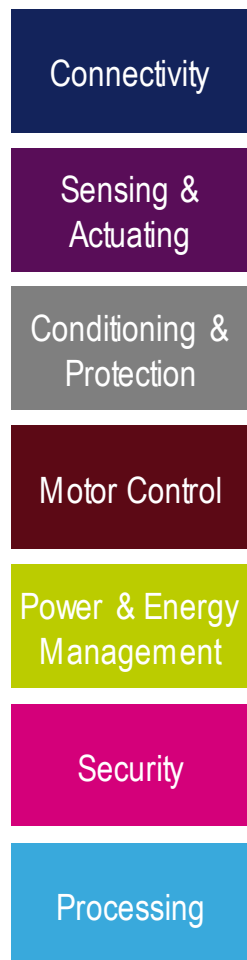


verizon





ST IoT & Operator Strategy



>15 Billion
ST MEMS



WW Top
#1 #2



Industrial
WW Top #3

>3 Billion
ST MCU



WW Top #2


SensorTile


BlueCoin


SmarTAG


Discovery Kit IoT Node


STM32 Nucleo Development
& Expansion boards

Pre-integrated SW for vertical applications



Smart Things



Smart Home



Smart City



Smart Industry

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

Development Ecosystem



Code generators



Prototyping
software



Development
environments



Debug
solutions



Simulation
and analysis tools



On-line
design tools



STM32 portfolio positioning

11



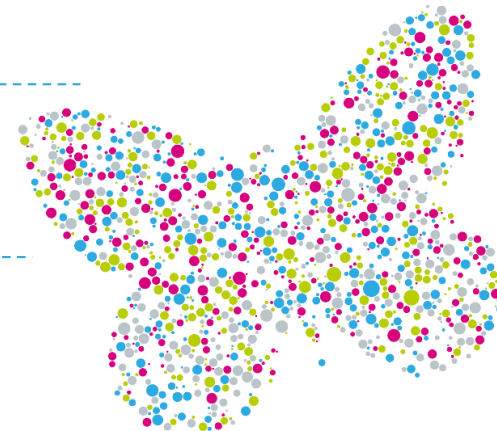
14 product series / More than 50 product lines



High-performance



Mainstream



Ultra-low-power



Wireless



arm

Cortex-M0
Cortex-M0+

Cortex-M3

Cortex-M33

Cortex-M4

Cortex-M7

A7, Dual-A7



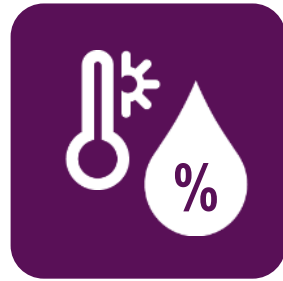
MEMS Sensors and Actuators

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



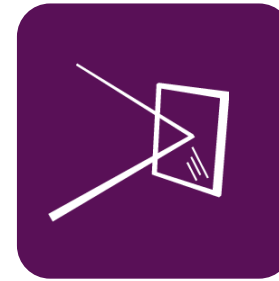
Environment

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

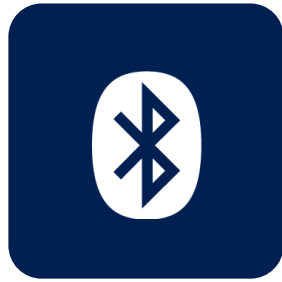
Connectivity

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

14



Targets:

- Embedded Developers
- IoT evangelist
- OEMs
- Mass market

HW, SW, Documentation...

Packaged
Embedded
Solutions

New Products on
the market

Return On Investment:

- Use ST products
- Use Operator service

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

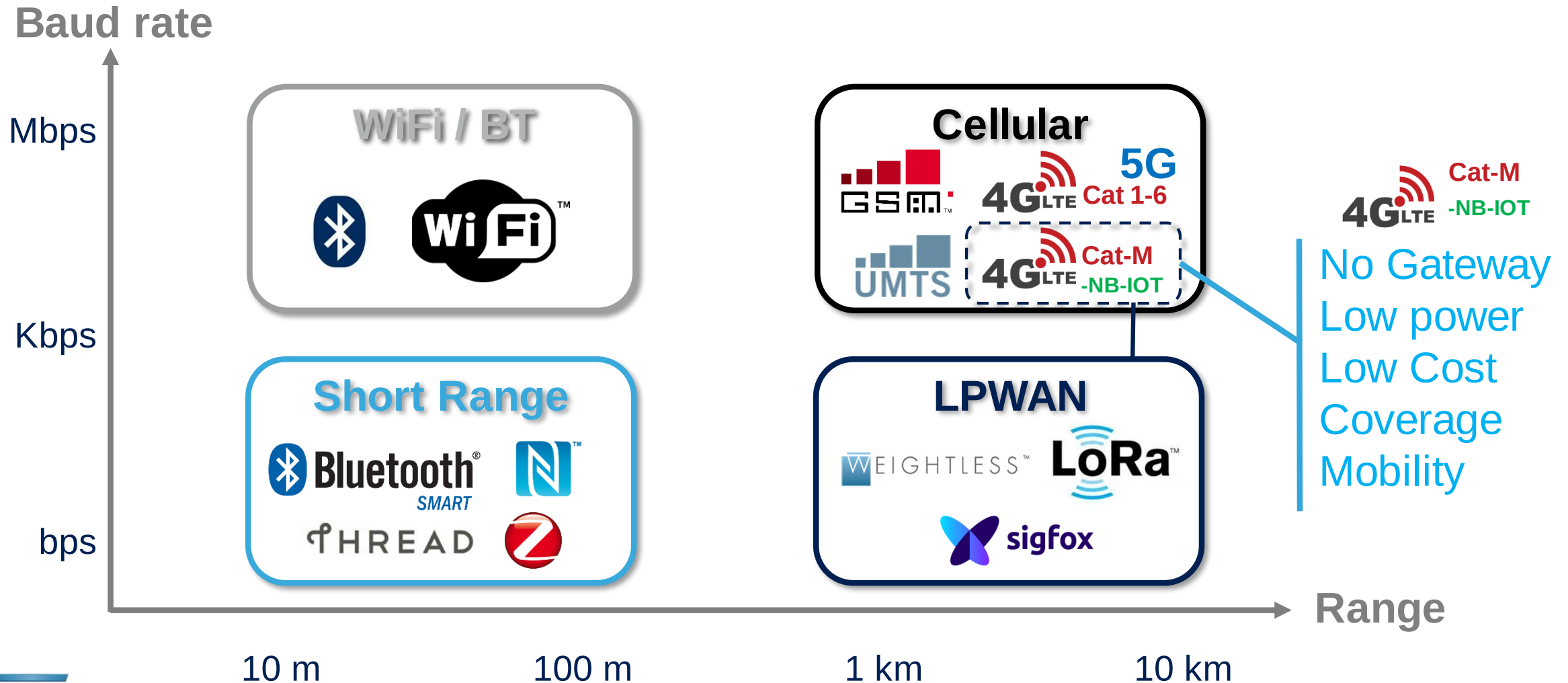


ST IoT LPWAN Cellular



Communication Technologies - Overview

16



STM32 based Development Kits with AT&T



LTE-M

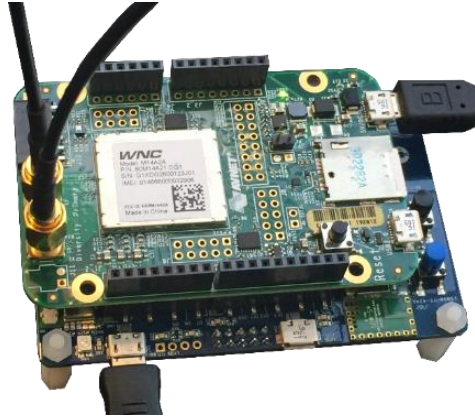
4G^{LTE}-M



AT&T

IoT STM32 LTE Starter Kit

18



STM32L4



Accelerometer
Gyroscope



Magnetometer



Humidity
Temperature



Pressure



Time of Flight
Proximity Sensor



2x MEMS
Microphone



NFC



Bluetooth[®]
Low Energy



Sub GHz



WiFi



LTE Cat-M
NB-IoT

WNC Modem

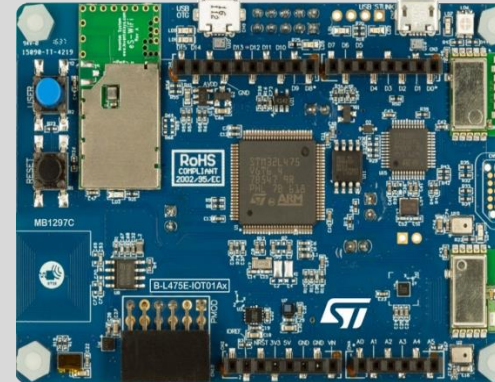
- LTE Cat-1
- LTE Cat-M



Avnet – Modem Board



AT&T



STM32L4 Discovery
Kit IoT Node



Avnet- AT&T Solution

19

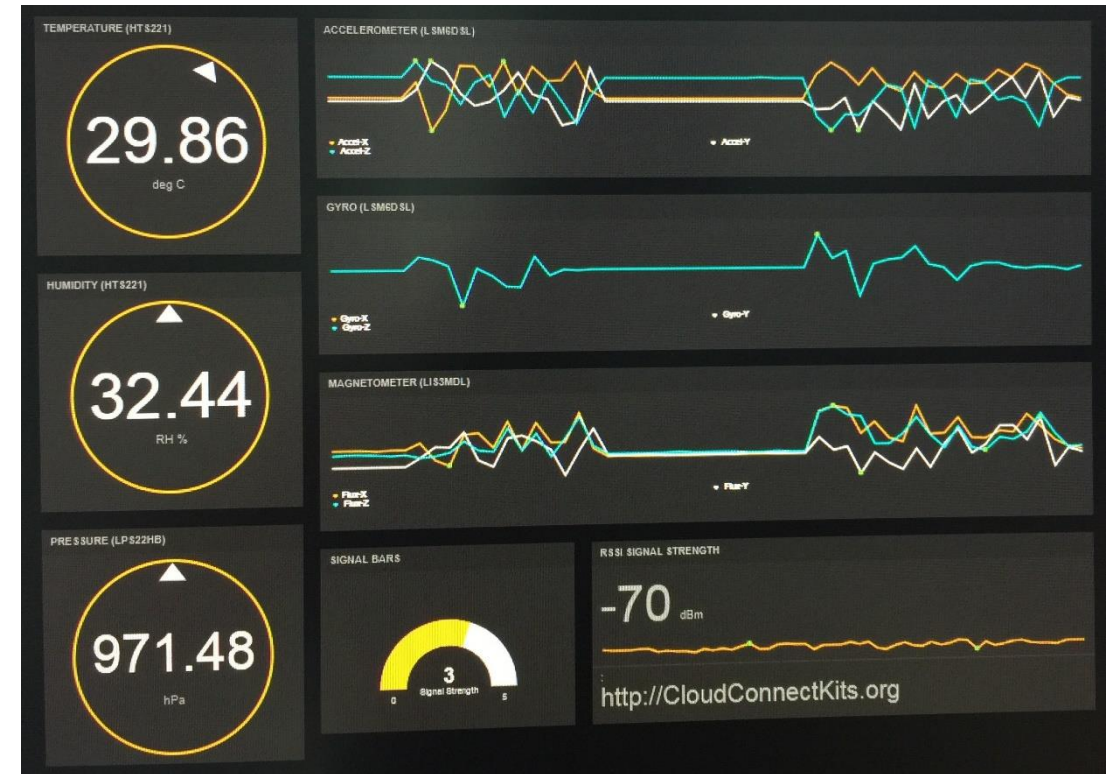
STM32 LTE Starter Kit



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

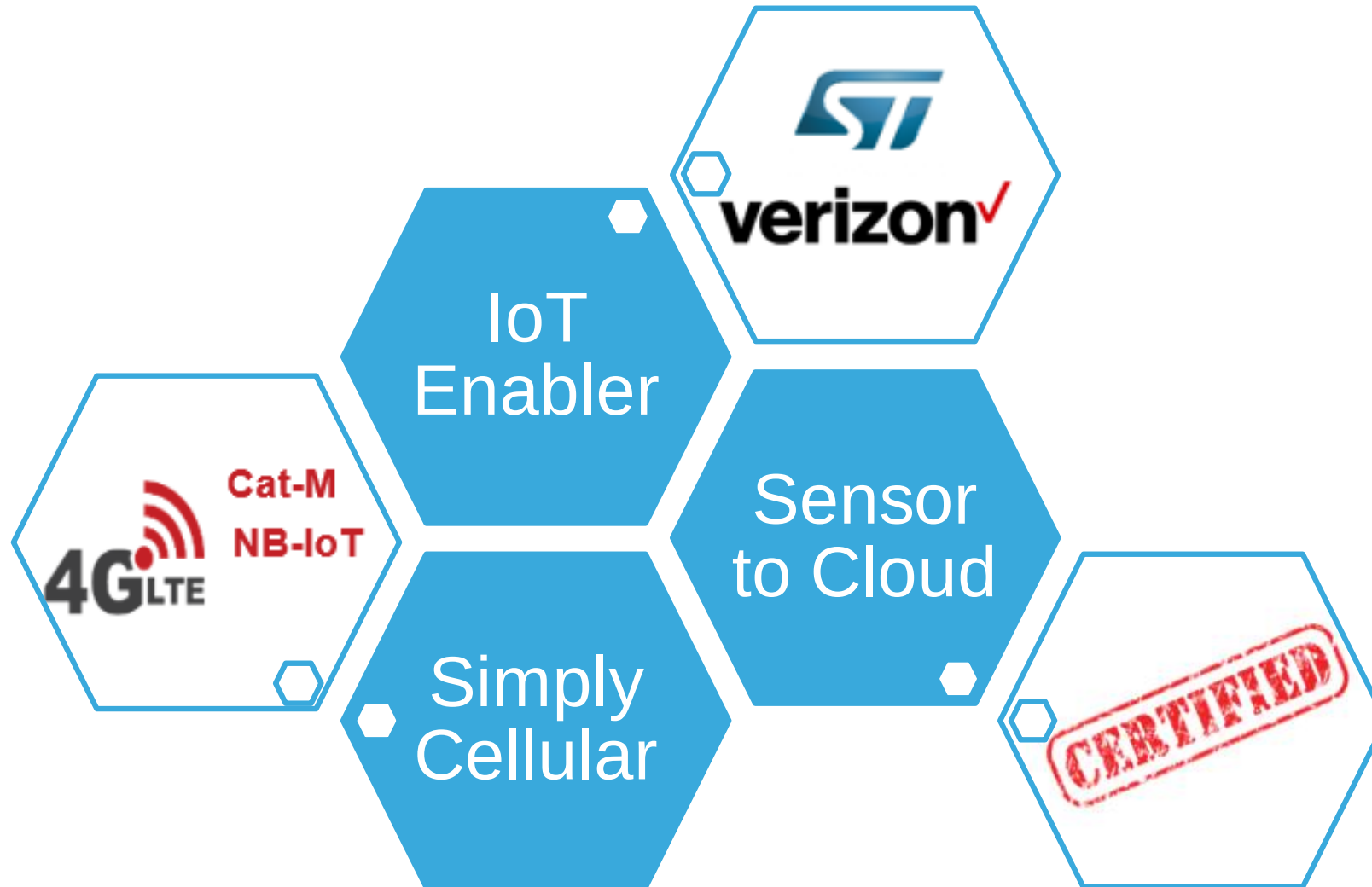


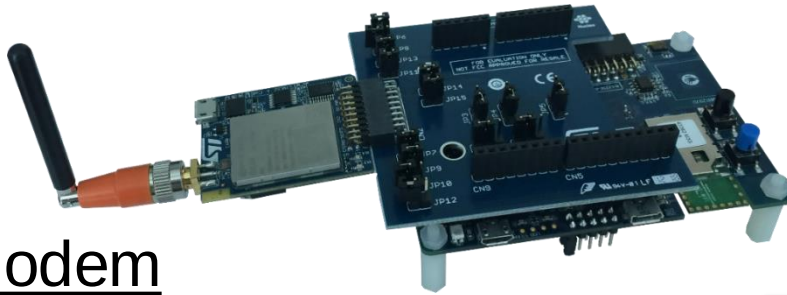
- Avnet resources

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

VERIZON LTE Starter Kit

Targets IoT Embedded Developers





Quectel Modem

- LTE Cat-M
- LTE NB-IoT



STM32L4



Accelerometer
Gyroscope



Magnetometer



Humidity
Temperature



Pressure



Time of Flight
Proximity Sensor



2x MEMS
Microphone

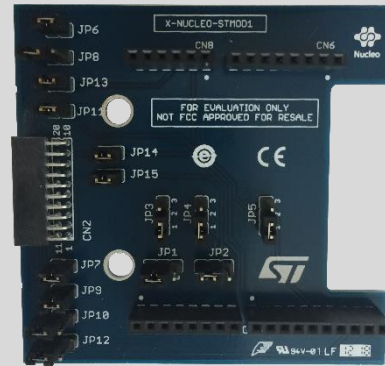


ST LTE Modem



verizon

ST SIM-Card



X-Nucleo
Expansion Board



STM32L4 Discovery
Kit IoT Node



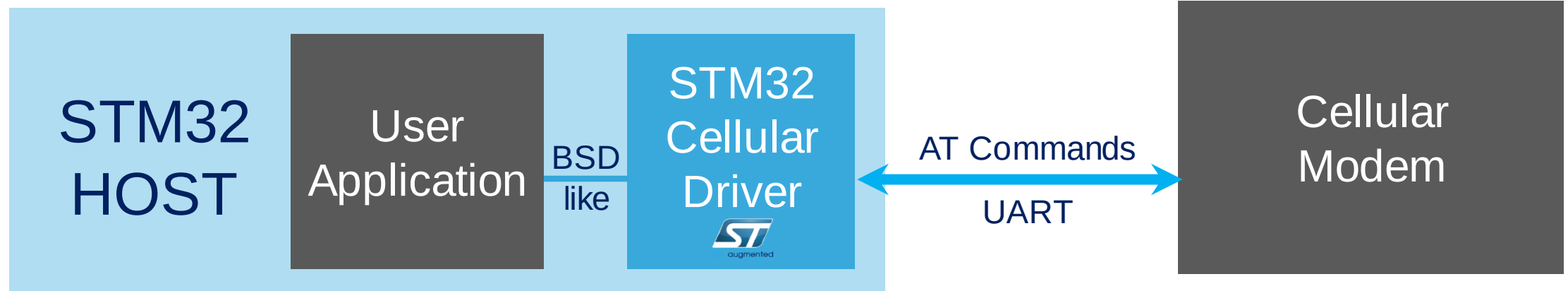
Bluetooth[®]
Low Energy



Sub GHz

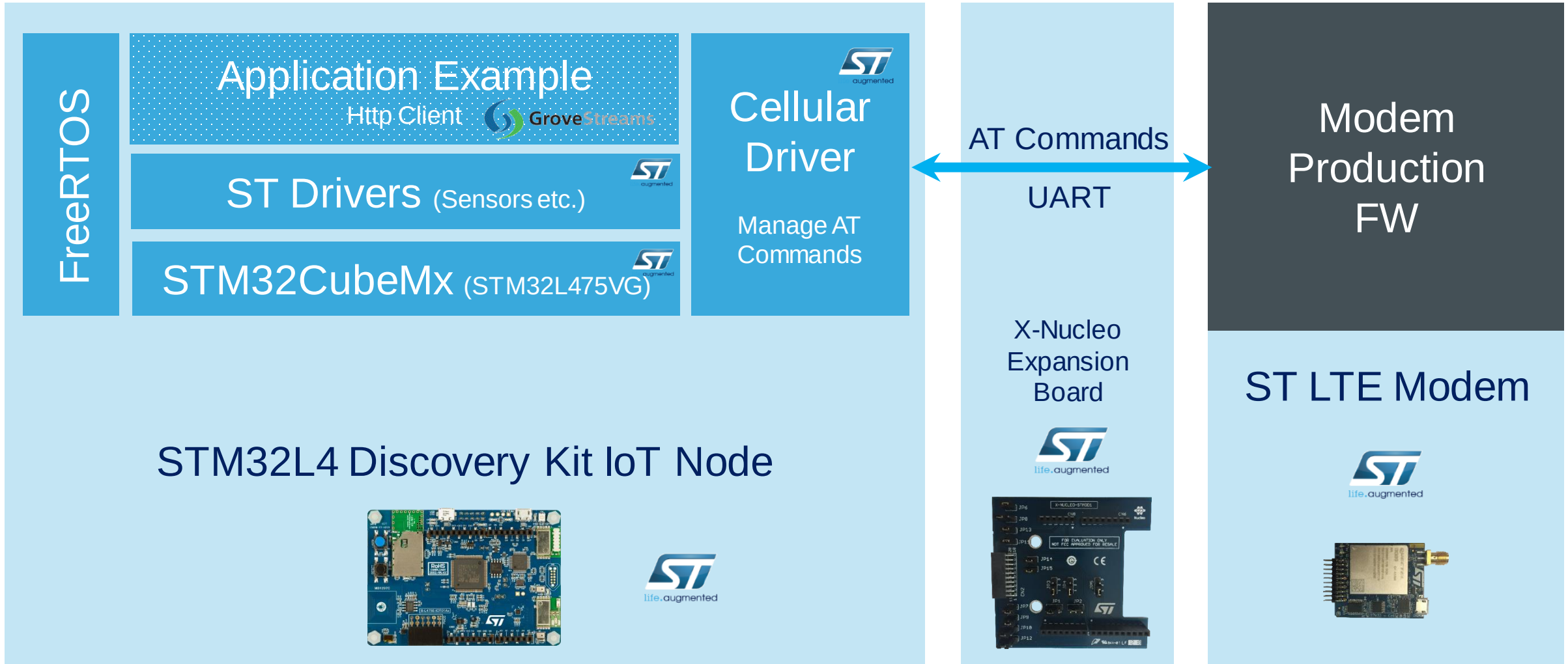


LTE Cat-M
NB-IoT



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

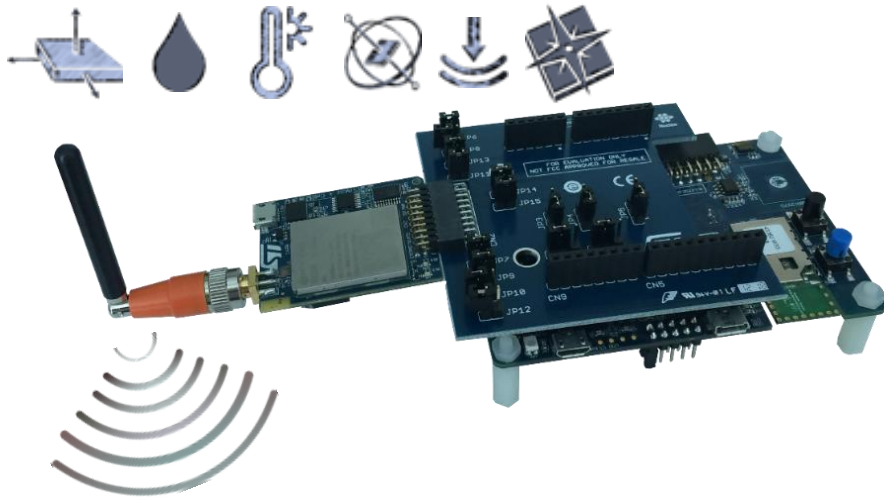




X-CUBE-CELLULAR

25

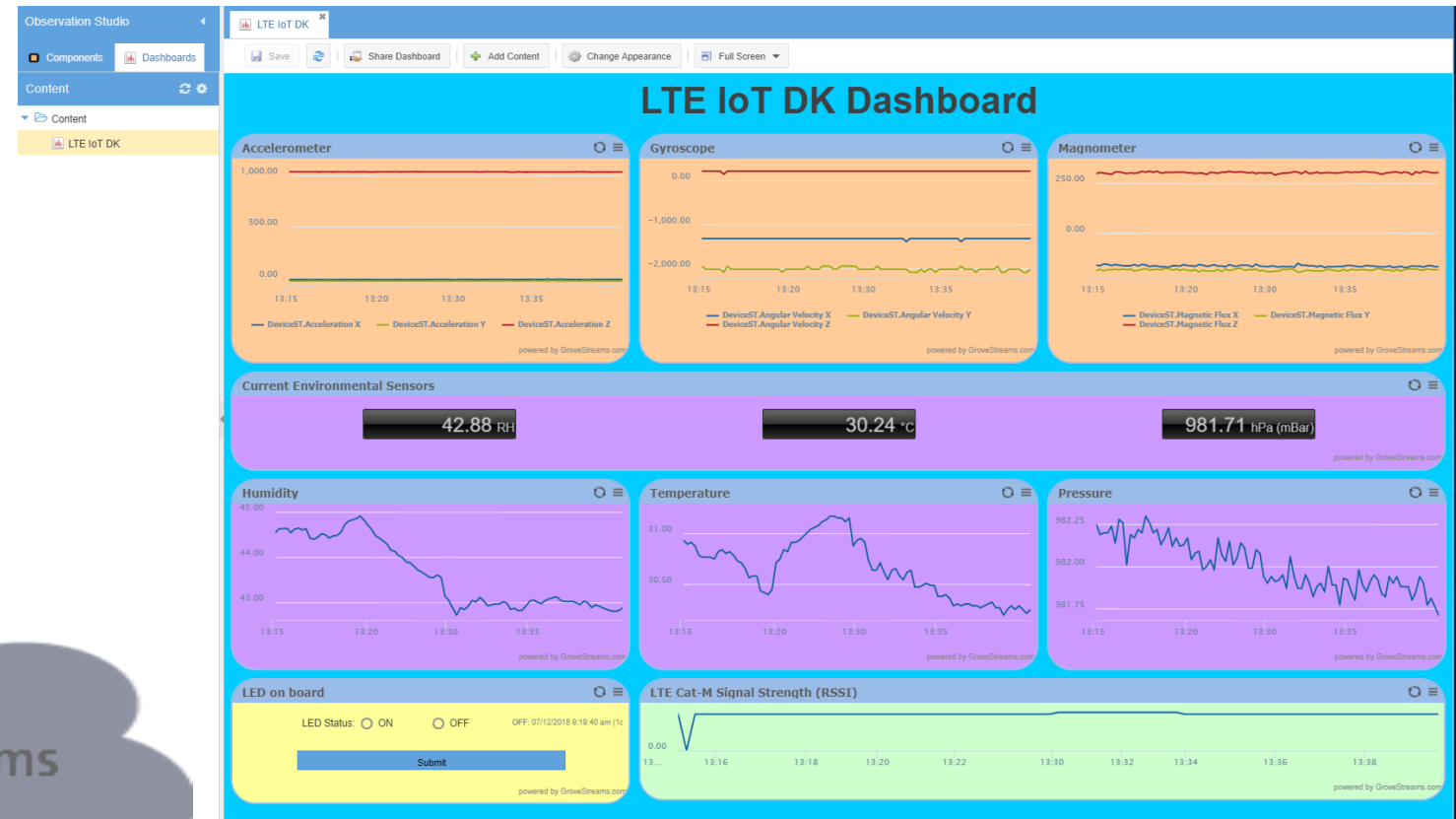
STM32 LTE Starter Kit x-cube-cellular

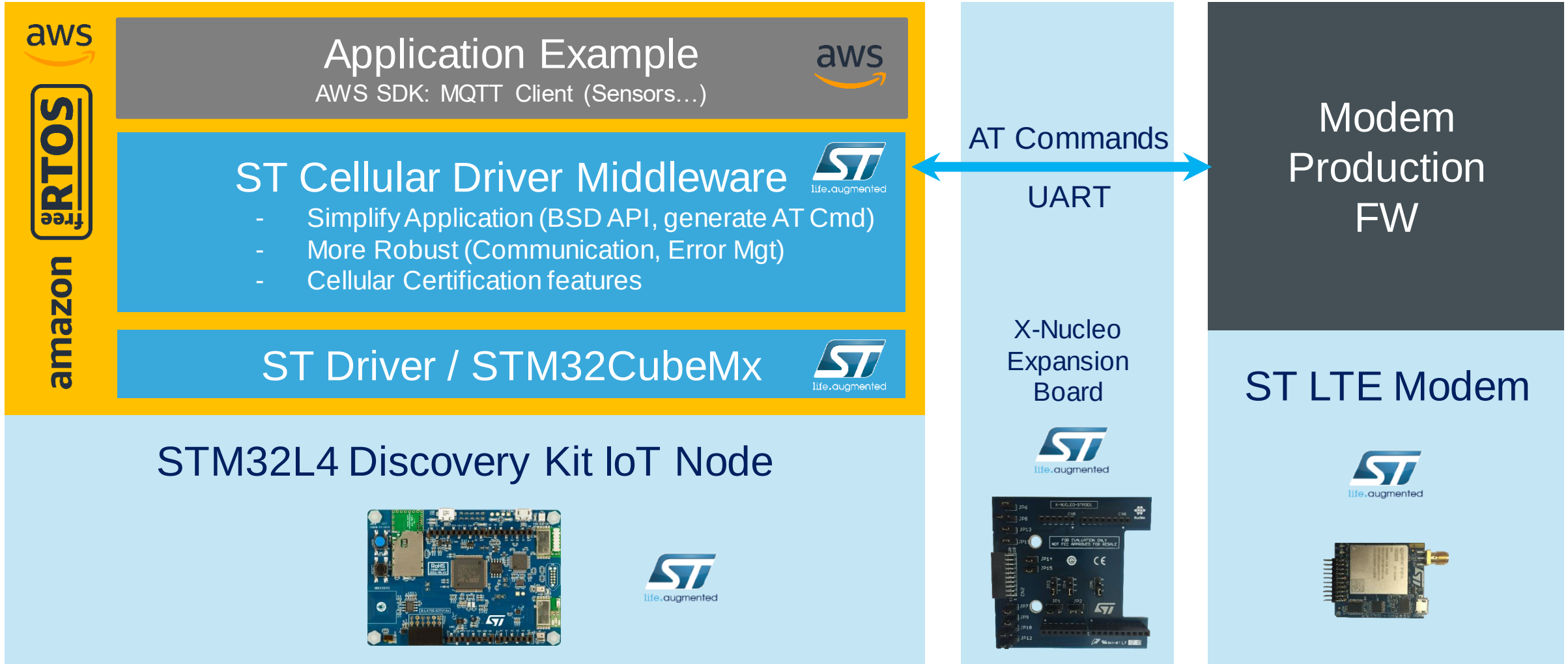


verizon
LTE Cat-M



Web Browser





verizon[✓]

STM32 LTE Starter Kit

amazon **freeRTOS**



verizon[✓]

LTE Cat-M

aws

Amazon FreeRTOS

27

Web Browser
AWS – KIBANA Dashboard



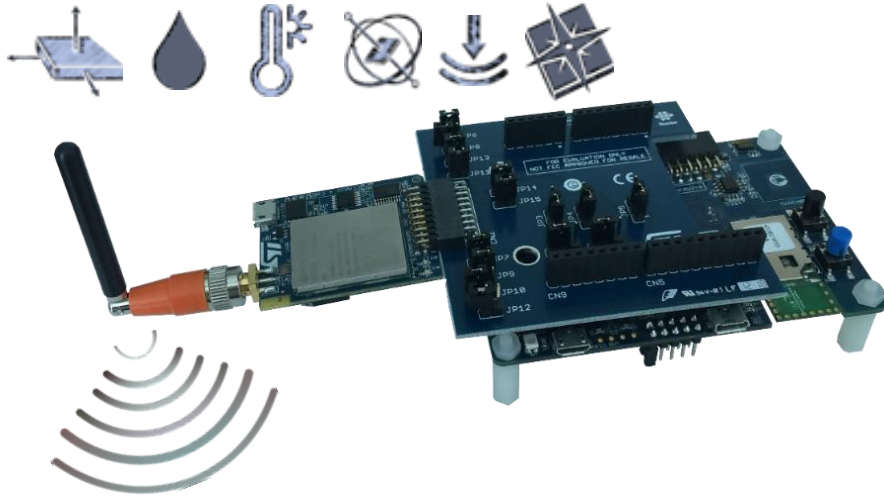


Amazon FreeRTOS

28

STM32 LTE Starter Kit

amazon **freeRTOS**

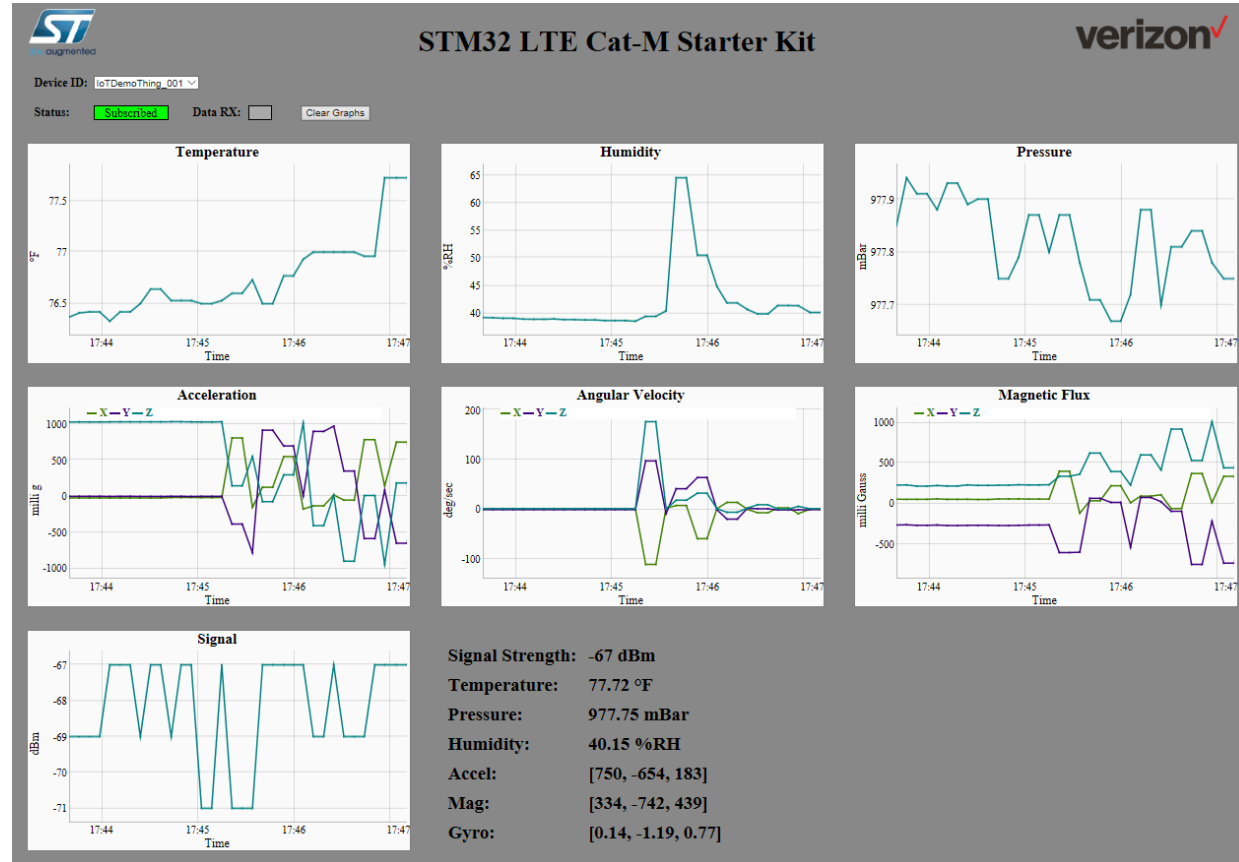


verizon
LTE Cat-M

aws



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

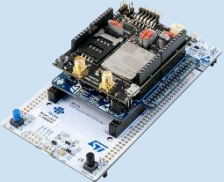
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Search for X-CUBE-CELLULAR



Amazon FreeRTOS – Verizon GitHub

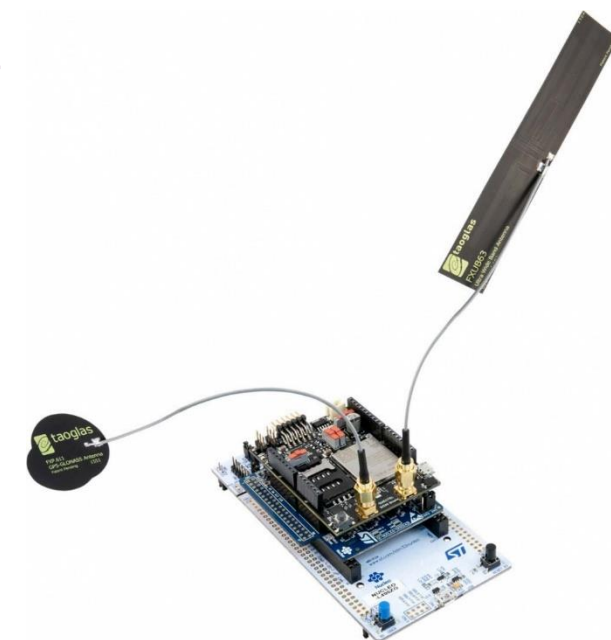
https://github.com/verizonlabs/vz_aws_st

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

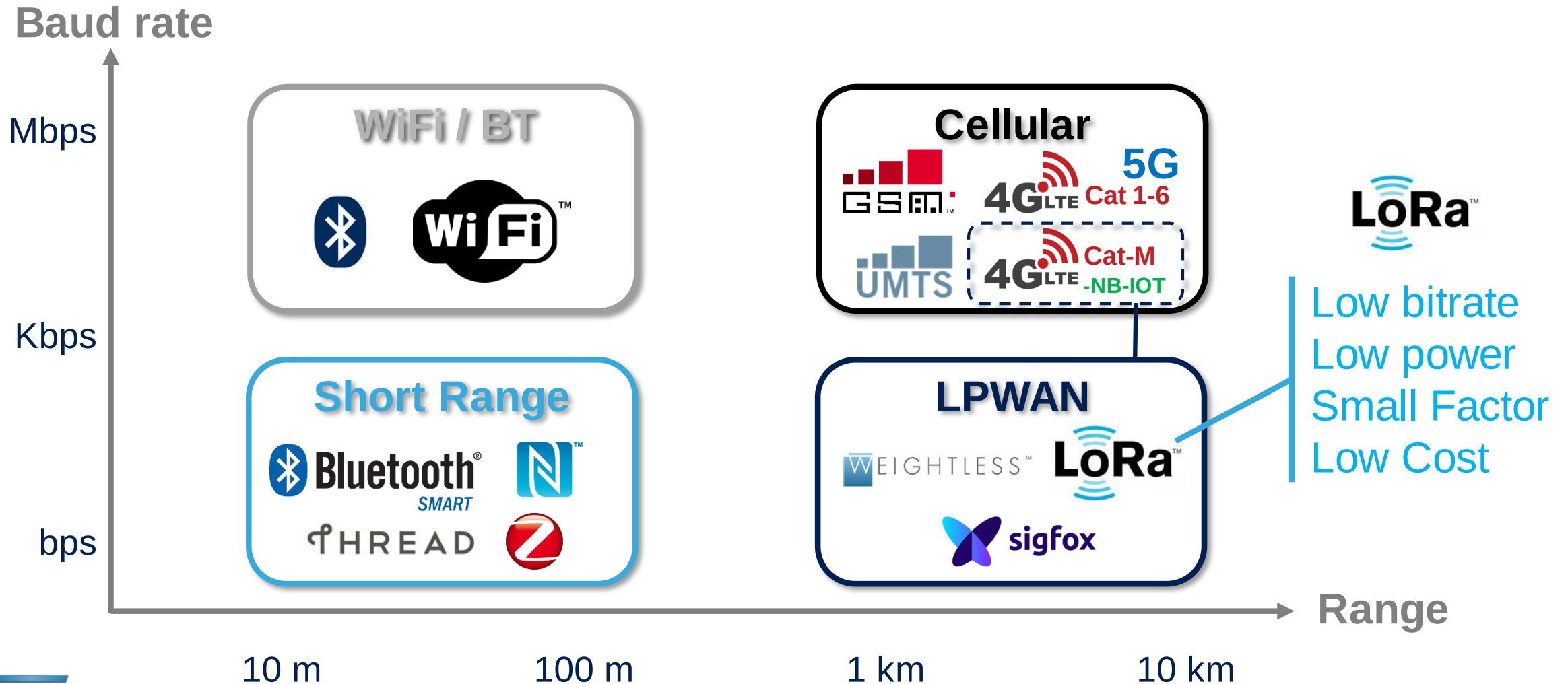




ST IoT LPWAN LoRa®

Communication Technologies - Overview

32





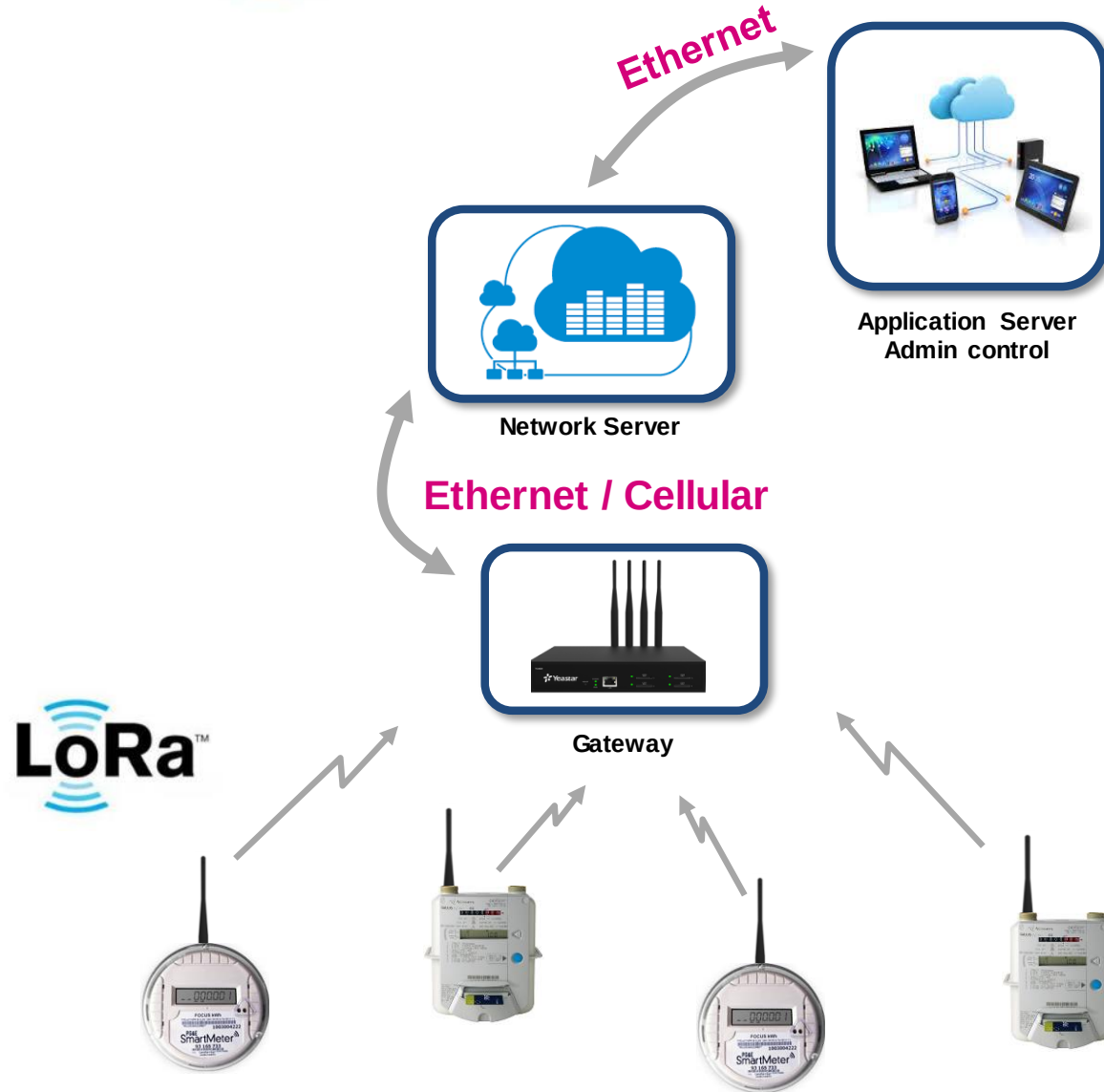
IoT use cases

33

Key Verticals

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

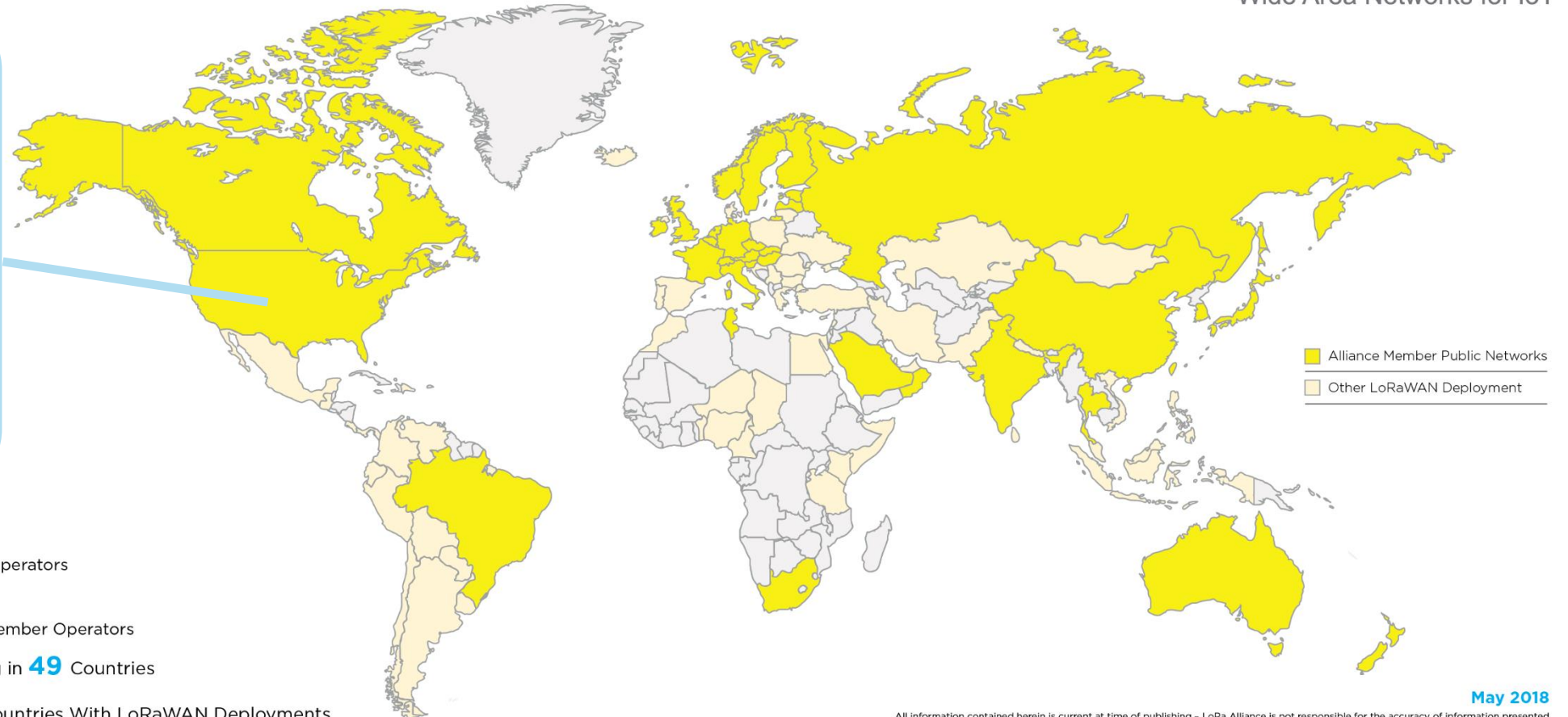
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LoRa® Network Deployments

34

LoRaWAN™ NETWORKS



83

Network Operators

56

Alliance Member Operators

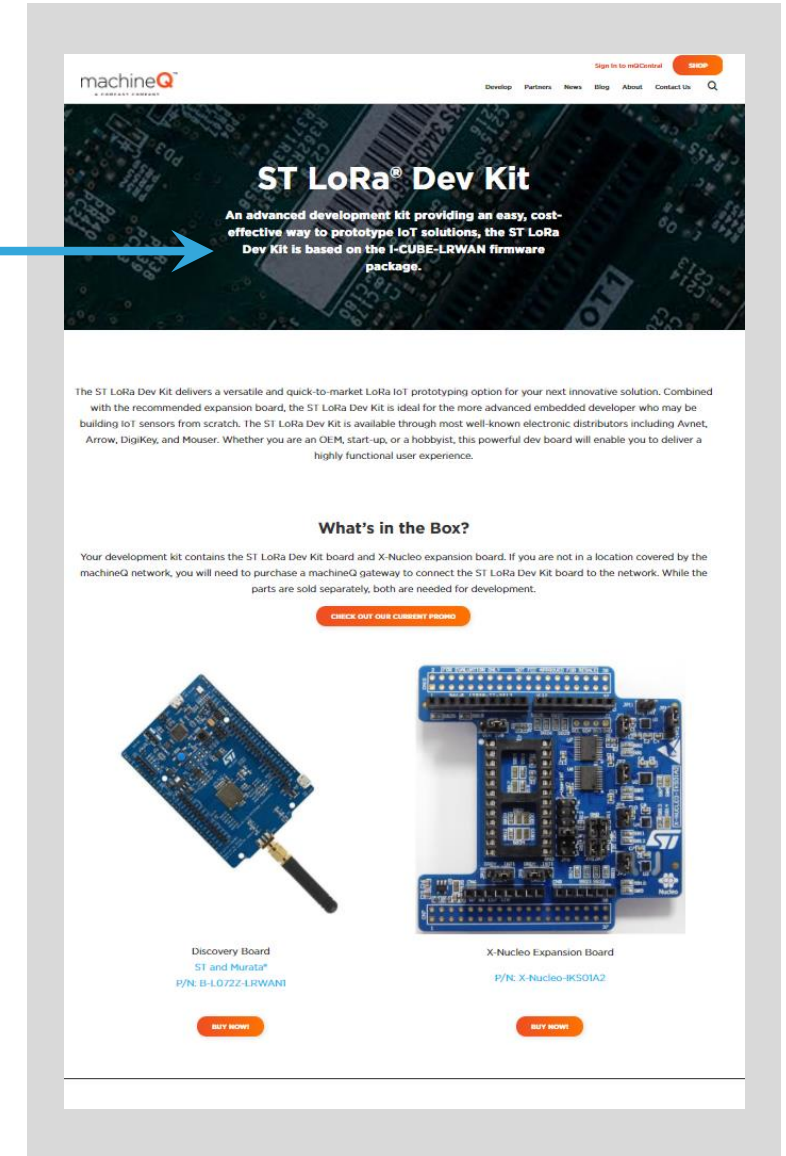
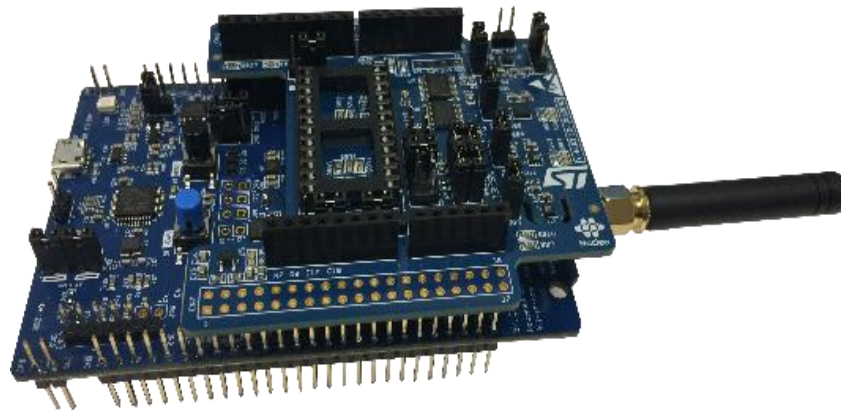
Operating in **49** Countries

~100 Countries With LoRaWAN Deployments

May 2018

All information contained herein is current at time of publishing - LoRa Alliance is not responsible for the accuracy of information presented

- 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



machineQTM
A COMCAST COMPANY

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Develop Partners News Blog About Contact Us

ST LoRa[®] Dev Kit

An advanced development kit providing an easy, cost-effective way to prototype IoT solutions, the ST LoRa Dev Kit is based on the I-CUBE-LRWAN firmware package.

The ST LoRa Dev Kit delivers a versatile and quick-to-market LoRa IoT prototyping option for your next innovative solution. Combined with the recommended expansion board, the ST LoRa Dev Kit is ideal for the more advanced embedded developer who may be building IoT sensors from scratch. The ST LoRa Dev Kit is available through most well-known electronic distributors including Avnet, Arrow, DigiKey, and Mouser. Whether you are an OEM, start-up, or a hobbyist, this powerful dev board will enable you to deliver a highly functional user experience.

What's in the Box?

Your development kit contains the ST LoRa Dev Kit board and X-Nucleo expansion board. If you are not in a location covered by the machineQ network, you will need to purchase a machineQ gateway to connect the ST LoRa Dev Kit board to the network. While the parts are sold separately, both are needed for development.

[CHECK OUT OUR CURRENT PROMOS](#)



Discovery Board
ST and Murata[®]
P/N: B-L072Z-LRWAN1

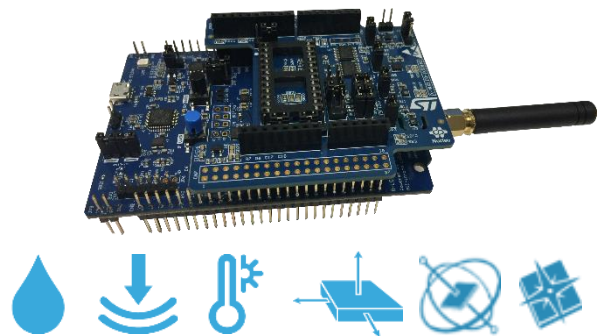
[BUY NOW](#)



X-Nucleo Expansion Board
P/N: X-Nucleo-1K501A2

[BUY NOW](#)

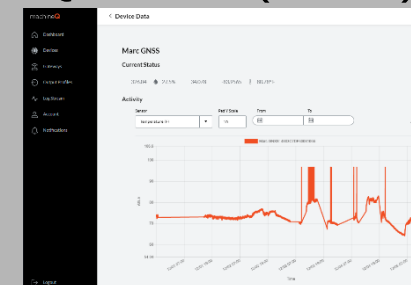
ST LoRa[®] Dev Kit Solution



MACHINE QTM
IoT Gateway



MQcentral (SaaS)



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

ST LoRa[®] Dev Kit Hardware

base board B-L072Z-LRWAN1

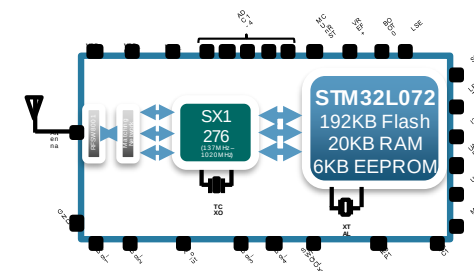
ST-Link
Debugger

Arduino Connector

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



Murata[®] Module
All-in-one Open



B-L072Z-LRWAN1

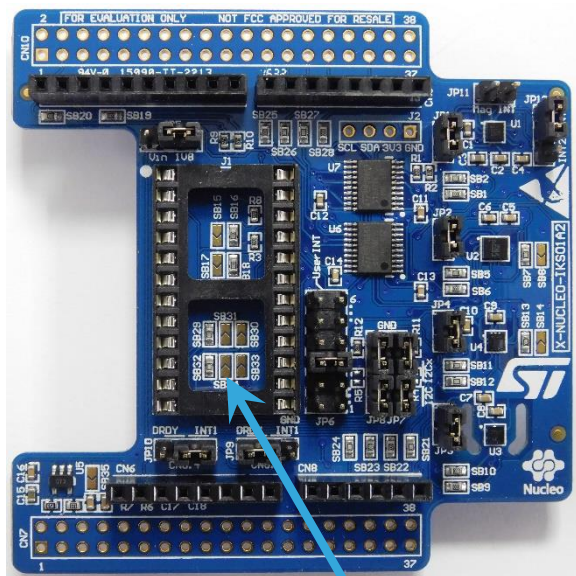
- Murata Module
 - Host: STM32L0
 - 20KB RAM, 192KB Flash, 6KB Eeprom
 - Radio: Semtech SX1276



ST LoRa® Dev Kit Hardware

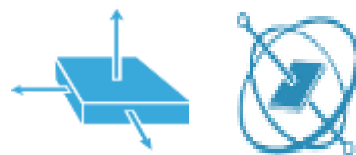
Sensor Shield X-NUCLEO-IKS01A2

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

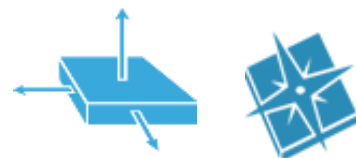


DIL-24 Extension

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



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

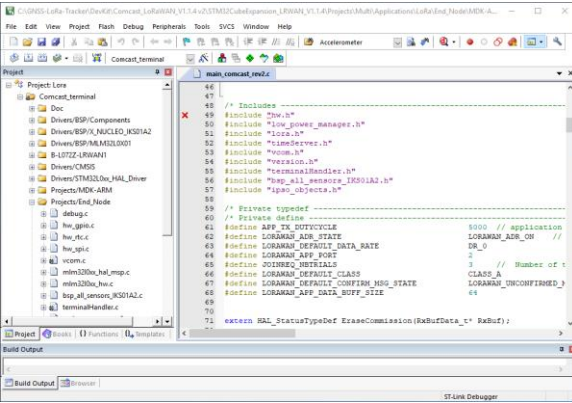


Pressure (LPS22HB)



Temperature + Humidity (HTS221)

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



ARM KEIL[®]

Microcontroller Tools

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

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



ST LoRaWAN stack → I-CUBE-LRWAN
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Search for I-CUBE-LRWAN

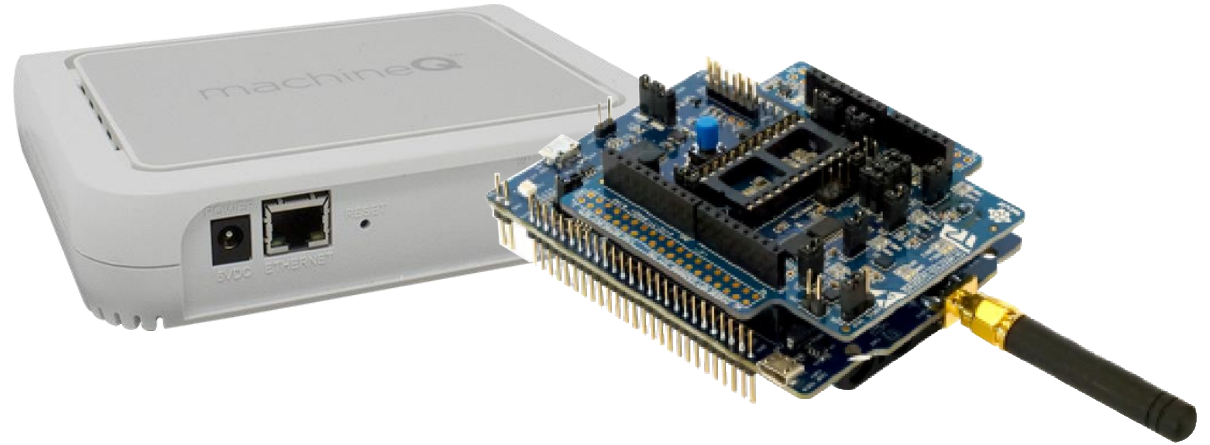
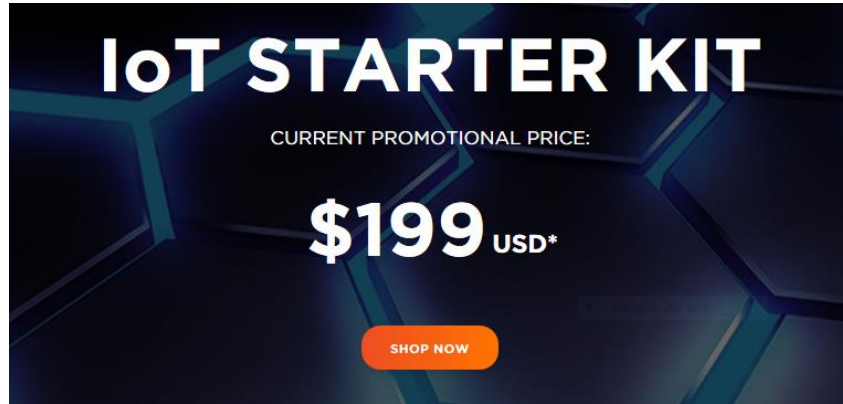
+

Sensors → raw data to the cloud

+

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

Starter Kit - Deal



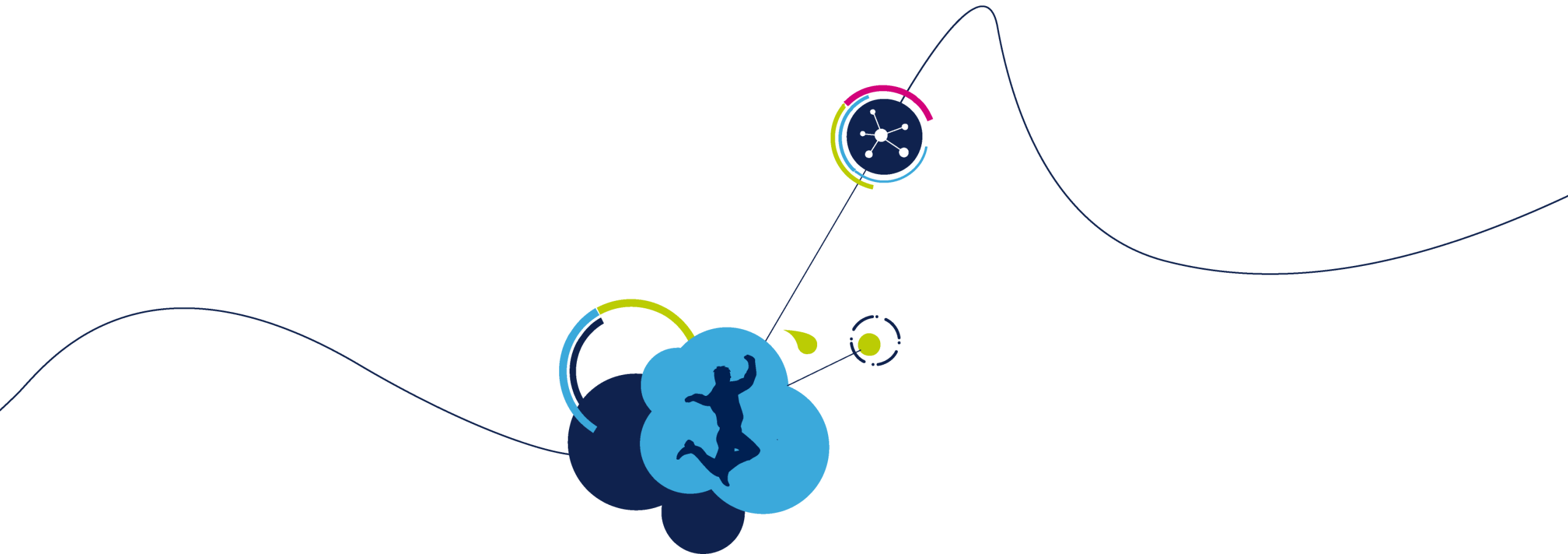
Offer Details

- 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

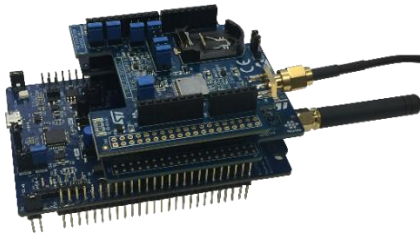
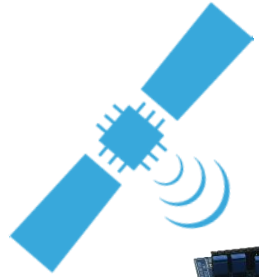


- Applications

- 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

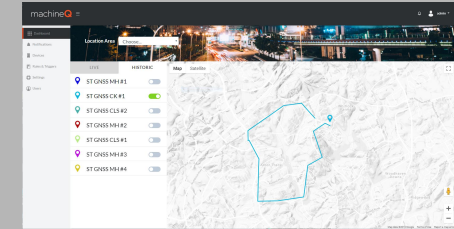


LoRa®

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

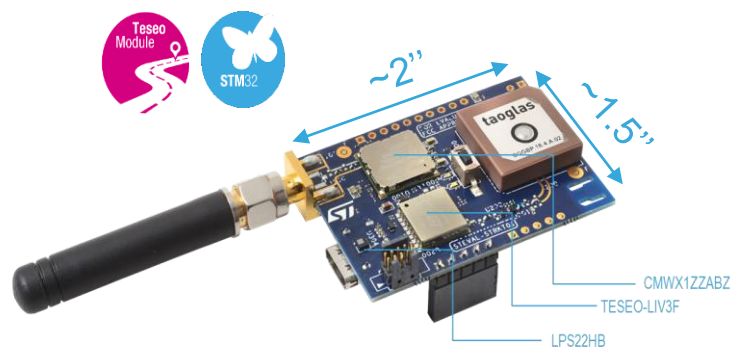


Beidou2



QZSS

ST LoRa[®] Asset Tracking Ref Design



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Search for STEVAL-STRKT01

LoRa[®] Asset Tracking Function Pack

FP-ATR-LORA1

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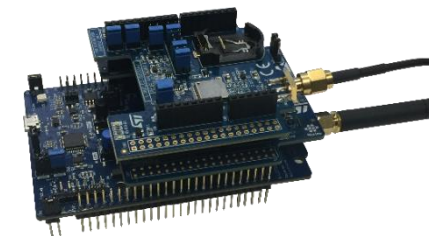


Key Features

- 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		

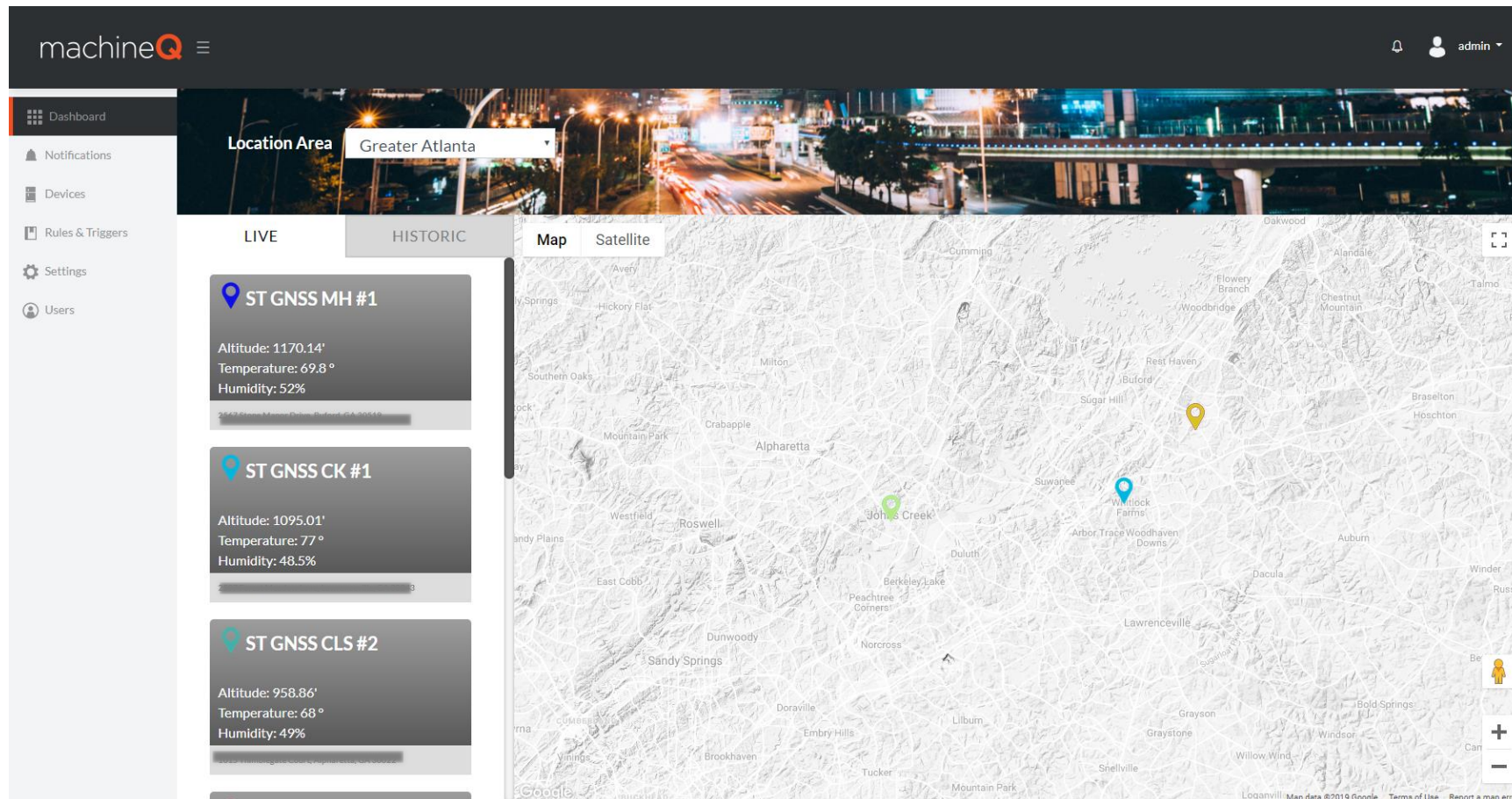


Asset Tracker – MQportal UI

Sensor Monitoring

Monitoring

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

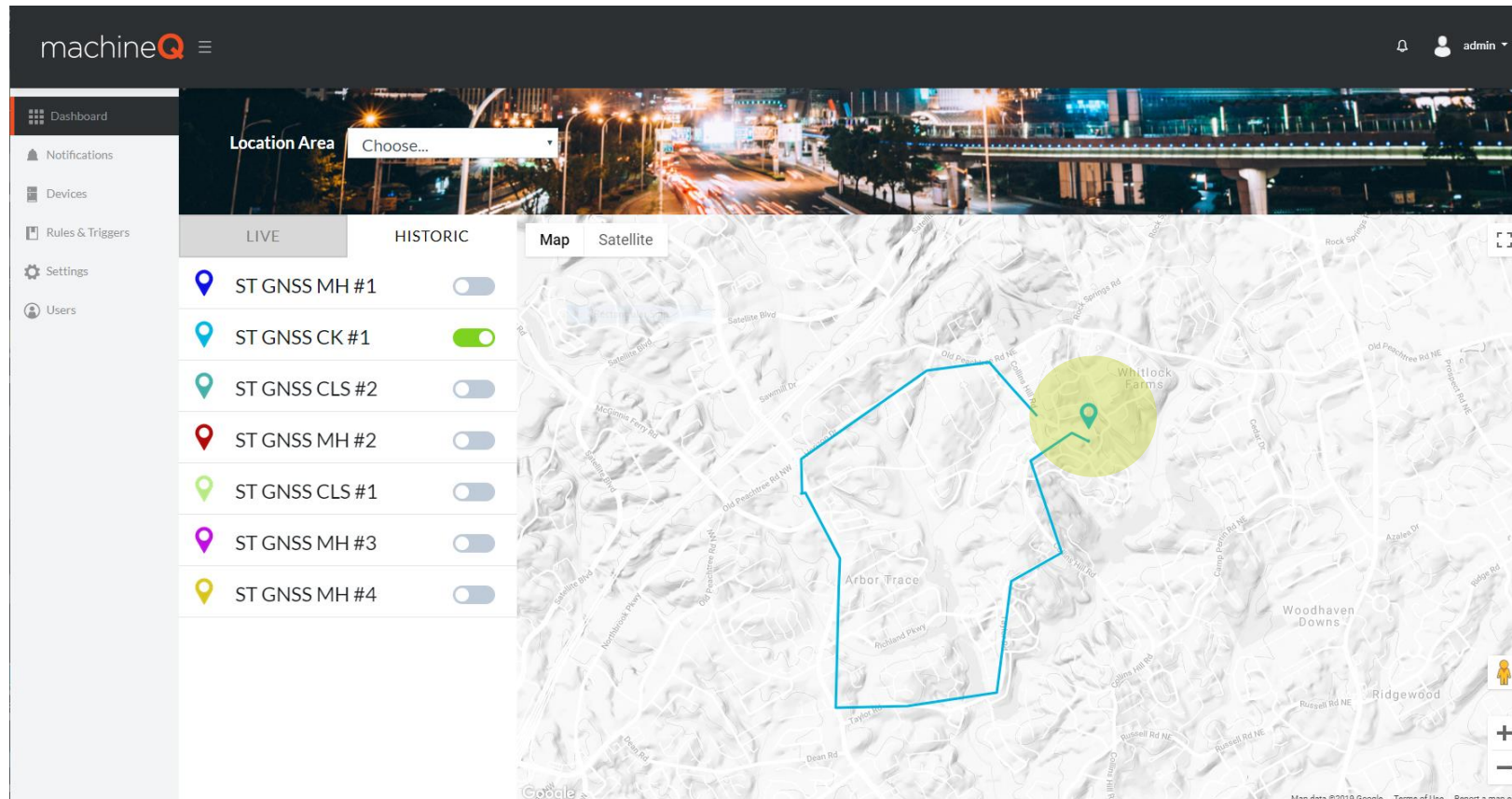


Asset Tracker – MQportal UI

Asset Tracking

Historic Path

- 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

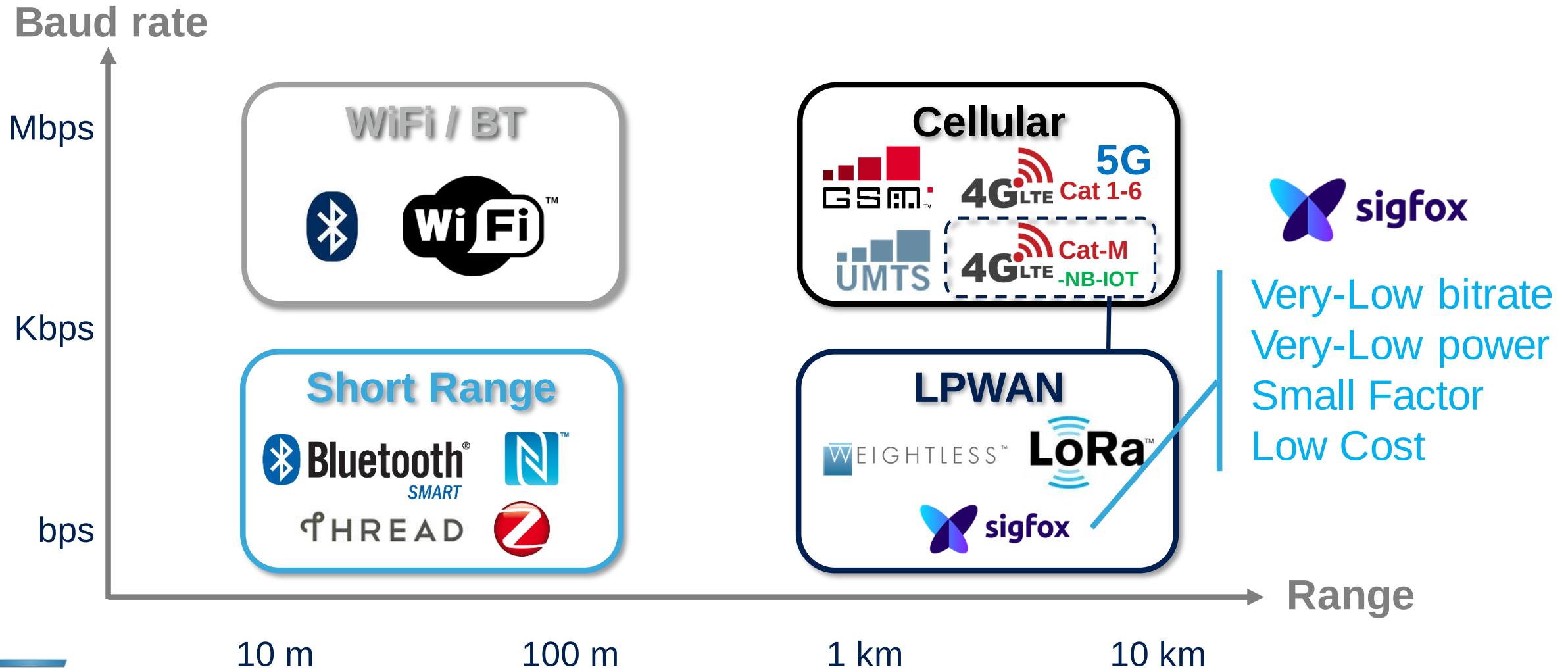
Video and Material available on line.

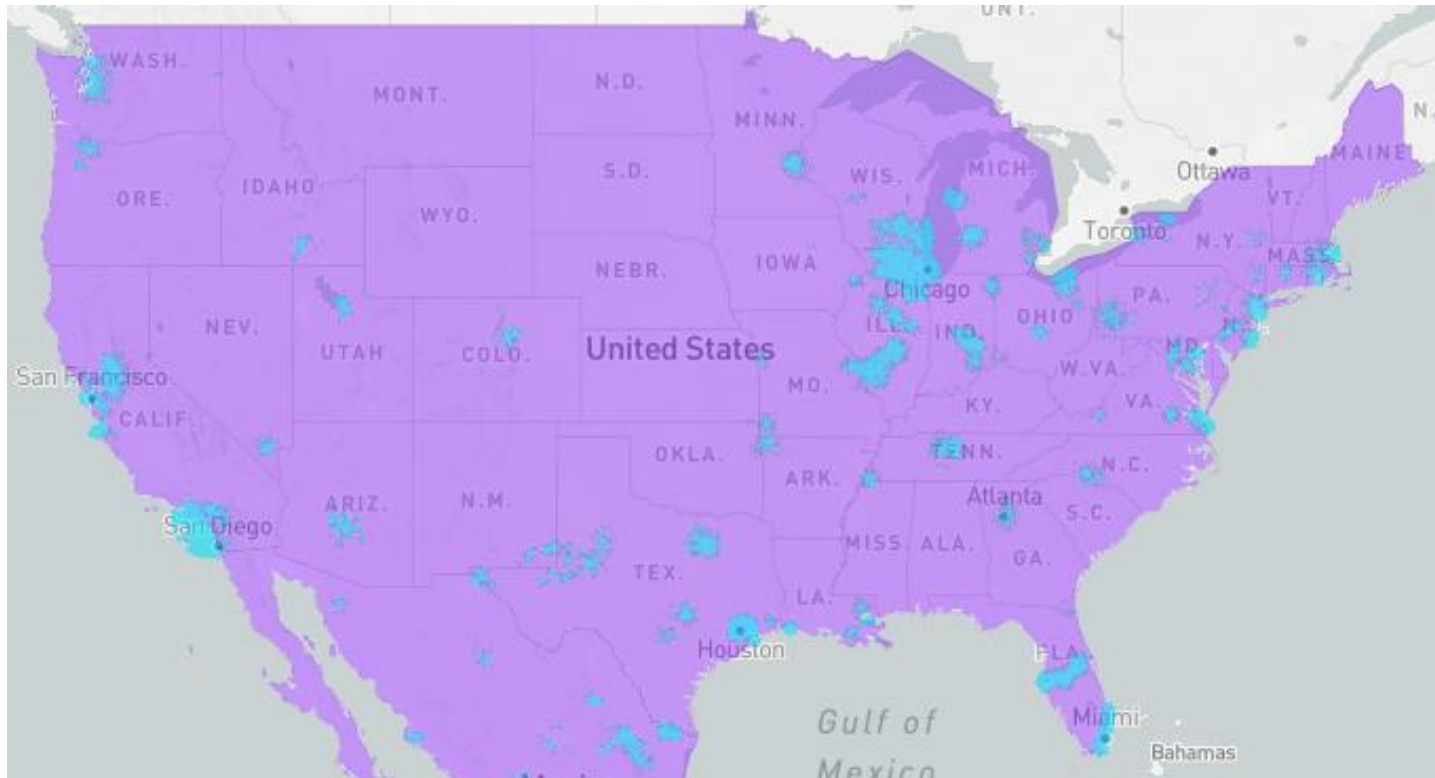


SigFox

Communication Technologies - Overview

50





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

SIGFOX certified tools

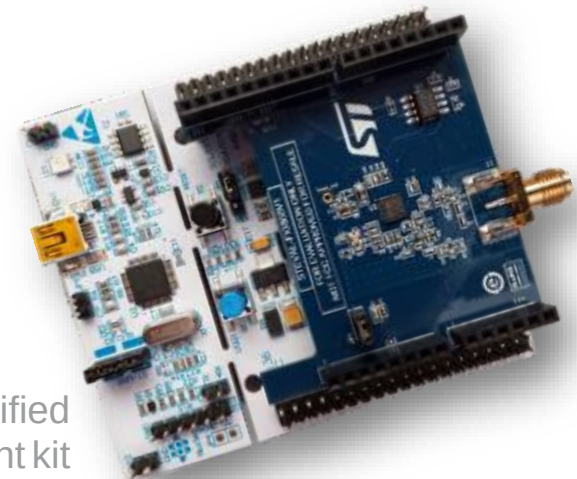
STEVAL-FKI868V1 / FKI915V1

52

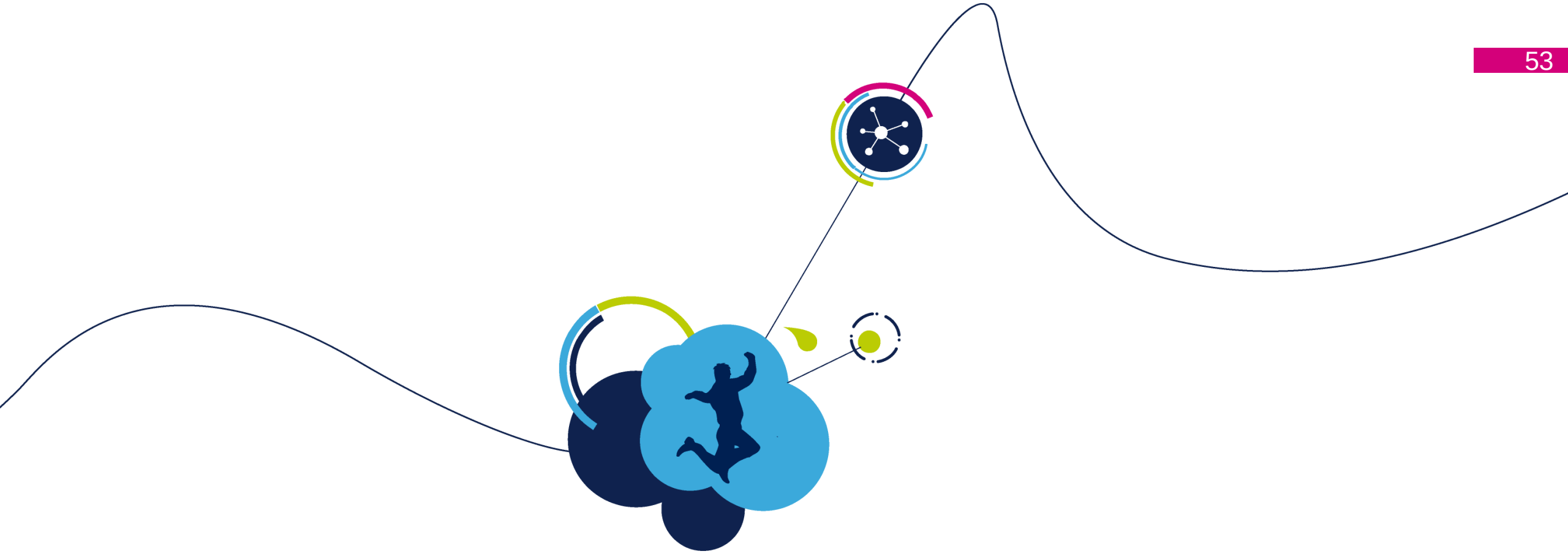
SIGFOX-ready sub-1GHz RF kits accelerate sensor-to-cloud IoT applications

- 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.

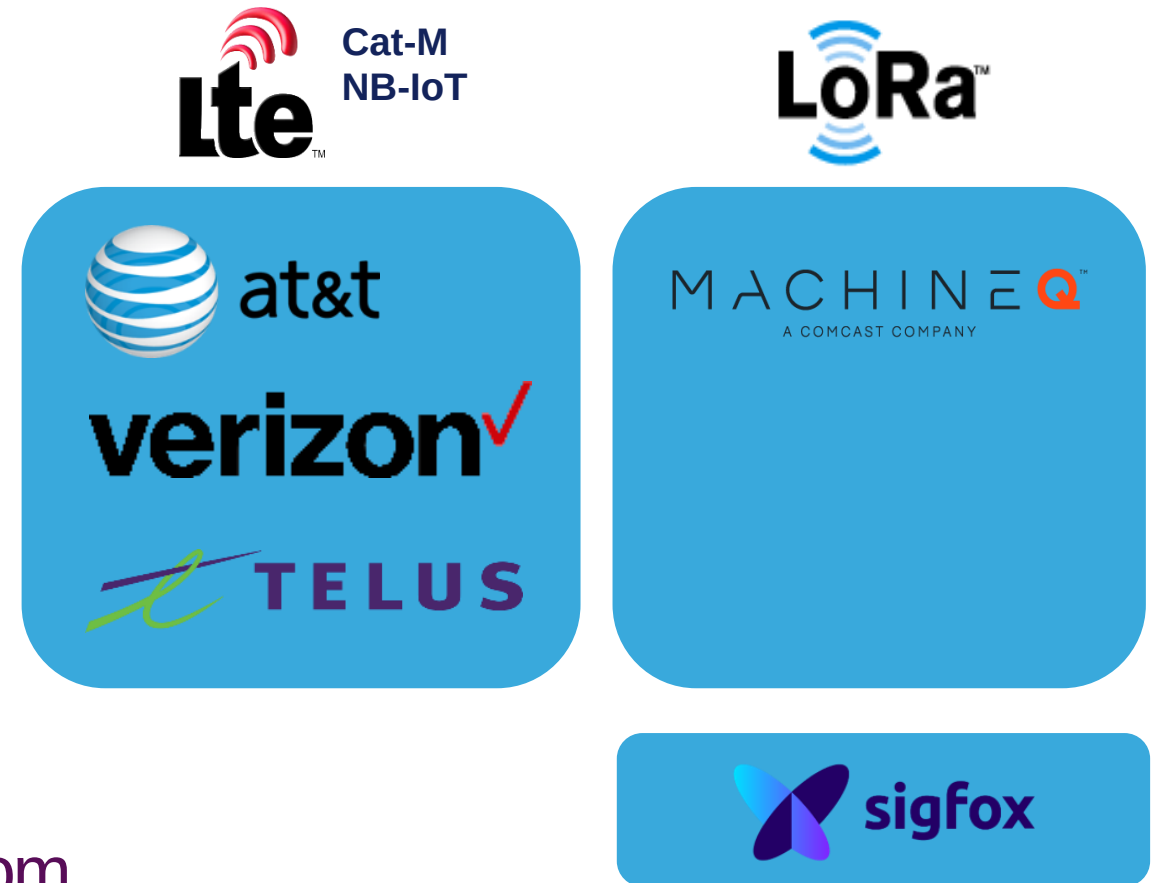
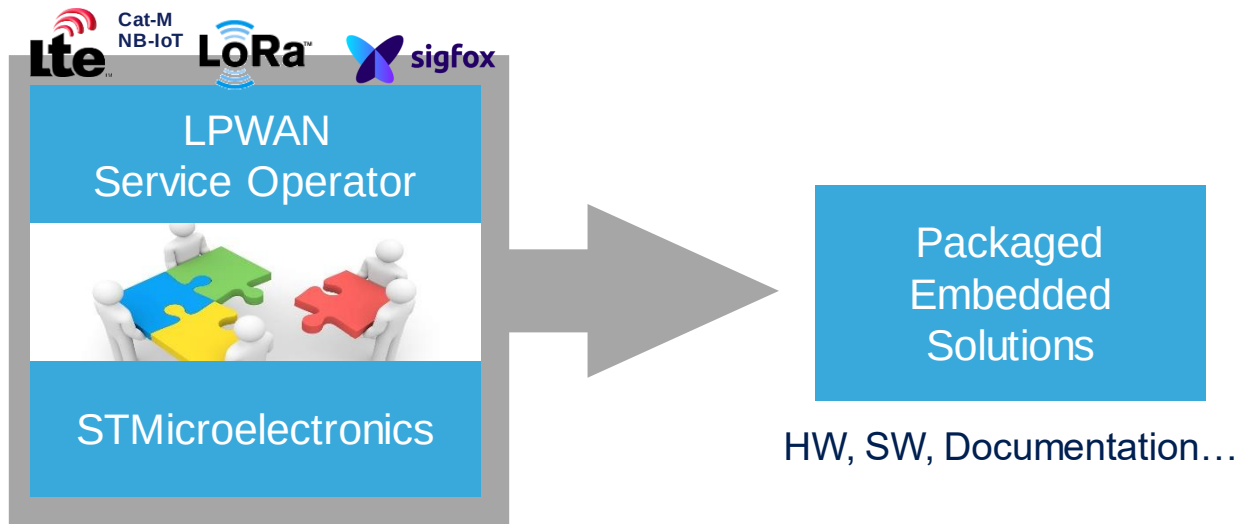
Development Kit for Out-of-the-box
Sensor-to-Cloud Connectivity



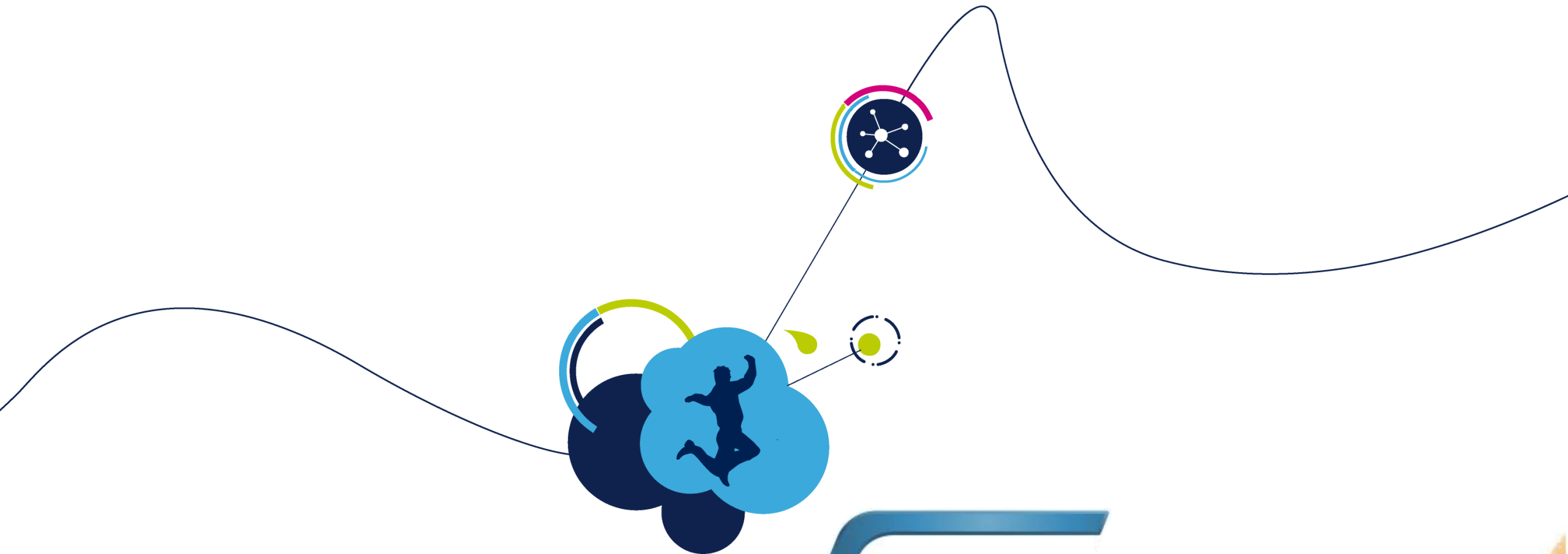
SIGFOX End Product certified
Development kit



Wrap-Up



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



life.augmented

Thank you!

