ST GNSS modules Teseo-LIV3x and LoRa Reference Design

Max Nicotra
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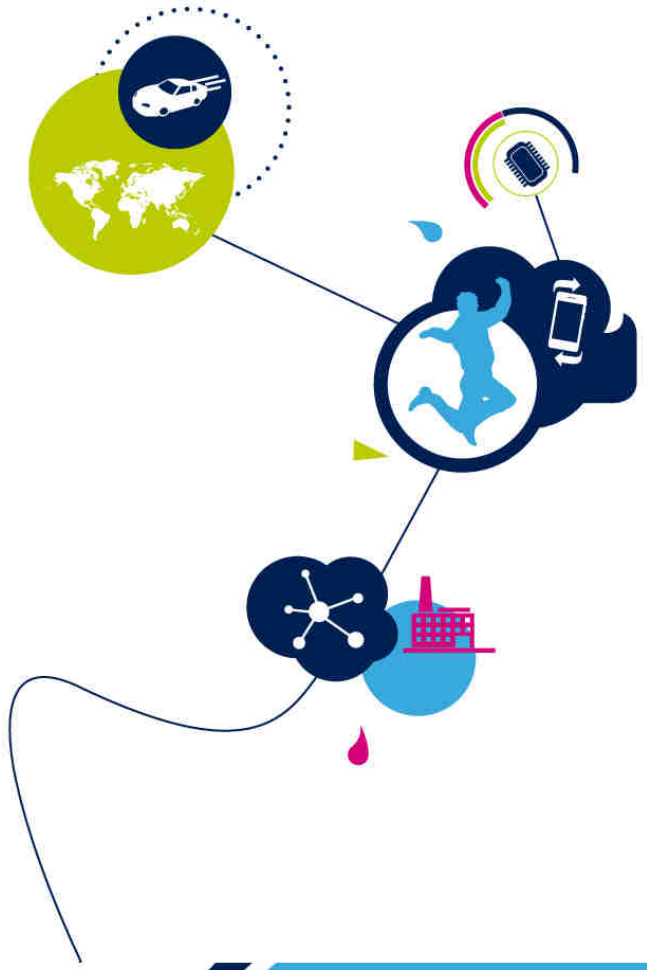

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Technology Tour 2019
Vancouver, BC | September 24

Teseo-LIV3x GNSS Module

Best-In-Class Multi-Constellation-based precision modules for numerous location-aware applications.
Teseo-LIV3x embeds TeseoIII single die standalone positioning receiver IC which leverages simultaneous multi-constellation GNSS (GPS/Galileo/Glonass/BeiDou/QZSS).

GLONASS
Galileo
QZSS
GPS
Beidou2

Making your Design Easier and Faster at a Competitive Price

Full collateral package

Evaluation Software

Evaluation Board

X-Nucleo Board for STM32

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Target Applications

Wearables, 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 industrial and IoT applications

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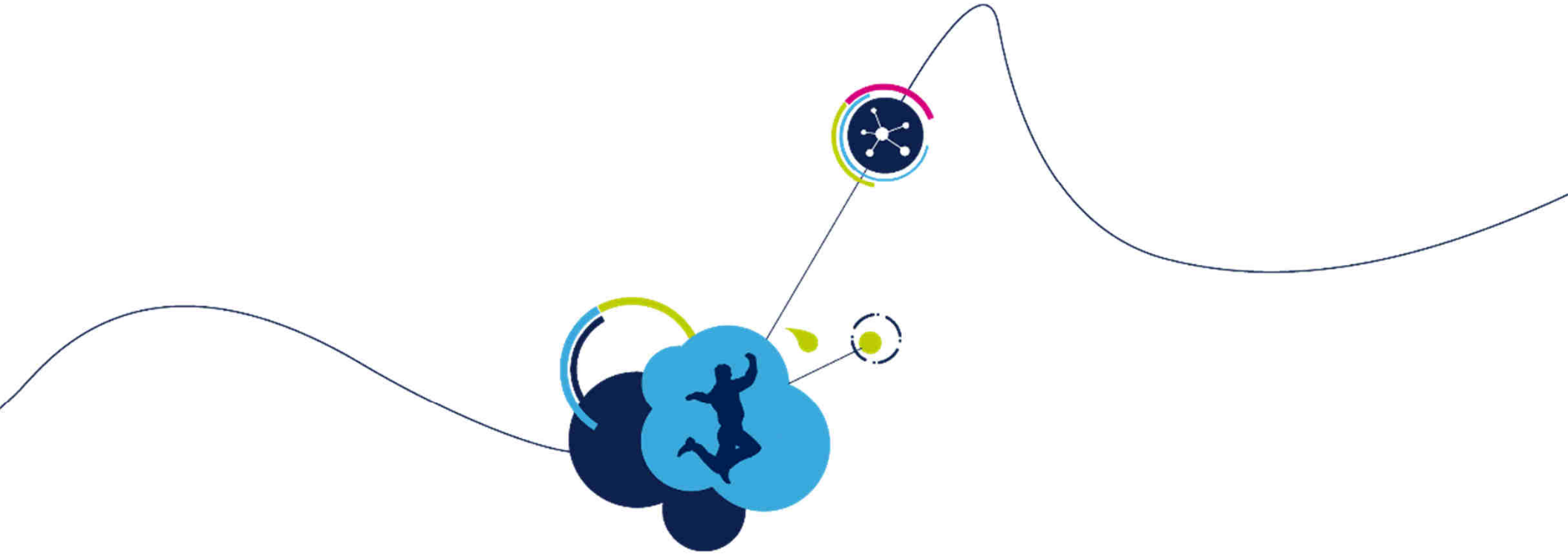

Teseo-LIV3x Overview

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Teseo-LIV3F
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,IC)

- 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

- Multiconstellation*
- Low Power Modes
- Assisted GNSS*
- Powerful ARM9 processor
- Pre-loaded functions*
- Pre-Certified RF Module (CE,FCC,IC)

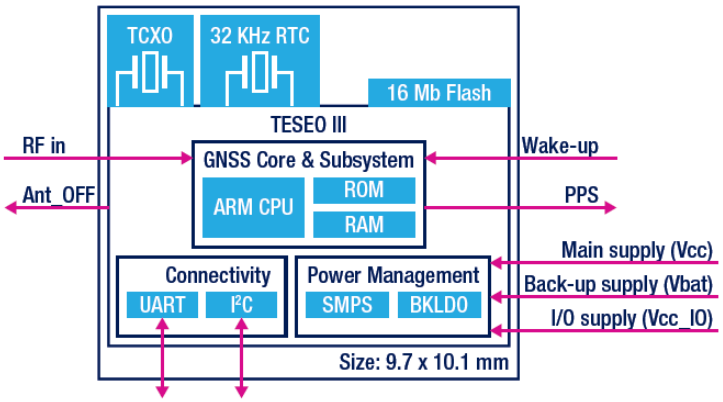
- Best in class accuracy
- Lowest Standby consumption
- Reduce cold/warm TTFF
- Concurrent functions
- Simplify design
- Reduce design risks/costs/time

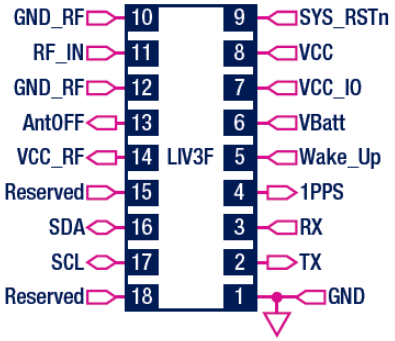
Best-In-Class GNSS Module (ROM version)

*different features from Teseo-LIV3F

Teseo-LIV3F Key Features

- 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; <15µA stand-by current including RTC backup
- TCX0 26MHz for fast TTFF , RTC 32KHz for maintaining accurate time

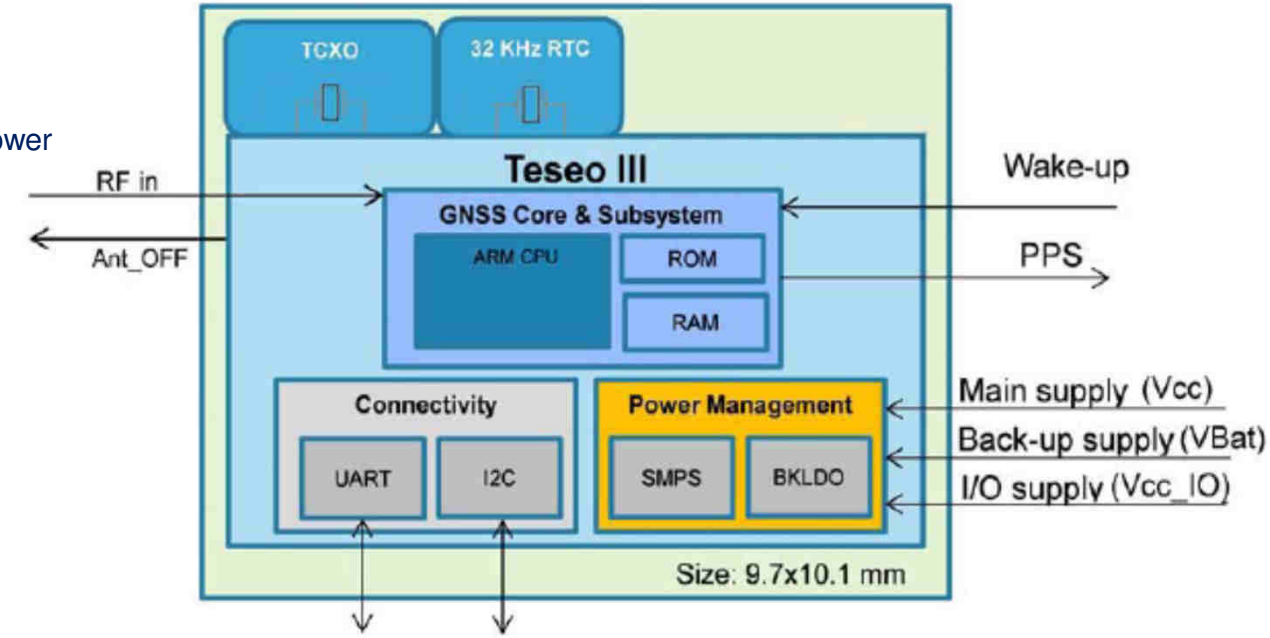




Integrated ARM9 processor for Superior performance

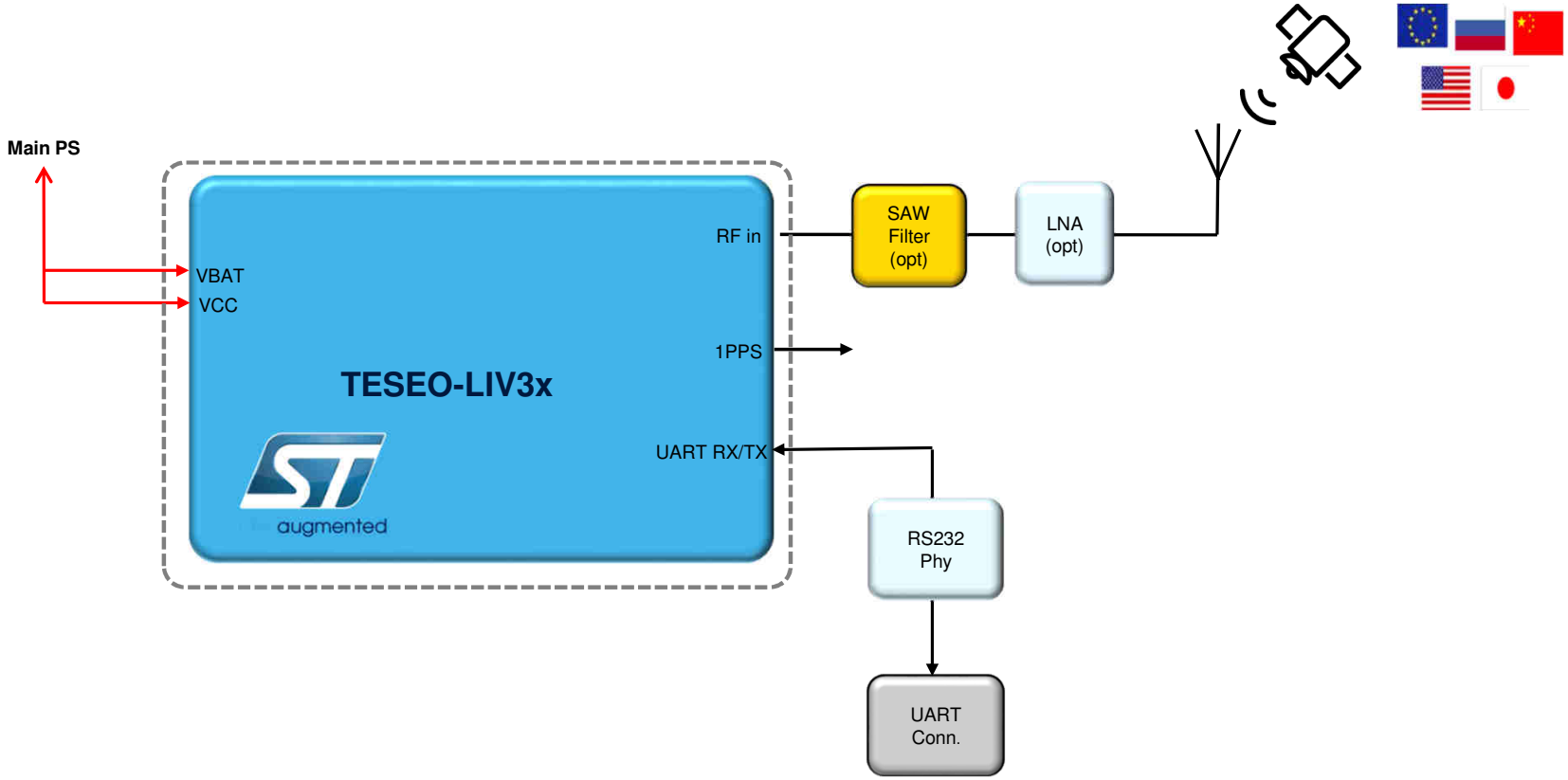
Teseo-LIV3R Key Features

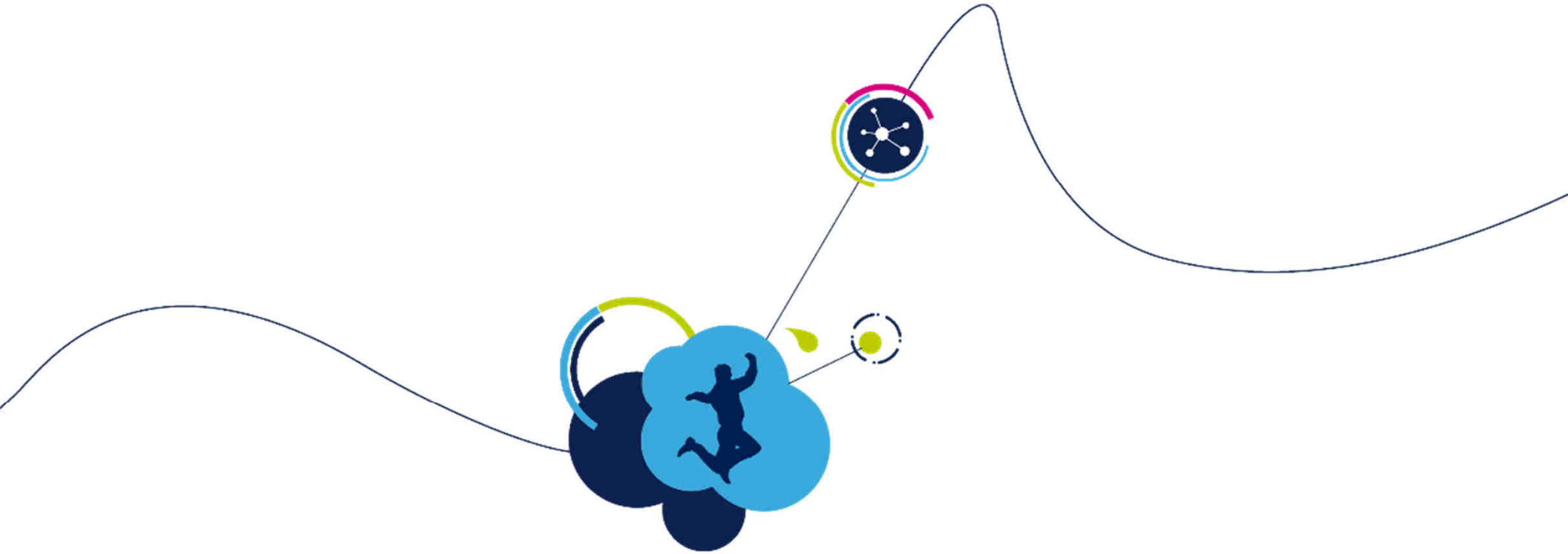
- Tiny LCC18 package (9.7 x 10.1 x 2.3 mm)
- Simultaneous multi-constellation positioning
- 17 µW standby current and 70 mW tracking power consumption
- TCX0 26MHz for fast TTFF , RTC 32KHz for maintaining accurate time
- 2.1 to 4.3 V supply voltage range
- Operating temperature: –40 to 85 °C



Integrated ARM9 processor for Superior performance

Simple Design, minimal BOM





Teseo-LIV3
Performance & Features

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GNSS

Multi constellation

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

Galileo * (European)

Up to 3 simultaneous active constellations

Differential-GPS

S-BAS (satellite-based augmentation system):

WAAS (USA), EGNOS (Europe), MTSAT (Japan), GAGAN (India),

QZSS (Japan & Australia)

RTCM v3.1

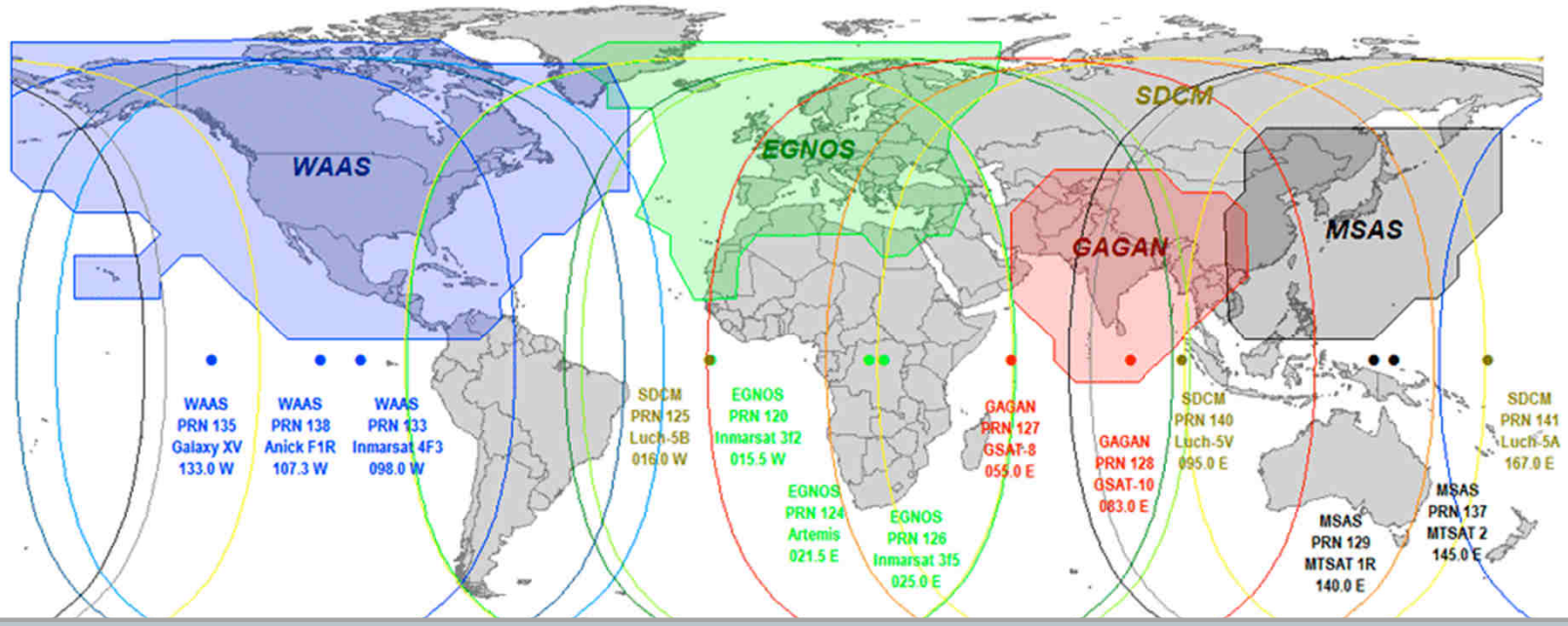
Algorithm

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

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

* Teseo-LIV3F only

Satellite Based Augmentation Systems (SBAS)



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

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GNSS Performance

	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 (m/s)	0.01	-	0.01
	Heading (deg)	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

Self Trained*	Predicted*	Real-Time
ST-AGNSS predicts satellite data based on previous observation of satellite broadcast data	**P-AGNSS** predicts satellite data based on data downloaded by an assistance server	**RT-AGNSS** uses real-time satellite data downloaded by an assistance server
Internet **NOT** needed	Internet **NEEDED** (8kB data per download)	Internet **NEEDED** (6kB data every 2hrs)
6-days prediction	**14-day prediction**	**Continuous/RealTime**
Available for free	**Assistance server available for free**	**Assistance server available for free**
TTFF ~1-4sec	TTFF ~1-4sec	TTFF <= 1sec

* Teseo-LIV3F only

Low Power Modes

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

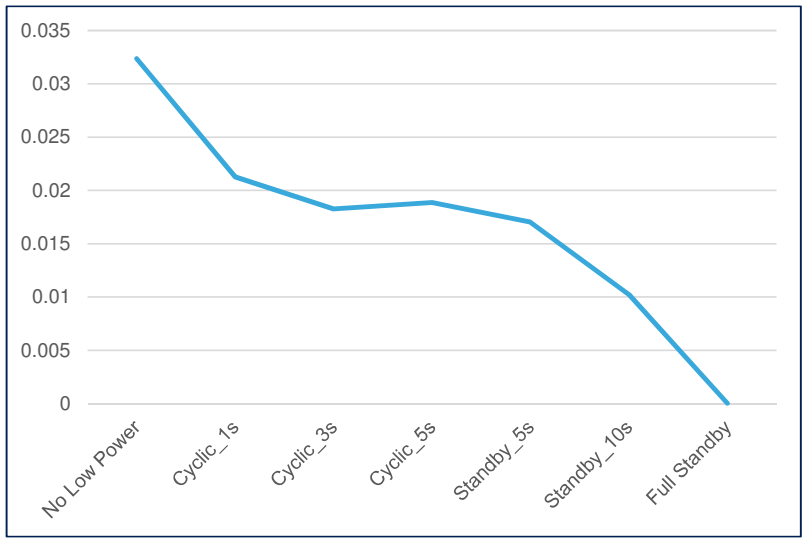
Lowest Power Option

Teseo-LIV3F has the lowest standby power consumption

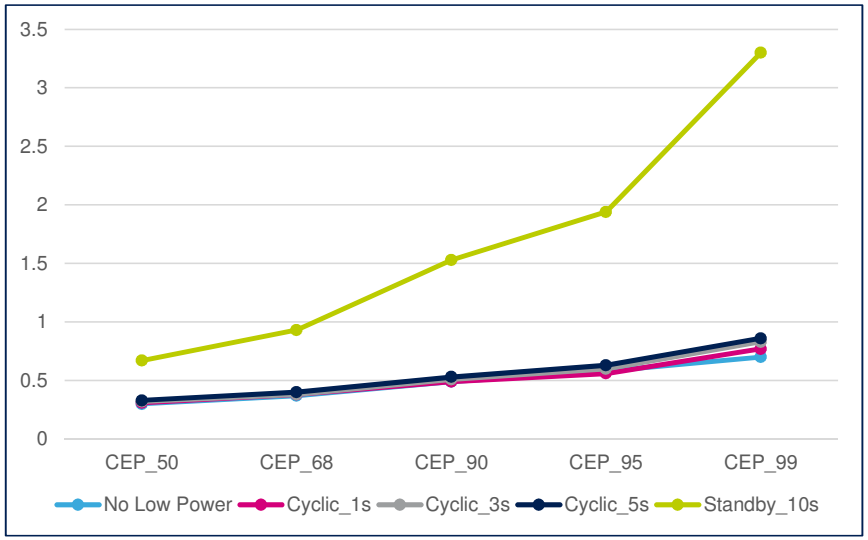
* Teseo-LIV3F only

Low Power Curves

- IoT application tradeoffs:
  - Fix Frequency
  - Average Power
  - Accuracy



Average current consumption (A)



Accuracy – CEP%

Test conditions: Teseo-LIV3F in Static position & Full sky

Flash* advantages

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

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

Ready to be used

Configured and programmed with our best solution

NO SDK required

* Teseo-LIV3F only

Standard Applications

Datalogging*

saves lat/lon to flash for retrieval by host

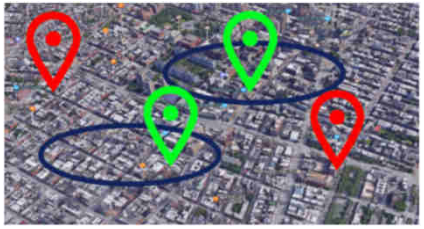
Up to 12h data logging (1Hz)

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

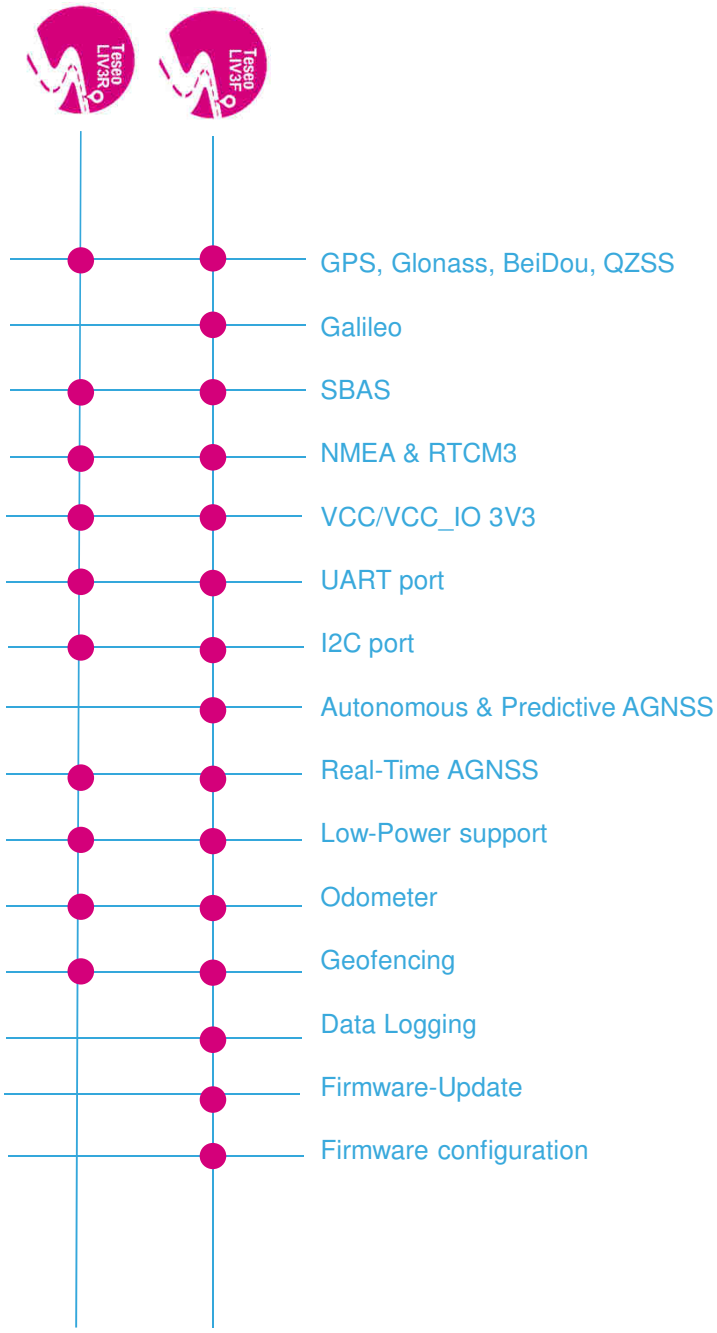
computes distance travelled from position & velocity data

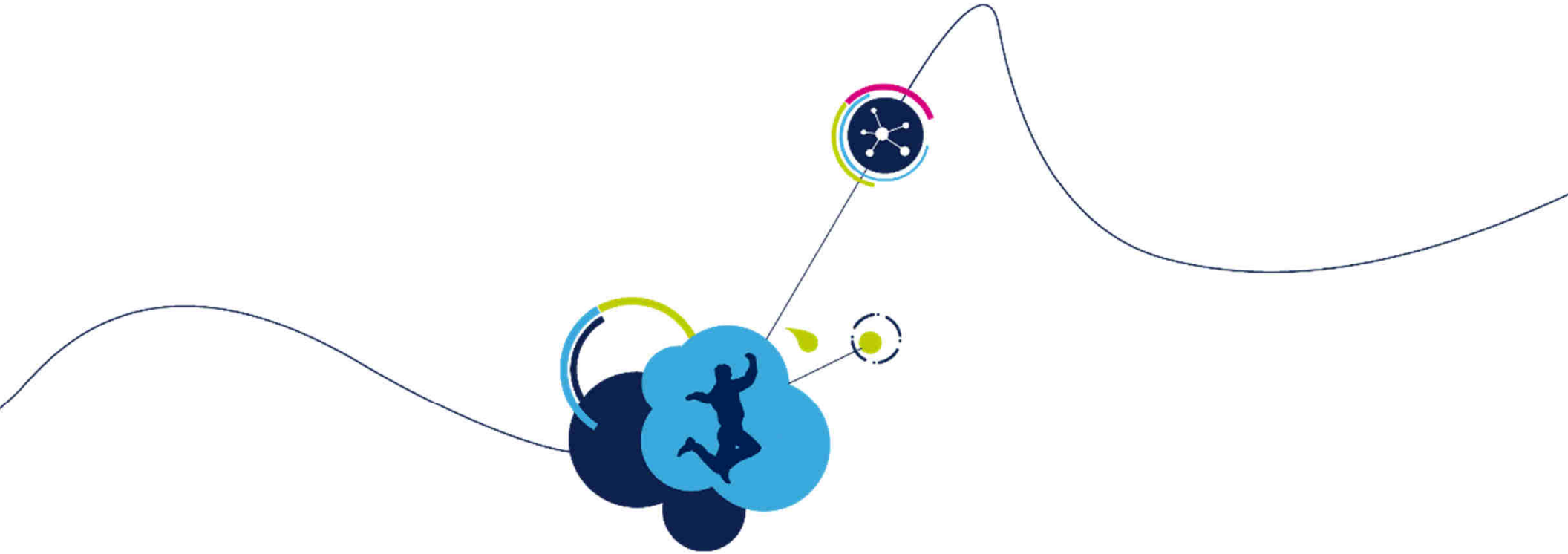
Up to 3 TRIP counters

Distance achieved alarm

* Teseo-LIV3F only

Teseo-LIV3x variants





Teseo-LIV3 Ecosystem

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Teseo-LIV3 – Platform Ready

STM32 CubeMX

ANDROID

ARDUINO

ARMmbed

Device Driver created for several platforms to speed-up development and time-to-market

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Teseo-LIV3 – Application Ready

STM32 Open Development Environment

Fast prototyping

LoRa™ Smart tracker

nx networks

Server - Assisted GNSS

Several STM32 applications ready to be used to speed-up development and time-to-market

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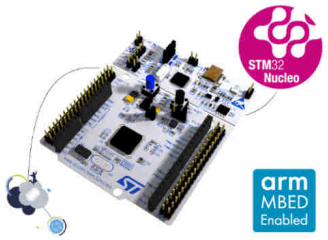
X-Nucleo-GNSS1A1

For development on STM32 based design, Teseo-LIV3F based

- 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



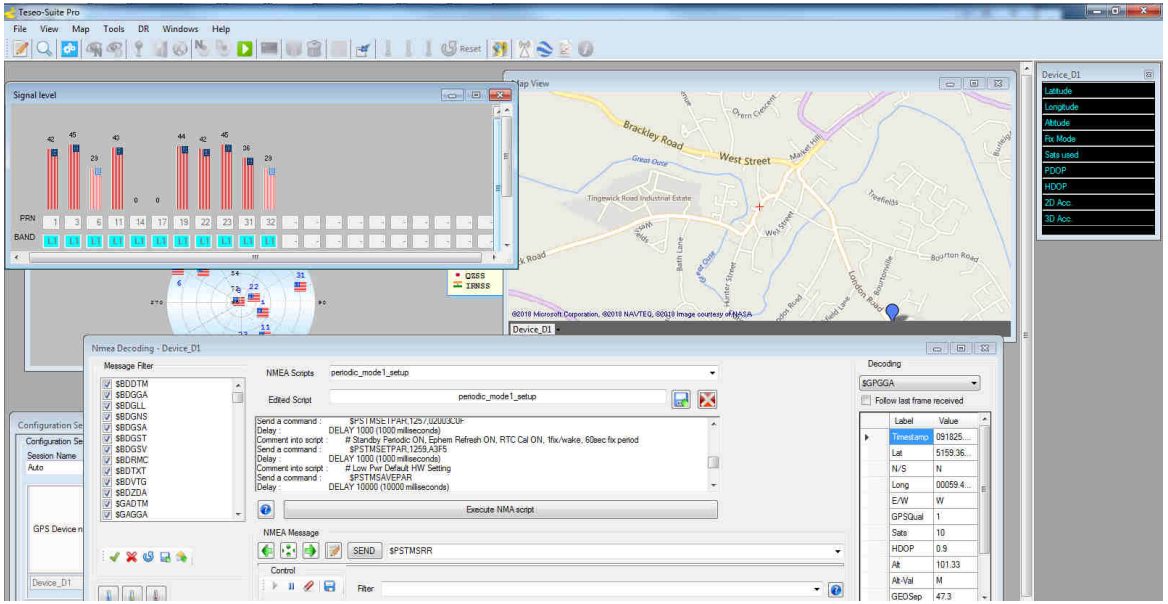
EVB-LIV3F / EVB-LIV3R

For complete evaluation of GNSS solution with Teseo-Suite, including power consumption measurement:

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

SW Tools
Teseo Suite

- View/Record/Playback
- NMEA & DEBUG
- View Graphics charts
  - Position
  - CN0
  - 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.

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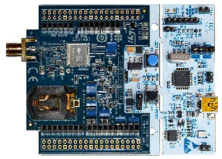
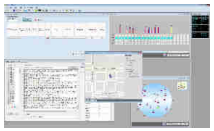
The Goods

Teseo-LIV3x	
Datasheet	Software User Manual
Hardware User Manual	Videos training
Application Note	

EVB-LIV3x	
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

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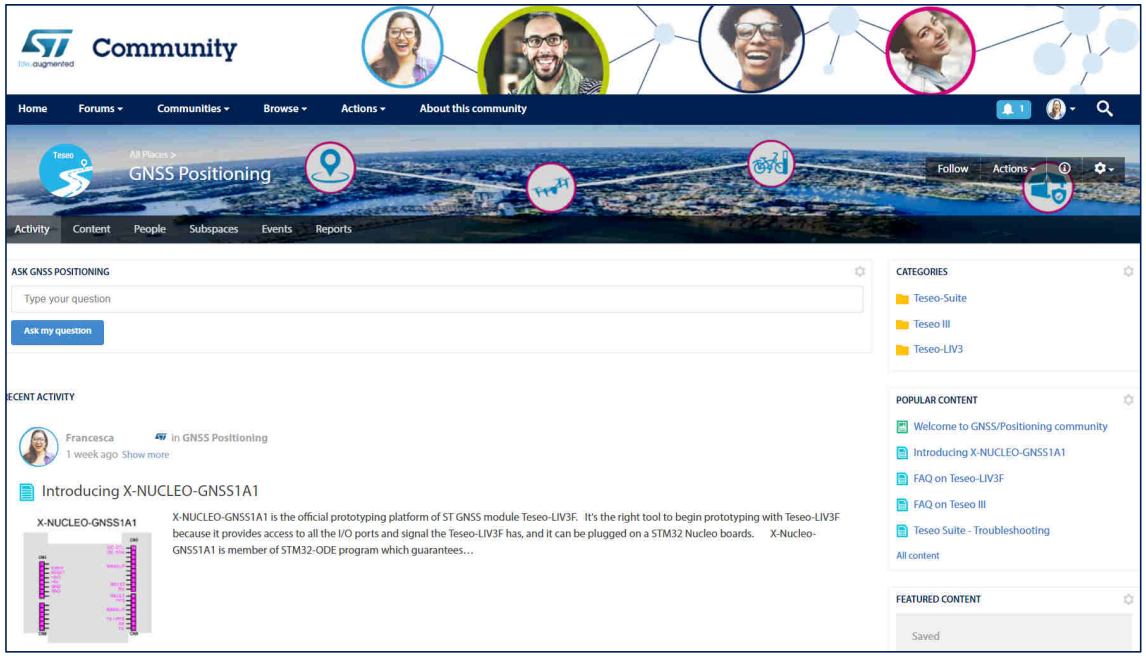
Join us in the ST GNSS community

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



https://community.st.com/community/gnss

GNSS Teseo-LIV3F based LoRa® Asset Tracker

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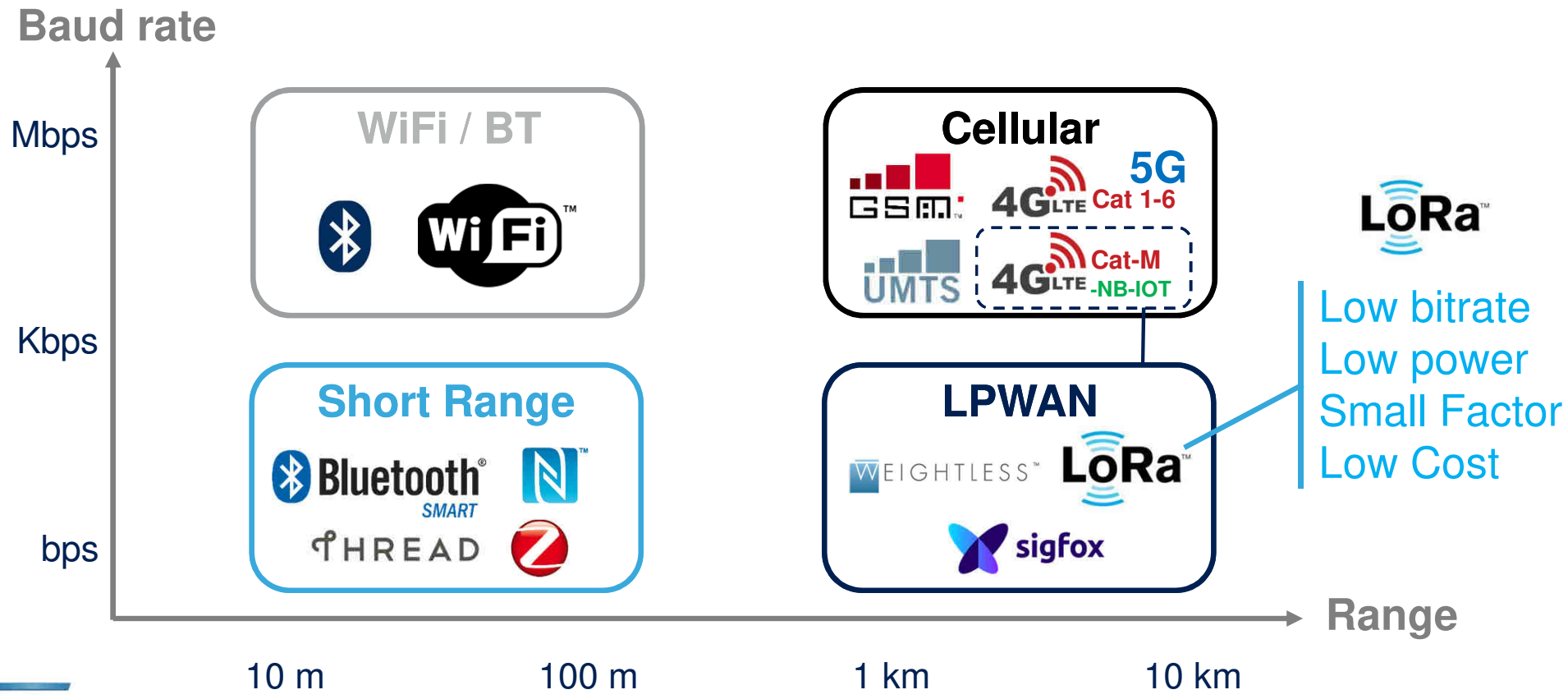
Communication Technologies - Overview



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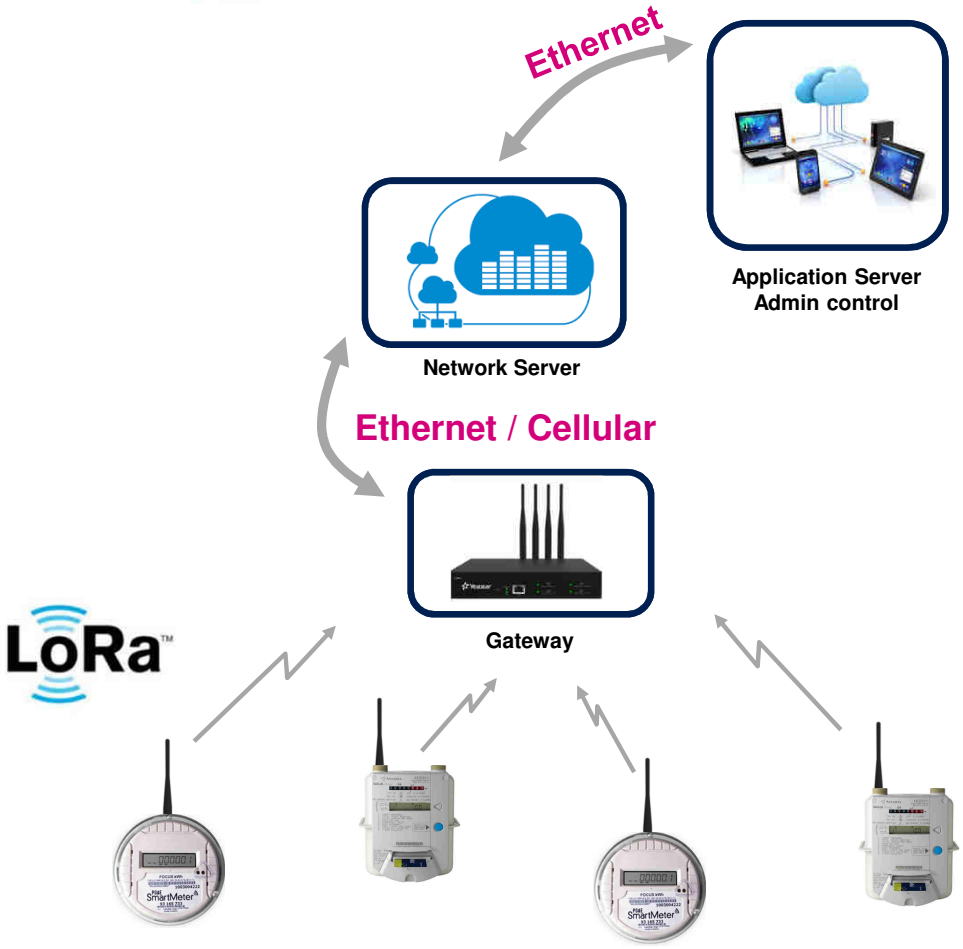
IoT use cases

Key Verticals

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

…



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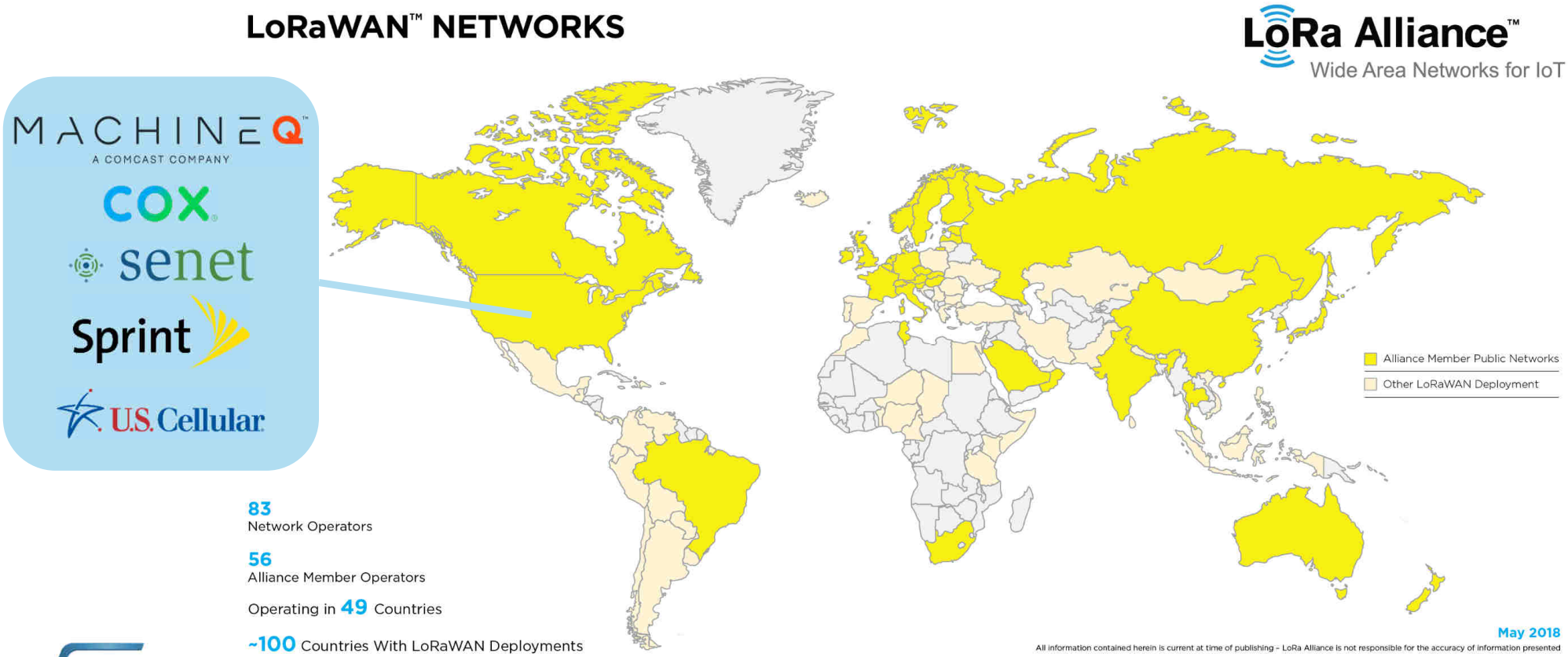
LoRa® Network Deployments



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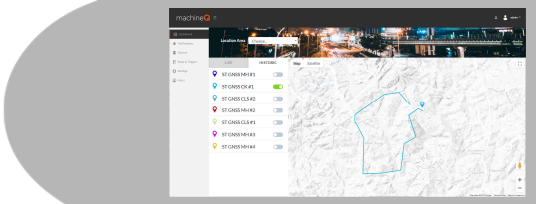
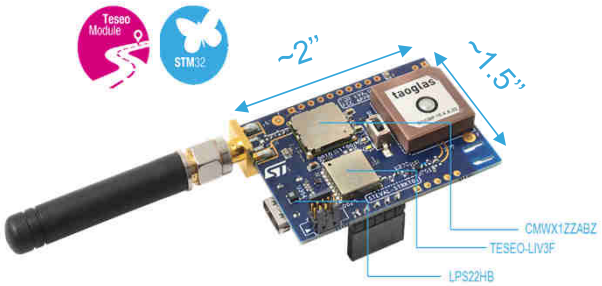
ST LoRa® Asset Tracking Ref Design

MACHINEQ
IoT Gateway



mQPortal



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

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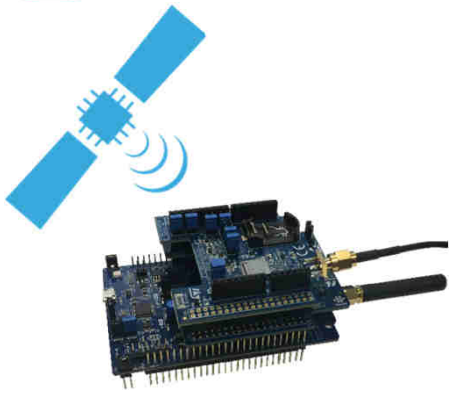
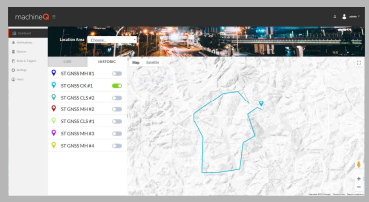
ST LoRa® Asset Tracking Dev-Kit



LoRa®

MACHINEQ
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

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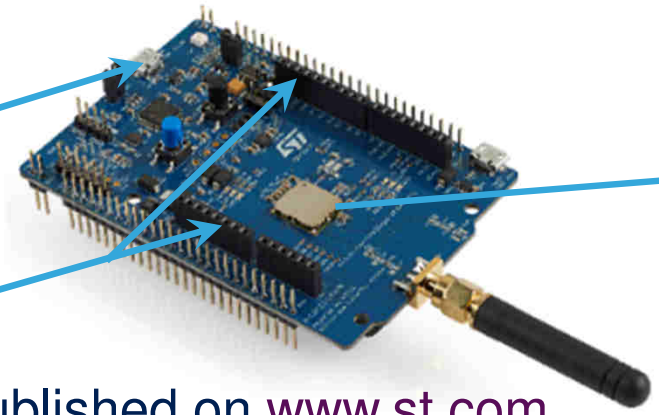
MACHINEQ
A COMCAST COMPANY

ST LoRa® Dev Kit Hardware

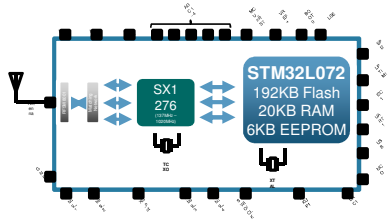
base board B-L072Z-LRWAN1

ST-Link
Debugger



Arduino Connector

Murata® Module
All-in-one Open



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Search for B-L072Z-LRWAN1

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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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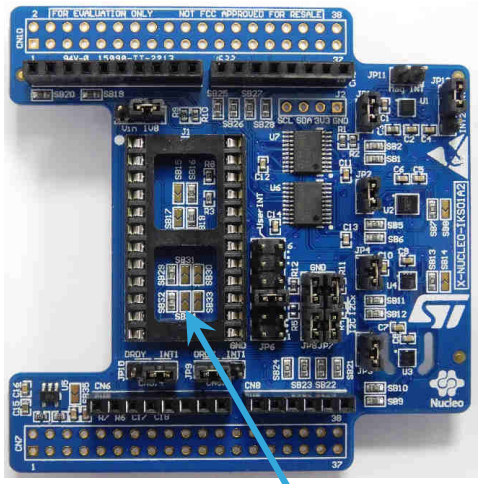

DIL-24 Extension

Published on www.st.com
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3D Accel. + 3D Gyro. (LSM6DSL)

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

Pressure (LPS22HB)

Temperature + Humidity (HTS221)

ST LoRa® Dev Kit Hardware

GNSS board X-NUCLEO-GNSS1A1

Published on www.st.com
Search for X-NUCLEO-GNSS1A1

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).

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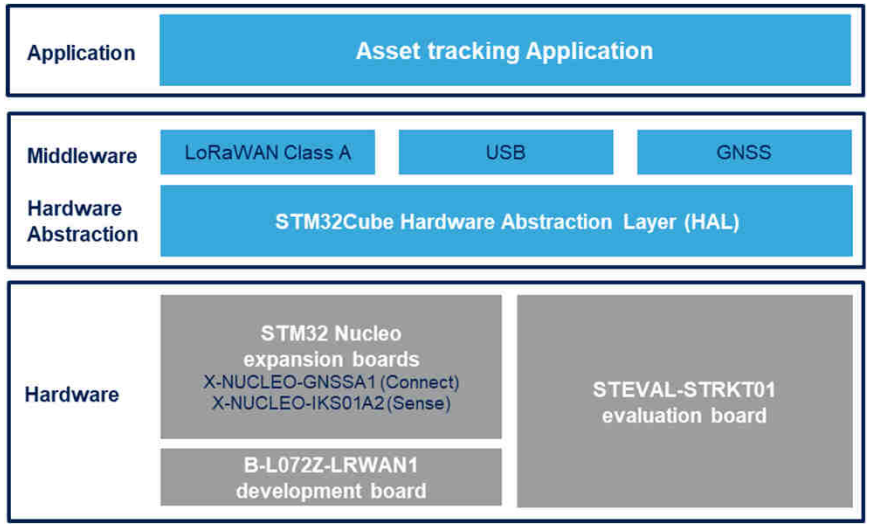
LoRa® Asset Tracking Function Pack

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



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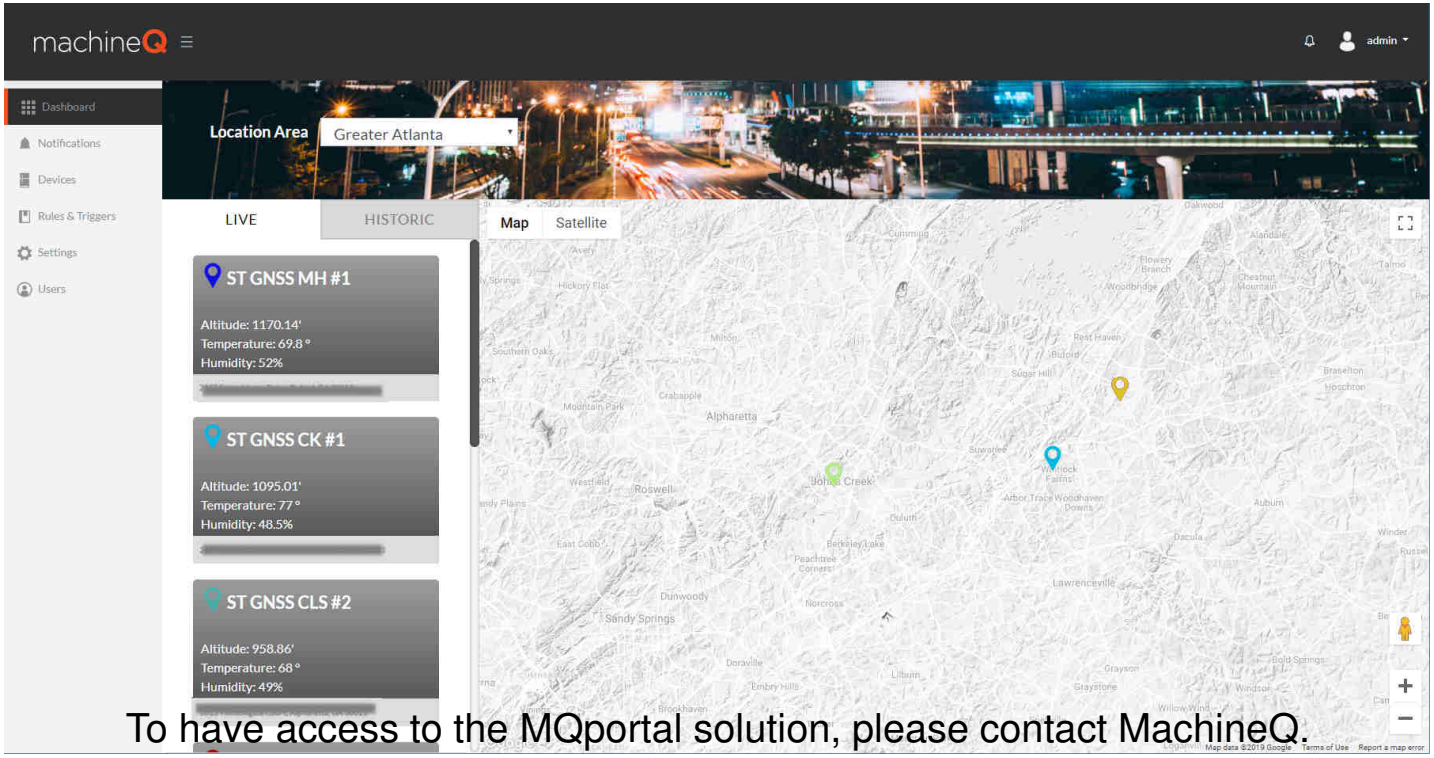
Asset Tracker – MQportal UI

Monitoring

Sensor Monitoring

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



To have access to the MQportal solution, please contact MachineQ.

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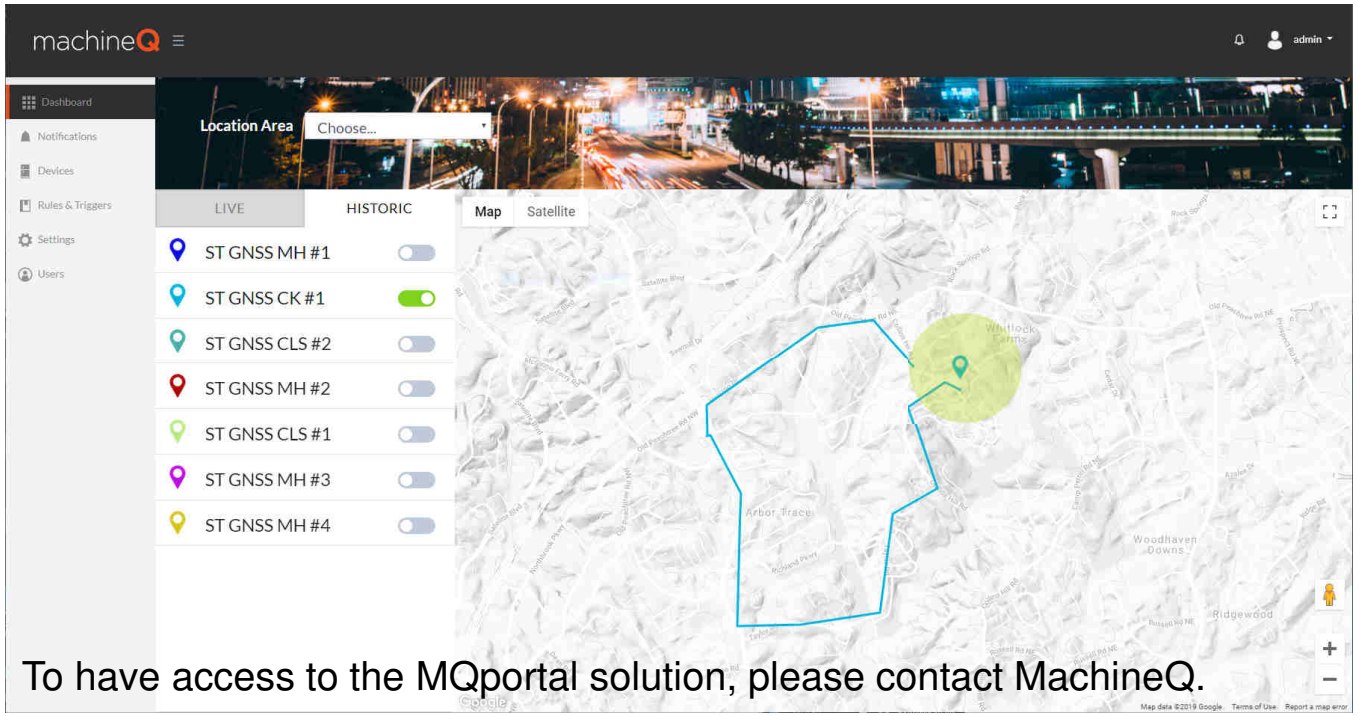
Asset Tracker – MQportal UI

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



To have access to the MQportal solution, please contact MachineQ.

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OSSO Pet Tracker

FUTURE
Connectivity Solutions

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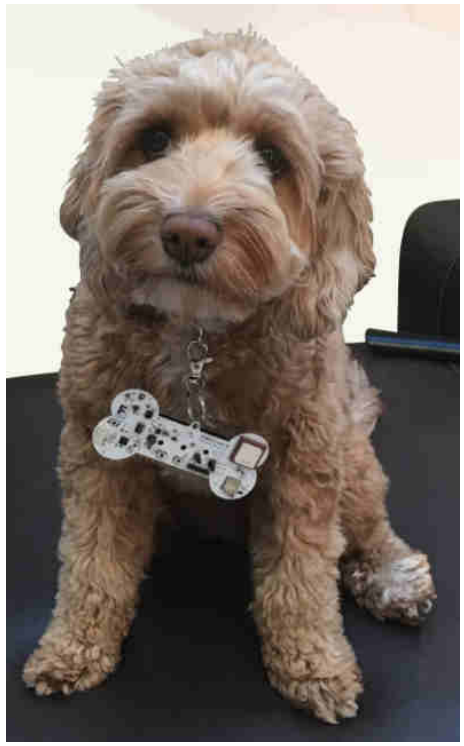
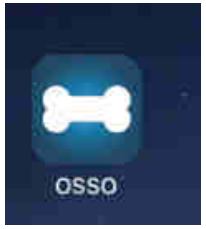
What is OSSO?

- 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





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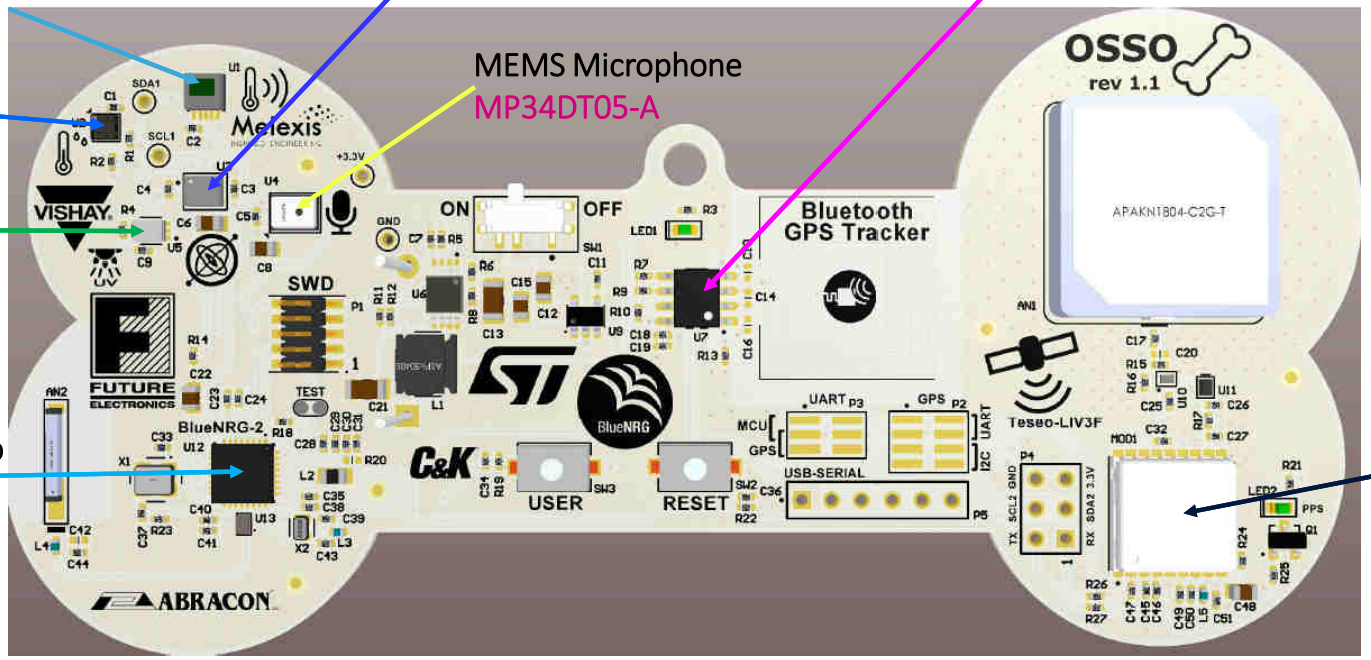
MEMS Microphone MP34DT05-A

NFC Tag IC M24SR64

GNSS Module Teseo-LIV3F



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If any questions please contact me at
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