

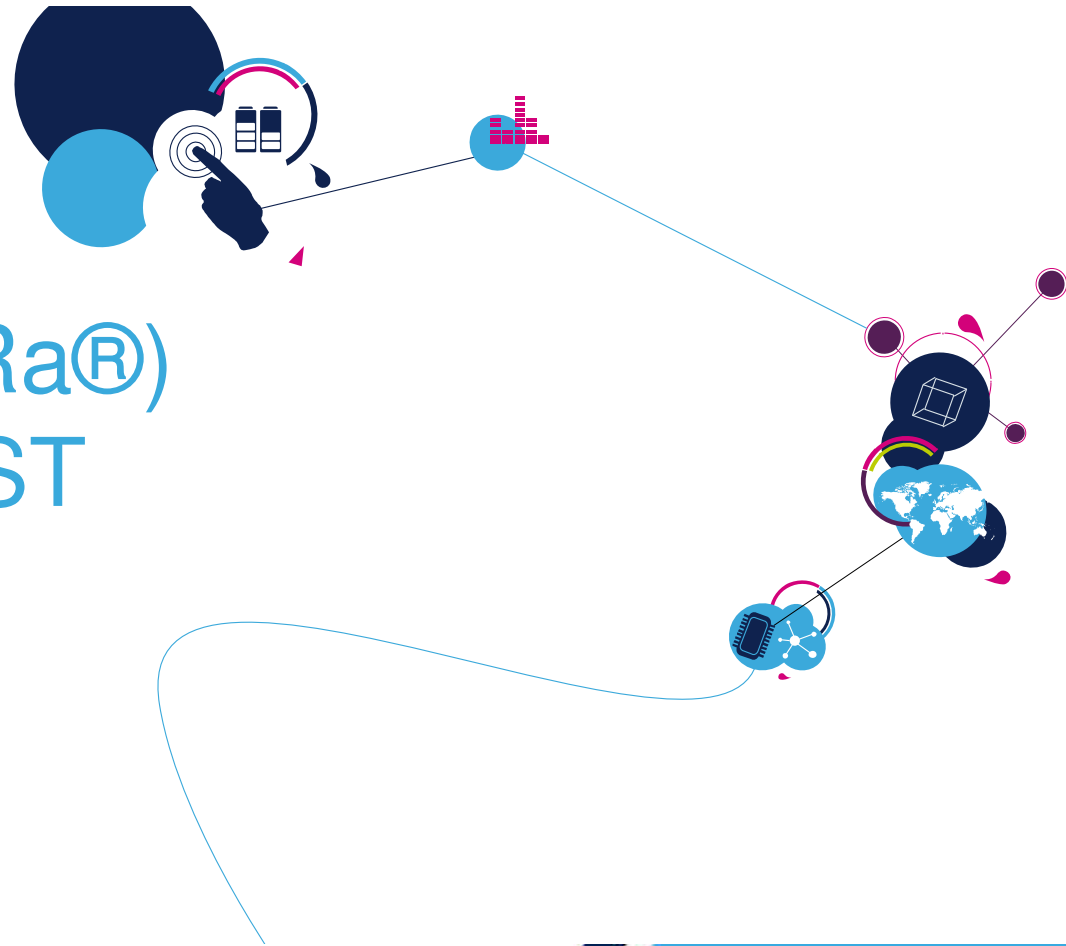
LPWAN (LTE & LoRa®) IoT Solutions from ST

Marc Hervieu
Marketing Manager



Technology Tour 2019

Toronto, Canada | May 29



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

LPWAN

Low Power Wide Area Network

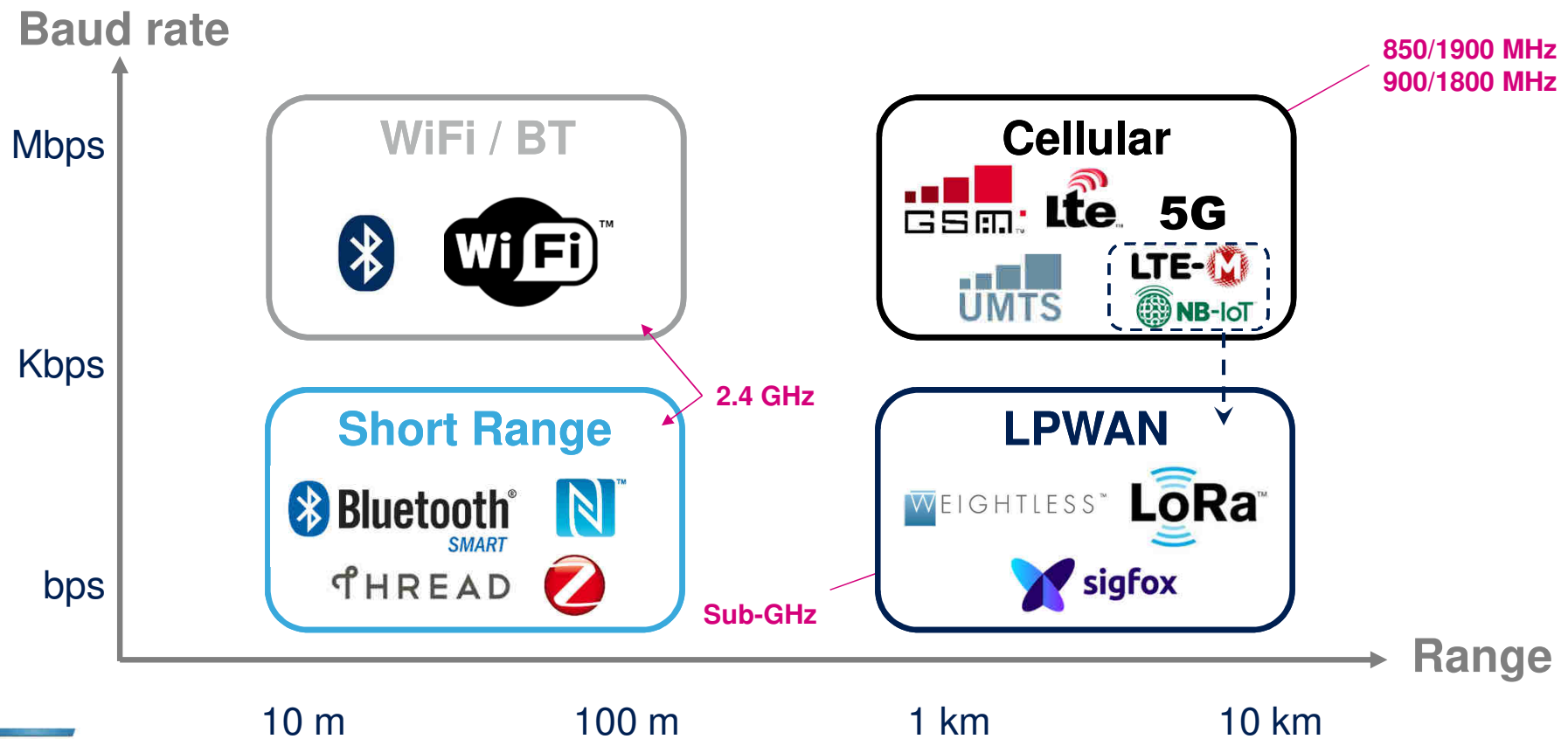
3



LPWAN Market Overview

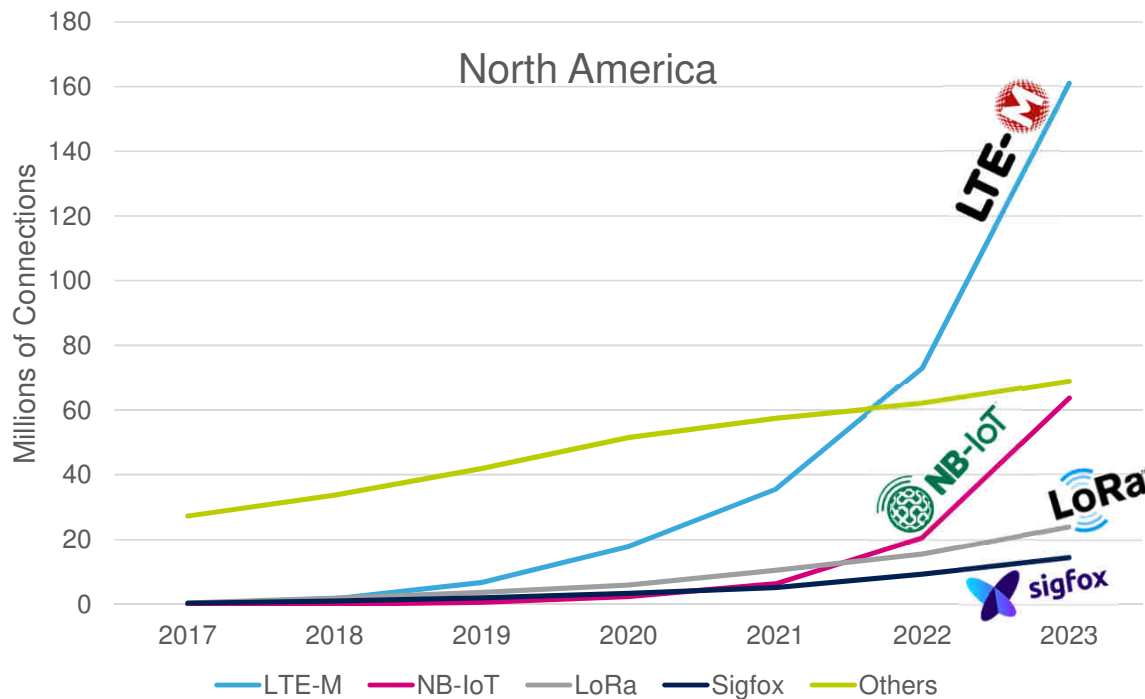
Communication Technologies - Overview

4



North America – LPWAN Market Trends

5



Applications driving LPWAN growth



Asset Tracking
People / Pet Tracking
Home Auto.
Metering
Street Lighting



Asset Tracking
Metering
People / Pet Tracking



Agriculture
Asset Tracking
Home Monitoring
Metering



Agriculture
Asset Tracking
Home Monitoring

Others

Home Automation

Communication Technologies - Overview

6

Emerging Technologies

- Long Range Low Power

LTE-M  **NB-IoT**

LoRa

 **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

LTE-M

verizon✓  **AT&T** **Bell**

 **ROGERS**™  **TELUS**

américa 
móvil

Telefonica

 **TRUPHONE**  **eseye** ...

 **NB-IoT**™

T-Mobile®

américa 
móvil

verizon✓

 **AT&T**

(MVNO)

LoRa™

machineQ™
A COMCAST SERVICE

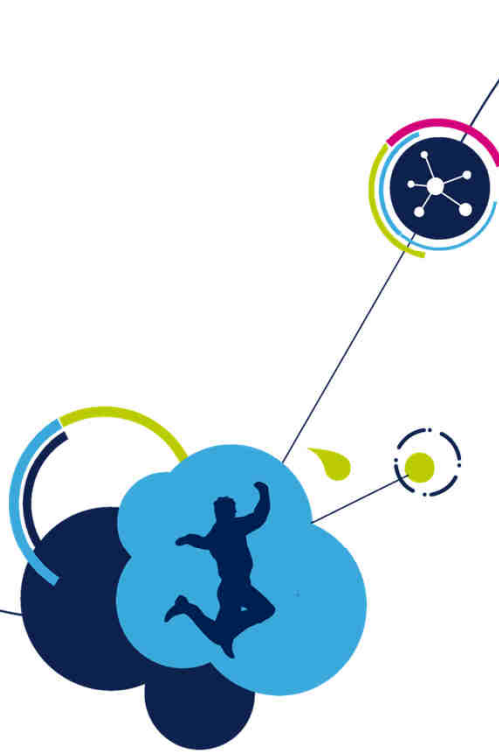
 **senet**

COX®

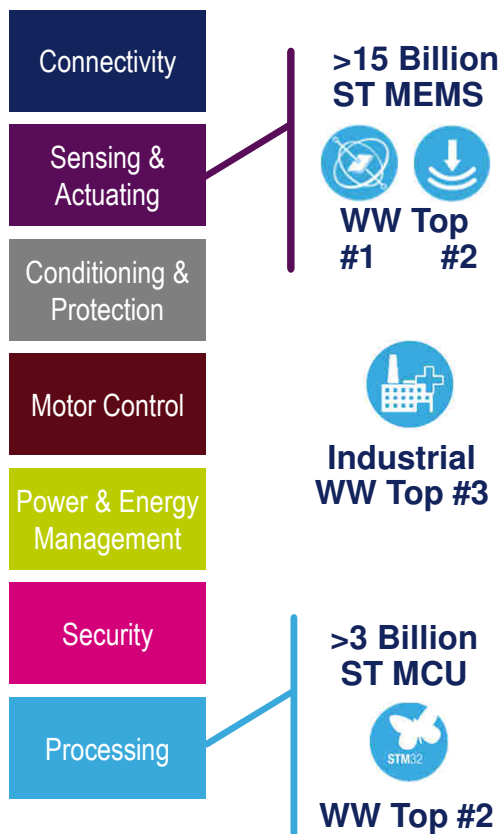
Sprint 

 **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

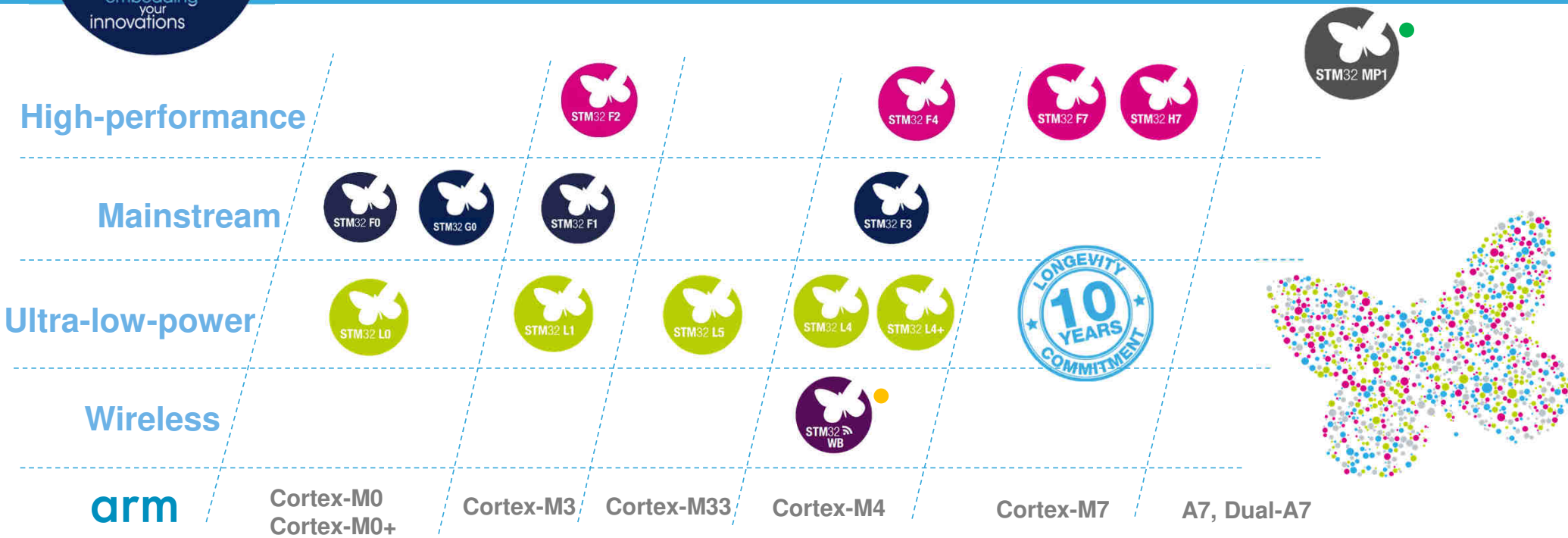


STM32 portfolio positioning

11



Largest Market Offering with >1000 STM32 Part Numbers



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

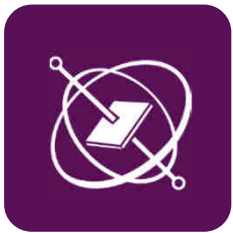
More than
40,000 customers



MEMS Sensors and Actuators

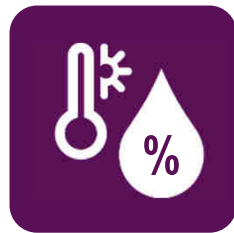
12

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



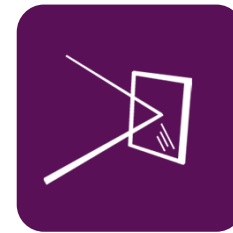
Environment

Temperature
Humidity
Pressure
VOC (Volatile Organic
Compound)



Interactivity

MEMS microphone
Touchscreen
controllers



Micro-Actuators

Micro-mirrors
Thin-film
Piezo-electric MEMS



Optical

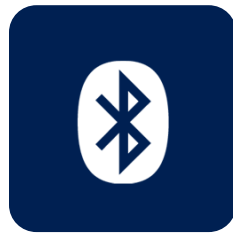
FlightSense™
Time-of-Flight
ranging sensors

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



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

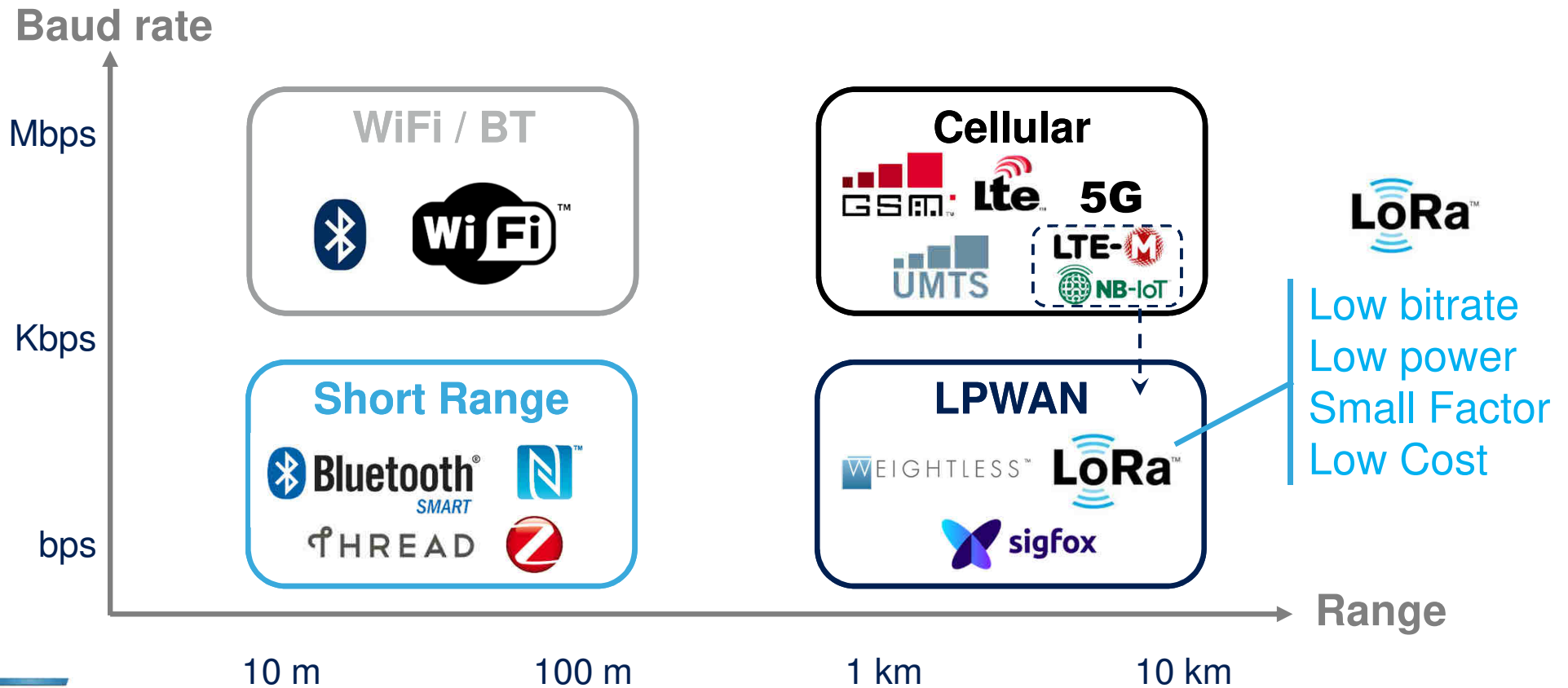
- Faster Time to Market
- Easier development: Less cost/resources



ST IoT LPWAN LoRa®

Communication Technologies - Overview

16



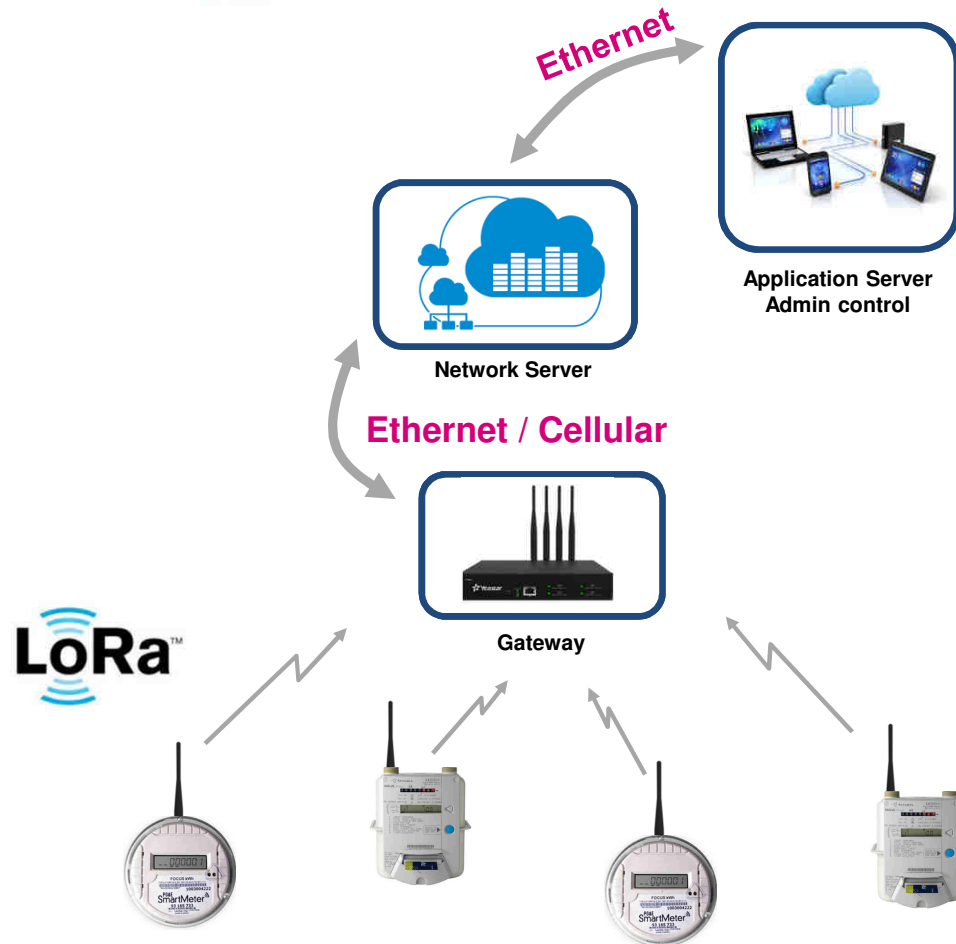
LoRa™ IoT use cases

17

Key Verticals

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

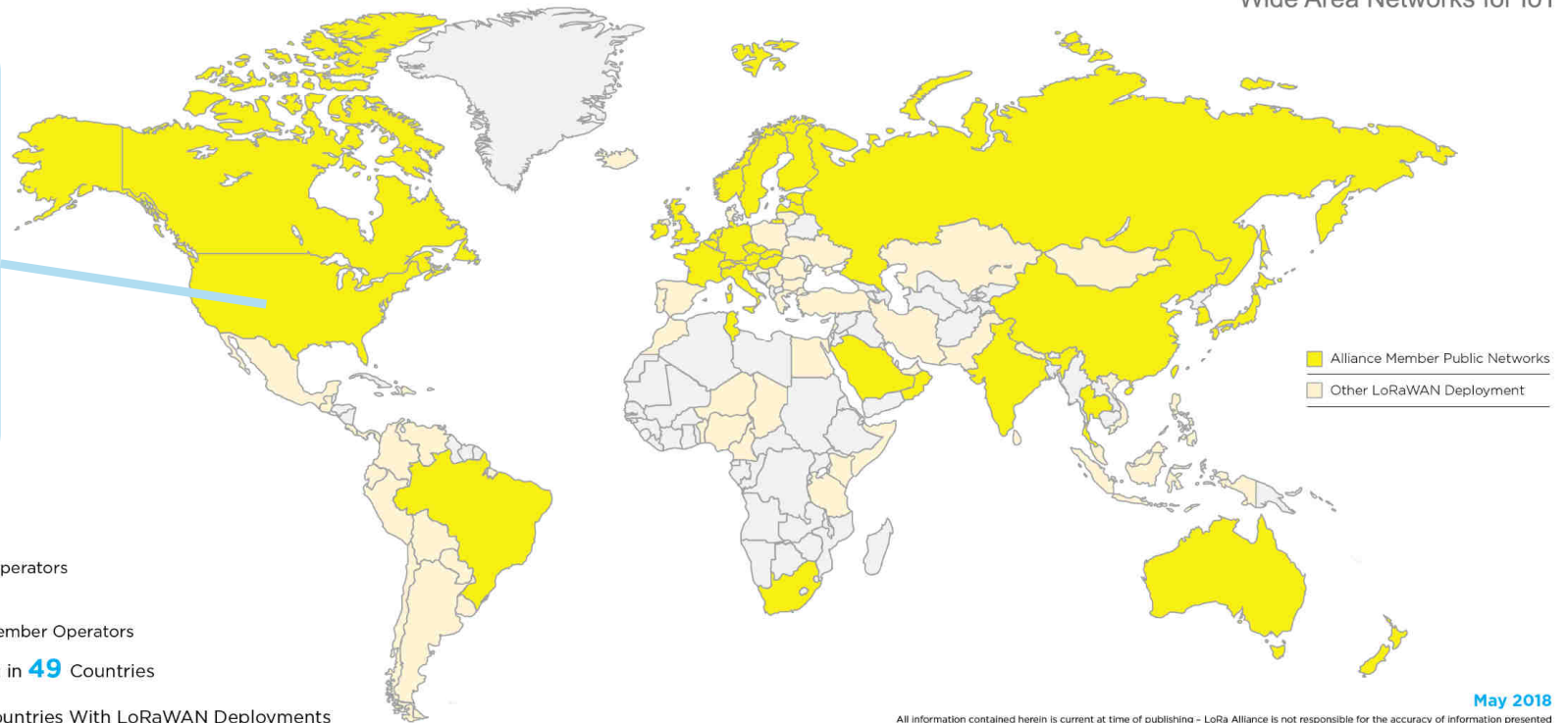
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LoRa® Network Deployments

18

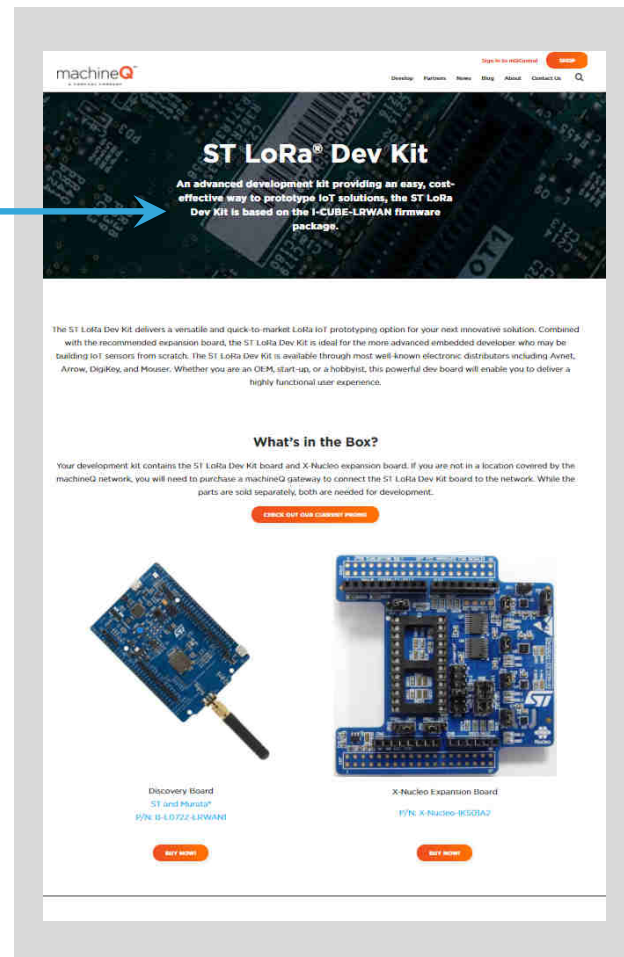
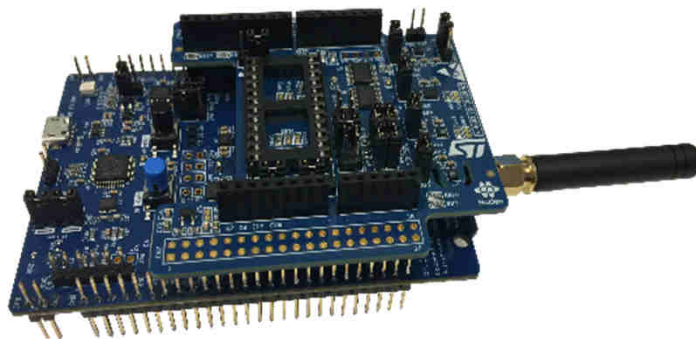
LoRaWAN™ NETWORKS

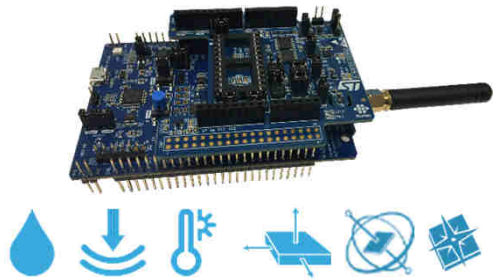


May 2018

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 distribution
 - FW and Step by step user Guide provided on machineQ.com





MACHINE QTM
IoT Gateway



MQcentral (SaaS)



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



ST LoRa[®] Dev Kit Hardware

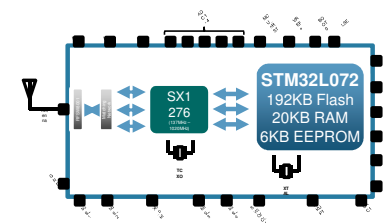
base board B-L072Z-LRWAN1

21

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



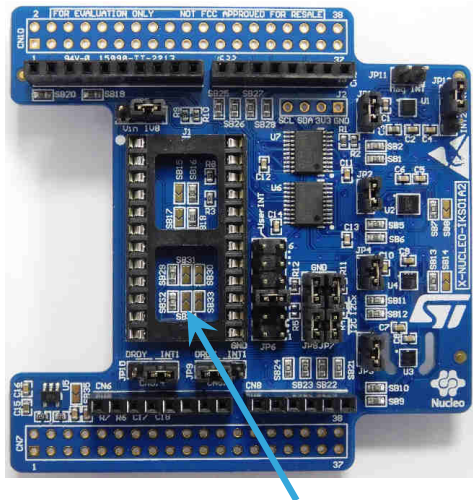


ST LoRa® Dev Kit Hardware

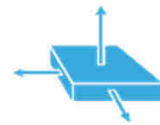
Sensor Shield X-NUCLEO-IKS01A2

22

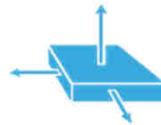
Published on www.st.com
Search for X-NUCLEO-IKS01A2



DIL-24 Extension



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



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



Pressure (LPS22HB)



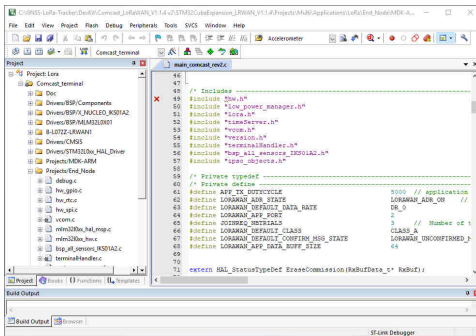
Temperature + Humidity (HTS221)

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



life.augmented

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

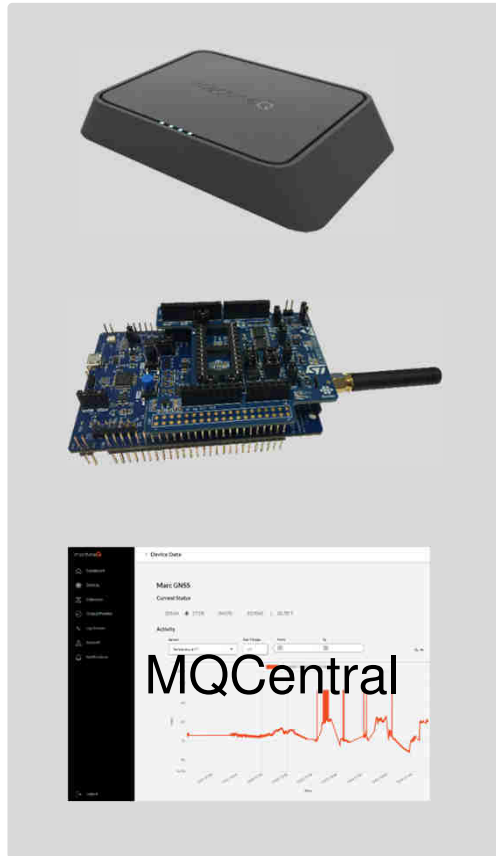
+

Sensors → raw data to the cloud

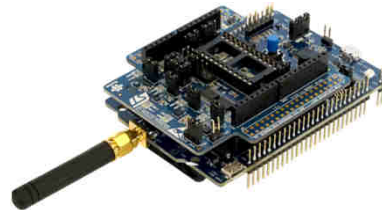
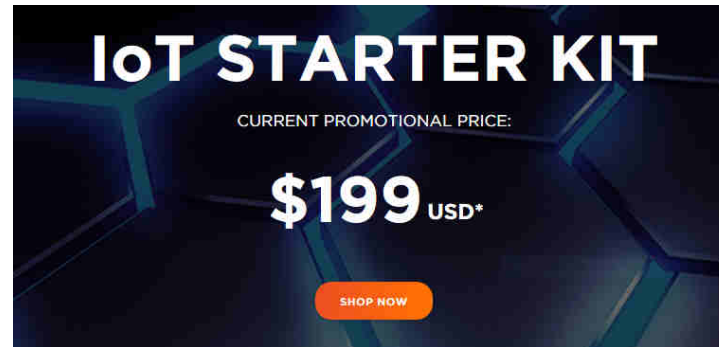
+

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

MACHINEQTM
A COMCAST COMPANY



ST LoRa[®] Dev-Kit Deal



ST LoRa Dev Kit

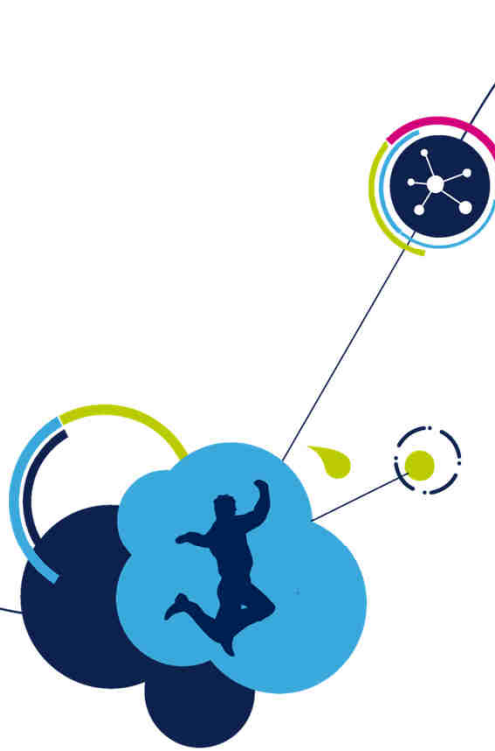
The ST LoRa development board and sensor is an advanced development kit optimized for engineers that are ready to prototype scalable solutions towards a complete IoT implementation.



<https://store.machineq.com/store/products/machineq-starter-kit>

Includes:

- 1** MachineQ Gateway (8 channel)
- 1** ST LoRa[®] Dev Kit (Select “Dev Kit: ST LoRa” in menu)
- 1 Year** MQcentral IoT Management



LoRa® Asset Tracker

Asset Tracking Use Case

26

Being to locate an asset and its environmental



- Applications

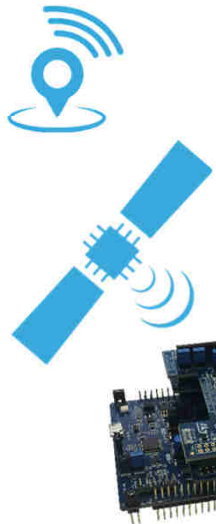
- Fleet Management → For ex. Truck delivery
- Asset / Good Tracking
- Pet/Child tracker

- 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

27

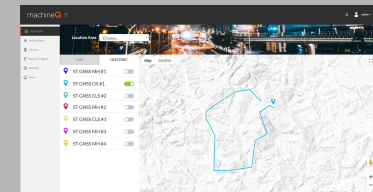


LoRa®

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

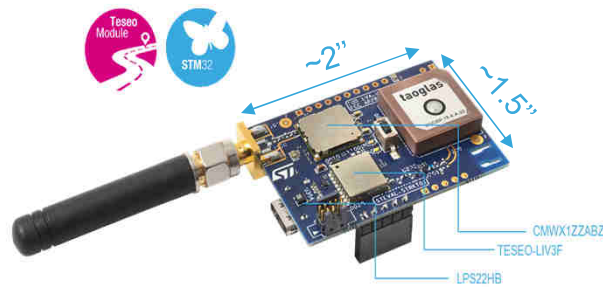


Beidou2



QZSS

ST LoRa® Asset Tracking Ref Design 28



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Search for STEVAL-STRKT01



LoRa® Asset Tracking Function Pack

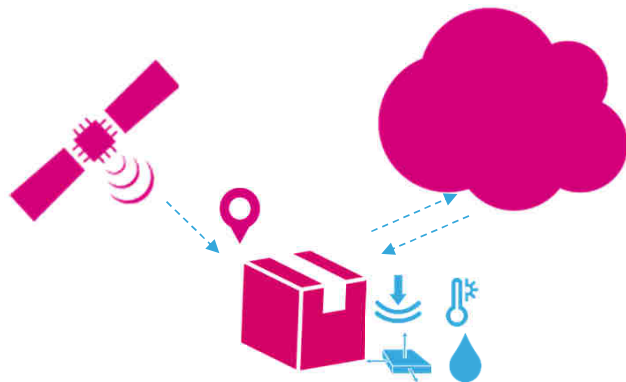
FP-ATR-LORA1

29

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		



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

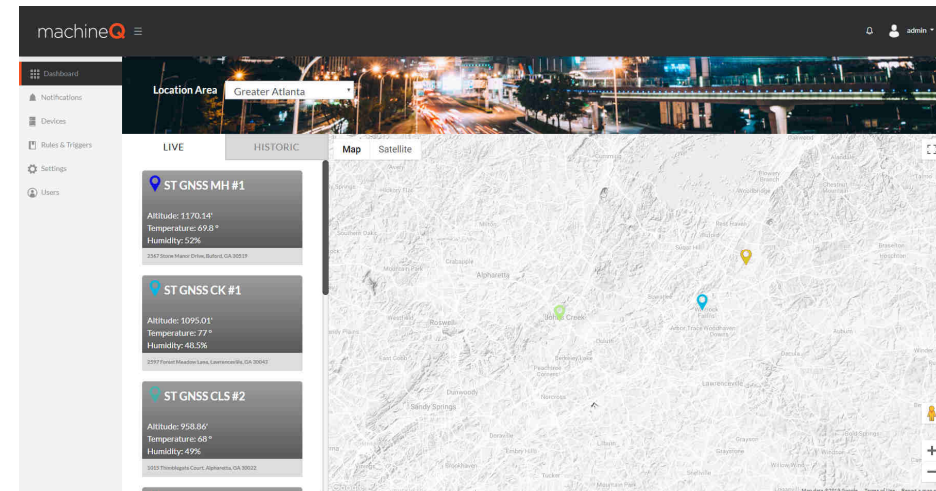
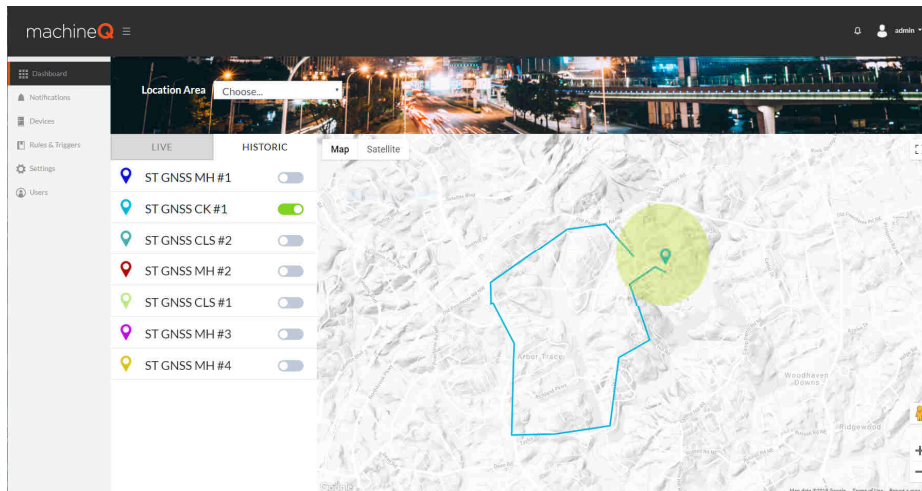
Asset Tracker Demo – MQportal UI

Historic Path

30

Asset Tracking – Sensor Monitoring

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



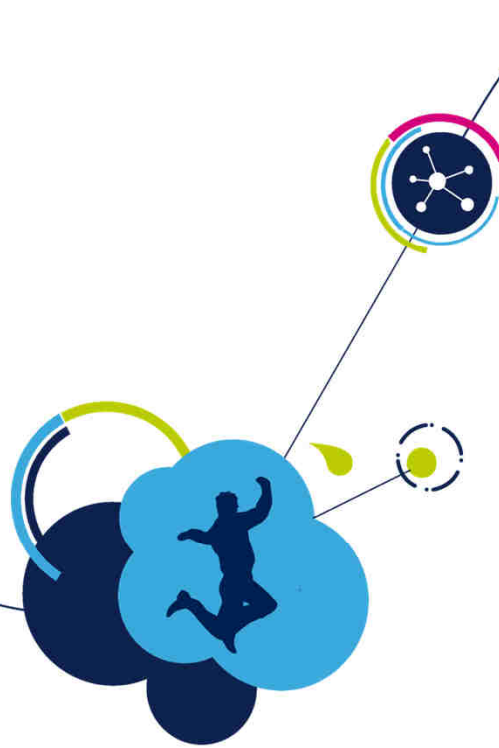


- **Getting it right the first time:
Accelerate your LoRa® Implementation**
 - ST Webinar Sponsored by MachineQ & Murata
 - Occurred on **Jan 30th 2019**



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

Video and Material available on line.

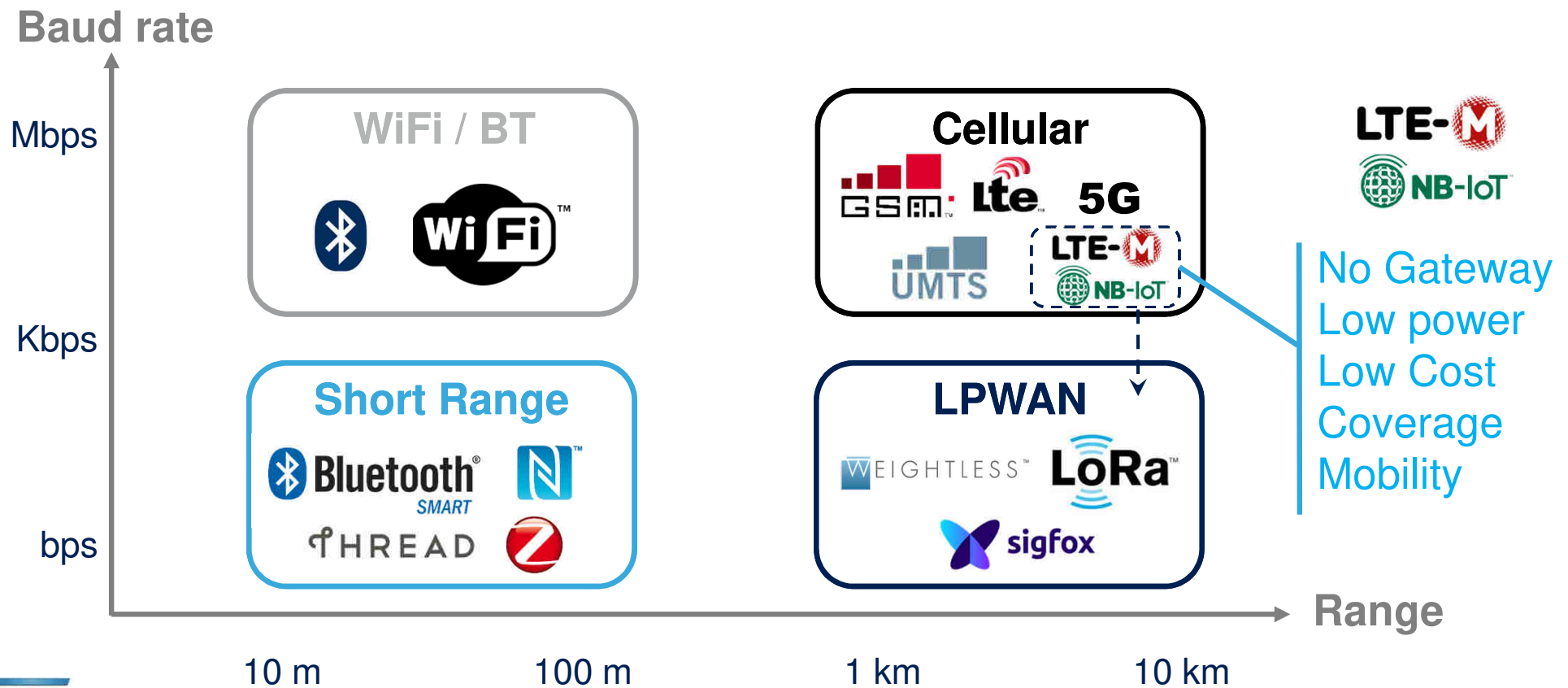


ST IoT LPWAN Cellular



Communication Technologies - Overview

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AT&T Starter Kit

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STM32 based Development Kits with AT&T



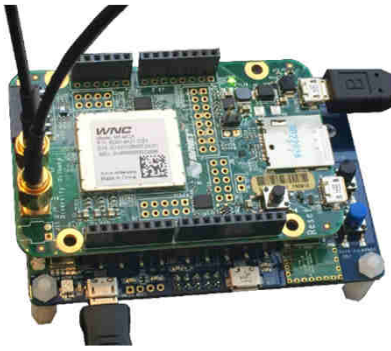
LTE-M
LTE-I





IoT STM32 LTE Starter Kit

35



STM32L4



LTE-M

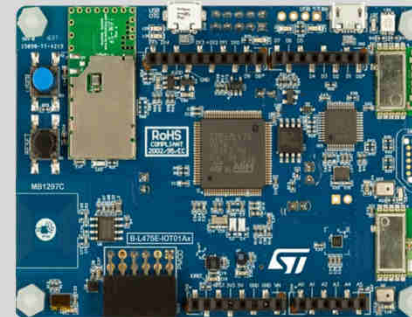
LTE-1



Avnet – Modem Board



AT&T



STM32L4 Discovery
Kit IoT Node





Avnet- AT&T Solution

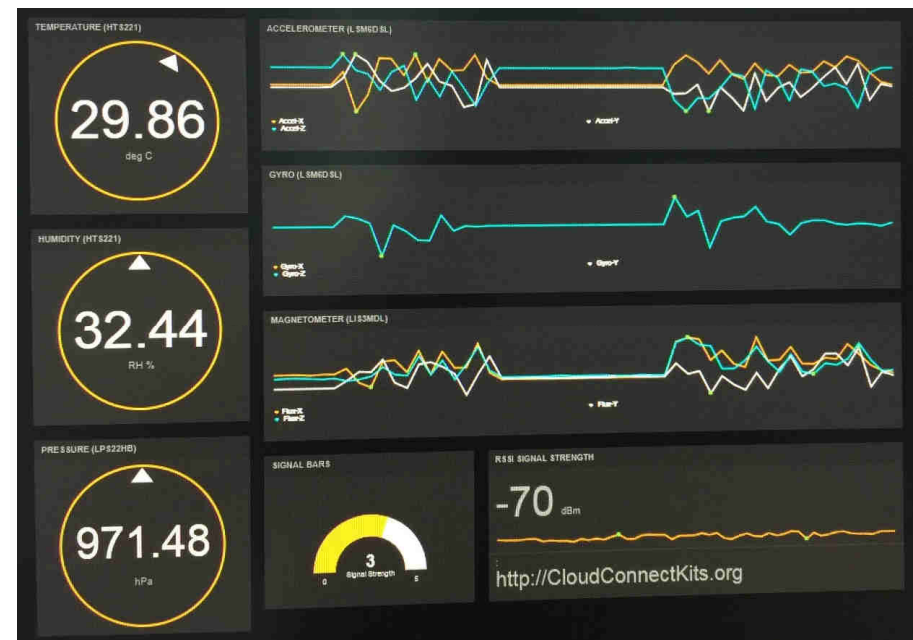
36

STM32 LTE Starter Kit



AT&T Flows

Web Browser



STM32 AT&T – How to Get Access

37

- 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



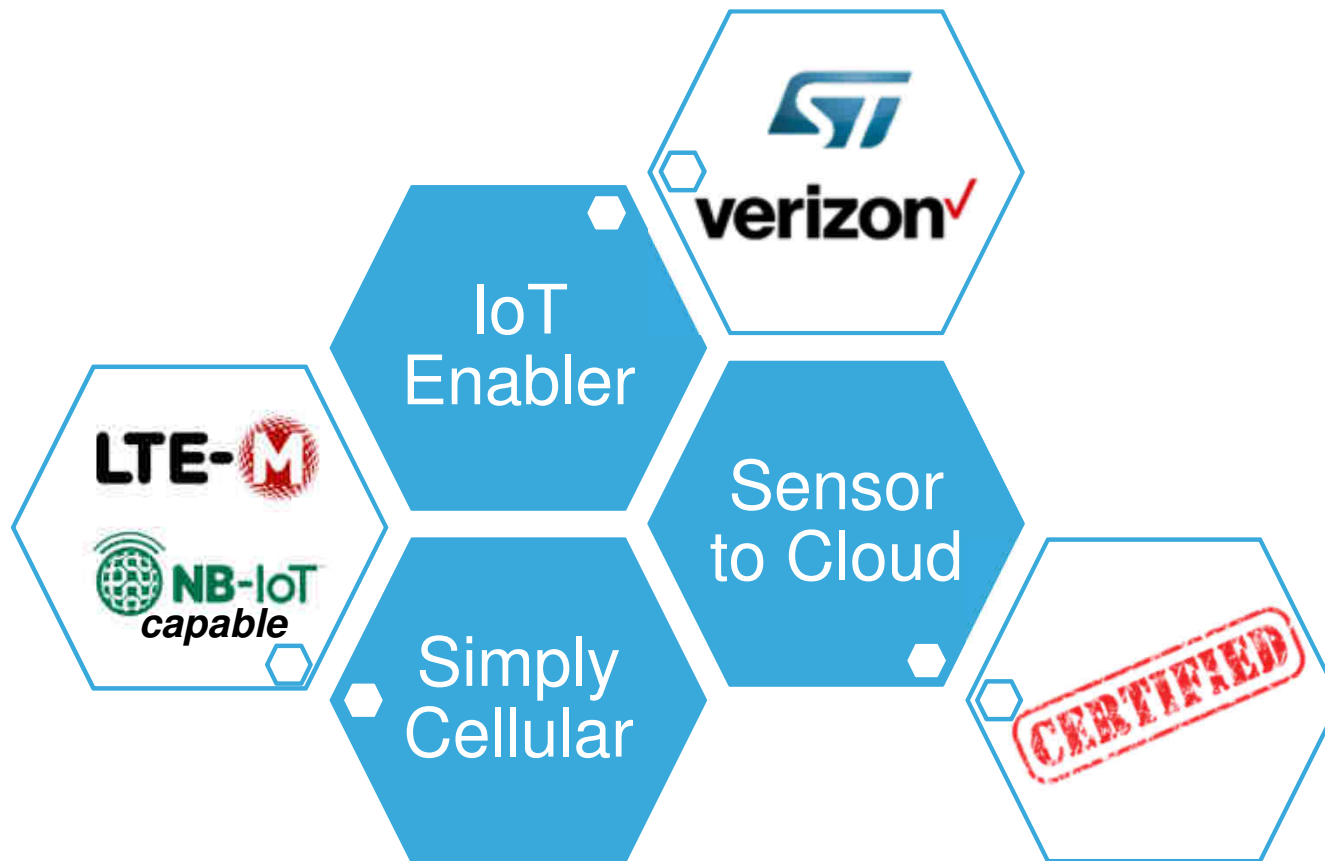
<http://cloudconnectkits.org/product/att-stm32-iot-starter-kit>



VERIZON LTE Starter Kit

Targets IoT Embedded Developers

38



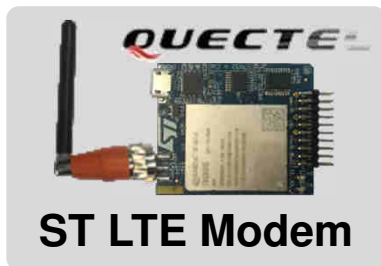
verizon[✓]

IoT STM32 LTE Starter Kit

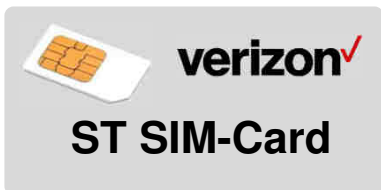
39



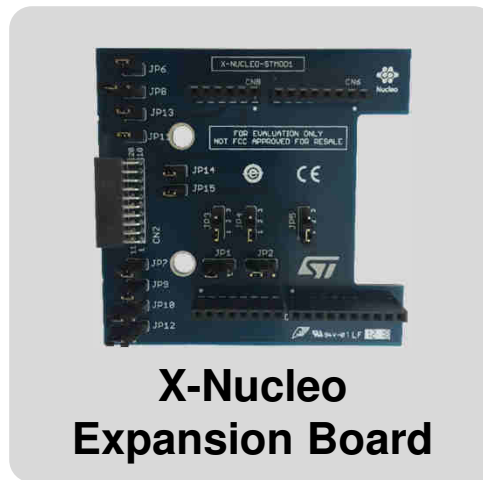
LTE-M NB-IoT



ST LTE Modem



ST SIM-Card

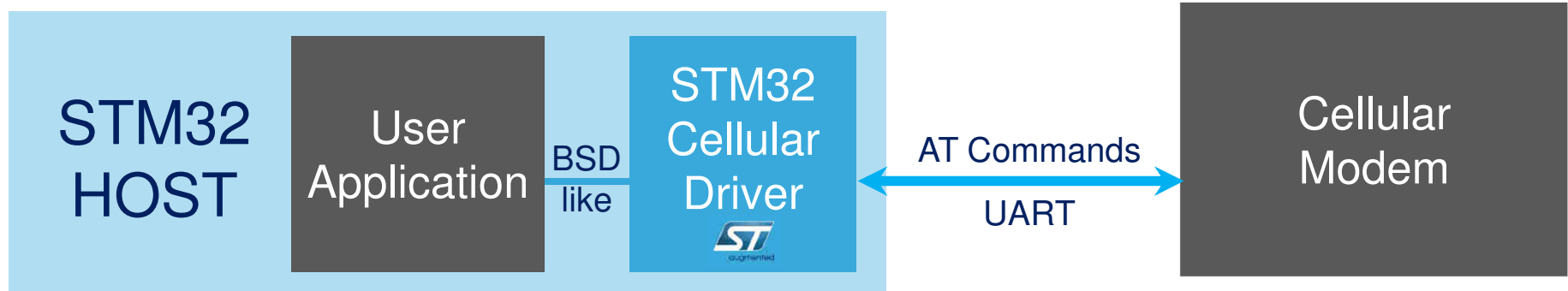


X-Nucleo
Expansion Board



STM32L4 Discovery
Kit IoT Node



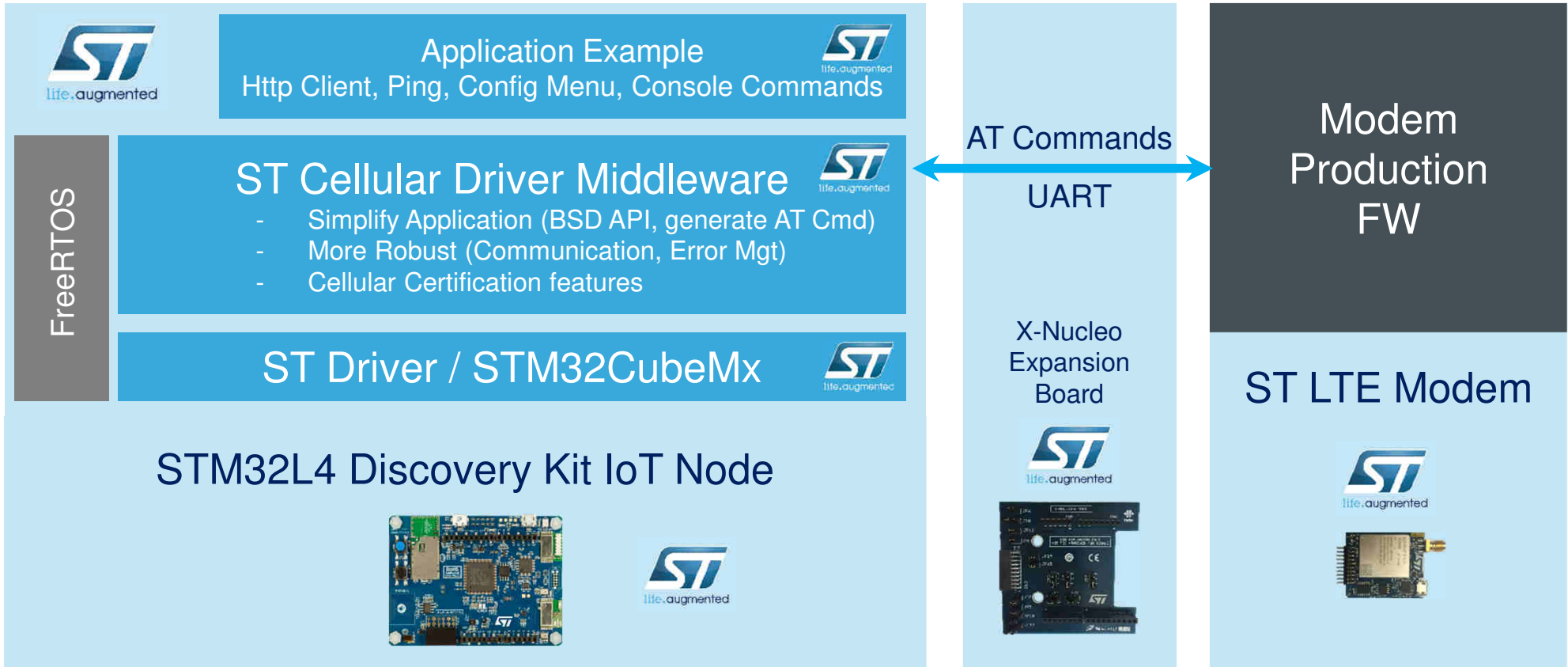


STM32 Cellular Driver Middleware

- 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

Released done with:

- Quectel BG96
- Sequans VZM20Q
- *User Guide to add more...*

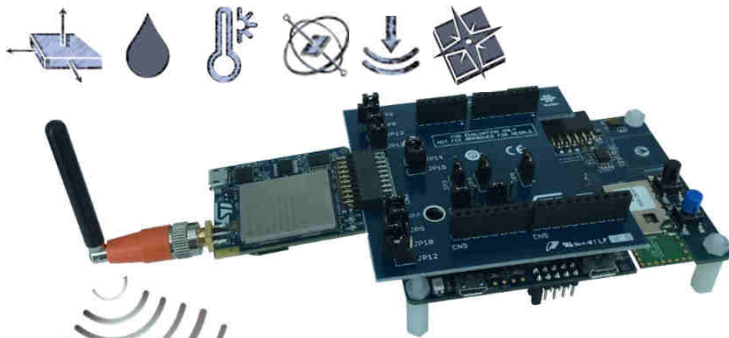


verizon[✓]

X-CUBE-CELLULAR

42

STM32 LTE Starter Kit x-cube-cellular

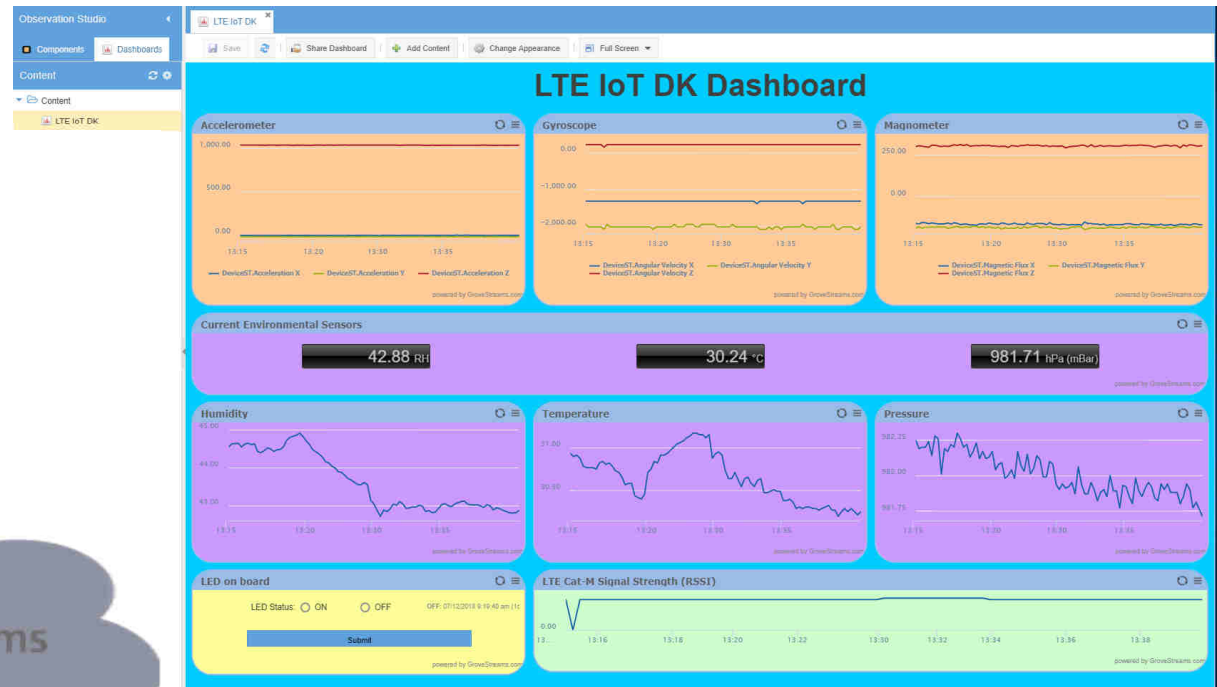


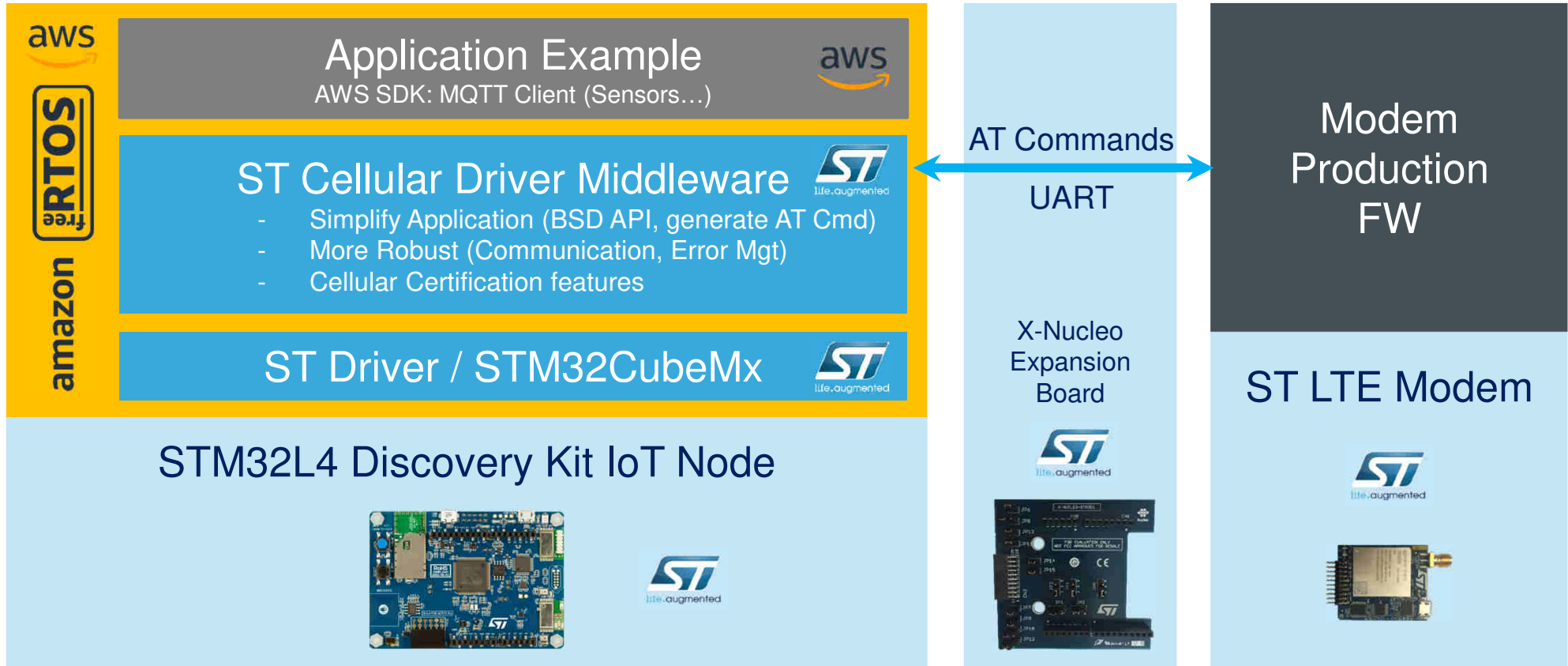
verizon[✓]
LTE-M

 GroveStreams


life.augmented

Web Browser





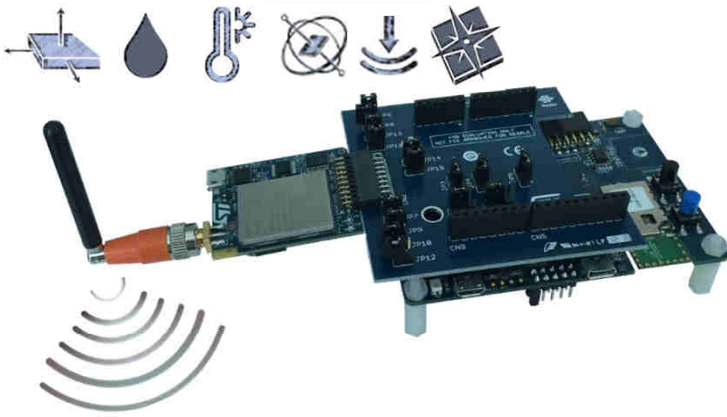
verizon[✓]

Amazon FreeRTOS

44

STM32 LTE Starter Kit

amazon **freeRTOS**



verizon[✓]
LTE-M

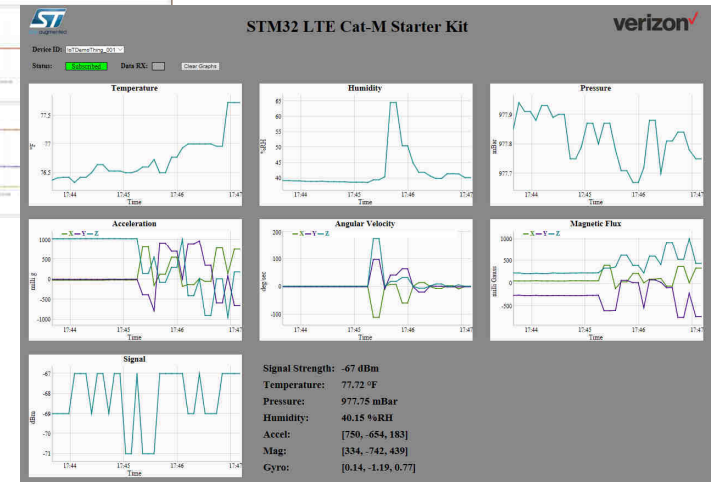
ST
life.augmented

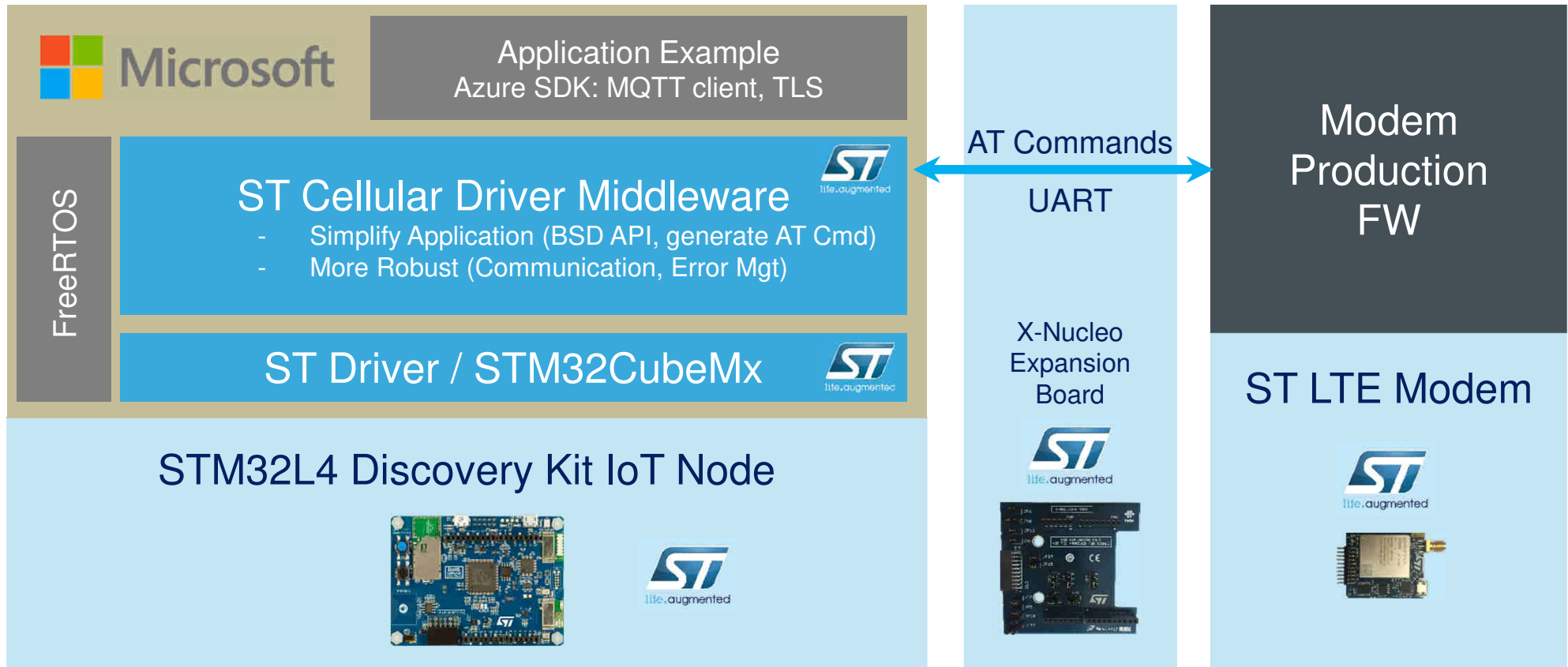


Web Browser AWS – KIBANA Dashboard



Web Browser ST JavaScript Dashboard



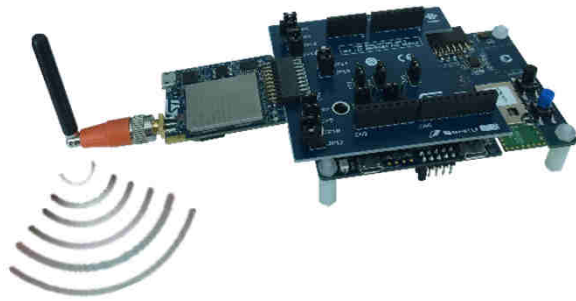




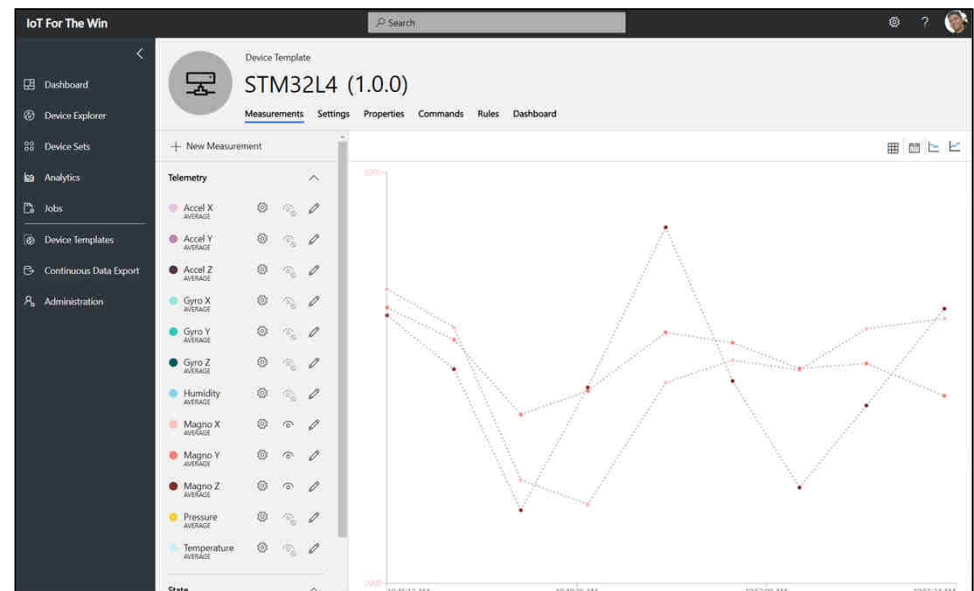
Microsoft Azure IoT Central Experience

46

STM32 LTE Starter Kit



Web Browser Azure IoT Central Dashboard



STM32 Verizon – How to Get Access

- Verizon ThingSpace Cloud connectors



Click on “Learn more”

IoT Development Kit
Build, connect and stream to AWS

Learn more

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

Data Plan <https://thingspaceportal.verizon.com/ccapp/#/home>



- Amazon Marketplace



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

- To buy the hardware



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



<http://cloudconnectkits.org/product/st-microelectronics-verizon-lte-m-iot-starter-kit>



verizon✓



Get your devices talking.

Now you can access the award-winning Verizon network and get the data plan you need to bring your IoT solution to life.

ThingSpace IoT Connectivity Plans for Developers

Automatically renew plans.
Cancel at any time.

Plan restricted to Verizon IoT certified devices. International roaming, voice capability and multimedia messaging are not included. No activation fee. Credit card only - no EFT. No subsidies.

1GB

\$20/year
+\$1/device/month

ThingSpace IoT for Developer - 1GB

- 1 GB data/year
- Share up to 20 Verizon certified devices
- 1,200 SMS per year per line of service
- Automatically renews (you can opt out at any time)

Subscribe

10MB

\$5/year
+\$1/device/month

ThingSpace IoT for Developer - 10MB

- 10MB data/year
- Share up to 20 Verizon certified devices
- 1,200 SMS per year per line of service
- Automatically renews (you can opt out at any time)

Subscribe



<https://thingspaceportal.verizon.com/ccapp/#/home>

Data Plan

48

verizon✓

STM32 – Software Resources

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X-CUBE-CELLULAR

www.st.com/x-cube-cellular



Amazon FreeRTOS – Verizon GitHub

https://github.com/verizonlabs/vz_aws_st



Azure IoT Central – Microsoft GitHub

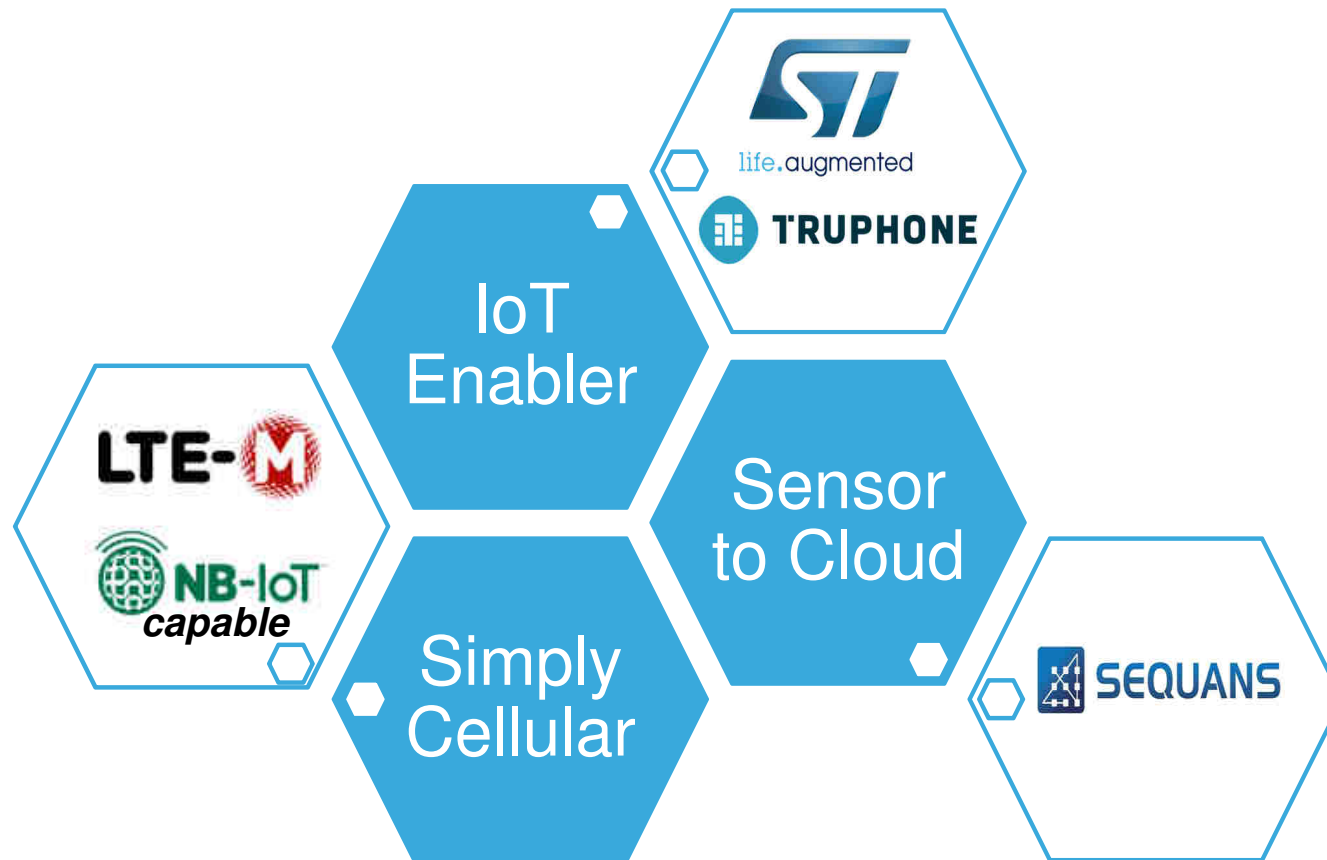
<https://github.com/Azure/iot-central-firmware/tree/master/freeRTOS/b-l475e-iot01a1-bg96-verizon>

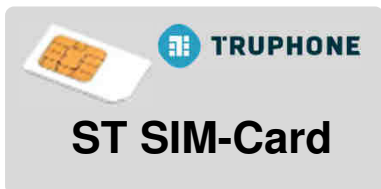
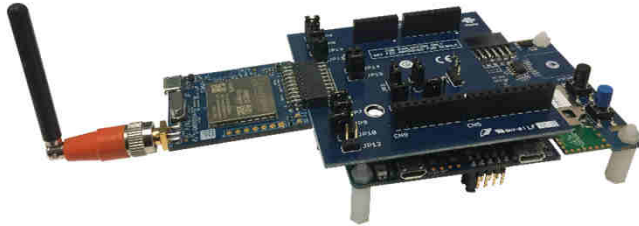


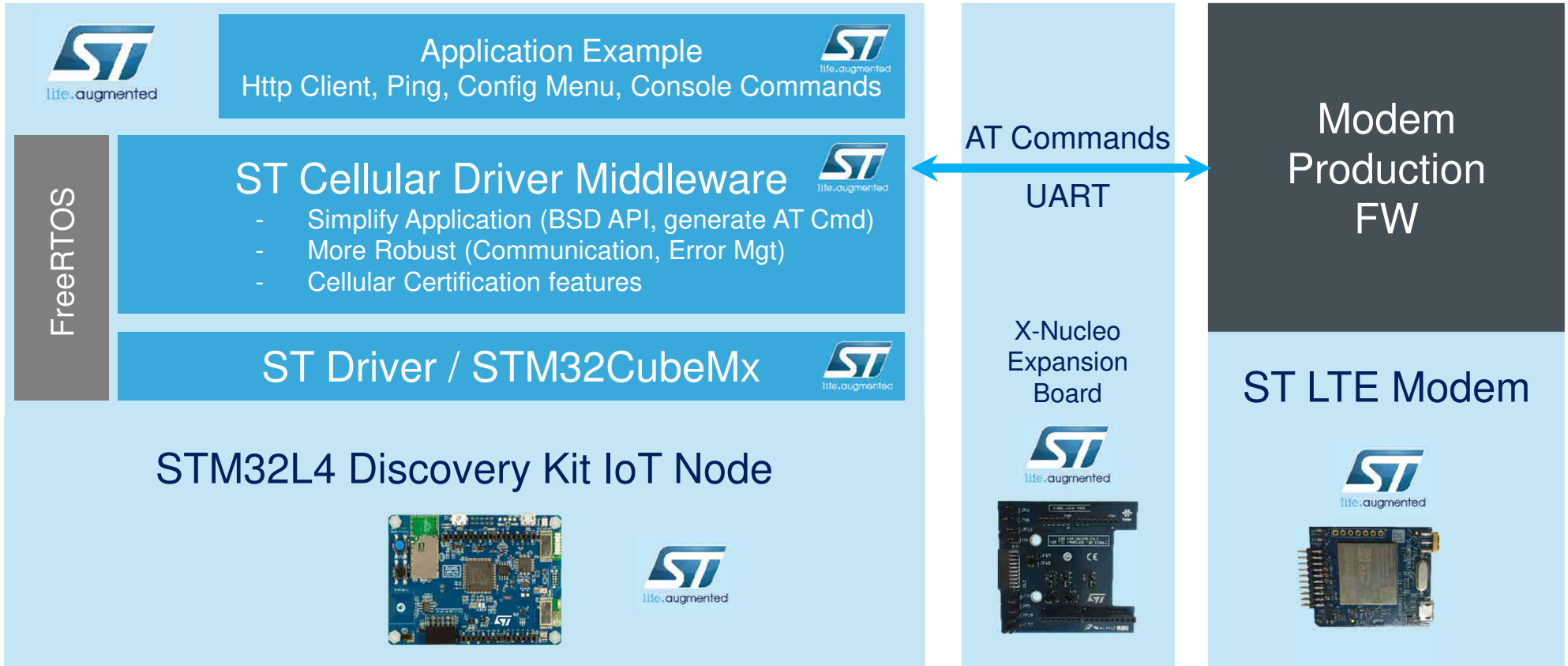
TRUPHONE Worldwide LTE-M Starter Kit

Targets IoT Embedded Developers

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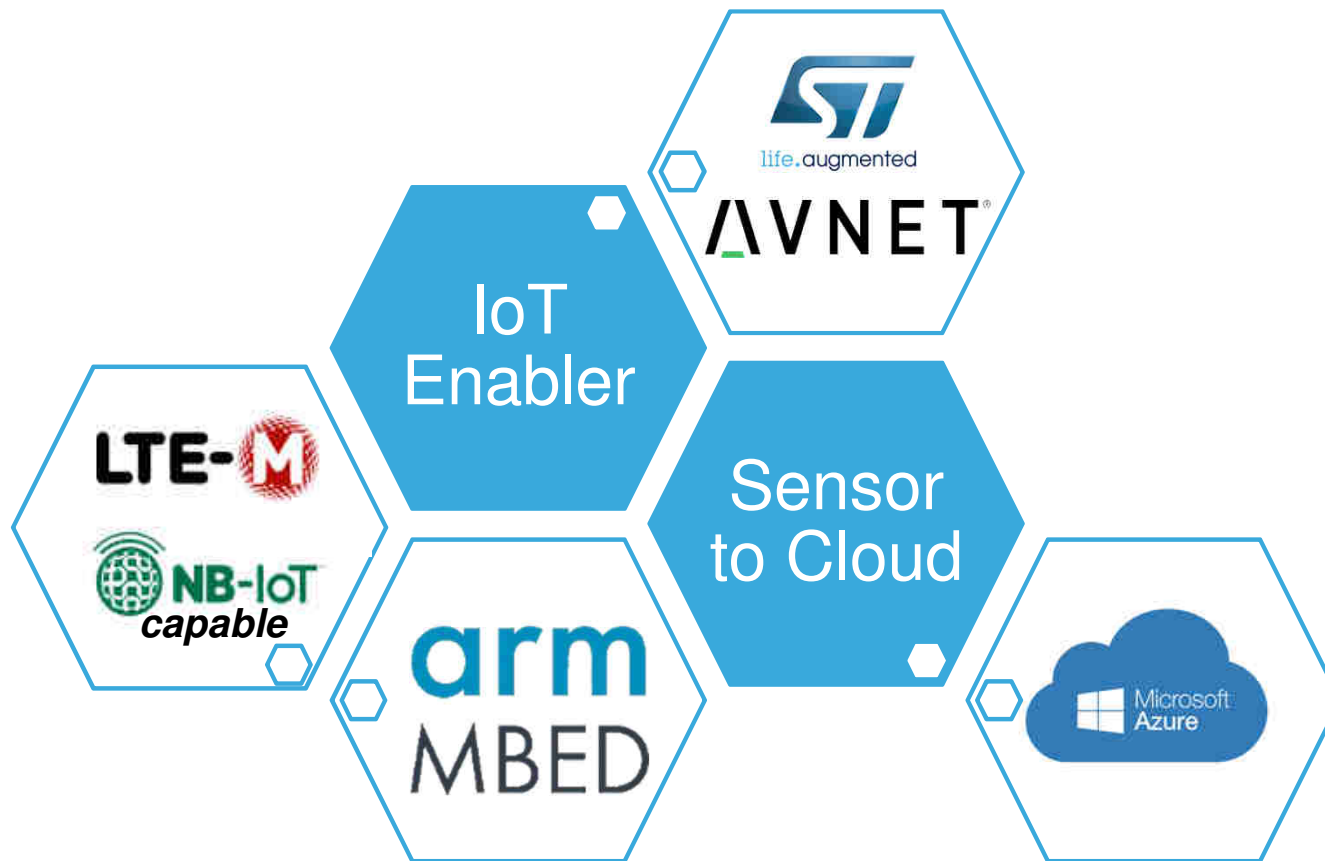




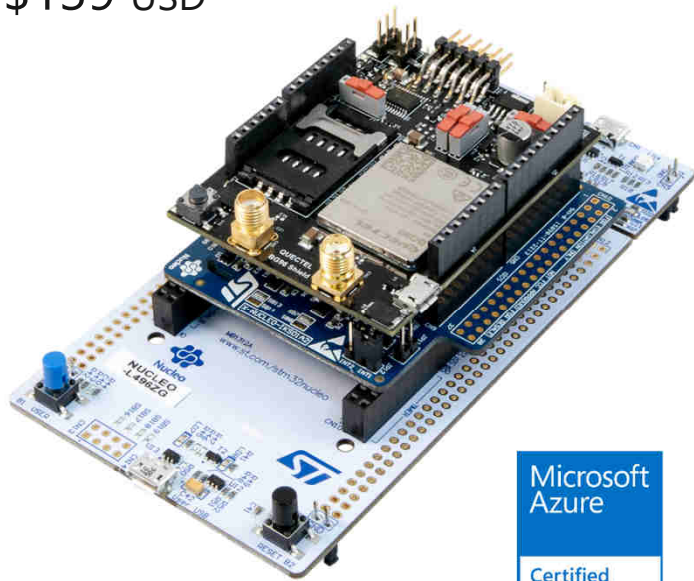


Telus LTE-M Starter Kit

Targets IoT Embedded Developers



Suggested Resale:
\$139 USD



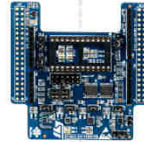
Microsoft
Azure
Certified

* Also includes LTE-M and GPS antennas from Taoglas



• Microcontroller Board

- ST Microelectronics L496 Nucleo board
- Arm® Cortex®-M4 MCU @ 80MHz
- Arduino™ Uno R3 expansion
- Supports Arm Mbed™ OS



• Sensor Shield

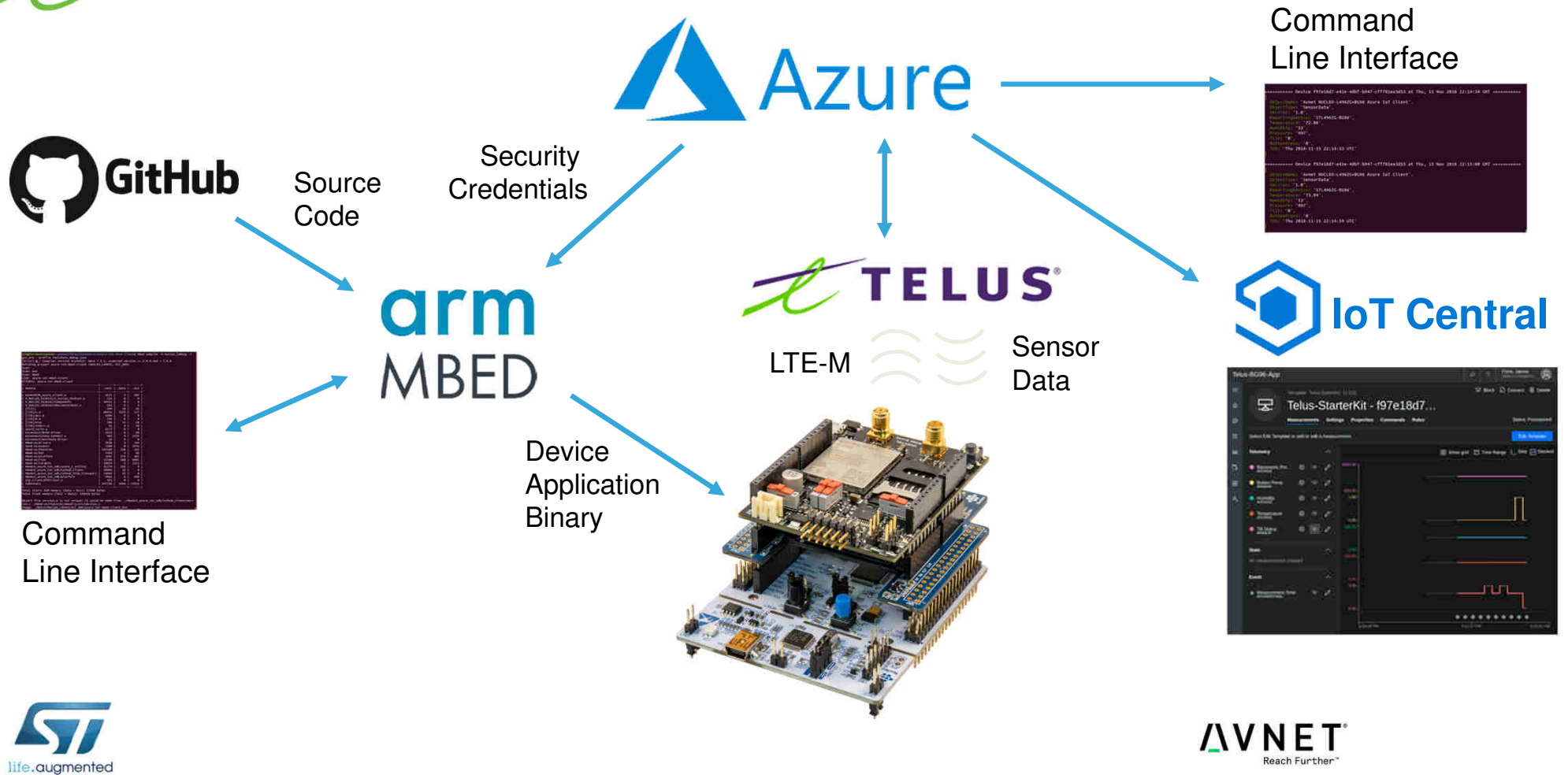
- Contains six I2C sensors (ST Microelectronics)
- Accelerometer, Gyro, Magnetometer, Temperature, Humidity, Pressure



• LTE-M Modem Shield

- Avnet designed Arduino shield format
- Based on Quectel BG96 LTE-M / NB-IoT modem
- Supports both SIM and eUICC options

Out-of-Box Overview

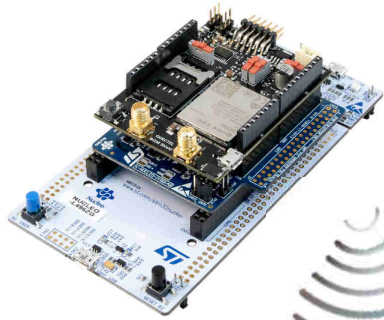




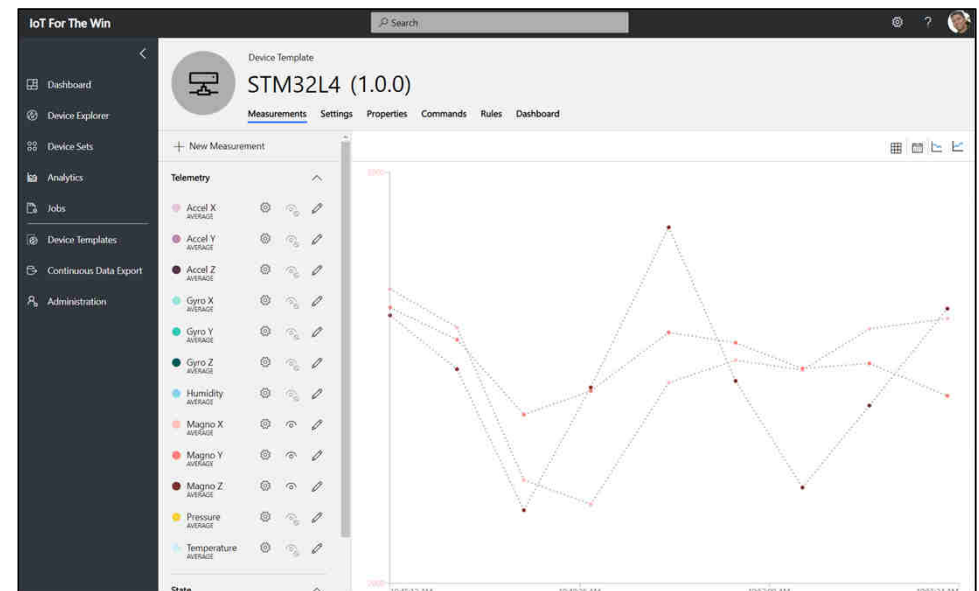
Azure IoT Central Experience

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STM32 LTE Starter Kit



Web Browser Azure IoT Central Dashboard





Telus Solution

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 **TELUS** <https://www.telus.com/lpwa>



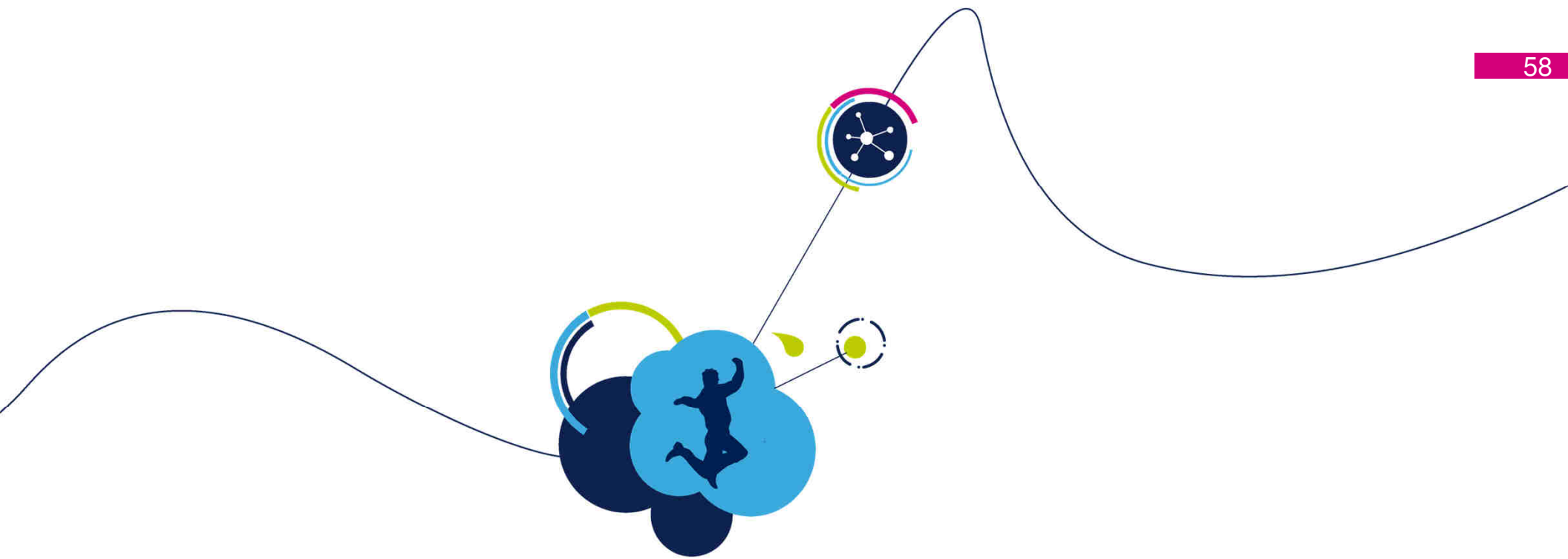
AVNET <http://cloudconnectkits.org/product/telus-lte-m-iot-starter-kit>



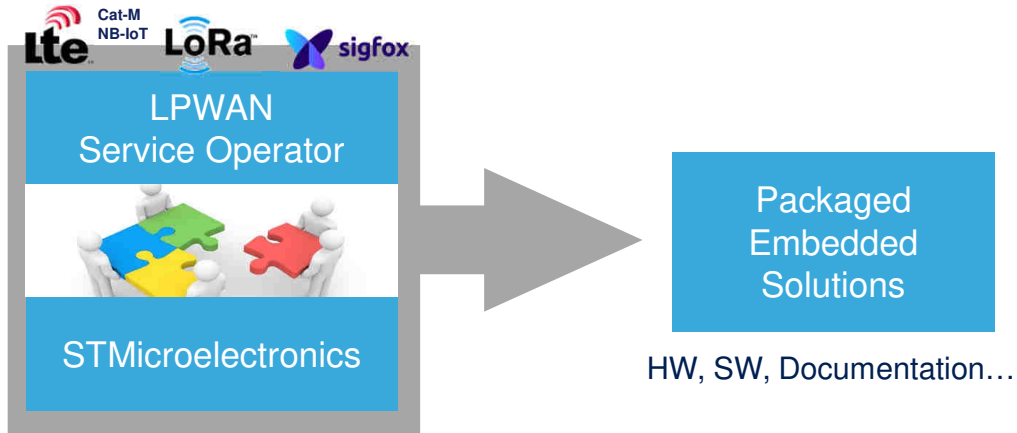
LTE-M  **NB-IoT**

- Cost – \$139 USD
- Data Plan – 150 MB / 6 Months



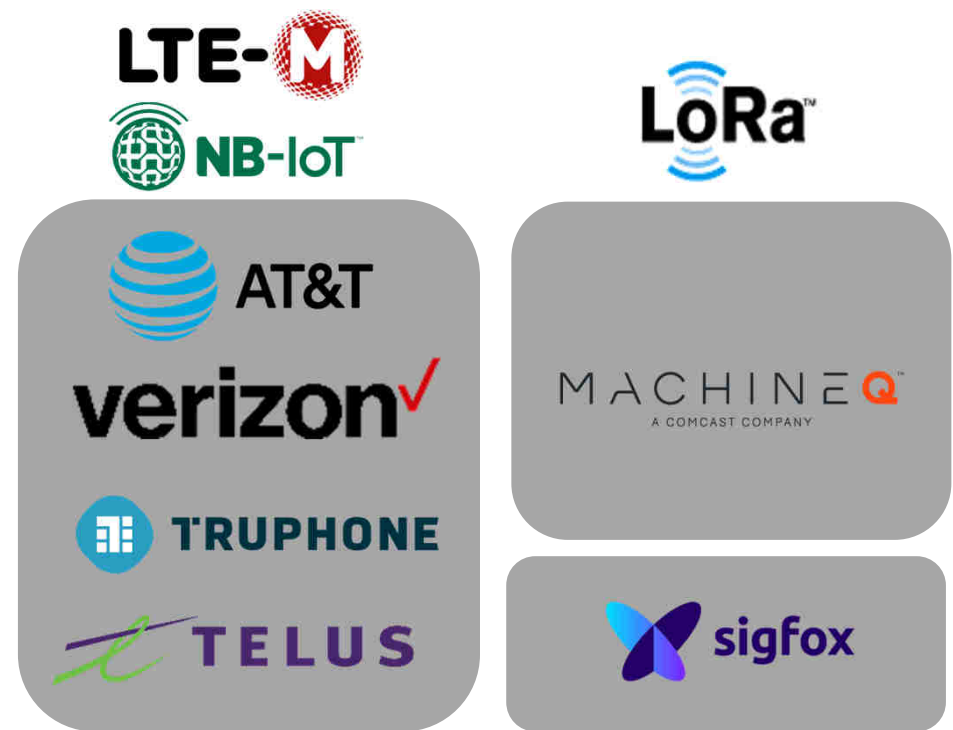


Wrap-Up

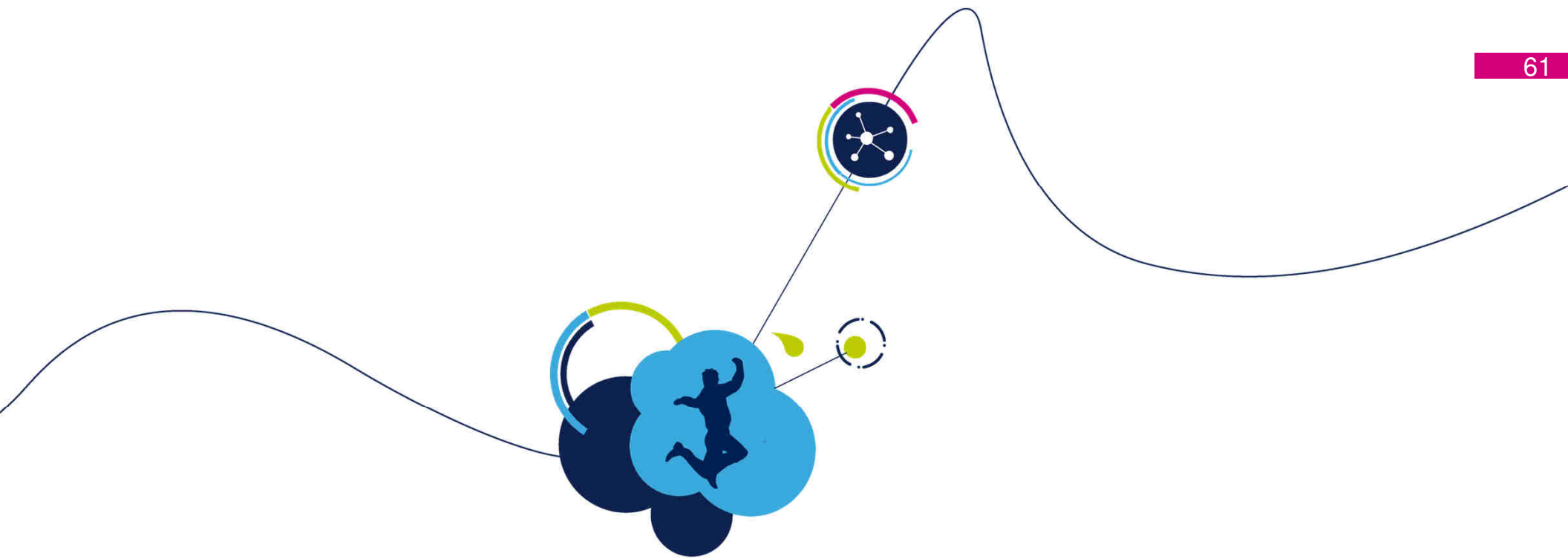


Come see the demos...

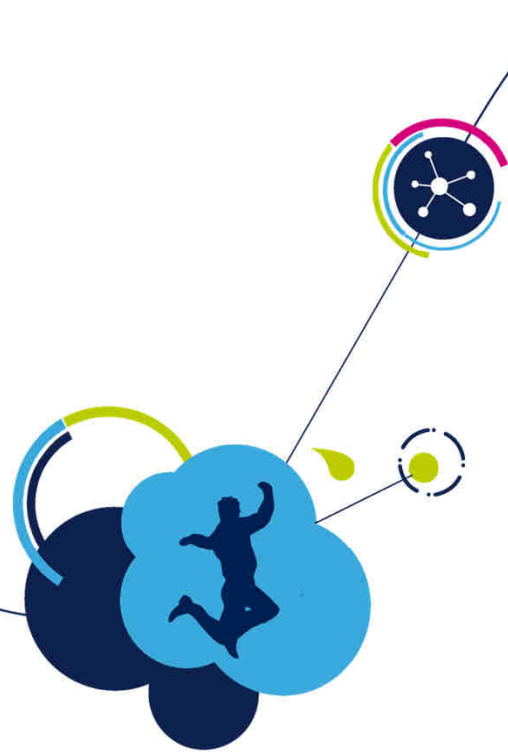
Contact: Marc.Hervieu@st.com







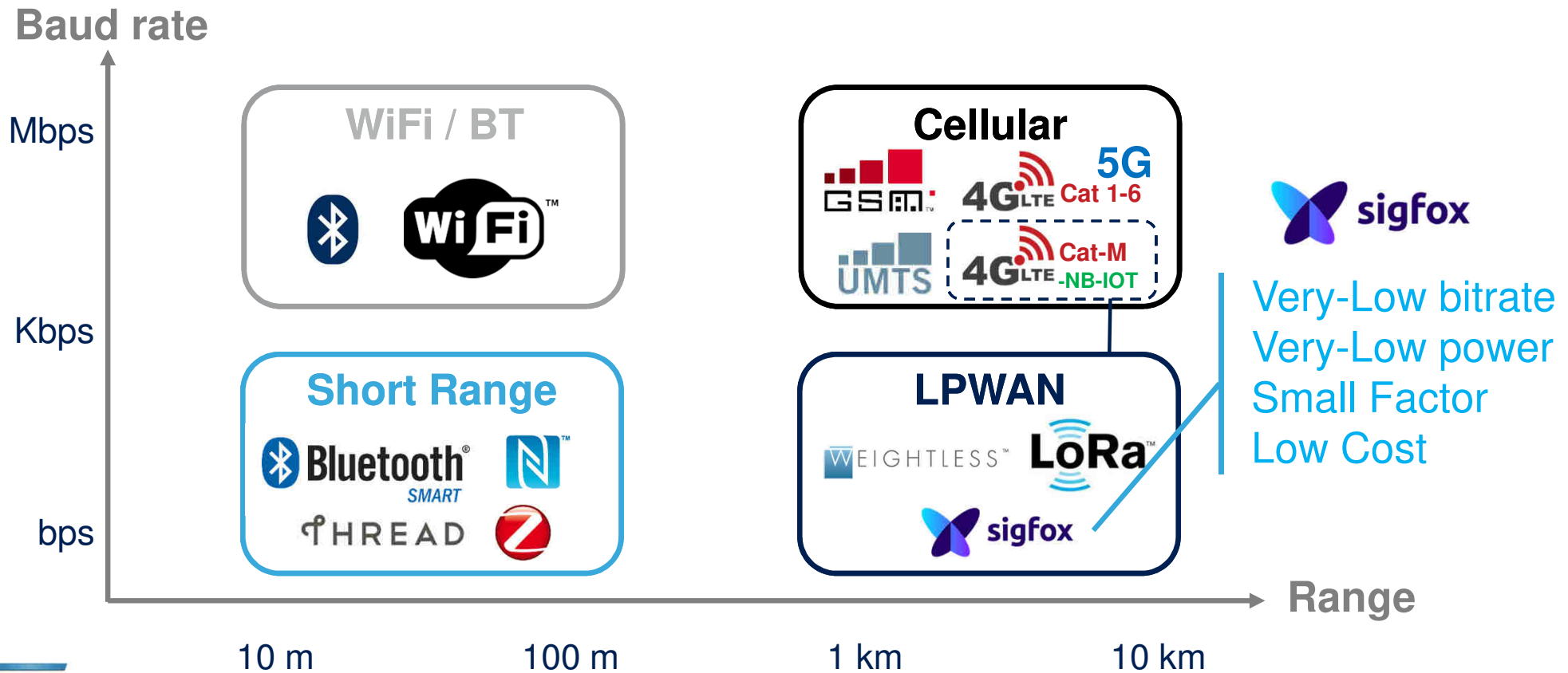
BACKUP



SigFox

Communication Technologies - Overview

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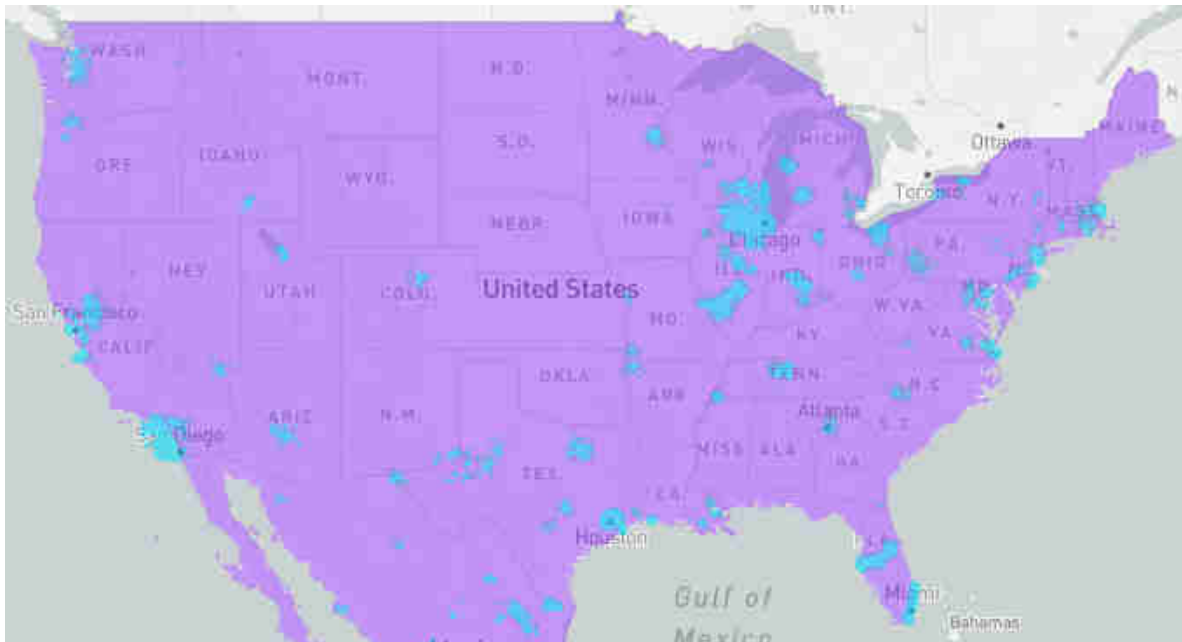




Sigfox USA Service

Feb 2019

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- Use Cases

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

SIGFOX certified tools

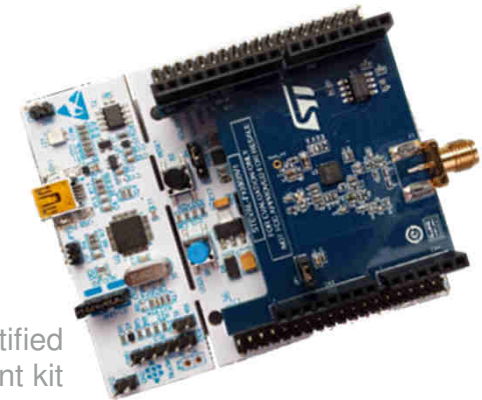
STEVAL-FKI868V1 / FKI915V1

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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