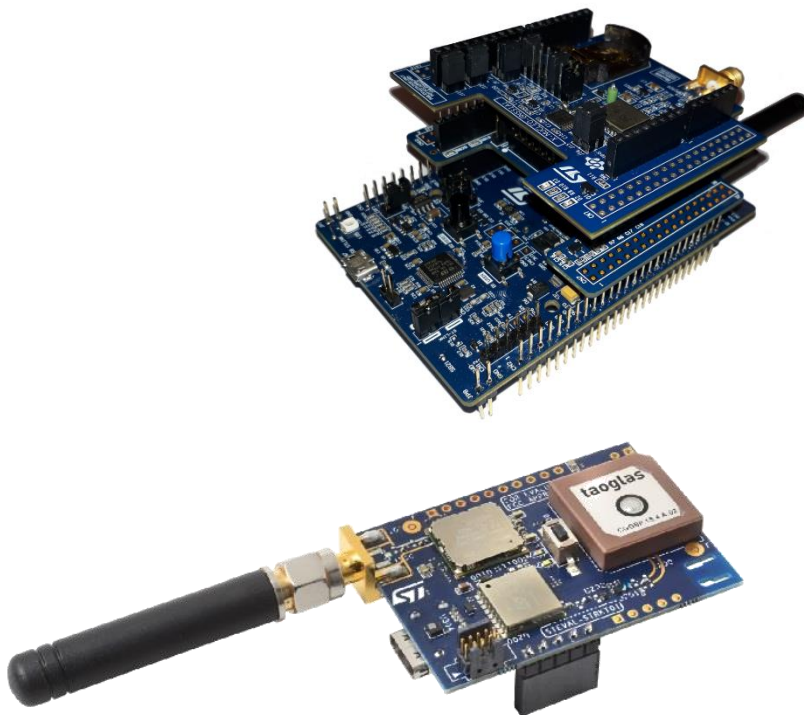# Quick Start Guide

STM32Cube function pack for IoT tracker node with LoRa connectivity, GNSS and sensors (FP-ATR-LORA1)

Version 1.4 (Feb 28, 2021)

Agenda

Hardware and Software overview

Documents & Related Resources

Documents & Related Resources

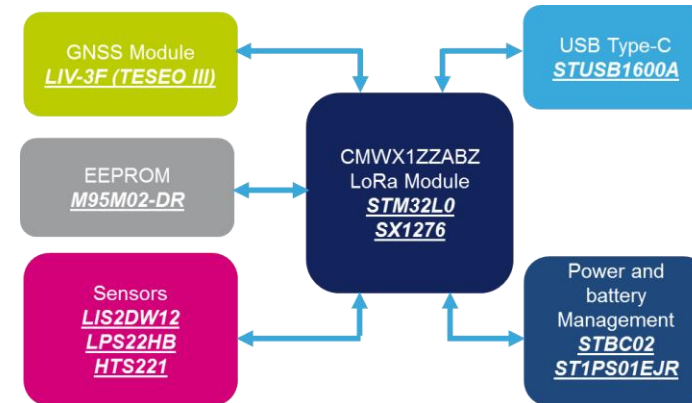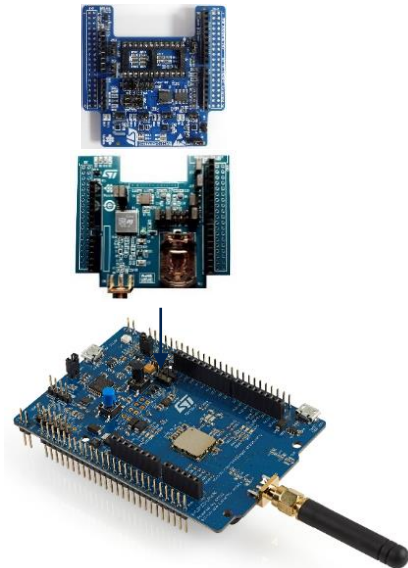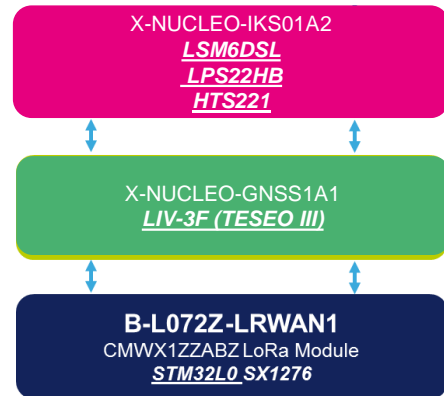**#** STM32 Open Development Environment: Overview

1- Hardware and Software overview

- FP-ATR-LORA1: STM32Cube function pack for IoT tracker node with LoRa connectivity, GNSS and sensors is available for two platforms: modular and integrated (STEVAL-STRKT01).

X-NUCLEO-IKS01A2
LSM6DSL
LPS22HB
HTS221

X-NUCLEO-GNSS1A1
LIV-3F (TESEO III)

B-L072Z-LRWAN1
CMWX1ZZABZ LoRa Module
STM32L0 SX1276

GNSS Module
LIV-3F (TESEO III)

USB Type-C
STUSB1600A

EEPROM
M95M02-DR

CMWX1ZZABZ
LoRa Module
STM32L0
SX1276

Sensors
LIS2DW12
LPS22HB
HTS221

Power and
battery
Management
STBC02
ST1PS01EJR

4

B-L072Z-LRWAN1 discovery kit

B-L072Z-LRWAN1 hardware description

- The B-L072Z-LRWAN1 Discovery kit embeds the CMWX1ZZABZ-091 LoRa®/Sigfox™ module (Murata). This Discovery kit allows users to develop easily applications with the STM32L072CZ and the LoRa®/Sigfox™ RF connectivity in one single module.

- The B-L072Z-LRWAN1 Discovery kit has the full set of features available in the STM32L0 series and offers ultra-low-power and LoRa®/Sigfox™ RF features. The B-L072Z-LRWAN1

- Discovery kit is a low-cost and easy-to-use development kit to quickly evaluate and start a development with an STM32L072CZ microcontroller.

- The B-L072Z-LRWAN1 Discovery kit includes LoRa®/Sigfox™ RF interface, LEDs, pushbuttons, antenna, Arduino™ Uno V3 connectors, USB 2.0 FS connector in Micro-B format.

- The integrated ST-LINK/V2-1 provides an embedded in-circuit debugger and programmer for the STM32L0 MCUs.

- The LoRaWAN™ stack is certified class A and C compliant. It is available inside the I-CUBE-LRWAN firmware package.The Sigfox™ stack is RCZ1, RCZ2, and RCZ4 certified.

- It is available inside the X-CUBE-SFOX expansion package.

- To help users setting up a complete node (LoRaWAN™, Sigfox™, or both), the B-L072Z-LRWAN1 Discovery kit comes with the STM32 comprehensive free software libraries and examples available with the STM32Cube package, as well as a direct access to the Arm® Mbed Enabled™ resources at the http://mbed.org website.
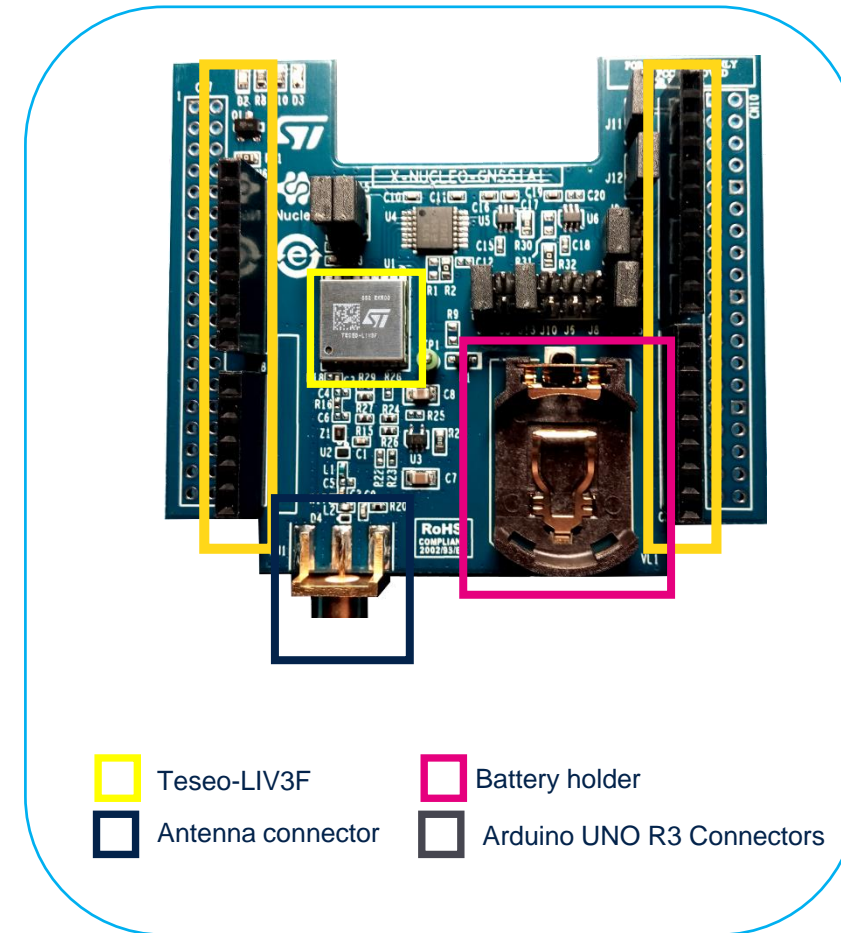
X-NUCLEO-GNSS1A1 Hardware Description

- The X-NUCLEO-GNSS1A1 expansion board is based on the Teseo-LIV3F tiny GNSS module.

- It represents an affordable, easy-to-use, global navigation satellite system (GNSS) module, embedding a Teseo III single die standalone positioning receiver IC, usable in different configurations in your STM32 Nucleo project.

- The Teseo-LIV3F is a compact (9.7x10.1 mm) module that provides superior accuracy thanks to the on-board 26 MHz temperature compensated crystal oscillator (TCXO) and a reduced time-to-first fix (TTFF) with its dedicated 32 KHz real-time clock (RTC) oscillator.

- The Teseo-LIV3F module runs complete GNSS firmware (X-CUBE-GNSS1) to perform all GNSS operations including acquisition, tracking, navigation and data output without external memory support.

- The X-NUCLEO-GNSS1A1 expansion board is compatible with the Arduino™ UNO R3 connector and the ST morpho connector, so it can be plugged to the STM32 Nucleo development board and stacked with additional STM32 Nucleo expansion boards.

Key Products on board

Teseo-LIV3F: Single die standalone positioning receiver IC working on multiple constellations, 10x10mm compact size.

26MHz Temperature Compensated Crystal Oscillator (TCXO) and reduced Time To First Fix (TTFF) relying to a 32KHz Real Time Clock (RTC) oscillator for superior accuracy.


- ☐ Teseo-LIV3F
- ☐ Antenna connector
- ☐ Battery holder
- ☐ Arduino UNO R3 Connectors

Latest info available at www.st.com
X-NUCLEO-GNSS1A1

6

Motion MEMS and environmental sensors expansion board

X-NUCLEO-IKS01A2 Hardware Description

- The X-NUCLEO-IKS01A2 is a motion MEMS and environmental sensor evaluation board system.

- It is compatible with the Arduino UNO R3 connector layout,and is designed around ST's latest sensors.

Key Product on board

- **LSM6DSL** :MEMS 3D accelerometer (±2/±4/±8/±16 g) + 3D gyroscope (±125/±245/±500/±1000/±2000 dps)

- **LSM303AGR** MEMS 3D magnetometer (±50 gauss) + MEMS 3D accelerometer (±2/±4/±8/±16 g)

- **LPS22HB** MEMS pressure sensor, 260-1260 hPa absolute digital output barometer

- **HTS221** Capacitive digital relative humidity and temperature

- **DIL 24-pin Socket** available for additional MEMS adapters and other sensors (UV index)

- HTS221
- LPS22HB
- LSM6DSL
- LSM303AGR
- ST morpho connector**
- Arduino UNO R3 connector
- DIL 24-pin
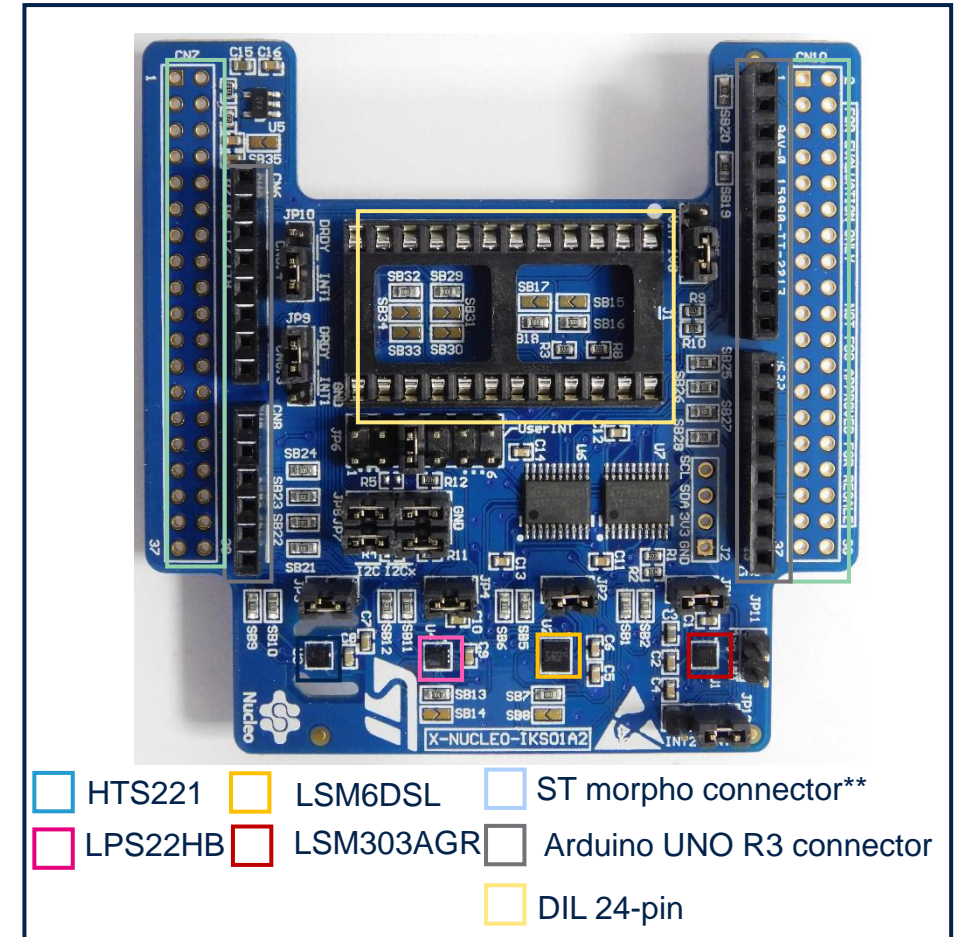
Latest info available at www.st.com
X-NUCLEO-IKS01A2

** Connector for the STM32 Nucleo Board

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STEVAL-STRKT01 evaluation board

STEVAL-STRKT01 Hardware Description

• The STEVAL-STRKT01 LoRa® IoT tracker is designed and optimized to implement the latest technologies in IoT tracker applications such as asset, people and animal tracking as well as fleet management. Thanks to the STM32L072CZ embedded in the CMWX1ZZABZ-091 LoRa® module (by Murata), it allows acquiring position from Teseo-LIV3F GNSS module and monitoring motion (LIS2DW12) and environmental (HTS221 and LPS22HB) sensors. The board also transmits and receives data to and from the cloud over a LoRaWAN™ network.

The STEVAL-STRKT01 is a LiPo battery operated solution and implements low power strategies thanks to an enhanced power/battery management design, based on the STBC02 battery charger and the ST1PS01 step-down converter, to ensure long battery autonomy. The STUSB1600A addresses 5 V USB Type-C port management and implements high voltage protection features against short-circuits to VBUS up to 28 V.

Latest info available at www.st.com
STEVAL-STRKT01
http://www.st.com/IoTLoraTracker

STEVAL-STRKT01 evaluation board

Key Products on board

CMWX1ZZABZ

LoRaTM module based on high-performance and low power ARM® Cortex®-M0 32-bit STM32L072 and SX1276 Semtech LoRa transceiver

TESEO-LIV3F

GNSS standalone module based on TESEO III

STBC02

Li-Ion linear battery charger with LDO, load switches and reset generator

ST1PS01EJR

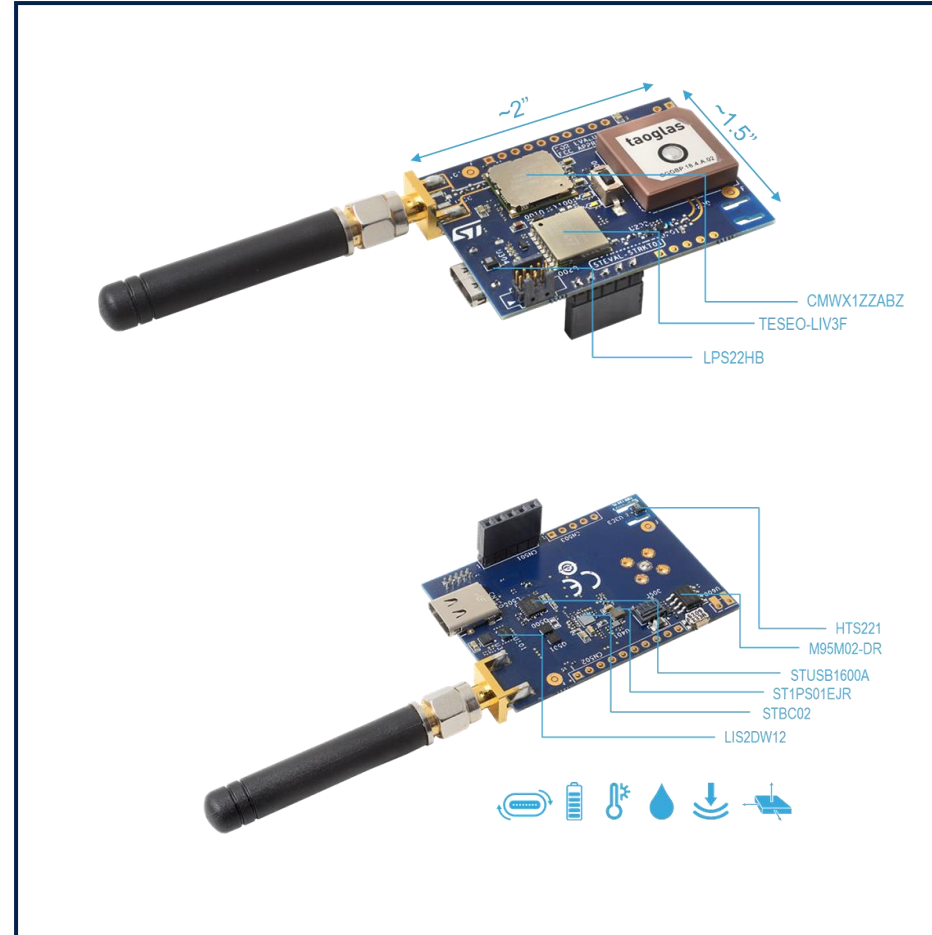400mA Nano-Quiescent™ Synchronous step-down converter with voltage selection and power good

STUSB1600A

USB Type-C controller

LIS2DW12, HTS221, LPS22HB

Motion and environmental sensors
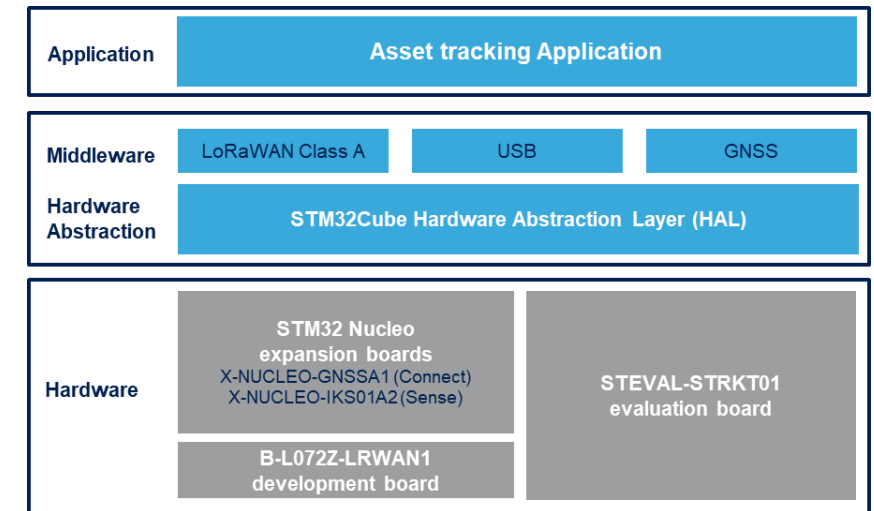
M95M02-DR

EEPROM

9

FP-ATR-LORA1 Software Description

FP-ATR-LORA1 is an STM32Cube function pack which lets you read data from environmental and motion sensors, retrieve geo-position from GNSS and send collected data via LoRaWAN connectivity.
The package implements low power profiles and related transitions to ensure long battery autonomy. This software together with the suggested combination of STM32 and ST devices can be used, for example, to develop asset tracking, fleet management and pet/child tracking applications.
The software runs on the STM32 microcontroller and includes drivers for the LoRa radio, Teseo-LIV3F GNSS module, the motion and environmental sensors, and the power management.

Key features

- Complete firmware to connect an IoT node to a LoRaWAN network, sending geo-position coming from GNSS and environmental and sensor data.

- Middleware library supporting LoRaWAN specification 1.0.2 class A and USB 2.0.

- Teseo-LIV3F based GNSS positioning and geofencing

- LoRaWAN keys provisioning via USB

- Power/Battery Management with low-power operating modes

- Datalogging on external EEPROM for STEVAL-STRKT01 and on internal RAM for B-L072Z-LRWAN1, with data download over-the-air or off-line via USB

- Sample implementation available for STEVAL-STRKT01 evaluation board and for X-NUCLEO-GNSS1A1 and X-NUCLEO-IKS01A2 expansion boards connected to a B-L072Z-LRWAN1 development board

Overall Software Architecture

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

Latest info available at www.st.com
FP-ATR-LORA1

2- Setup & Demo Example

HW prerequisites

- When using the LoRa IoT Tracker:
  - 1 x LoRa IoT Tracker (**STEVAL-STRKT01**)
  - 1 x Type-C cable
  - 1 x ST-LINK/NUCLEO BOARD

- Alternatively, when using the Discovery Kit LoRa:
  - 1x GNSS STM32 Nucleo expansion board based on Teseo-LIV3F module (**X-NUCLEO-GNSS1A1**) with GPS antenna
  - 1x motion mems and environmental sensors expansion board (**X-NUCLEO-IKS01A2**)
  - 1x STM32L0 Discovery kit LoRa (**B-L072Z-LRWAN1**)
- LoRa gateway (**Multitech Conduit**)
- Laptop/PC with Windows 7, 8 or 10
- 1 x micro USB cable, one Type-C USB cable and a Type-A to Type-C USB adapter is included in the box

STEVAL-STRKT01
(LoRa IoT Tracker)

ST-LINK/NUCLEO BOARD

B-L072Z-LRWAN1
(STM32L0 Discovery Kit

Multitech Conduit
LoRa gateway
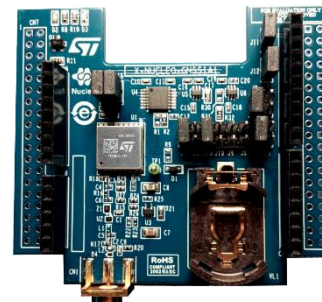
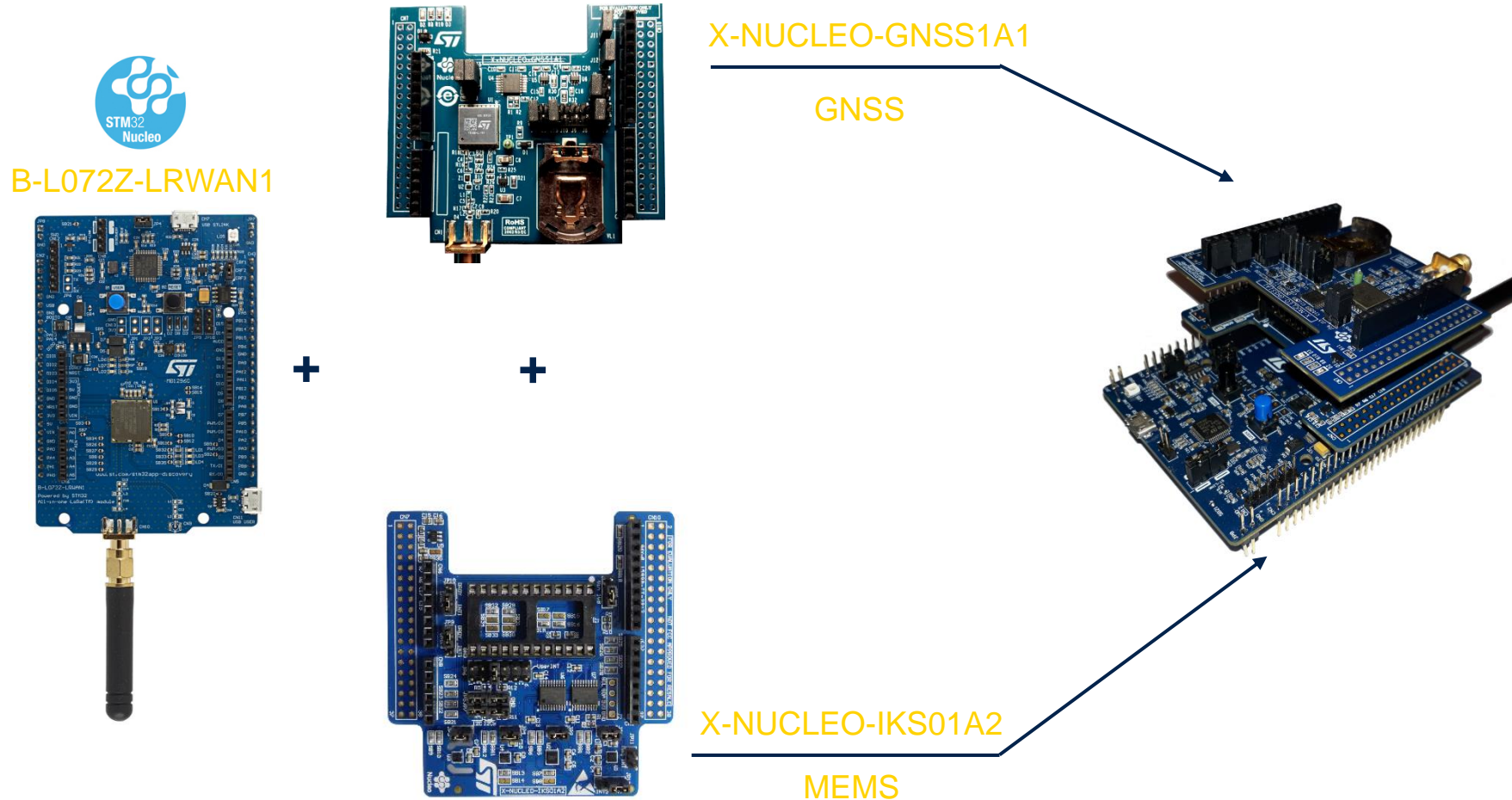MicroUSB Cable   X-NUCLEO-GNSS1A1
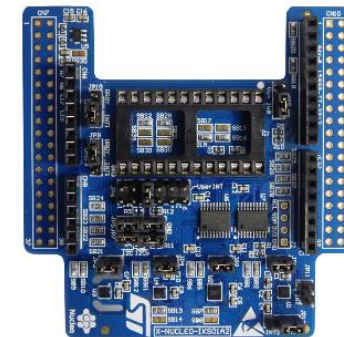
X-NUCLEO-IKS01A2

FP-ATR-LORA1 hardware setup
on STM32 discovery and Expansion boards

B-L072Z-LRWAN1

X-NUCLEO-GNSS1A1

GNSS

X-NUCLEO-IKS01A2

MEMS

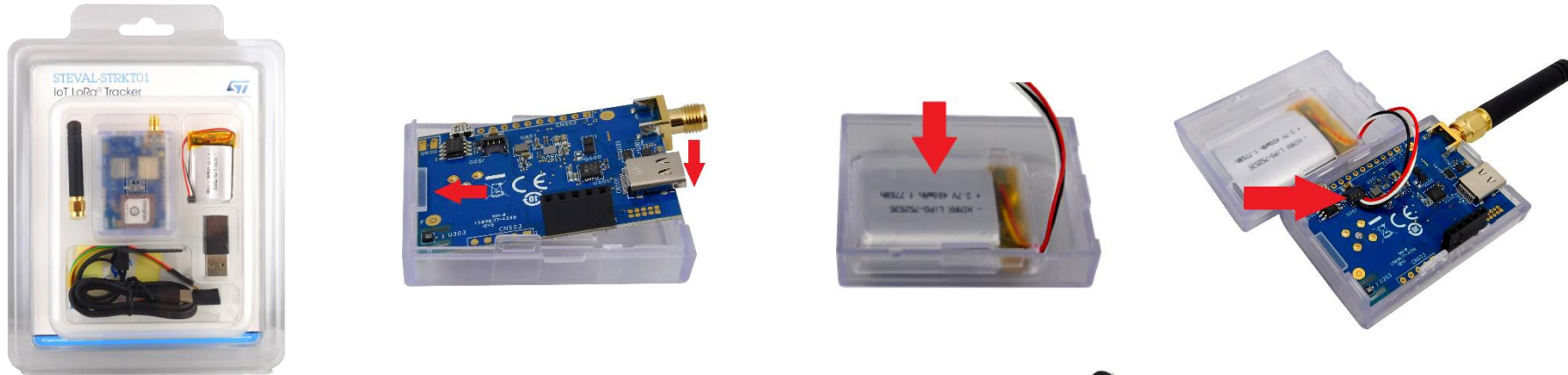# FP-ATR-LORA1 hardware setup on STM32 discovery and Expansion boards

Important hardware setup information

- On the X-NUCLEO-GNSS1A1 expansion board
  - the following jumpers must be open: J3, J5, J6, J7, J8 and J10.
  - the following jumpers must be closed: J2, J4, J9, J11, J12, J13, J14 and J15.

- On the X-NUCLEO-IKS01A2 expansion board, the solder bridge SB25 must be unsoldered.

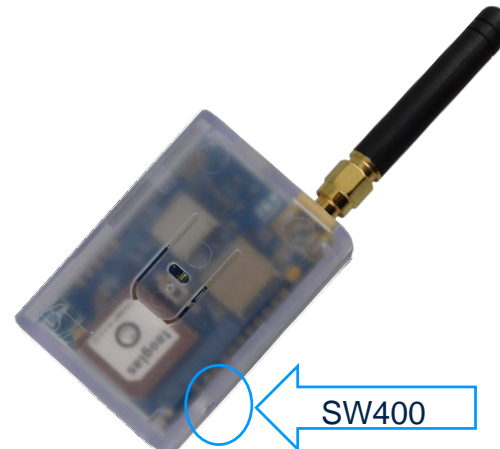- On the B-L072Z-LRWAN1 discovery board, the solder bridges SB32 and SB35 must be unsoldered.

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STEVAL-STRKT01 system start up

- Connect LoRa Antenna into J101 and assembly the board as follow

- Power on
 - Push SW400 (more than 1.25s)
  - Or plug USB cable

SW400

STEVAL-STRKT01 system start-up

Programming procedure:
- Use Nucleo board (e.g. NUCLEO-F401RE)
- Connect CN4(SWD) to CN501 of STEVAL-STRKT01 (by 5 poles cable or by plugging directly on the STlink connector. (Pin1 CON4 of ST-LINKV2 has to be connected to Pin5 CON 501 of STEVAL-STRKT01).
- Connect a USB A-to-TypeC adapter to the PC. Connect the typeC cable to the adapter.
- Remove NUCLEO-F401RE CN2 jumpers
- Connect the NUCLEO-F401RE BOARD to the PC through a USB A-to-miniB cable.
- Download the firmware (see next slide for details).

CN2 remove jumpers

SWD (Pin1)

PIN1 CON4 STLINK-V2 connected to PIN5 CON501 STEVAL-STRKT01

PIN1
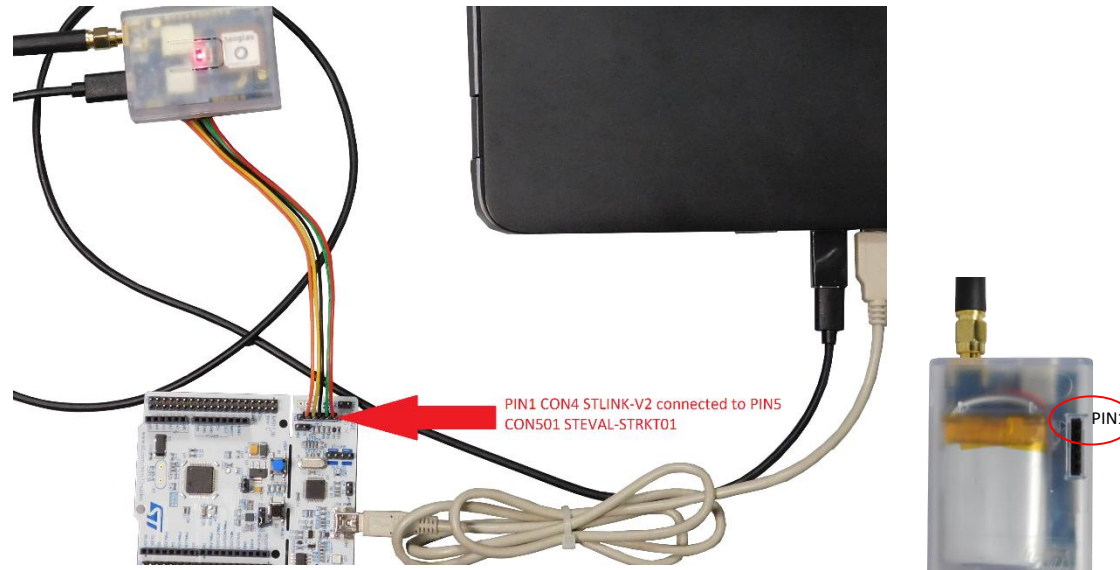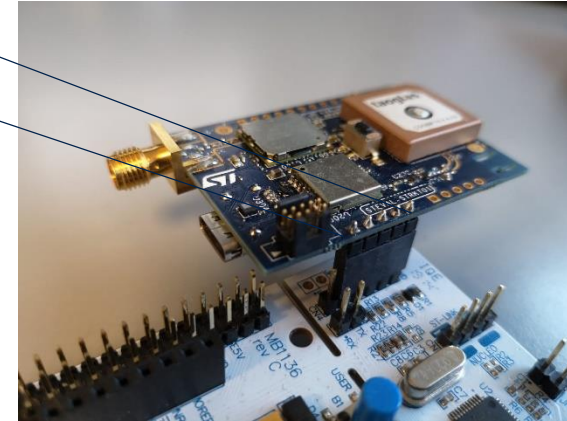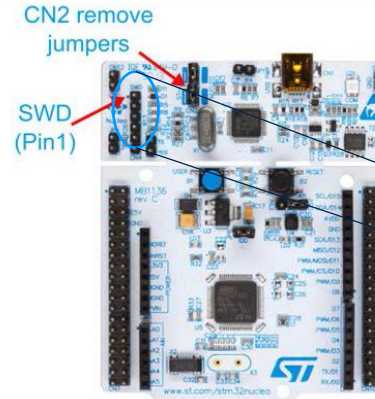
Setup & Application Examples
Software and Other prerequisites

- **STM32 ST-Link Utility**
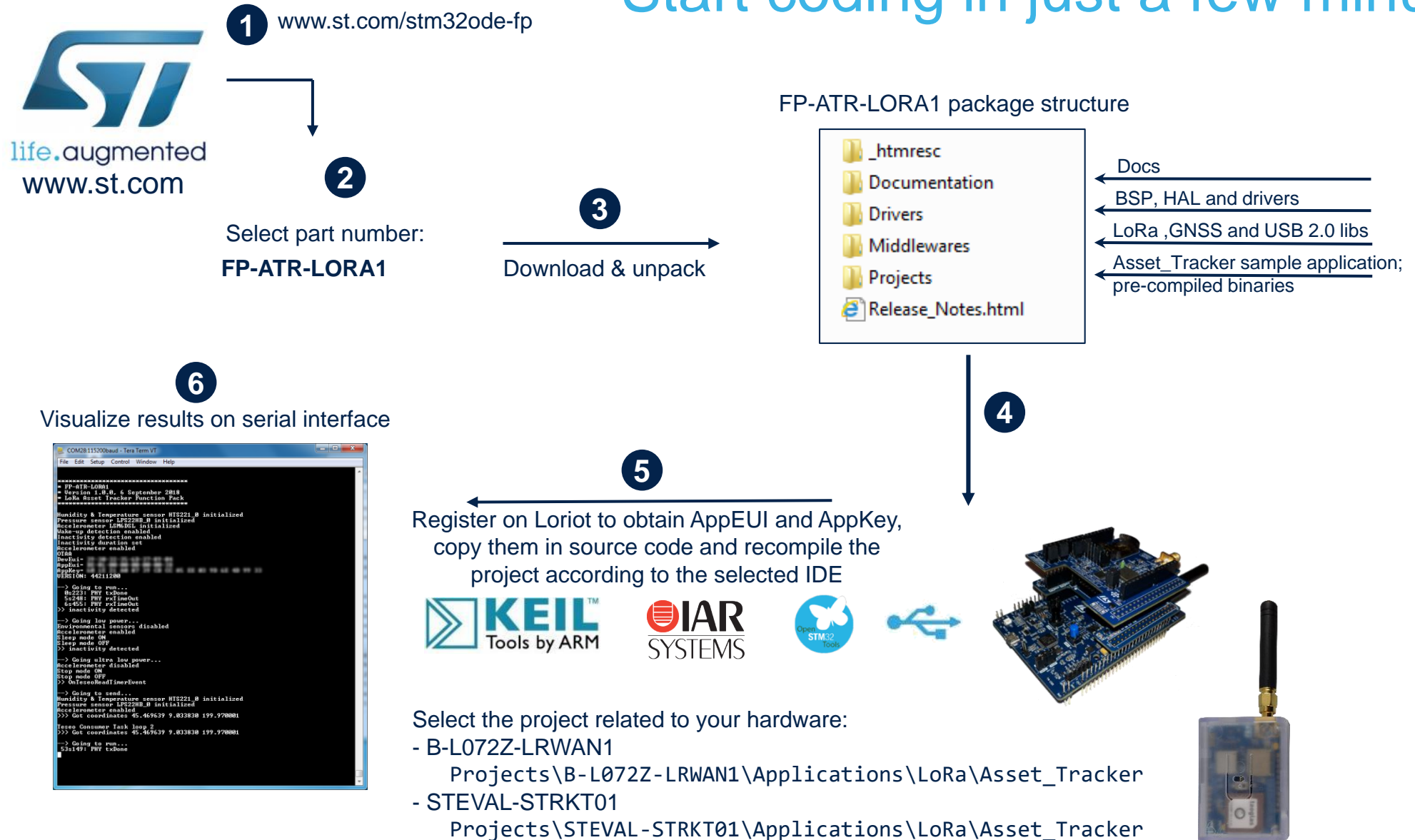 - Download and install STSW-LINK004 from www.st.com

- **FP-ATR-LORA1**
  - Download FP-ATR-LORA1 package from www.st.com
  - copy the .zip file content into a folder on your PC.
  - The package contains binaries and source code with project files for several IDEs (Keil, IAR, System Workbench) for B-L072Z-LRWAN1 discovery kit or STEVAL-STRKT01 evaluation board

- **Serial line monitor,** e.g. TeraTerm (https://ttssh2.osdn.jp/)

- Network server and application server accounts (for example refer to the help of the dashboard DSH-ASSETRACKING)

FP-ATR-LORA1. Sample applications
## Start coding in just a few minutes

1 www.st.com/stm32ode-fp

www.st.com

2

Select part number:

FP-ATR-LORA1

3

Download & unpack

FP-ATR-LORA1 package structure

- _htmresc
- Documentation ← Docs
- Drivers ← BSP, HAL and drivers
- Middlewares ← LoRa ,GNSS and USB 2.0 libs
- Projects ← Asset_Tracker sample application; pre-compiled binaries
- Release_Notes.html

4

6

Visualize results on serial interface

5

Register on Loriot to obtain AppEUI and AppKey, copy them in source code and recompile the project according to the selected IDE

KEIL Tools by ARM

IAR SYSTEMS

Open STM32 Tools

Select the project related to your hardware:
- B-L072Z-LRWAN1
    Projects\B-L072Z-LRWAN1\Applications\LoRa\Asset_Tracker
- STEVAL-STRKT01
   Projects\STEVAL-STRKT01\Applications\LoRa\Asset_Tracker

FP-ATR-LORA1: Step by step setup
Launch sample application. Use pre-compiled binaries

- Pre-compiled binary can be found at
  - B-L072Z-LRWAN1 discovery kit
    `Projects\B-L072Z-LRWAN1\Applications\LoRa\Asset_Tracker\Binary\mlm32l07x01.bin`
  - STEVAL-STRKT01 evaluation board
    - `Entire application FP-ATR-LORA1 for EU region (868MHz)`
      `Projects\STEVAL-STRKT01\Applications\LoRa\Asset_Tracker\Binary\STEVAL_STRKT01_868.bin`
    - `Entire application FP-ATR-LORA1 for US region (915MHz)`
      `Projects\STEVAL-STRKT01\Applications\LoRa\Asset_Tracker\Binary\STEVAL_STRKT01_915.bin`

  - To start the application, simply connect the board to your PC and drag&drop the binary on the folder dedicated to the STM32 device.
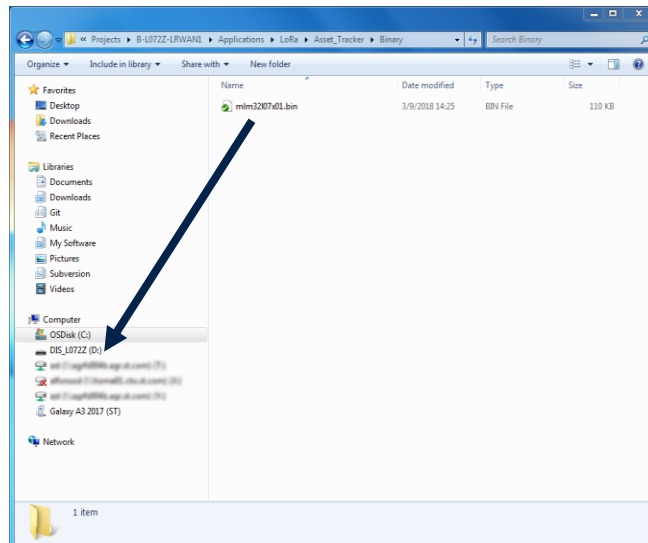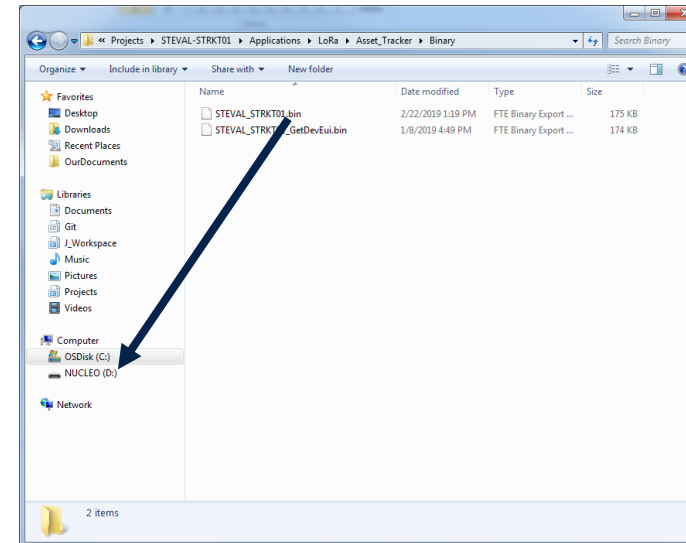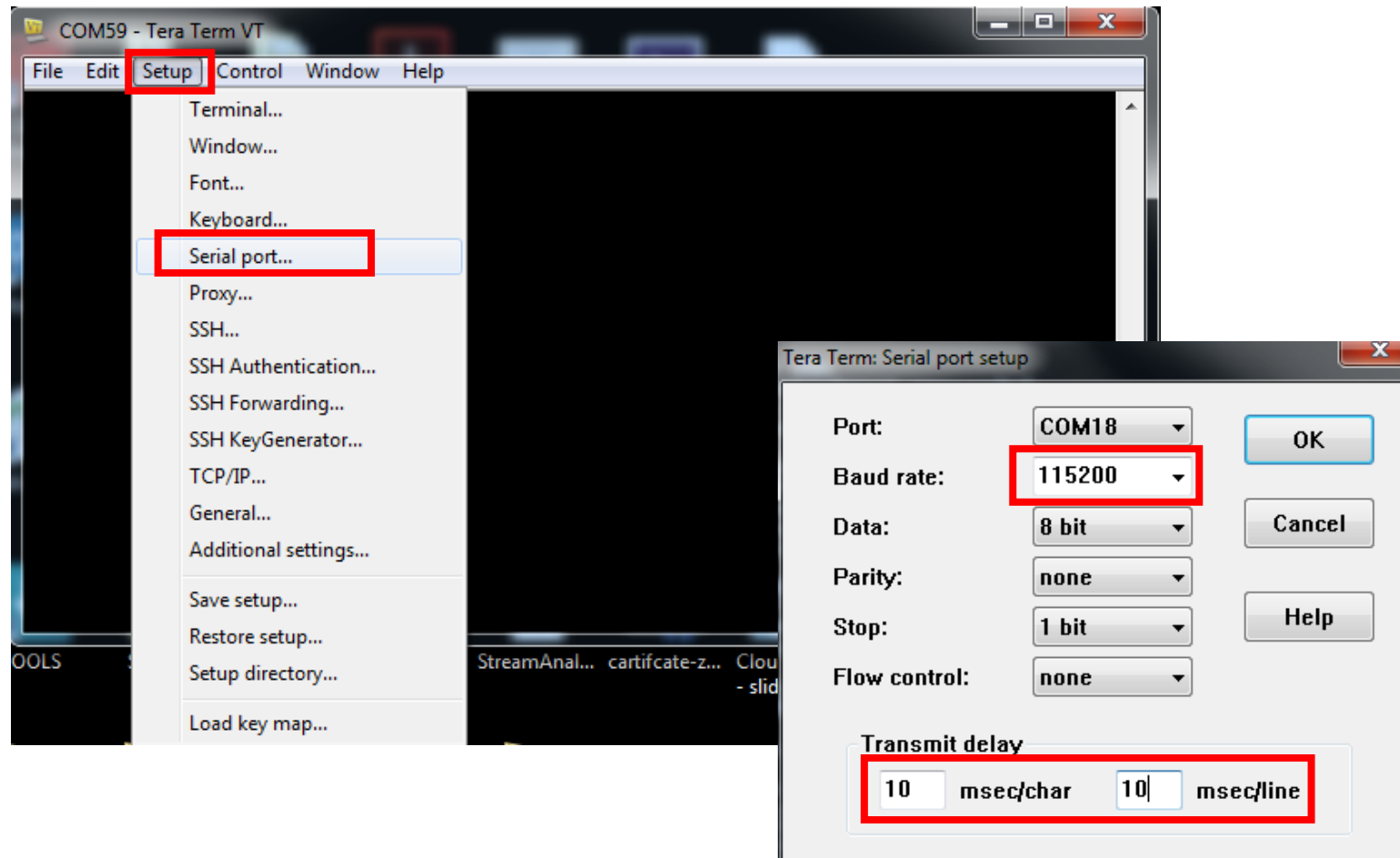
B-L072Z-LRWAN1   STEVAL-STRKT01

FP-ATR-LORA1: Step by step setup
## Launch sample application. Configure Serial Terminal

- Open serial terminal then configure baud rate speed to 115200 (**Setup → Serial port** in TeraTerm).

- Also set transmit delays to a value bigger than zero, like 10.

Launch sample application. Configure Serial Terminal

- In Terminal configuration (**Setup** → **Terminal** in TeraTerm) enable Local Echo and set newlines to AUTO for Receive and CR+LF for Transmit.
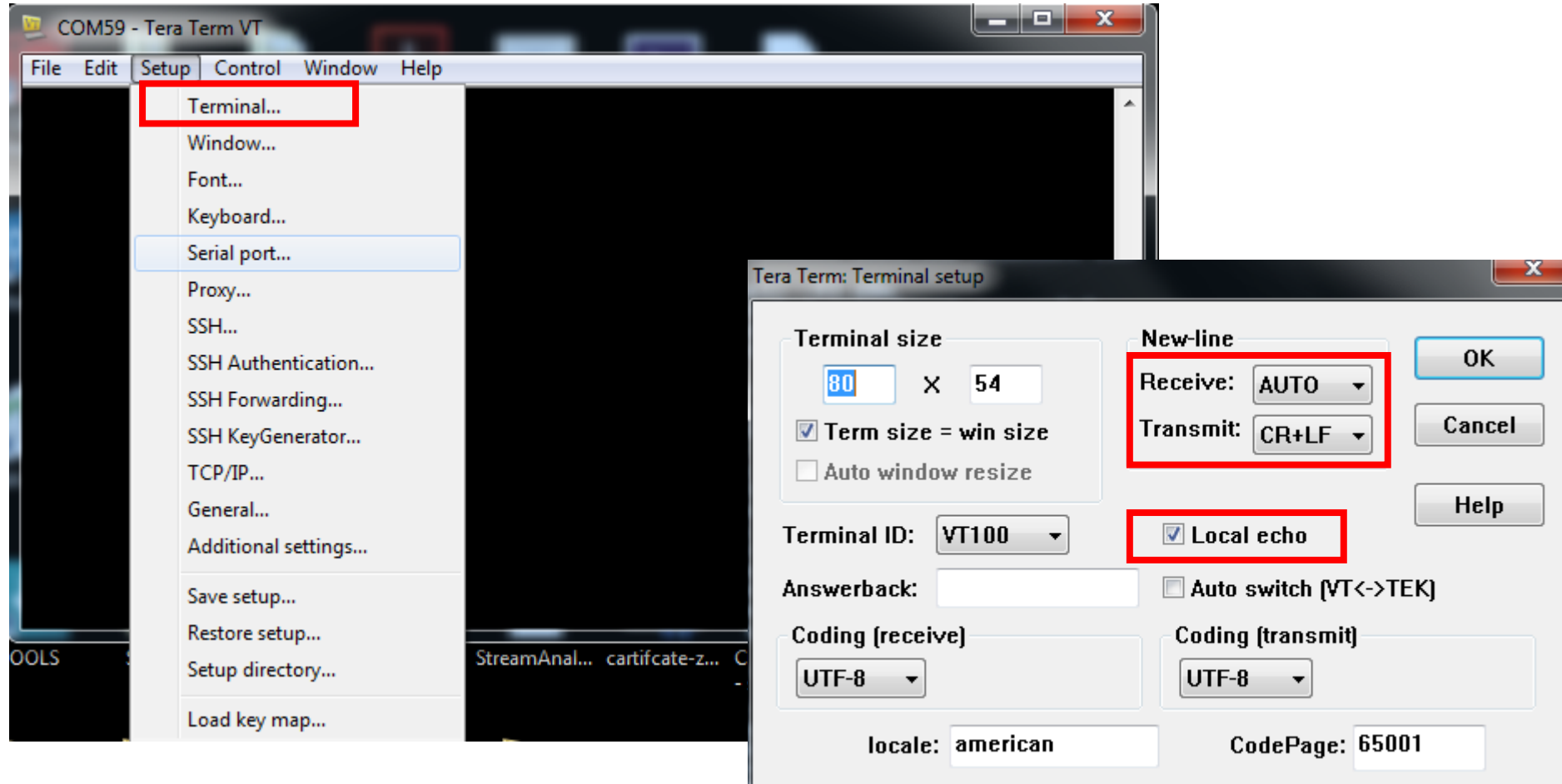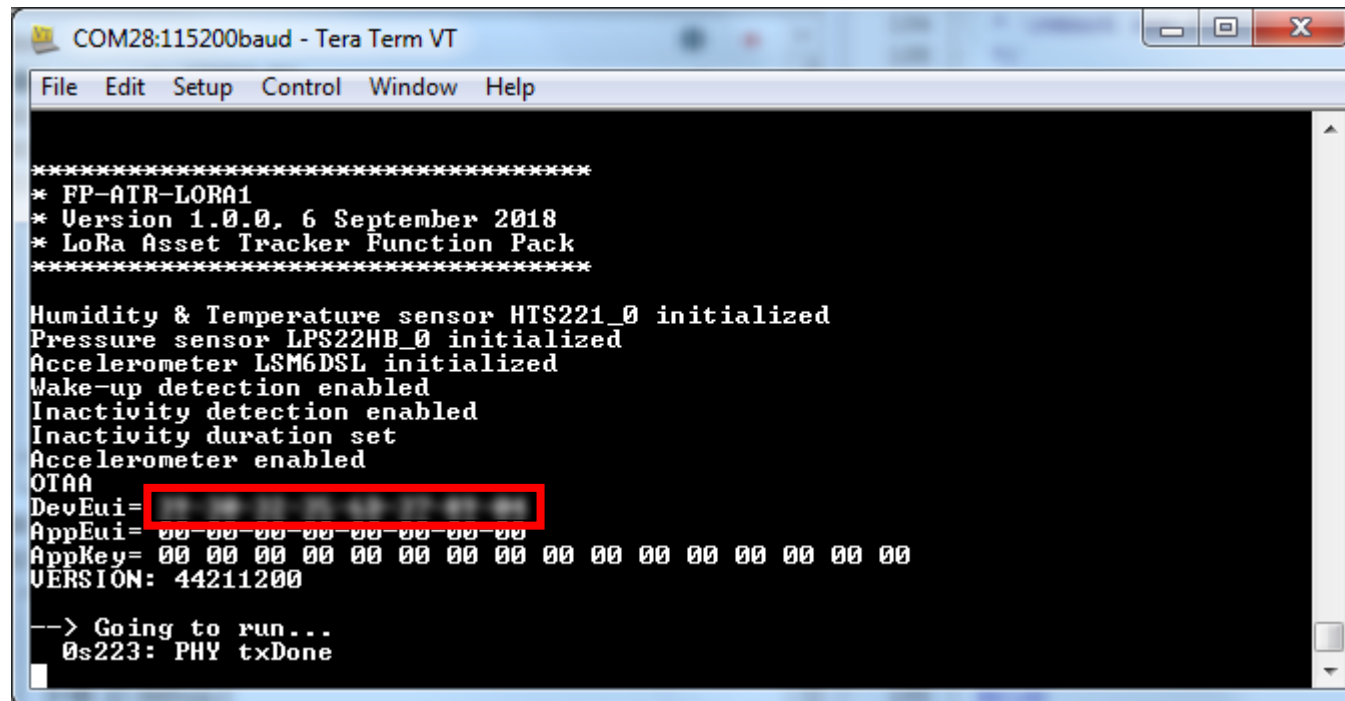
FP-ATR-LORA1: Step by step setup
LoRaWAN network setup

- Turn on your own LoRaWAN gateway already register on your chosen network server.

- The join procedure requires the end-device to be customized with:
    - DevEUI – for theFP-ATR-LORA1, we suggest to use the default DevEUI related to the STM32 MCU ID
    - JoinEUI - application EUI for v LoRaWAn 1.0.3 Specification or older
    - NwkKey
    - •AppKey - set at the same value of NwkKey for compatibility with Specs 1.0.2 and 1.1

- Usually the JoinEUI (AppEUI), NwkKey and AppKey are provided by the chosen network server once a newdevice is enrolled on a network server

- For example Loriot https://www.loriot.io or TTN https://www.thethingsnetwork.org/

FP-ATR-LORA1: Step by step setup
Launch sample application

- On first run, take note of the unique DevEUI string, which will be used later.

- AppEui and AppKey strings will be set later.

FP-ATR-LORA1: Step by step setup
Select B-L072-LRWAN1 or STEVAL-STRKT01 project

- Set LoRa keys at runtime, avoiding project rebuild; the keys are stored in the board's EEPROM for subsequent use.

- To do this, use the following commands on serial interface:
  - `!deviceeui-xxxxxxxxxxxxxxxx` to set Device EUI
  - `!joineui-xxxxxxxxxxxxxxxx` to set Application EUI
  - `!appkey-xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx` to set Application Key
  - `!ntwkkey-xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx` to set Network Key (usually same as Application Key).

- After that, restart the board with command `!sysreset`

IMPORTANT NOTE: All the above serial commands **MUST** be called

Select B-L072-LRWAN1 or STEVAL-STRKT01 project

- As an alternative, edit the project file to add the keys manually Lorawan/App/inc/Commissioning.h in the project related to your hardware (B-L072Z-LRWAN1 or STEVAL-STRKT01)

- Copy the AppEUI key after the `#define LORAWAN_JOIN_EUI`

- Copy the AppKey after the `#define LORAWAN_APP_KEY` and `#define LORAWAN_NWK_KEY`

- Recompile

```
/*!
 * App/Join server IEEE EUI (big endian)
 */
#warning Add here the AppEUI from Loriot site
#define LORAWAN_JOIN_EUI                    { 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 } // LorIOT

/*!
 * Application root key
 * WARNING: NOT USED FOR 1.0.x DEVICES
 */
#warning Add here the Application Key from Loriot site
#define LORAWAN_APP_KEY                     { 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 }

/*!
 * Network root key
 * WARNING: FOR 1.0.x DEVICES IT IS THE \ref LORAWAN_APP_KEY
 */
#warning This must be copied from LORAWAN_APP_KEY
#define LORAWAN_NWK_KEY                     { 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 }
```
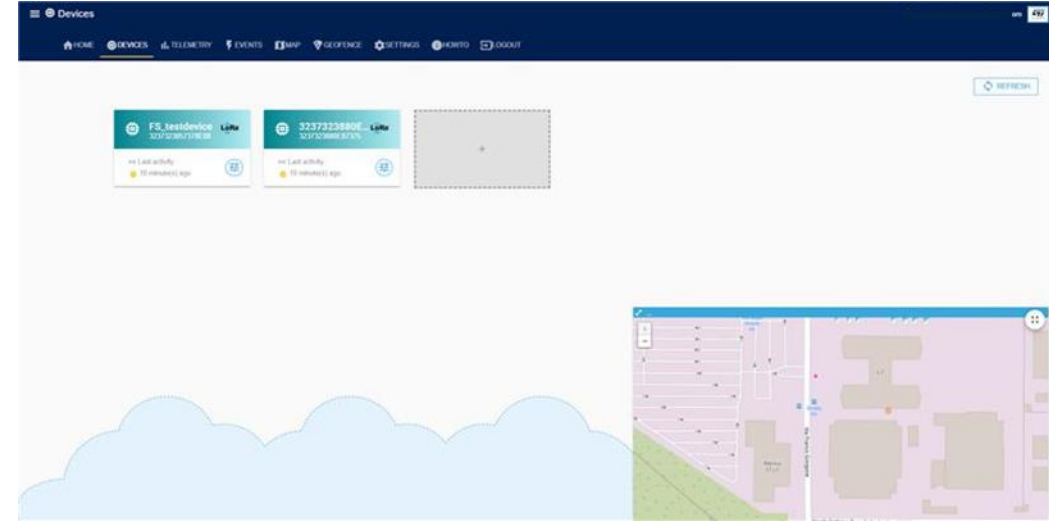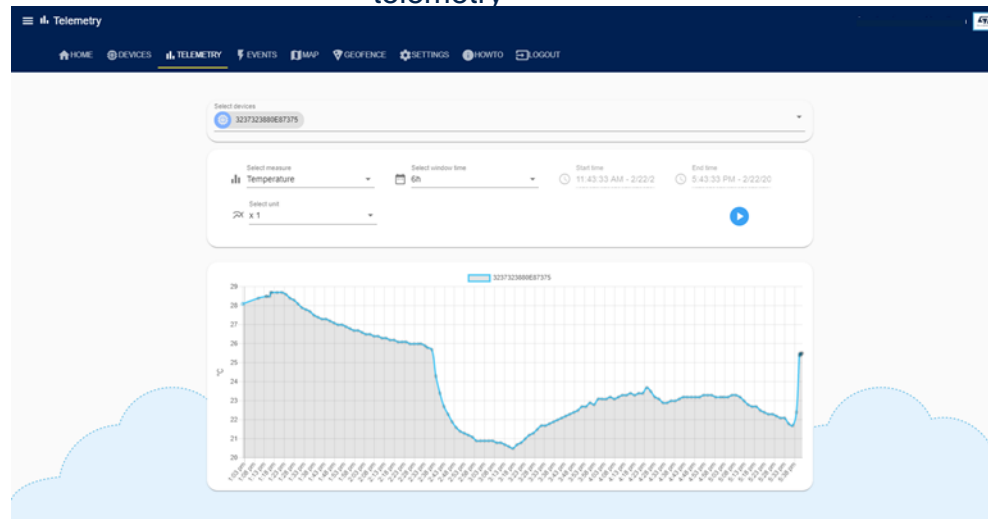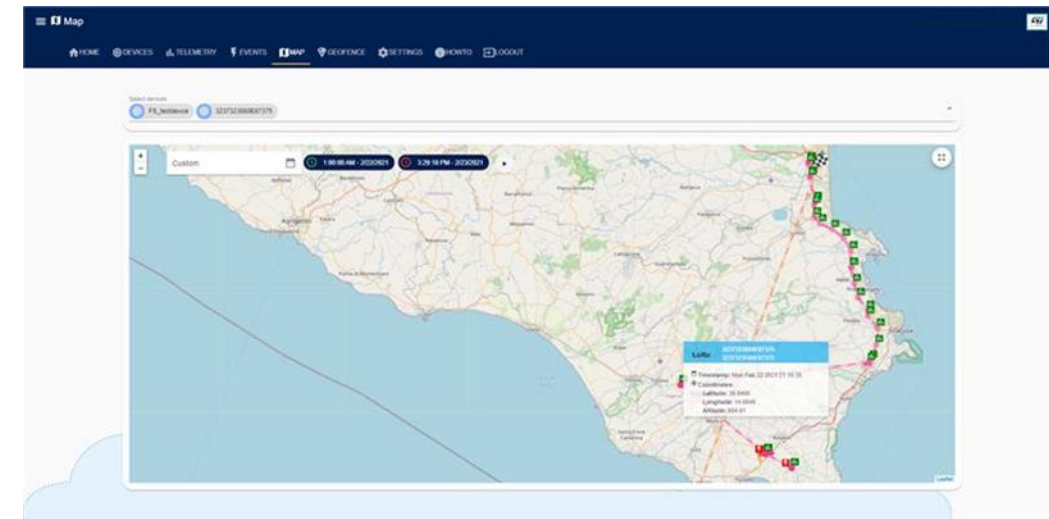
FP-ATR-LORA1: Step by step setup
ST-ASSET TRACKING DASHBOARD OVERVIEW

main view

device view

telemetry

https://dsh-assetracking.st.com/#/home
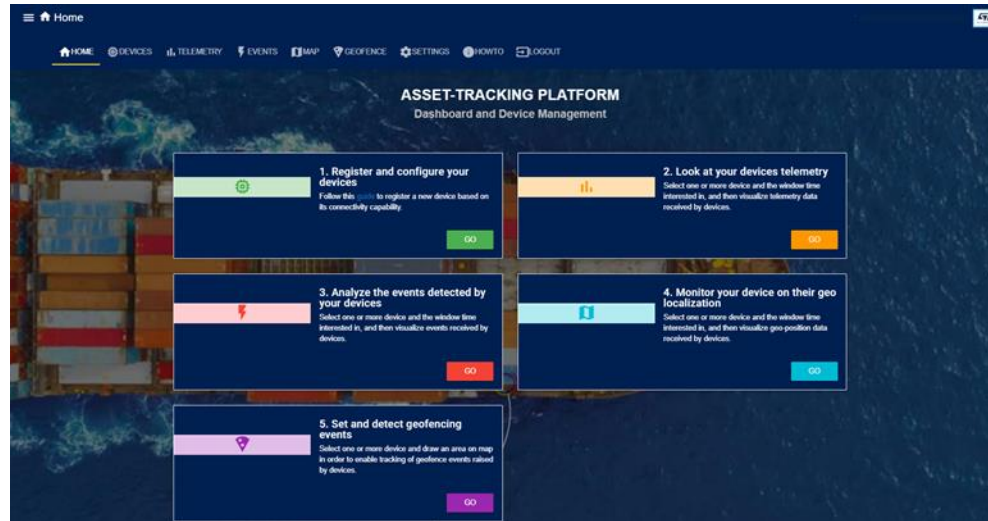
3- Documents & Related Resources

Documents & Related Resources

All documents are available in the DESIGN tab of the related products webpage

FP-ATR-LORA1:

- **DB3715:** STM32Cube function pack for IoT tracker node with LoRa connectivity, GNSS and sensors – **data brief**
- **UM2487:** Getting started with STM32Cube function pack for IoT tracker node with LoRa connectivity, GNSS and sensors – **user manual**
- Software setup file

DSH-ASSETRACKING:

- **DB4207:** Cloud Amazon-based web application for asset tracking **– data brief**

X-NUCLEO-GNSS1A1:

- Gerber files, BOM, Schematic
- **DB3458**: GNSS expansion board based on Teseo-LIV3F module for STM32 Nucleo – **data brief**
- **UM2327**: Getting started with the X-NUCLEO-GNSS1A1 expansion board based on Teseo-LIV3F tiny GNSS module for STM32 Nucleo – **user manual**
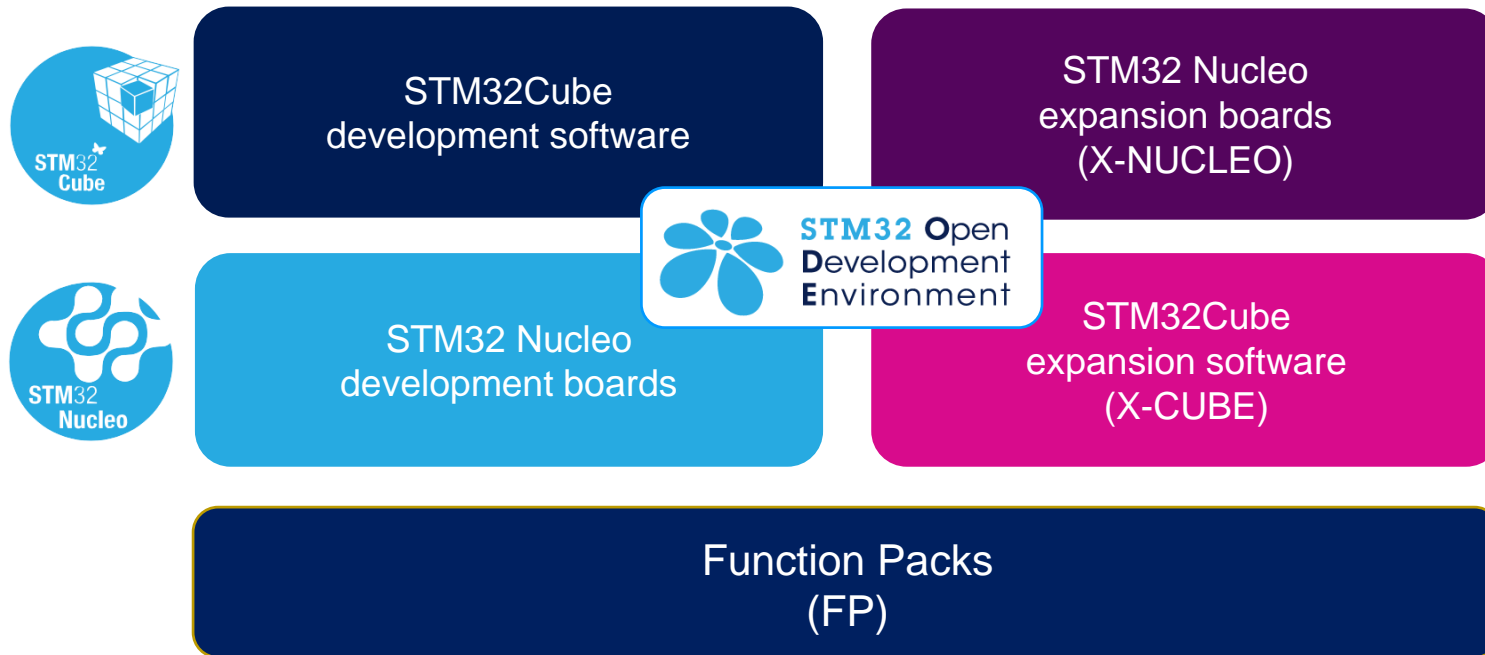
X-NUCLEO-IKS01A2:

- Gerber files, BOM, Schematic
- **DB3009:** Motion MEMS and environmental sensor expansion board for STM32 Nucleo – **data brief**
- **UM2121:** Getting started with the X-NUCLEO-IKS01A2 motion MEMS and environmental sensor expansion board for STM32 Nucleo – **user manual**

Consult www.st.com for the complete list

4- STM32 Open Development Environment: Overview

STM32 Open Development Environment
Fast, affordable Prototyping and Development

- The STM32 Open Development Environment (STM32 ODE) is an open, flexible, easy, and affordable way to develop innovative devices and applications based on the STM32 32-bit microcontroller family combined with other state-of-the-art ST components connected via expansion boards. It enables fast prototyping with leading-edge components that can quickly be transformed into final designs

STM32Cube development software	STM32 Nucleo expansion boards (X-NUCLEO)
STM32 Nucleo development boards	STM32Cube expansion software (X-CUBE)

STM32 Open **D**evelopment **E**nvironment

Function Packs
(FP)

For further information, please visit www.st.com/stm32ode

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Thank you

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