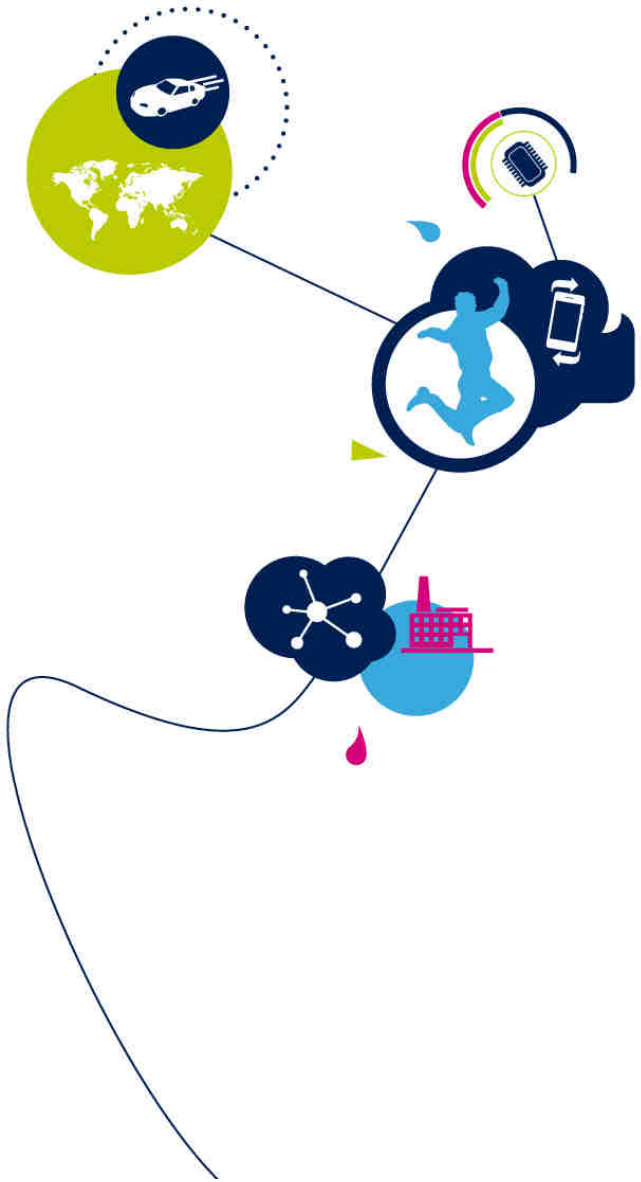
ST GNSS modules
Teseo-LIV3F, Teseo-LIV3R

Sara Mattioli - *ADG Marketing Region Americas*

ST Tech Tour, Minneapolis October 24th 2019



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Teseo-LIV3x GNSS Modules

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

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Target Applications

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)

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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)

- 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)

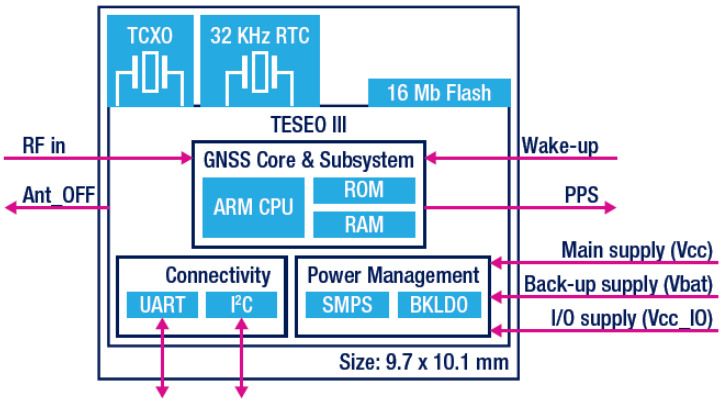
- Best in class accuracy
- Lowest Standby consumption
- Reduce cold/warm TTFF
- Concurrent functions
- Simplify design
- Reduce design risks/costs/time

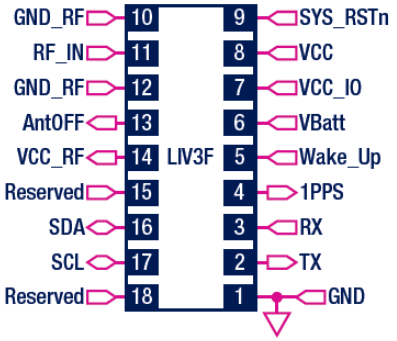
Best-In-Class GNSS Module (ROM version)

*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; 32µW stand-by current including RTC backup
- Temperature Compensated Crystal Oscillator 26MHz for fast TTFF, RTC 32KHz for maintaining accurate time

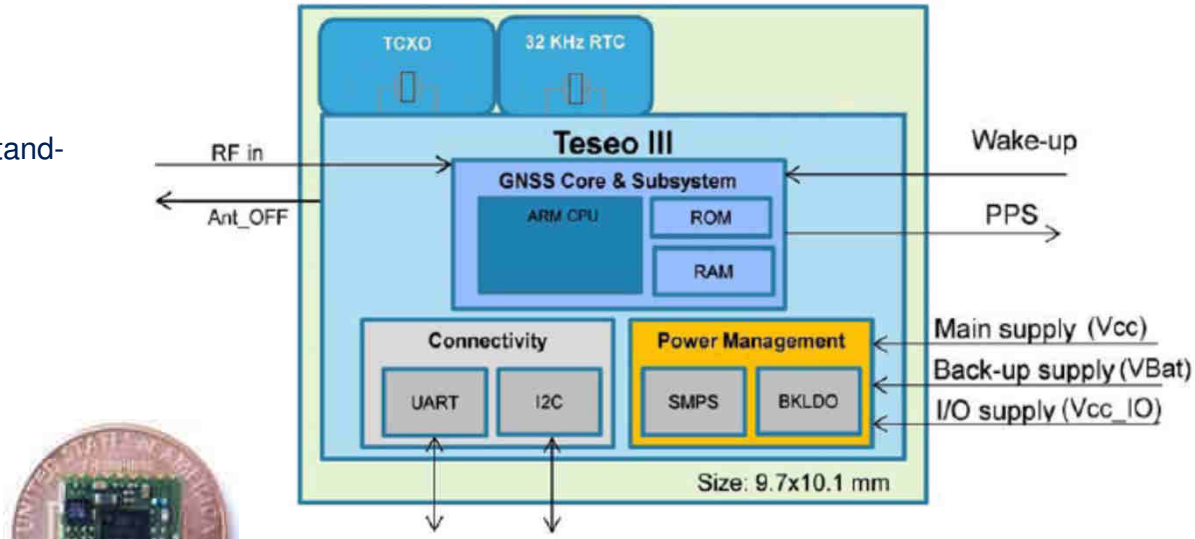




Integrated ARM9 processor for Superior performance

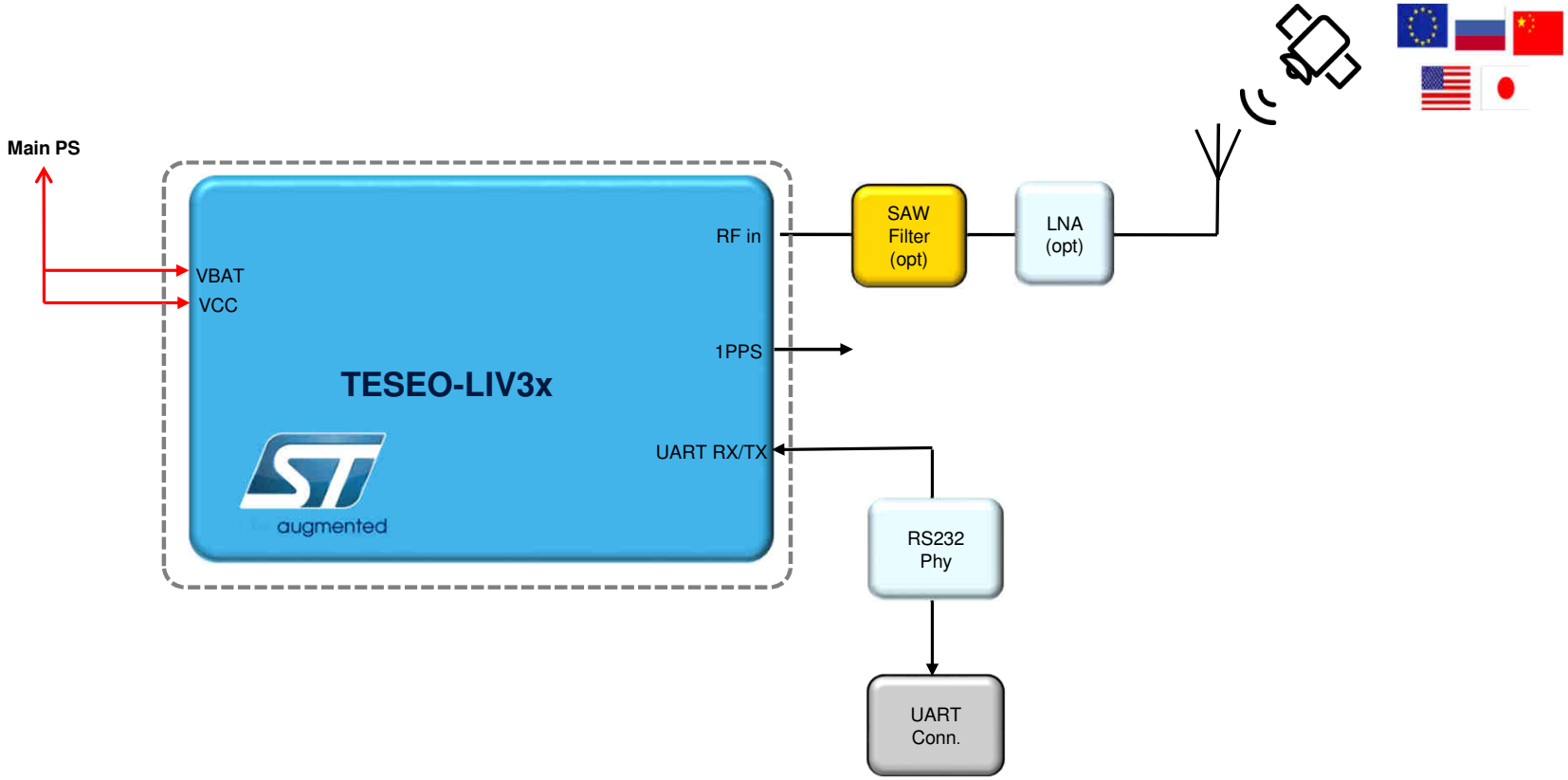
Teseo-LIV3R Key Features

- Tiny LCC18 package (9.7 x 10.1 x 2.3 mm)
- Simultaneous multi-constellation positioning
- 70mW tracking power consumption; 17µW stand-by current including RTC backup
- TCX0 26MHz for fast TTFF , RTC 32KHz for mantaining 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



Integrated ARM9 processor for Superior performance

Simple Design, minimal BOM



GNSS

Multi constellation

GPS (USA), **Galileo*** (European)

Plus GLONASS (Russian) **or Beidou** (Chinese)

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

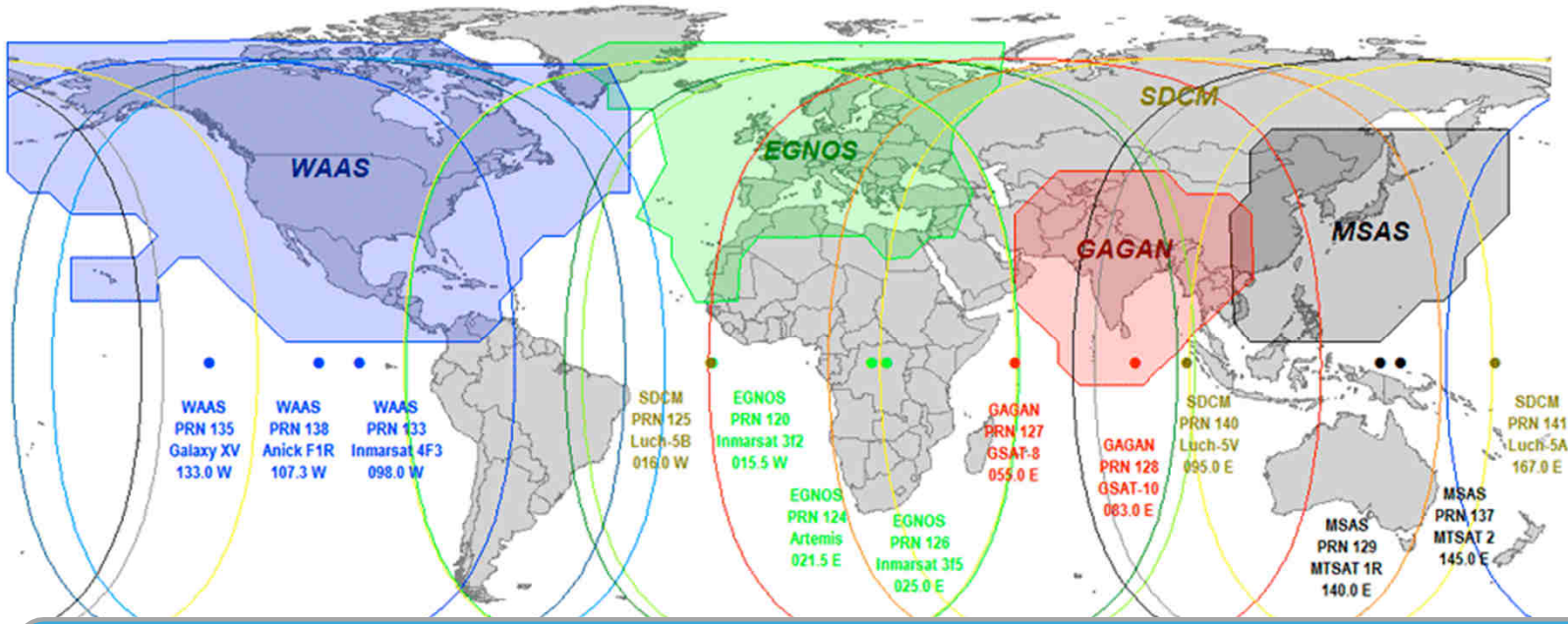
Teseo-LIV3 has **NOT** a reduced GNSS algorithm capability

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

* Teseo-LIV3F only

RTCM – Radio Technical Commission for Maritime Services

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 (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

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

* 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

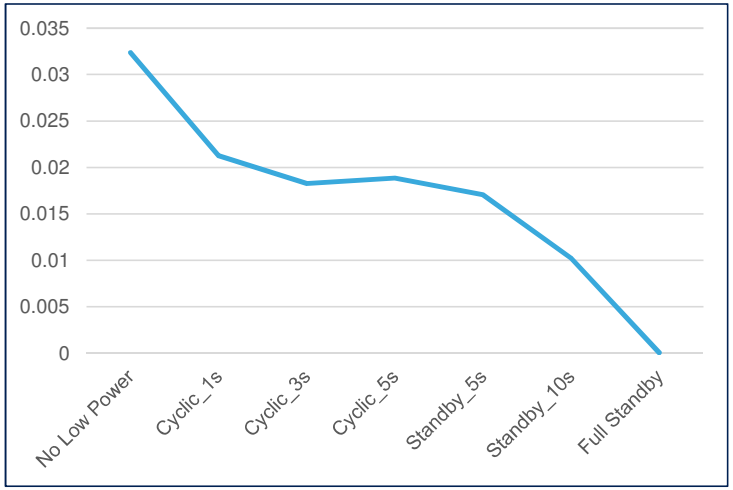
GNSS woken-up through the wakeup-pin based the host's needs

Lowest Power Option

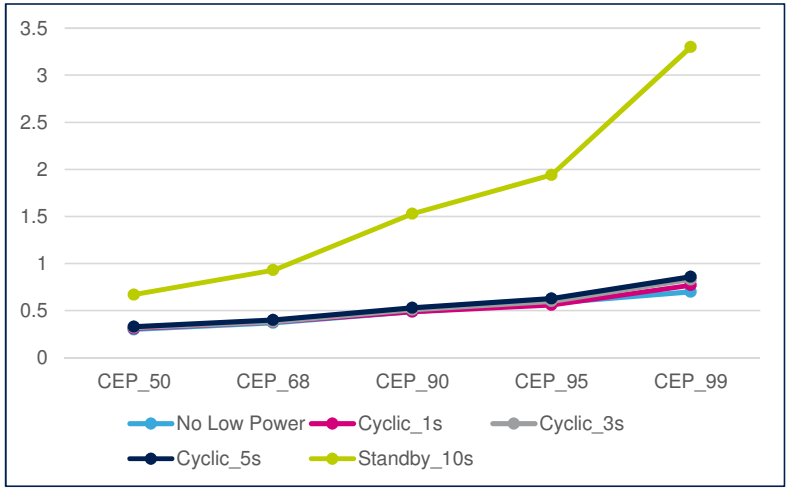
* Teseo-LIV3F only

Low Power measure

- Power consumption can be scaled based the application's needs:
  - Frequency of fixes
  - Average current consumption
  - Accuracy



Average current consumption (A)



Accuracy – CEP%

Measure 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

Extra GNSS SW Features

Datalogging*

saves lat/lon to flash for retrieval by host

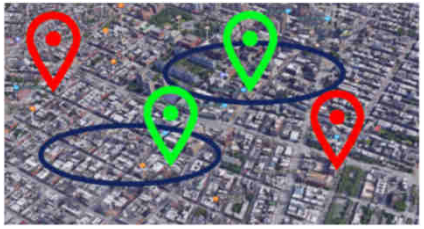
Up to 12h data logging (1Hz)

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

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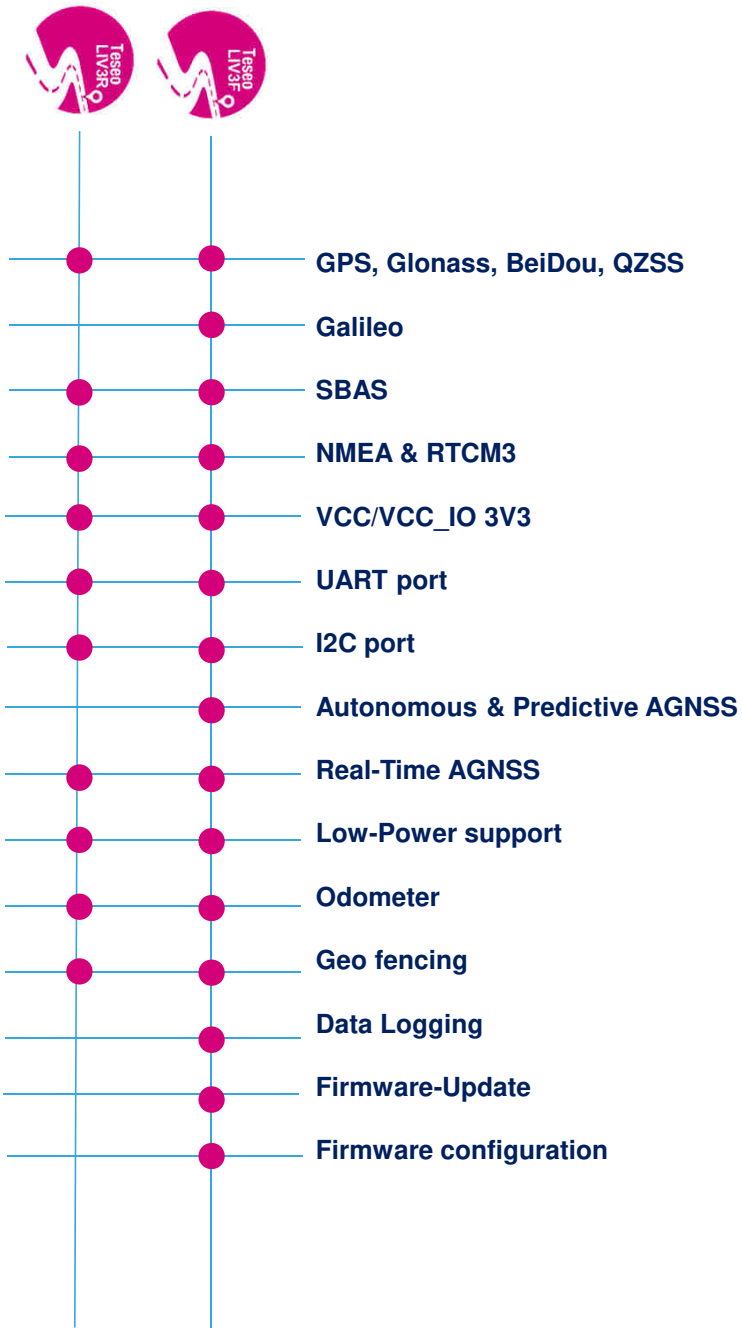
* Teseo-LIV3F only

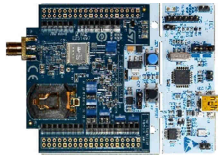
Teseo-LIV3x comparison summary



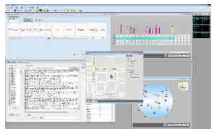
Marketing Package Summary

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

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HW Tools

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

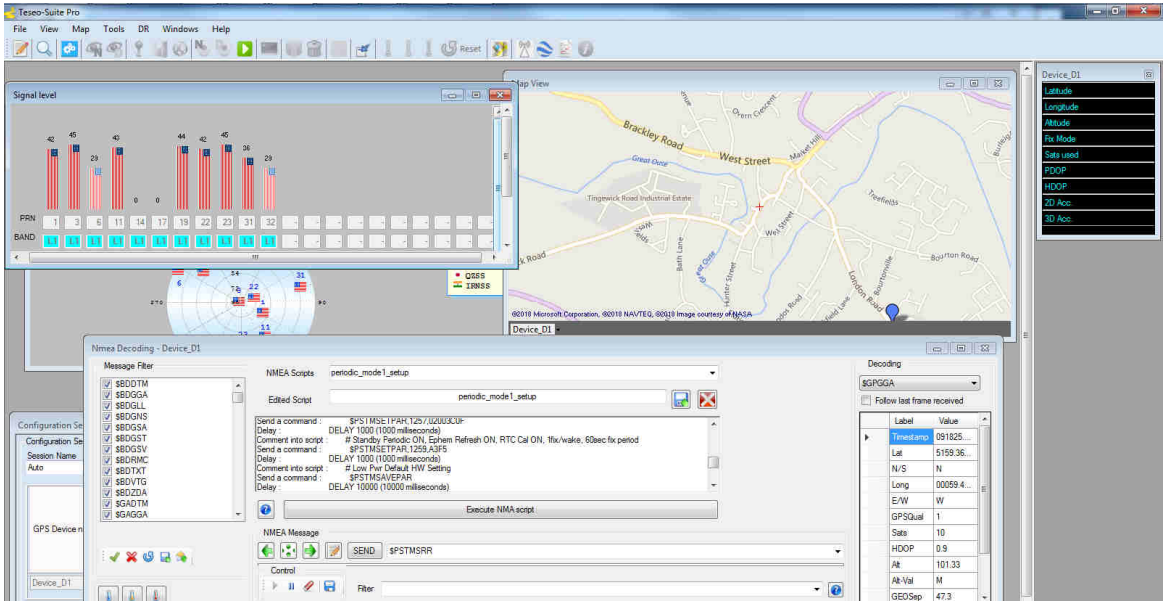
EVB-LIV3F / EVB-LIV3R

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

- 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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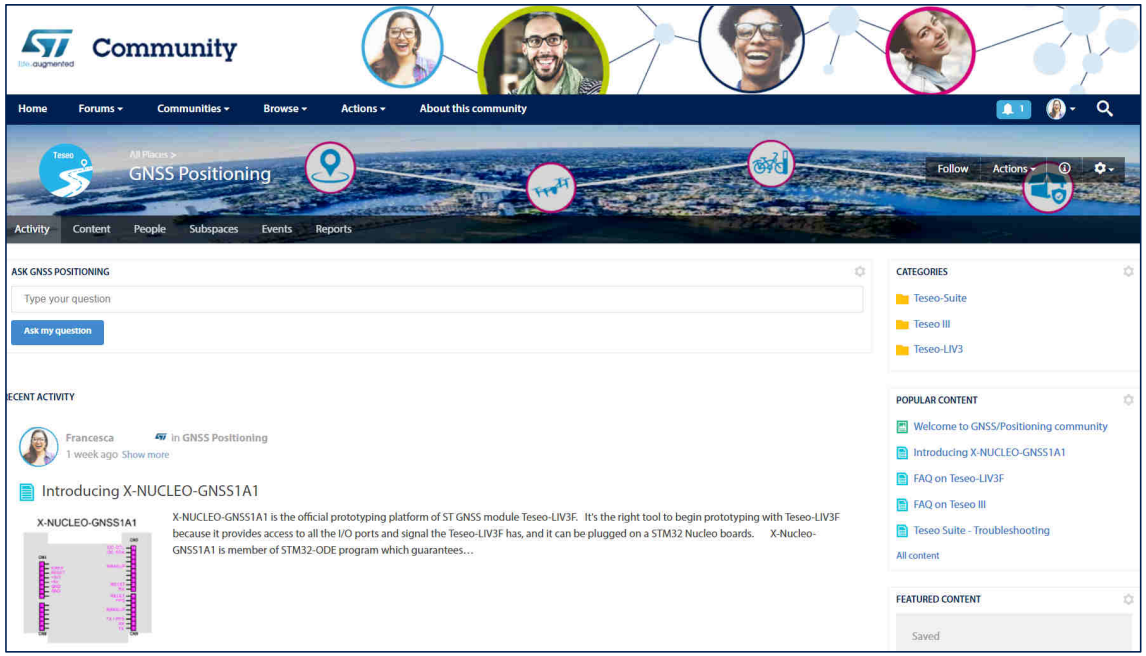
Join us in the ST GNSS community

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



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

GNSS LoRa® Asset Tracker Reference Design

(in collaboration w/MDG group, Marc Hervieu)

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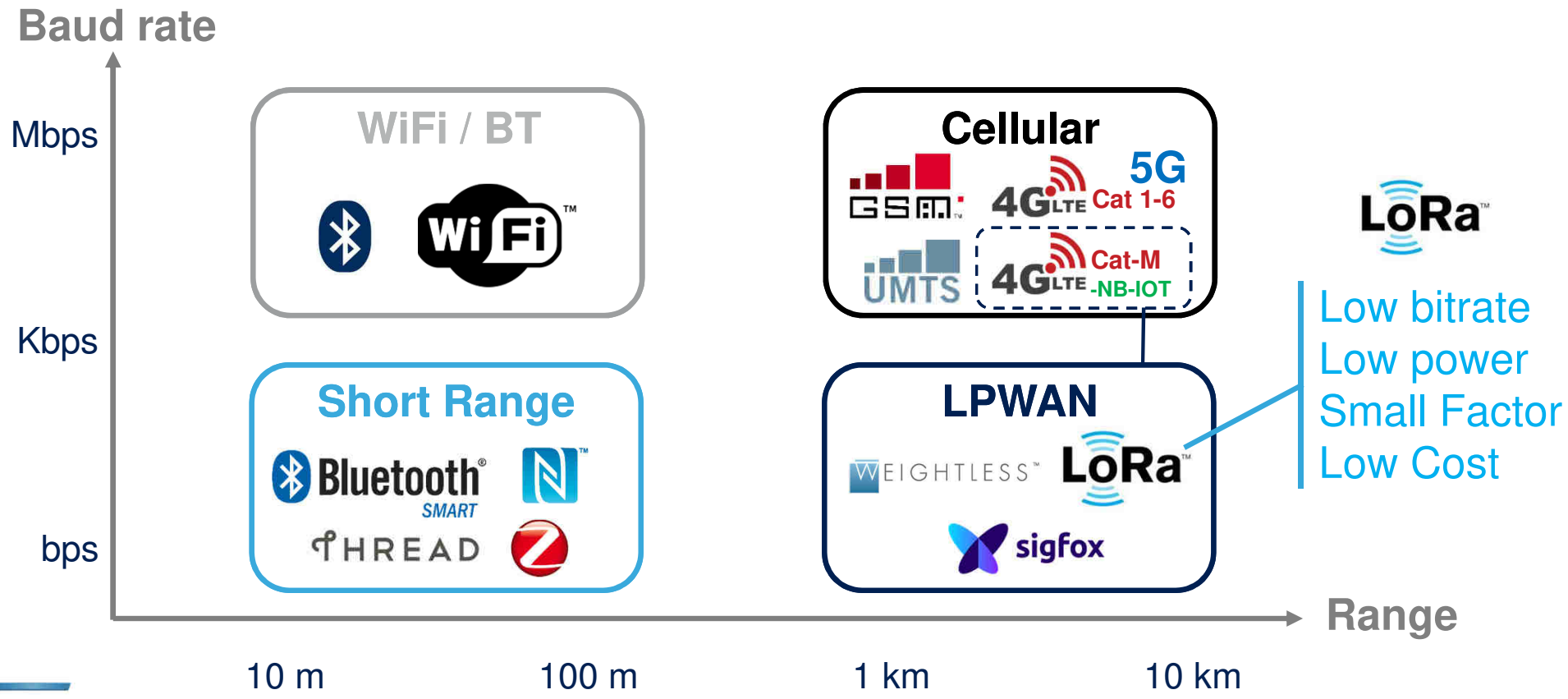
Communication Technologies - Overview



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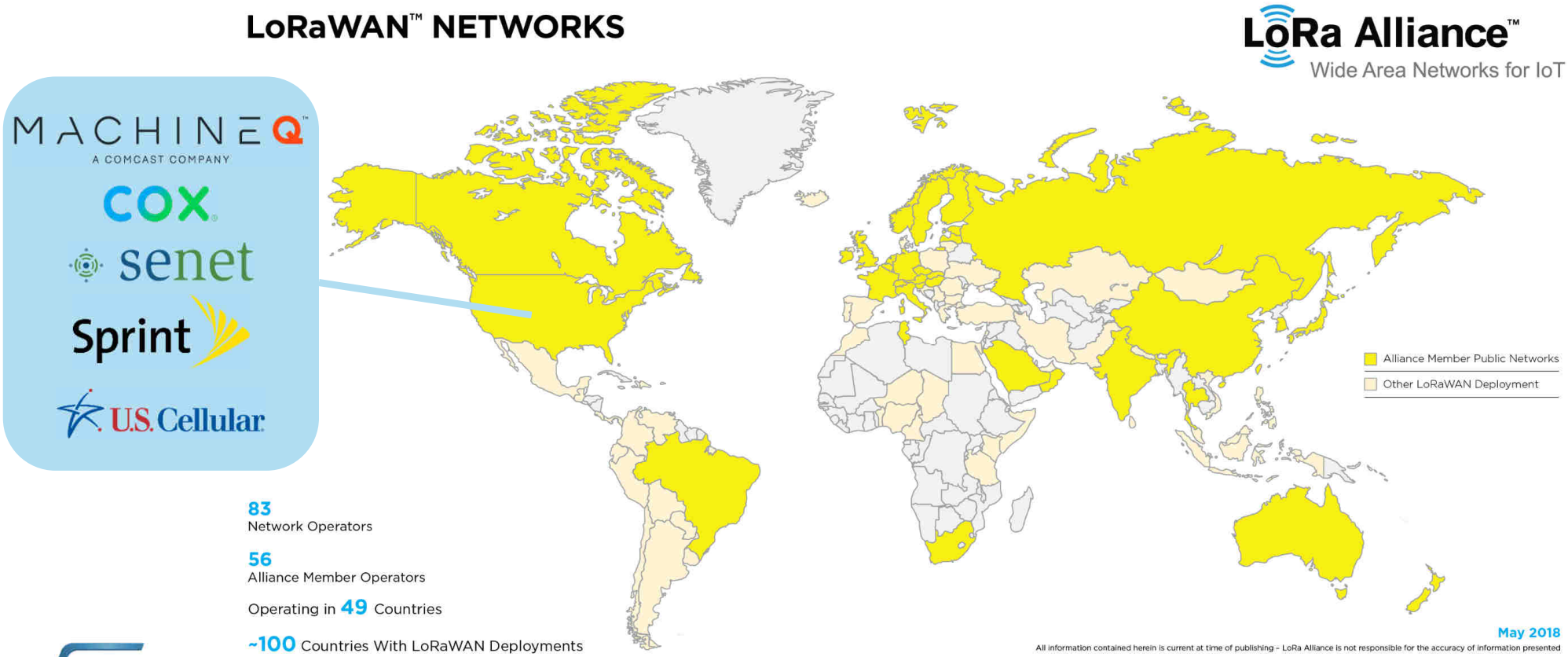
LoRa® Network Deployments



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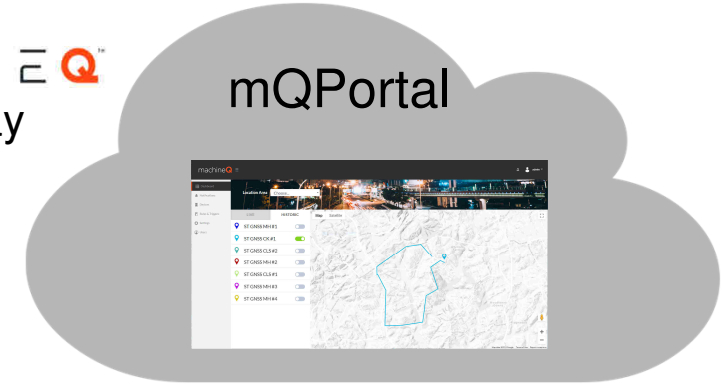
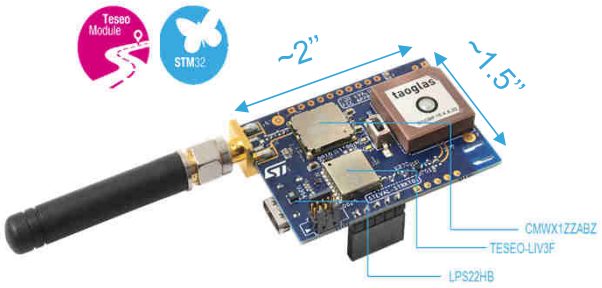
ST LoRa® Asset Tracking Ref Design

MACHINEQ
IoT Gateway





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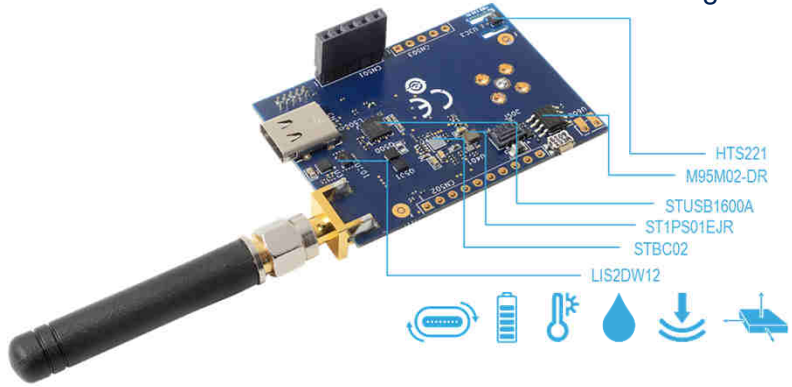
ST LoRa® Asset Tracking Ref Design

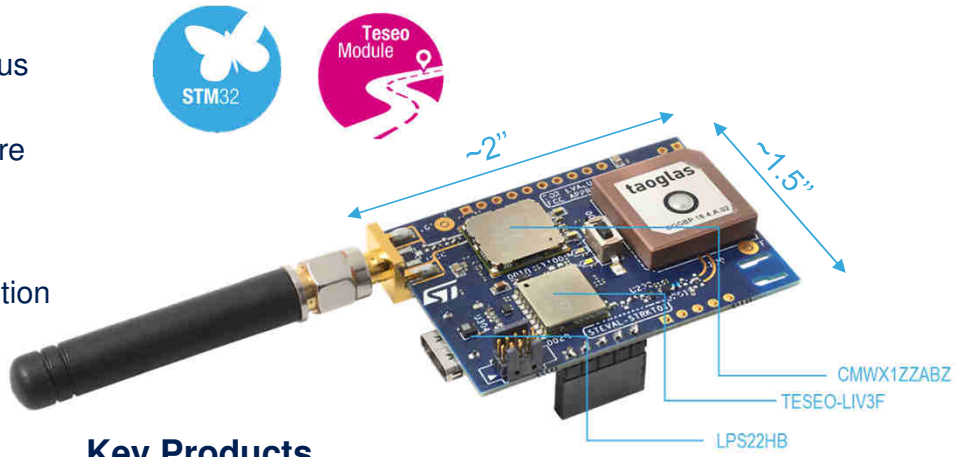
STEVAL-STRKT01

The perfect Small Form Factor Reference Design

Key Features

- Optimized tracker solution over LoRaWAN network with simultaneous multi-constellation GNSS positioning and Geofencing support
- Battery-operated solution with smart power-management architecture
- Environmental and motion sensors / Data Logging
- IoT ST reference design with USB Type-C
- FW Function Pack **FP-ATR-LORA1** for modular and integrated solution





Key Products

- **CMWX1ZZABZ**: LoRa® module
  - **STM32L072**, and SX1276 Semtech LoRa transceiver
- **TESEO-LIV3F**: GNSS standalone module based on TESEO III
- **STBC02**: Li-Ion linear battery charger with LDO and power path
- **ST1PS01EJR**: 400mA Nano-Quiescent™ Synchronous step-down converter
- **STUSB1600A**: USB Type-C controller
- **LIS2DW12, HTS221, LPS22HB:** Motion and environmental sensors
- **M95M02-DR** EEPROM

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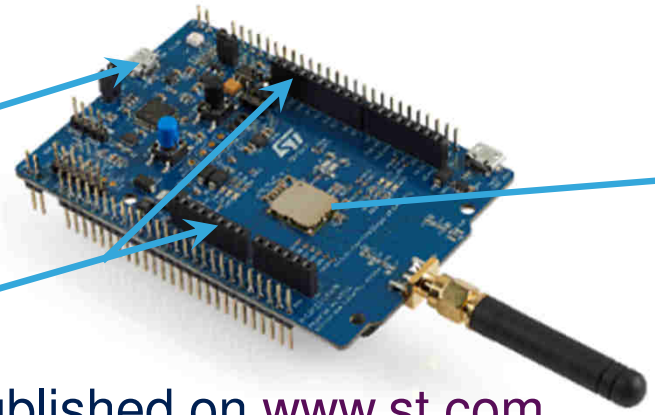
MACHINEQ
A COMCAST COMPANY

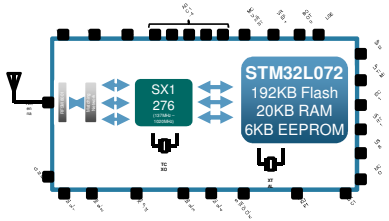
ST LoRa® Dev Kit Hardware

base board B-L072Z-LRWAN1

ST-Link
Debugger



Arduino Connector



Murata® Module
All-in-one Open

Published on www.st.com
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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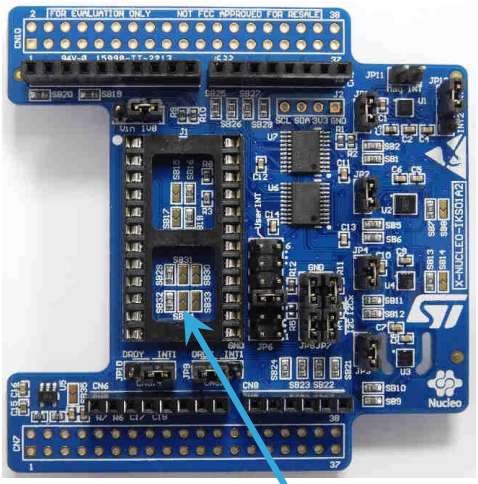

DIL-24 Extension

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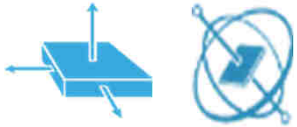
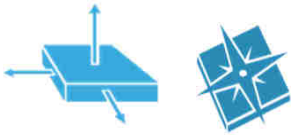


3D Accel. + 3D Gyro. (LSM6DSL)



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

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).

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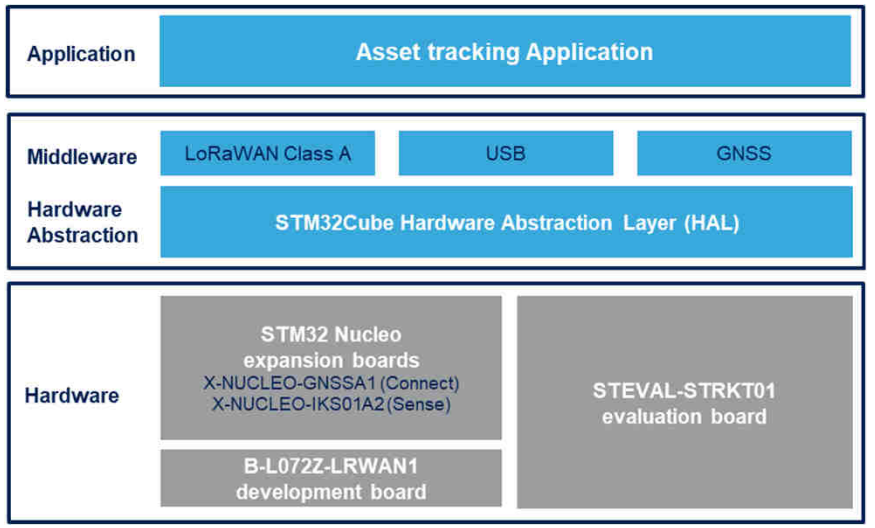
LoRa® Asset Tracking Function Pack

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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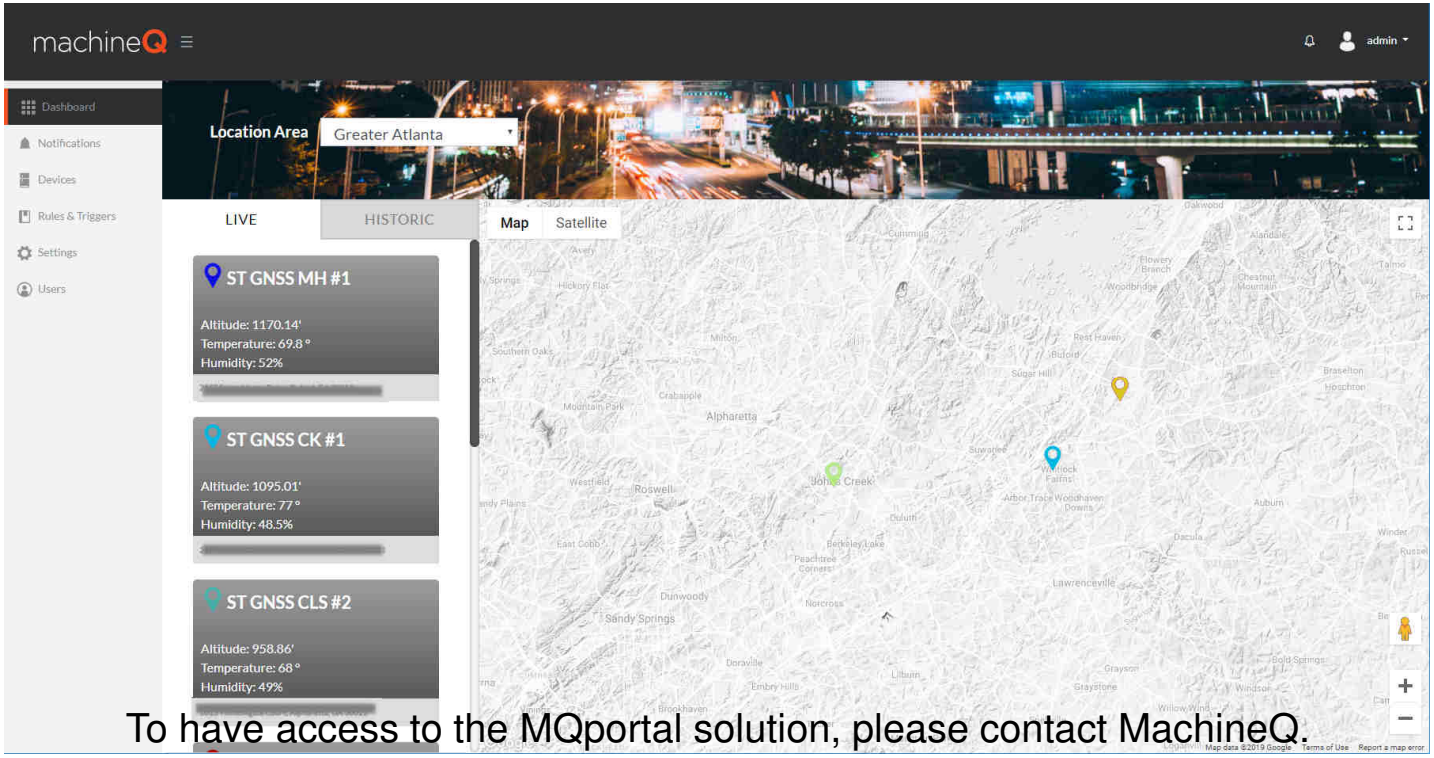
Asset Tracker – MQportal UI

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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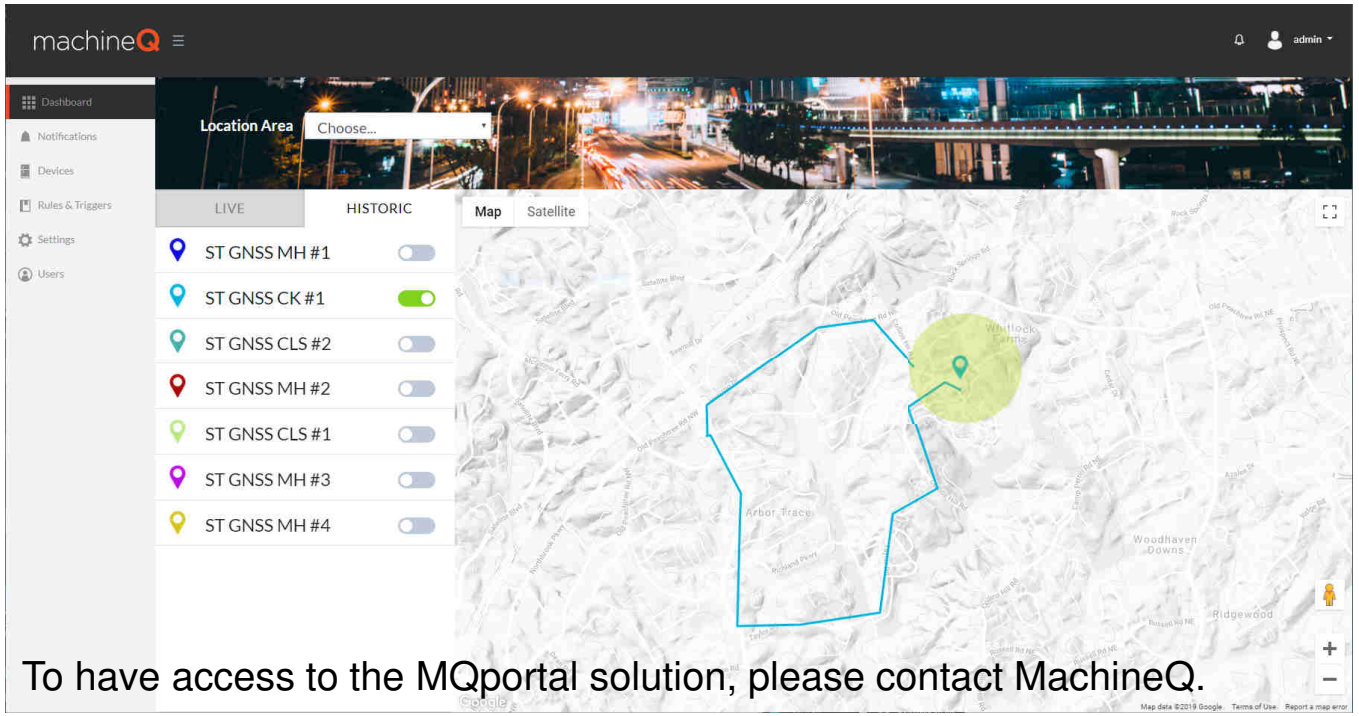
Asset Tracker – MQportal UI

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



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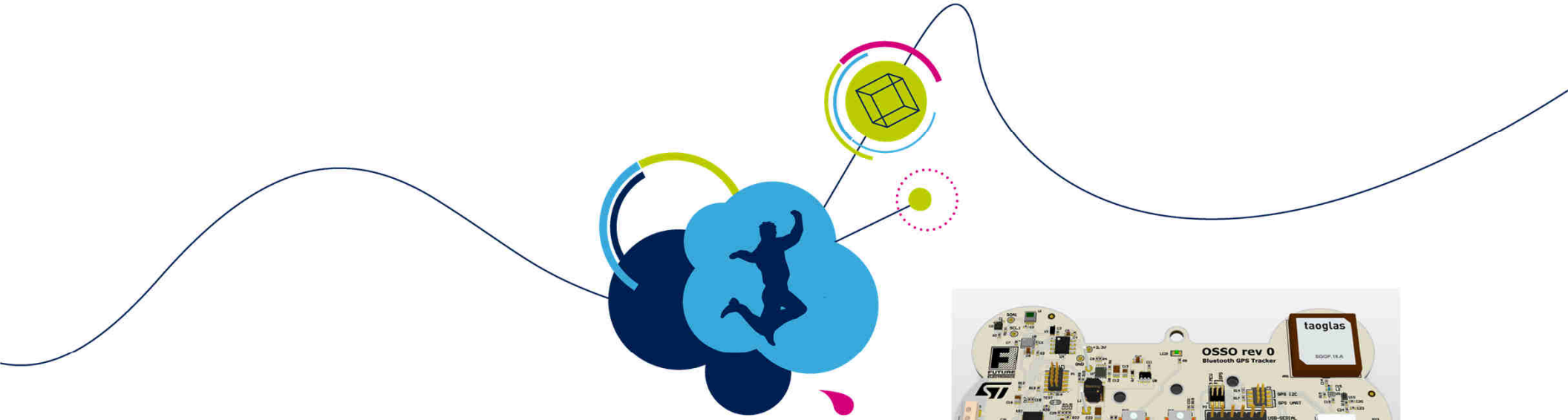

OSSO Pet Tracker Reference Design

(in collaboration w/Future)

FUTURE
Connectivity Solutions

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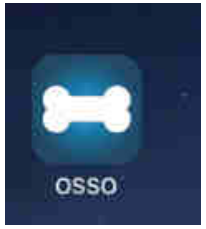
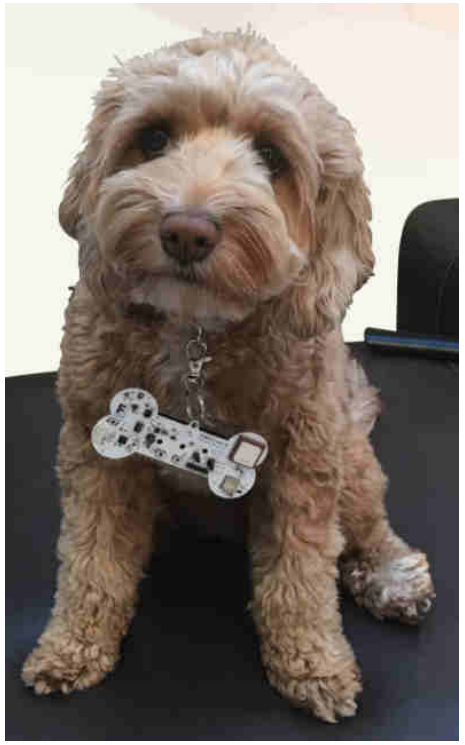
What is OSSO?

- 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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A closer look at OSSO

IR temperature sensor

Humidity/Temperature sensor HTS221TR

UVA Sensor

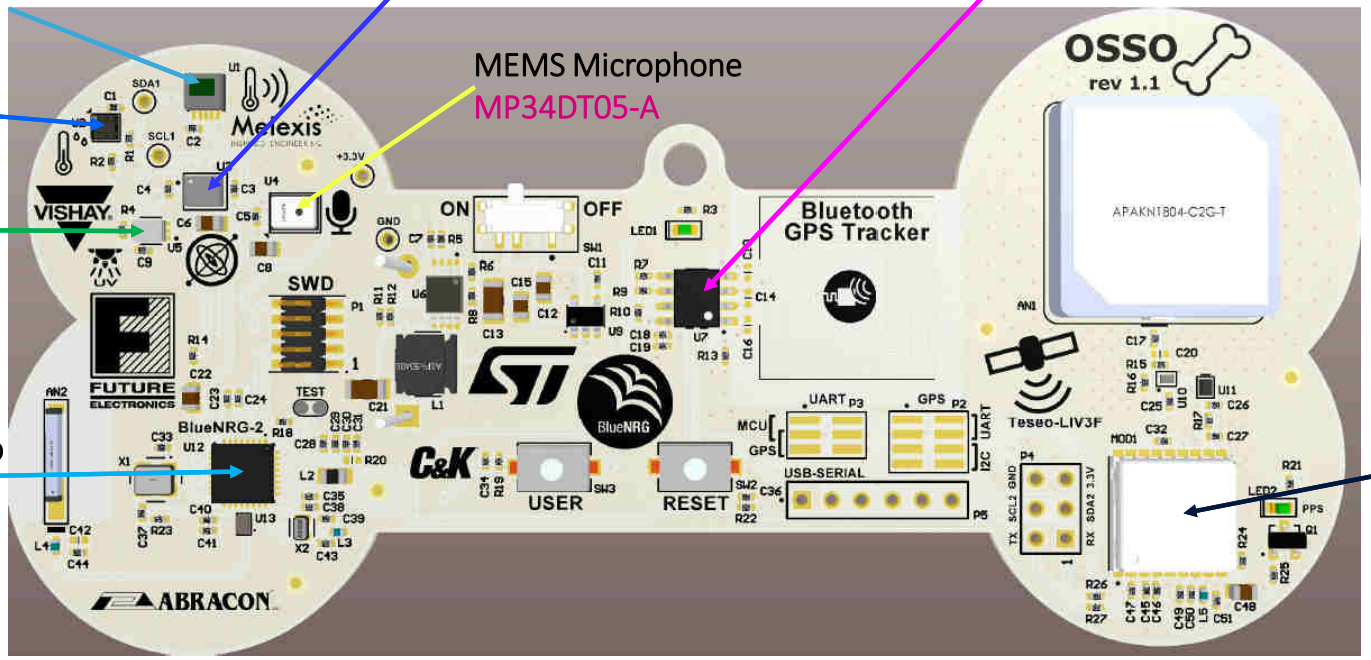
Bluetooth System-on-Chip BlueNRG-2

Accelerometer and Gyroscope LSM6DSOTR

MEMS Microphone MP34DT05-A

NFC Tag IC M24SR64

GNSS Module Teseo-LIV3F



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thank you!

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

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