

ST GNSS modules Teseo-LIV3x and Reference Designs

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**ST Developers
Conference**

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Santa Clara, CA





Teseo-LIV3x GNSS Modules

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Best-In-Class solutions embedding Teseo3 single die standalone positioning receiver IC, working simultaneously on multiple constellations (GPS/Galileo/Glonass/BeiDou/QZSS).

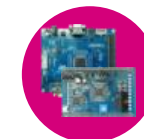


**Making your Design
Easier and Faster
at a Competitive Price**

Full set of collaterals



Evaluation
Software



Evaluation
Board



X-Nucleo
Board for
STM32



Target Applications

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**Pet and People Tracking,
Assets and Fleet Tracking,
Insurance OBD Dongles,
Road Tolling, Anti-theft,
Emergency calls, Drones,
Precise timings and much more**

Teseo-LIV3F, Teseo-LIV3R: GNSS modules for IoT applications

Teseo GNSS receivers: for Automotive applications, precise positioning (ADAS, RTK)



Teseo-LIV3F

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Key Features and Benefits



Multi-constellation

Low Power Modes



Assisted GNSS

Powerful ARM9 processor

Integrated Flash

Pre-loaded functions

Pre-Certified RF Module (CE,FCC)



Best in class accuracy

Lowest Standby consumption

Reduce cold/warm TTFF

Concurrent functions

Free FW Configuration /upgrade and datalogging

Simplify design

Reduce design risks/costs/time

Best-In-Class GNSS Module with Integrated Flash



Teseo-LIV3R

Key Features and Benefits

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Multiconstellation*

Low Power Modes



Assisted GNSS*

Powerful ARM9 processor

Pre-loaded functions*

Pre-Certified RF Module (CE,FCC)



Best in class accuracy

Lowest Standby consumption

Reduce cold/warm TTFF

Concurrent functions

Simplify design

Reduce design risks/costs/time

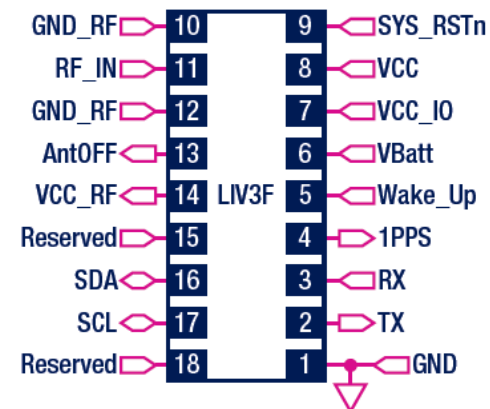
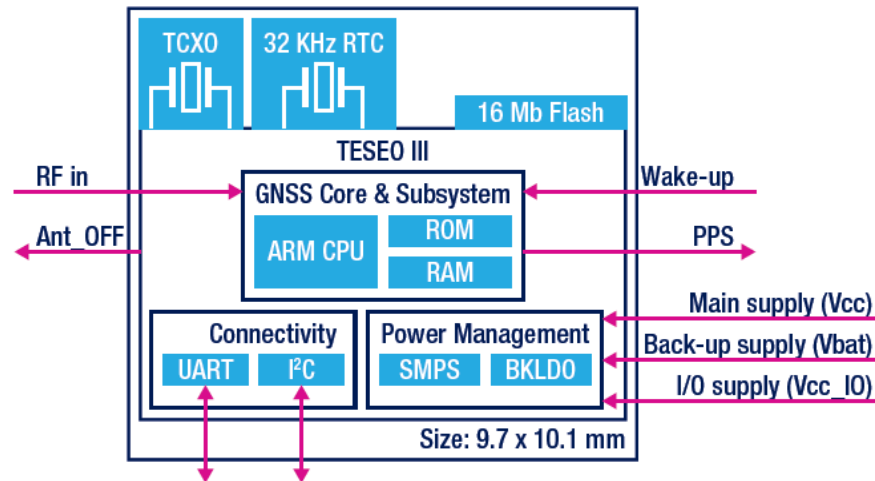
Best-In-Class GNSS Module (ROM version)



Teseo-LIV3F Key Features

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- Tiny LCC18 package (9.7 x 10.1 x 2.3 mm)
- 2.1 to 4.3 V supply voltage range
- Operating temperature: -40 to 85 °C – Industrial qualified
- Simultaneous multi-constellation positioning
- Teseo-LIV3F: 16-Mbit embedded Flash memory for data logging and FW upgrades
- 75mW tracking power consumption; 32µW stand-by current including RTC backup
- Temperature Compensated Crystal Oscillator 26MHz for fast TTFF, RTC 32KHz for maintaining accurate time

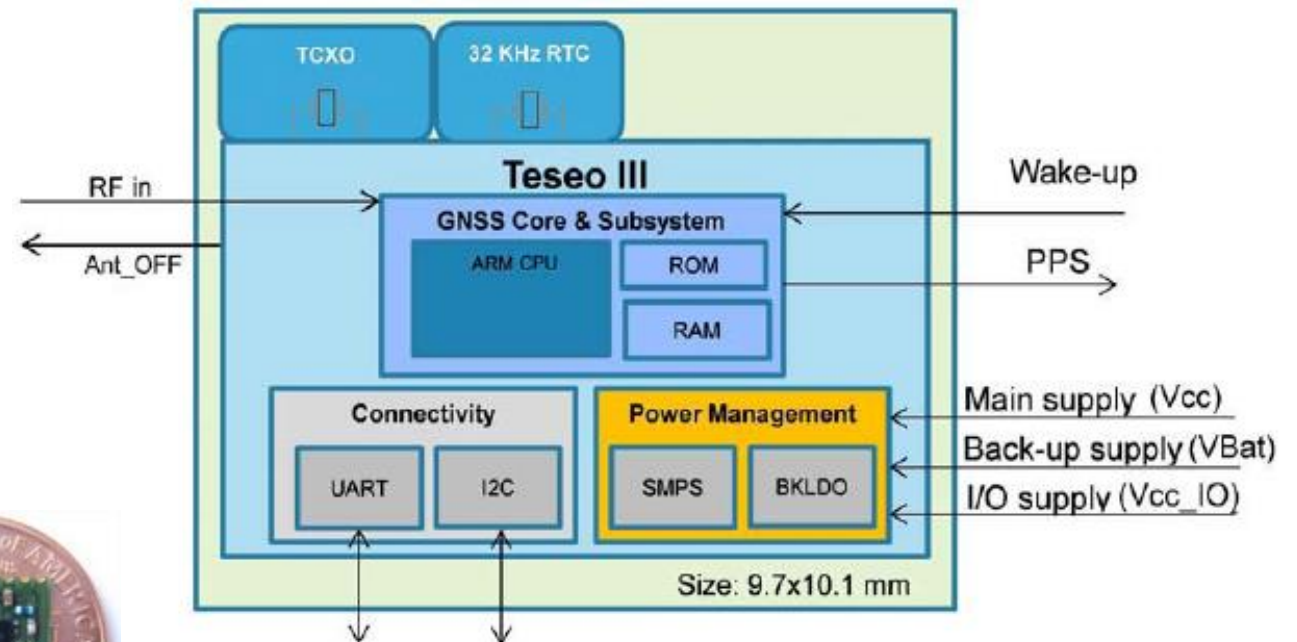
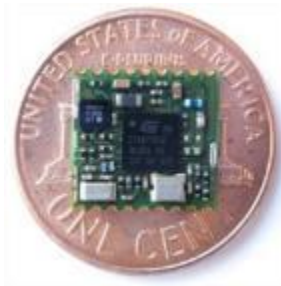




Teseo-LIV3R Key Features

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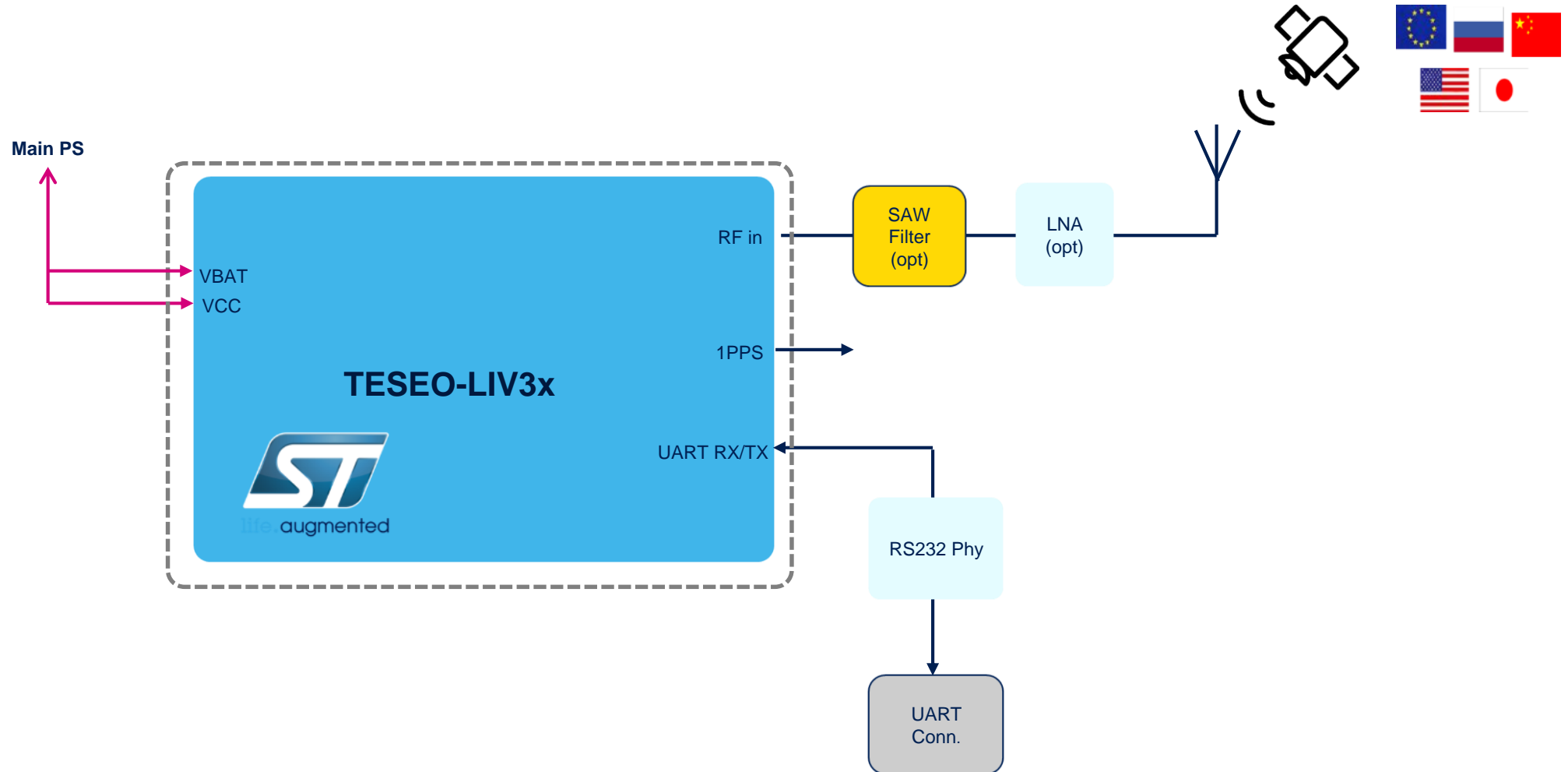
- Tiny LCC18 package (9.7 x 10.1 x 2.3 mm)
- Simultaneous multi-constellation positioning
- 70mW tracking power consumption; 17μW stand-by current including RTC backup
- TCXO 26MHz for fast TTFF , RTC 32KHz for maintaining accurate time
- 2.1 to 4.3 V supply voltage range
- Operating temperature: -40 to 85 °C
- P2P compatible with Teseo-LIV3F, drop-in replacement





Simple Design, Minimal BOM

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GNSS

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Multi constellation

GPS (USA), **GLONASS** (Russian), **Beidou** (Chinese)

Galileo * (European)

Up to 3 simultaneous active constellations

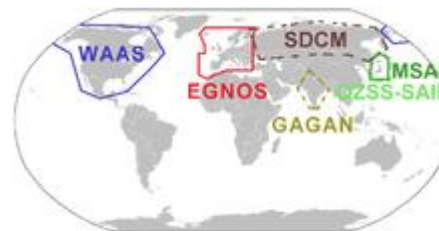


Augmentation Systems

S-BAS (satellite-based augmentation system):
WAAS (USA), **EGNOS** (Europe), **MTSAT** (Japan), **GAGAN** (India)

QZSS (Japan & Australia)

RTCM v3.1



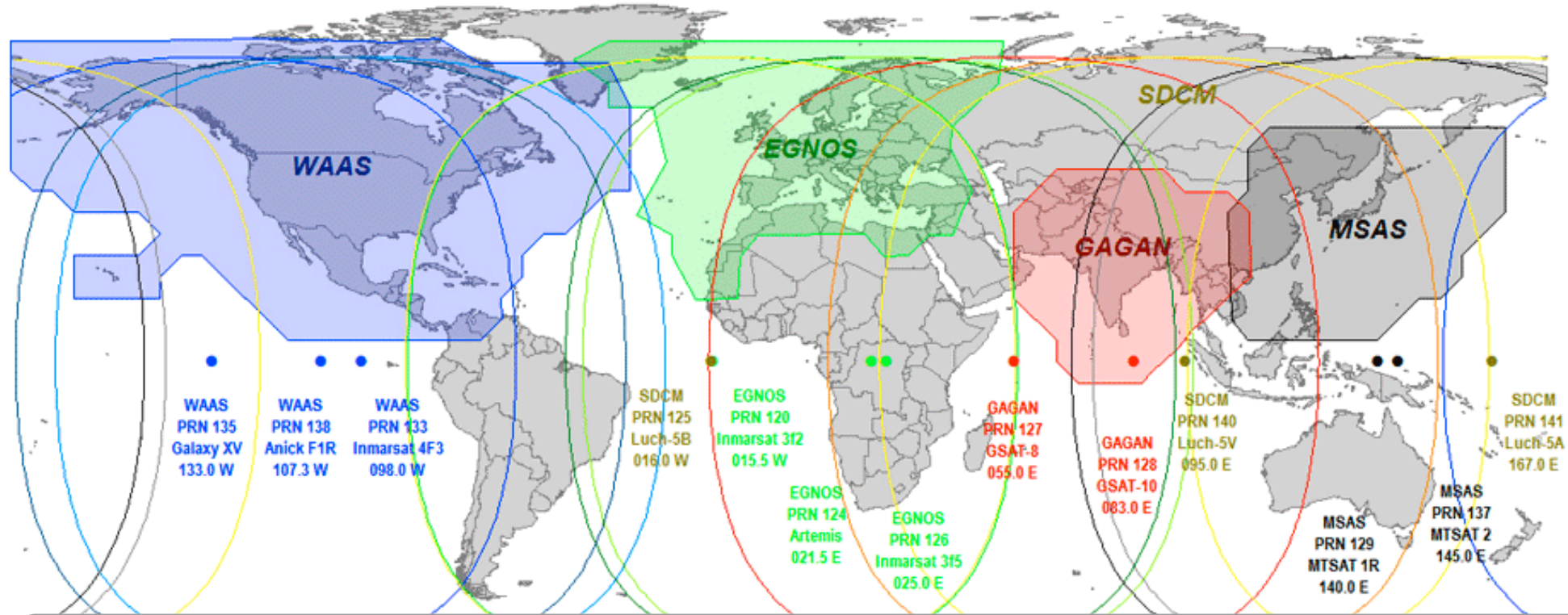
Algorithm

Teseo-LIV3 has **NOT** a reduced GNSS algorithm capability

On Teseo-LIV3, ST provides the **same** algorithm car-makers use.

Satellite-Based Augmentation Systems (SBAS)

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SBAS Benefits:

- Accuracy – Provide wide area corrections (Ionospheric, GPS satellite timing & orbit) for reducing GNSS ranging errors
- Integrity – Fast detection & indication to receivers when satellite signal errors occur
- Availability – If ranging signal is transmitted from SBAS satellite



GNSS Performance

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	Condition	GPS & GLONASS	GPS & BeiDou	GPS & Galileo
Time To First Fix (s)	Cold start	< 32	< 36	< 30
	Warm start	< 25	< 29	< 26
	Hot Start	< 1.5	< 2.5	< 2
Accuracy (CEP 50%)	Velocity (30m/s)	0.01	-	0.01
	Heading (30m/s)	0.01	-	0.01
	Horizontal position with AGNSS (m)	< 1.8	< 1.5	-
	Horizontal position with SBAS (m)	< 1.5	-	-
Sensitivity (dBm)	Tracking	-163	-163	-163
	Navigation	-158	-158	-158
	Reacquisition	-156	-156	-156



Assisted GNSS

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Self Trained*

ST-AGNSS predicts satellite data based on previous observation of satellite broadcast data

Internet **NOT** needed

6-days prediction

Available for free

TTFF ~1-4sec

Predicted*

P-AGNSS predicts satellite data based on data downloaded by an assistance server

Internet **NEEDED**
(8kB data per download)

14-day prediction

Assistance server available for free

TTFF ~1-4sec

Real-Time

RT-AGNSS uses real-time satellite data downloaded by an assistance server

Internet **NEEDED**
(6kB data every 2hrs)

Continuous/RealTime

Assistance server available for free

TTFF <= 1sec



Low Power Modes

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Continuous Fix * (GPS+GLONASS)

Adaptive

Dynamic Constellation switching and reduced tracked satellites (switching based on EHPE)

GLONASS RF OFF when not needed (use GPS)

Cycle

Dynamic change duty-cycle of RF channels and Base-Band (duty-cycle period based on EHPE)

~70% of time RF-channels and Base-Band are off

Periodic Fix (GPS only)

5sec to 18hour fix period in Standby mode or OFF when not active

Lowest Average Power Option

Fix On Demand

Device always in standby

GNSS woken-up through the wakeup-pin based the host's needs

Lowest Power Option

Teseo-LIV3x have the lowest standby power consumption

* Teseo-LIV3F only



Flash* Advantages

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Firmware Update*

New GNSS library can be provided on www.st.com to improve and/or fix the GNSS device to guarantee longevity to a product in the field

Firmware Configuration & GNSS data *

The whole configuration and GNSS data sit on flash.

Battery backup

Not needed

Ready to be used

Configured and programmed with our best solution

NO SDK required

Host doesn't need to re-configure the module and download GNSS data on each start-up



Extra GNSS SW Features

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Datalogging *

saves lat/lon to flash for retrieval by host



Up to 12h data logging (1Hz)
Logged data-fields configurable
Memory full alarm

Geofencing

notifies when lat/lon is close to a defined circle



Up to 8 configurable circles
Crossing fence alarm

Odometer

computes distance travelled from position & velocity data



Up to 3 TRIP counters
Distance achieved alarm

Teseo-LIV3x Comparison Summary

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	GPS, Glonass, BeiDou, QZSS	Galileo	SBAS	NMEA & RTCM3	VCC/VCC_IO 3V3	UART port	I2C port	Autonomous & Predictive AGNSS	Real-Time AGNSS	Low-Power support	Odometer	Geo fencing	Data Logging	Firmware-Update	Firmware configuration
Teseo LIV3F	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Teseo LIV3R	●		●	●	●	●	●		●	●	●	●			



Marketing Package Summary

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Teseo-LIV3F, Teseo-LIV3R

Datasheet	Software User Manual
Hardware User Manual	Videos training
Application Notes	



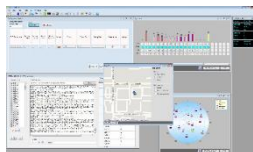
EVB-LIV3F, EVB-LIV3R

Datasheet	Schematic/BOM/Gerber
User Manual	Quick Start Guide



X-Nucleo-GNSS1A1

Datasheet	Schematic/BOM/Gerber
User Manual	Device driver



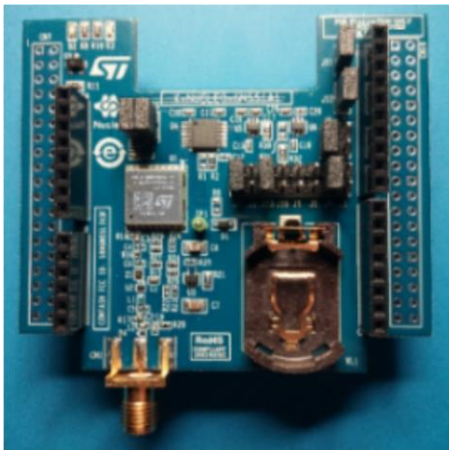
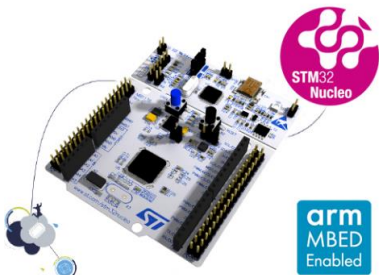
Teseo Suite PC Tool

Datasheet	Videos training
Quick Training Guide	User Manual



Learn more:

www.st.com/gnssmodules



X-Nucleo-GNSS1A1

For Teseo-LIV3F evaluation with Teseo-Suite

For development on STM32 based design:

SW: STM32Cube with GNSS libraries (X-CUBE-GNSS1)

HW compatible with:

- STM32 Nucleo boards:
 - NUCLEO-F401RE
 - NUCLEO-L073RZ
 - NUCLEO-L476RG
- Arduino boards
- Protocols: NMEA
- Interfaces:
 - 1 UART
 - 1 DDC (I2C compliant)
 - Digital I/O configurable timepulse
 - 1 EXTINT input for Wakeup

EVB-LIV3F / EVB-LIV3R

For complete Teseo-LIV3F / Teseo-LIV3R evaluation with Teseo-Suite, including power consumption measurement:

- Protocols: NMEA
- Interfaces:
 - 1 UART
 - 1 DDC (I2C compliant)

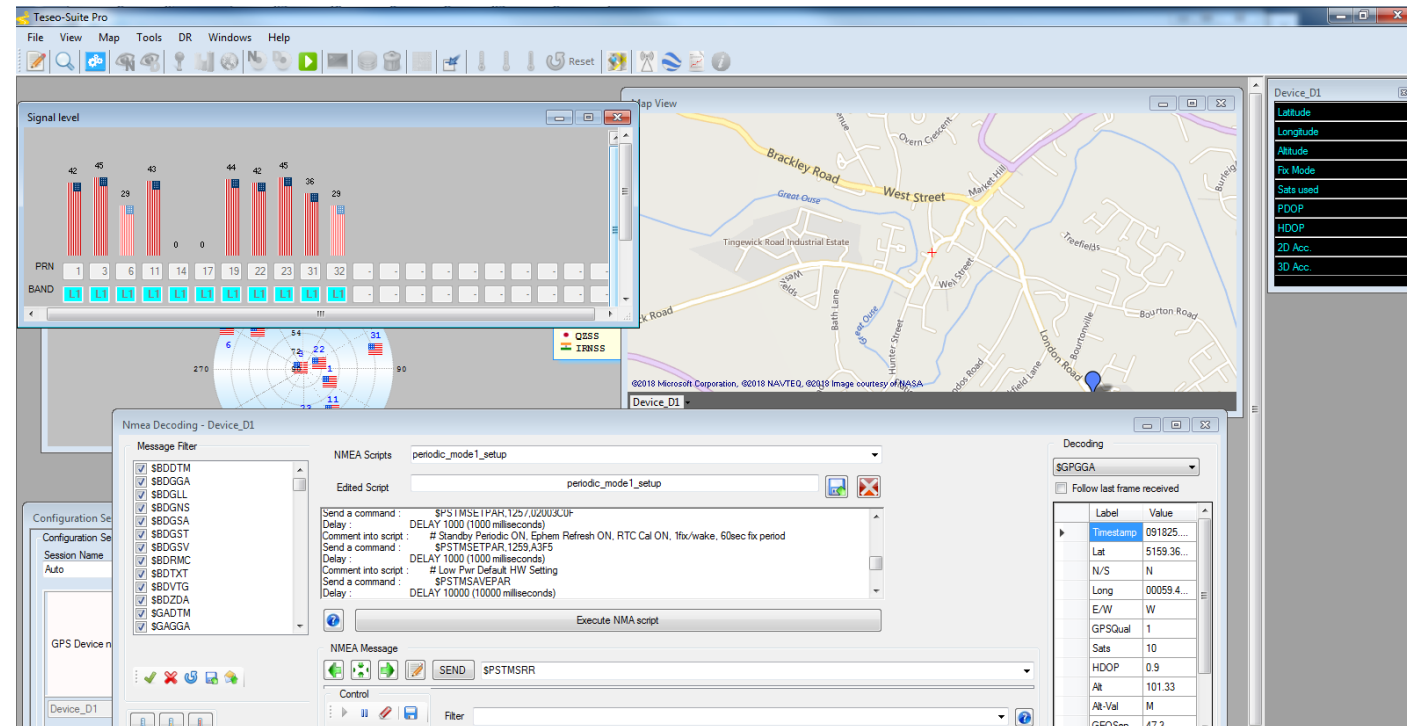


SW Tools

Teseo Suite

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- View/Record/Playback
- NMEA & DEBUG
- View Graphics charts
 - Position
 - CNO
 - Sky view
 - Map view
- Send Commands
- Dedicated panels:
 - Assisted GPS
 - FW configurator
- TEST plan
- Embedded TOOLS:
 - FW Upgrade

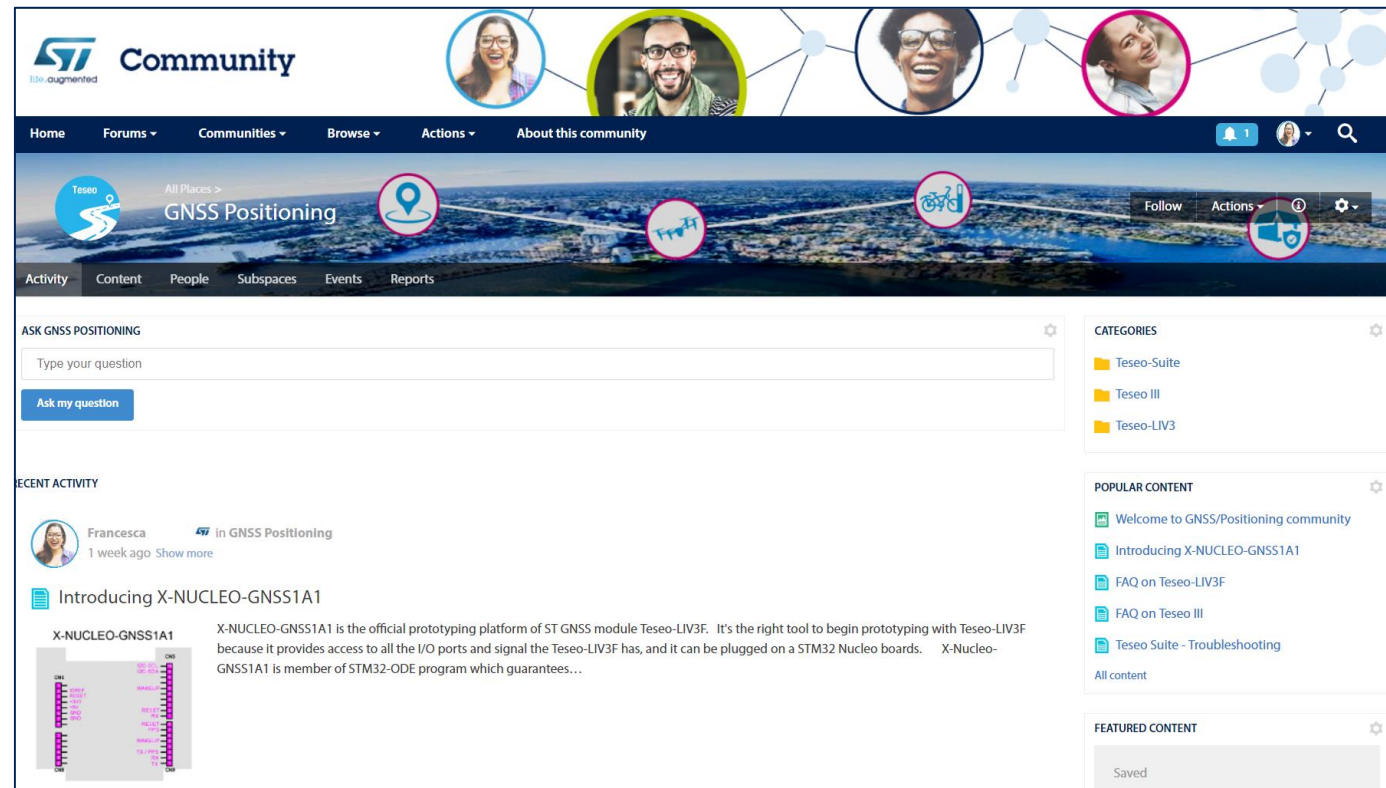


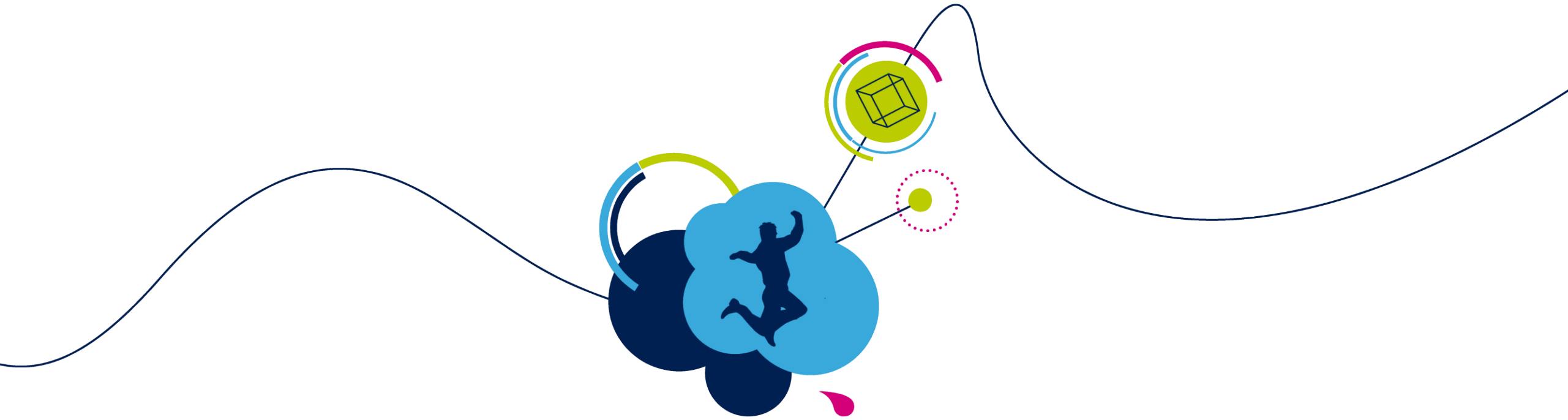
Free, Powerful, Easy PC-Windows SW Suite.
For evaluation, development and FW configuration updates.

Join Us in the ST GNSS Community

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- Get involved in the ST GNSS community
- Share ideas
- Ask questions

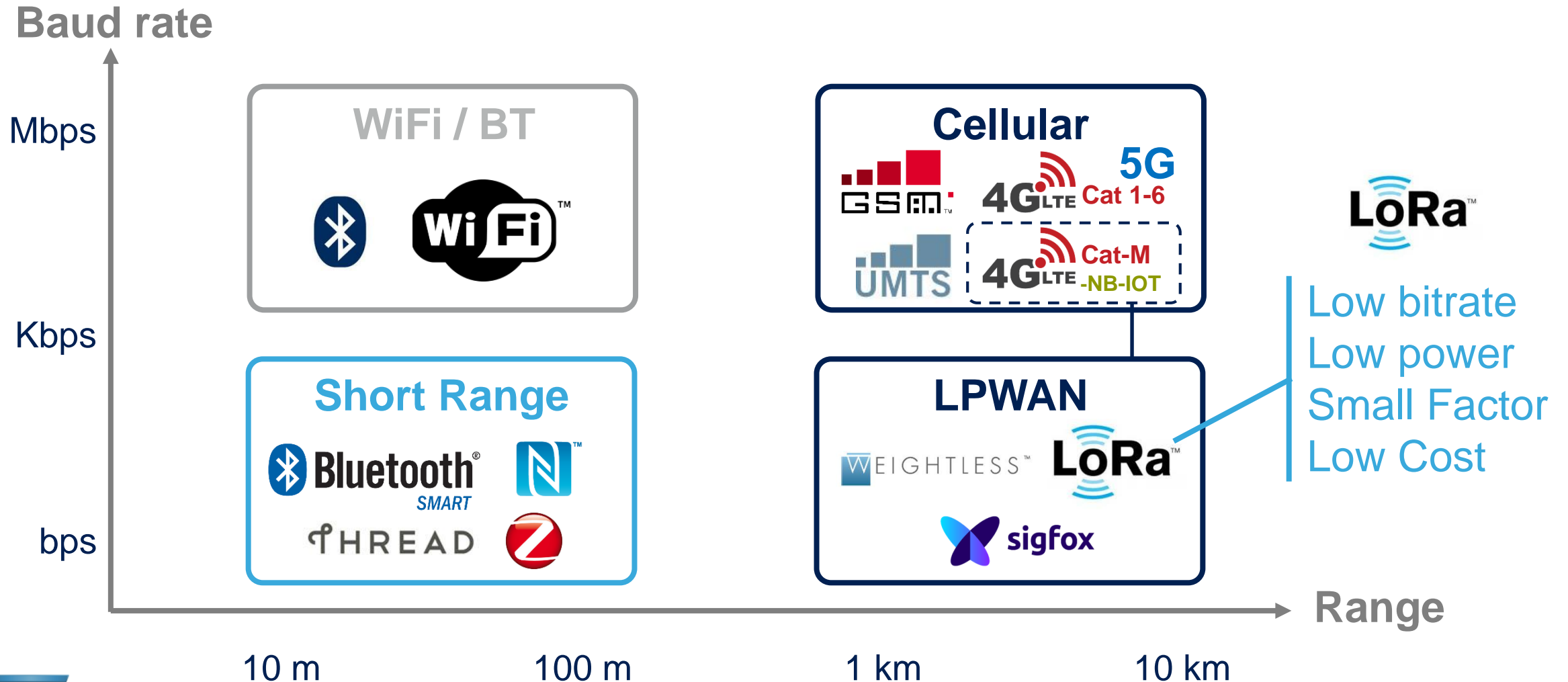




GNSS Teseo-LIV3F Based LoRa® Asset Tracker

Communication Technologies - Overview

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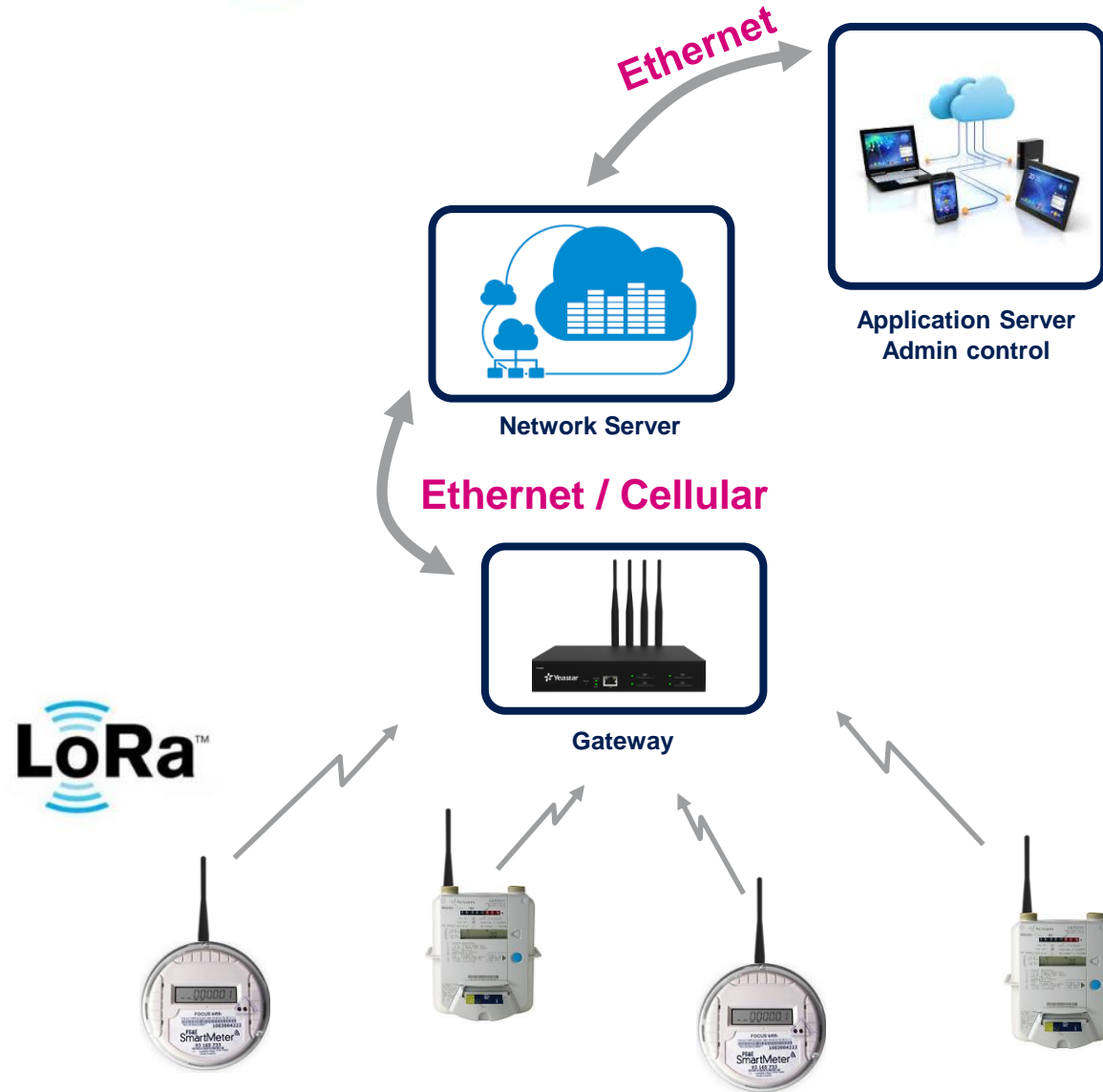
IoT Use Cases

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Key Verticals

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

...



LoRa® Network Deployments

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LoRaWAN™ NETWORKS



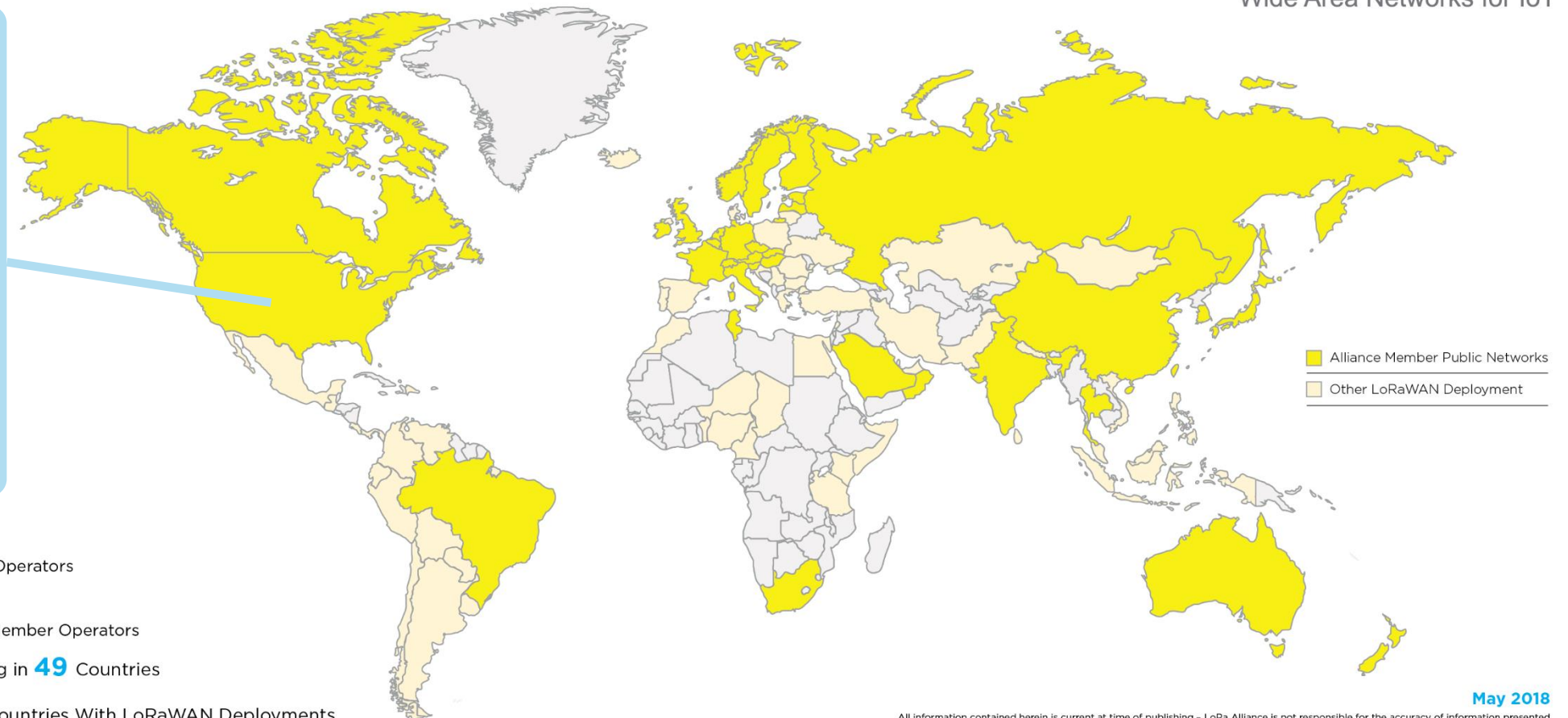
MACHINE Q™
A COMCAST COMPANY

COX®

senet

Sprint

U.S. Cellular



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Network Operators

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Alliance Member Operators

Operating in 49 Countries

~100 Countries With LoRaWAN Deployments

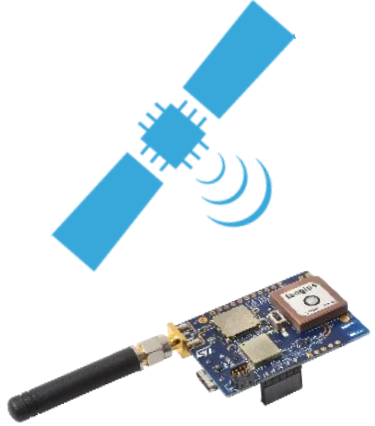
May 2018

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



ST LoRa[®] Asset Tracking Ref Design

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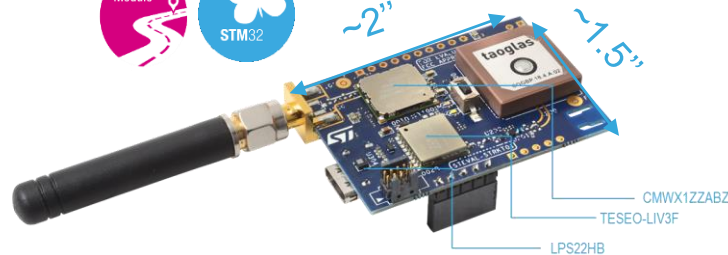
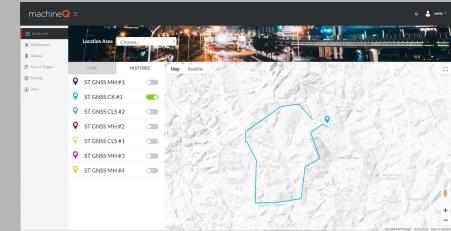
LoRa[®]



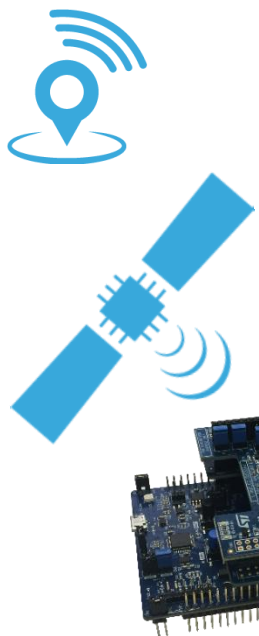
MACHINE Q[™]
IoT Gateway



mQPortal



Published on www.st.com
Search for STEVAL-STRKT01



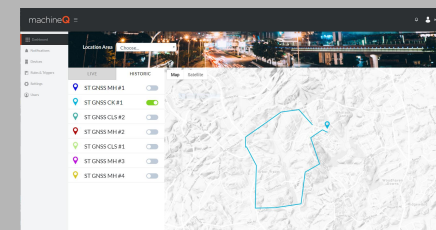
ST LoRa[®] Asset Tracking Dev-Kit

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MACHINE Q[™]
IoT Gateway



mQPortal(SaaS)



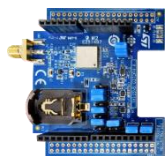
<https://MachineQ.com/st-lora-dev-kit/>



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[®] Dev Kit Hardware

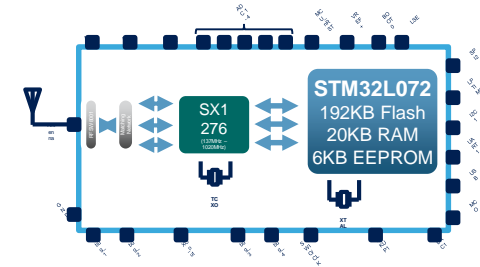
Base Board B-L072Z-LRWAN1

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ST-Link
Debugger

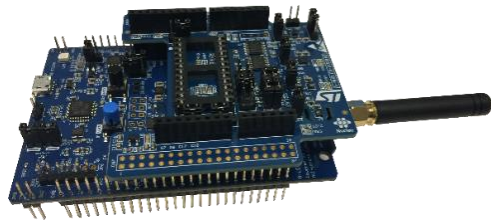


Murata[®] Module
All-in-one Open



Arduino Connector

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Search for B-L072Z-LRWAN1



B-L072Z-LRWAN1

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

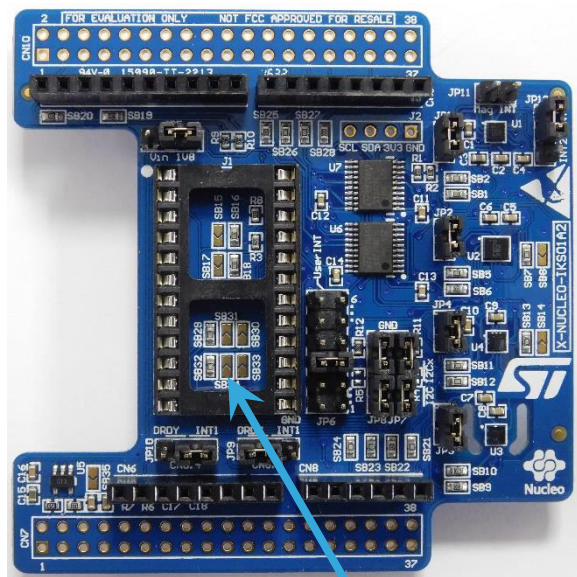


ST LoRa® Dev Kit Hardware

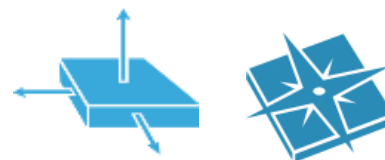
Sensor Shield X-NUCLEO-IKS01A2

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



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



Pressure (LPS22HB)



Temperature + Humidity (HTS221)

DIL-24 Extension

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

ST LoRa® Dev Kit Hardware

GNSS Board X-NUCLEO-GNSS1A1

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GPS



Galileo



GLONASS



Beidou2



QZSS



Teseo-LIV3F expansion board kit based on STM32 Nucleo:

Compatible with STM32 Nucleo boards and Arduino boards

Protocol: NMEA

Interfaces: 1 UART, 1 DDC (I2C compliant), Digital I/O configurable time-pulse, 1 EXTINT input for Wake-up.



Teseo-LIV3F module is an easy to use Global Navigation Satellite System (GNSS) standalone module, embedding TeseoIII single die standalone positioning receiver IC working simultaneously on multiple constellations (GPS/Galileo/Glonass/BeiDou/QZSS).

LoRa[®] Asset Tracking Function Pack

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FP-ATR-LORA1

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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		



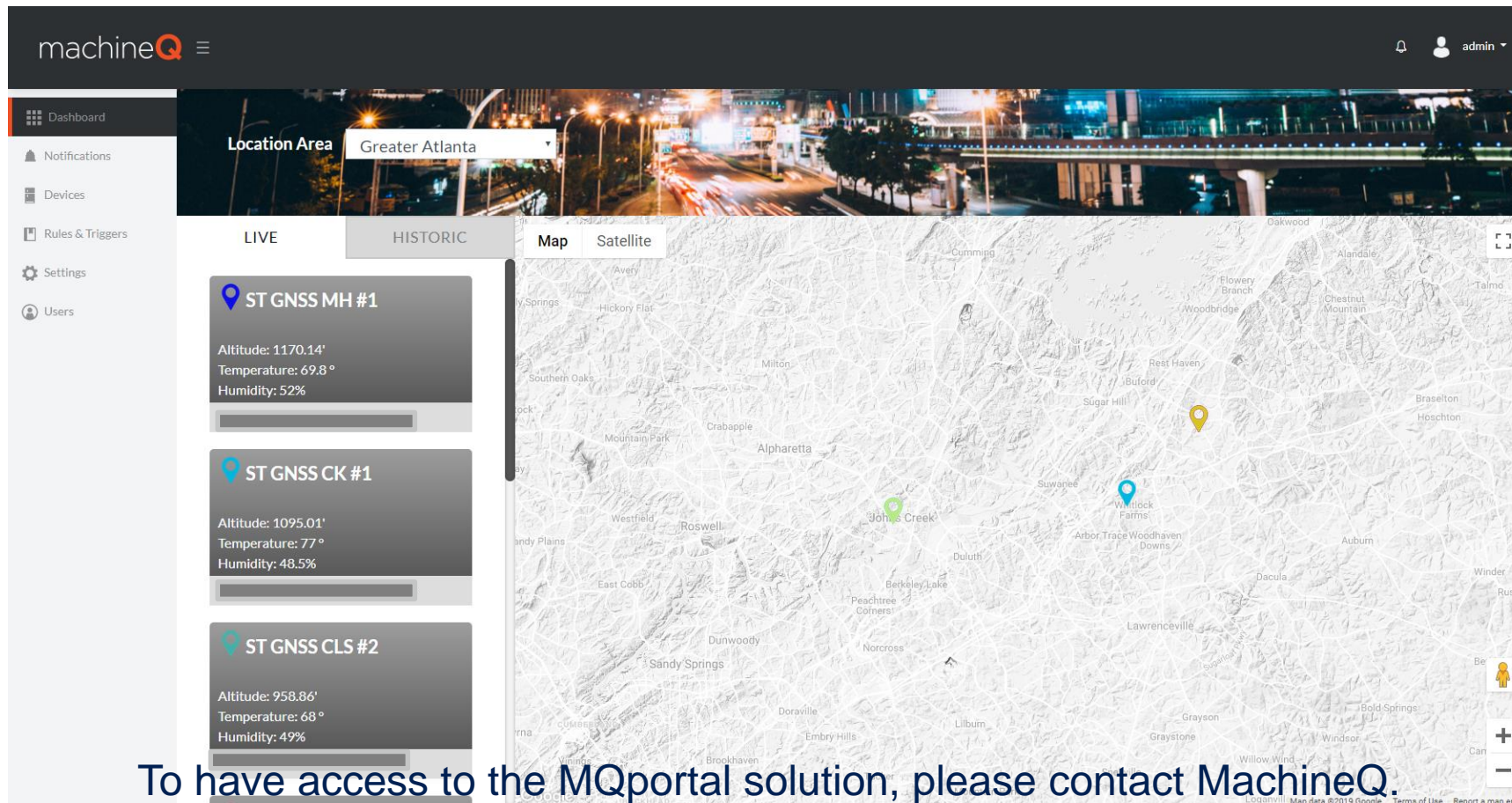
Asset Tracker – MQportal UI

Monitoring

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Sensor Monitoring

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



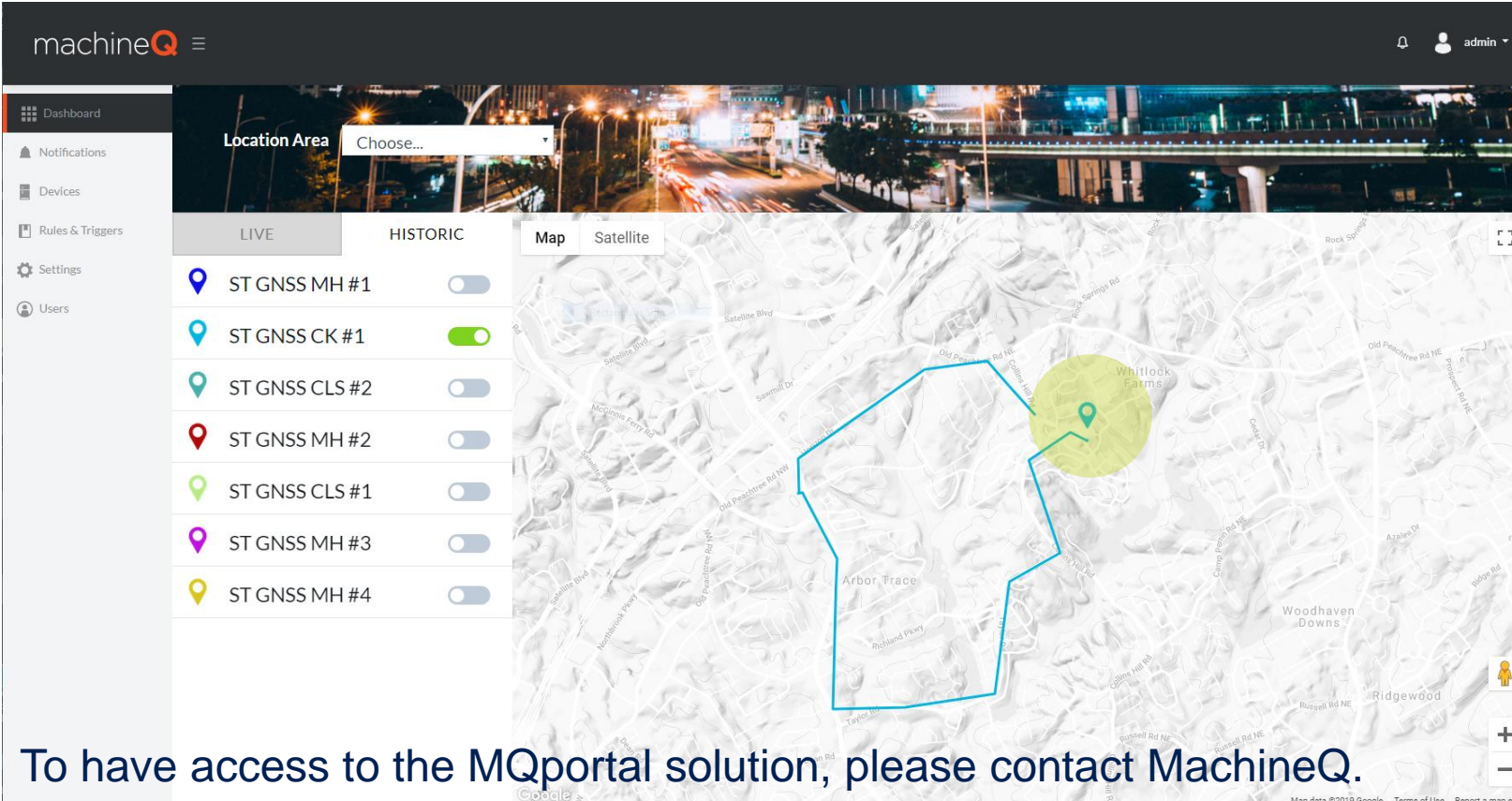
Asset Tracker – MQportal UI

Historic Path

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Asset Tracking

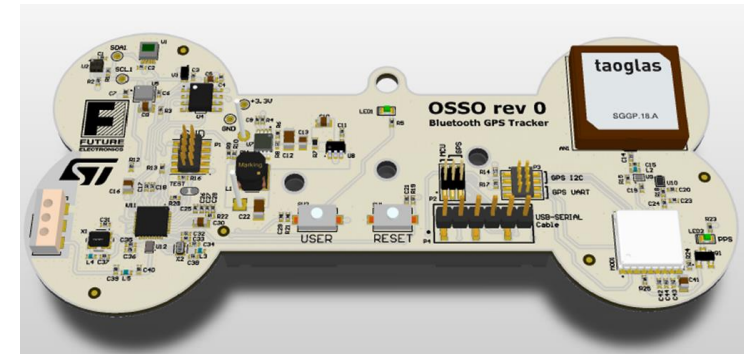
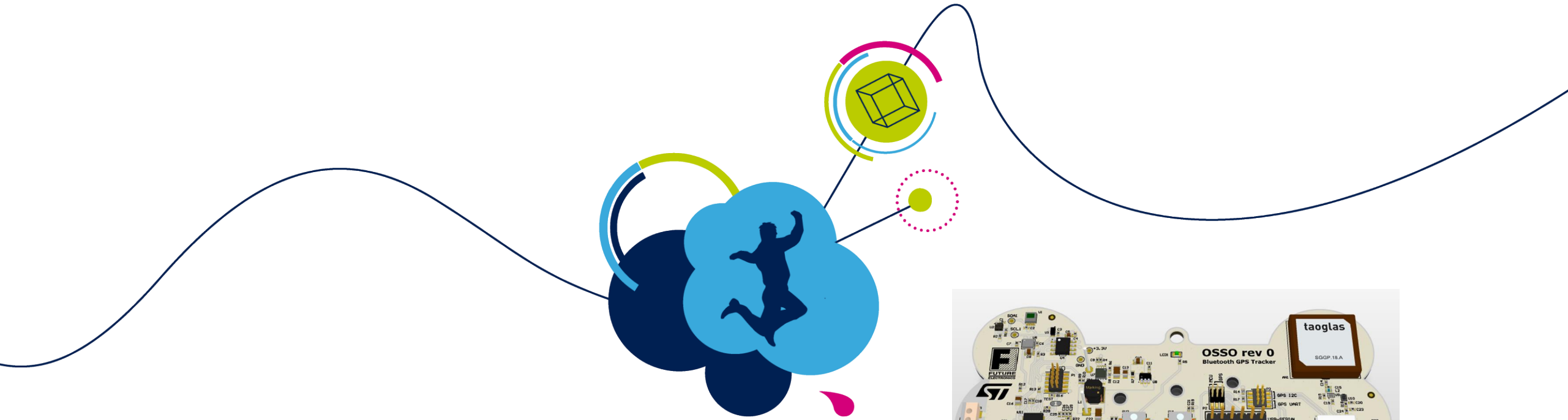
- Inside LoRa Network → Track position near real time
- Outside LoRa Network → Store position & catch-up when connection restored
 - Keep track of the time to rebuild the path



The screenshot displays the MachineQ MQportal UI. On the left is a sidebar with navigation links: Dashboard, Notifications, Devices, Rules & Triggers, Settings, and Users. The main content area features a 'Location Area' dropdown menu set to 'Choose...'. Below this, there are two tabs: 'LIVE' and 'HISTORIC'. The 'HISTORIC' tab is active, showing a list of assets with their status toggles. The assets listed are:

Asset Name	Status
ST GNSS MH #1	Off
ST GNSS CK #1	On
ST GNSS CLS #2	Off
ST GNSS MH #2	Off
ST GNSS CLS #1	Off
ST GNSS MH #3	Off
ST GNSS MH #4	Off

Below the list is a map showing a historic path as a blue line. A green circle indicates the current location of the selected asset. The map includes street names and landmarks. At the bottom of the screen, there is a text overlay: 'To have access to the MQportal solution, please contact MachineQ.'



OSSO Pet Tracker

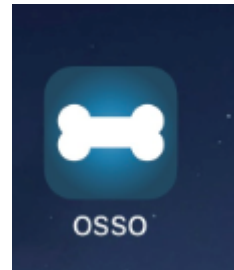


FUTURE
Connectivity Solutions

What is OSSO?

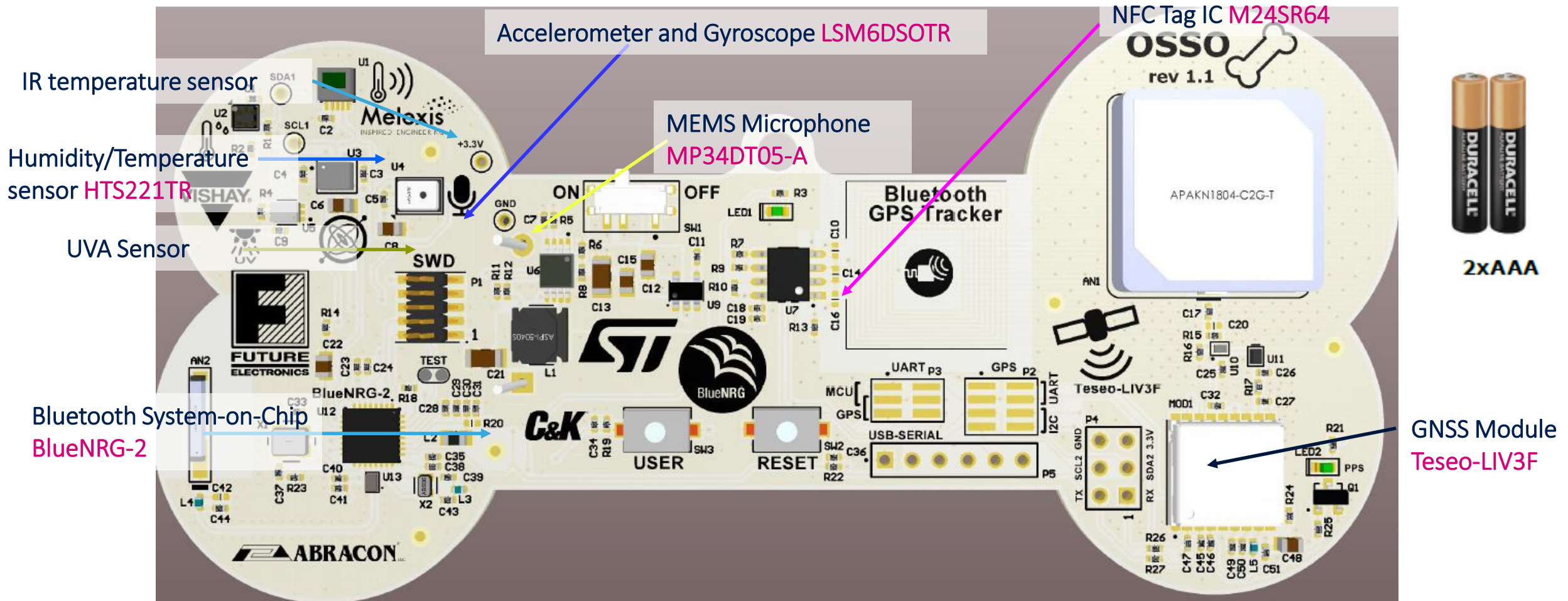
34

- OSSO is the Italian word for “ bone”
- OSSO is a Pet Tracking application Reference Design
- Created and designed by Future Connectivity Solutions and ST
- Accurate, Small and Light-weight, Bluetooth 5.0 compliant
- iOS and Android app functionalities:
 - Sensor Demo
 - ✓ Environmental demo
 - ✓ IR temperature demo
 - ✓ Accelerometer demo
 - ✓ Microphone demo
 - ✓ RSSI and battery demo
 - GPS Demo
 - ✓ Locate pet demo



A Closer Look at OSSO

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thank you!

If any questions pls. contact me at
sara.mattioli@st.com



life.augmented