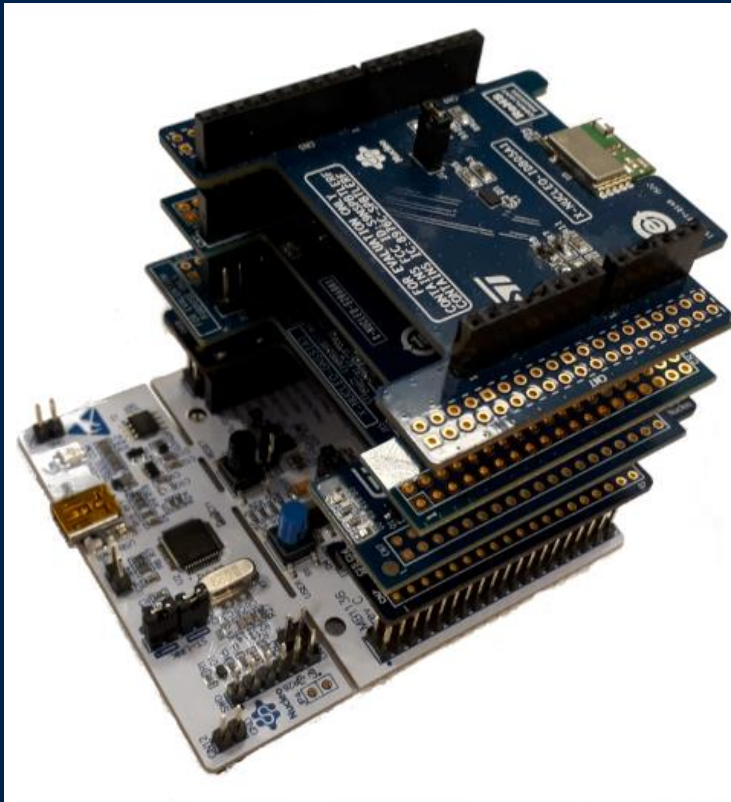# Quick Start Guide

STM32Cube Function Pack for IoT Tracker node with Sigfox connectivity, Bluetooth connectivity and Sensors
(FP-ATR-SIGFOX1)

Version 3.2 (April 30, 2021)

Agenda

1 Hardware and Software overview

2 Setup & Demo Examples

3 Documents & Related Resources

4 STM32 Open Development Environment: Overview

1- Hardware and Software overview

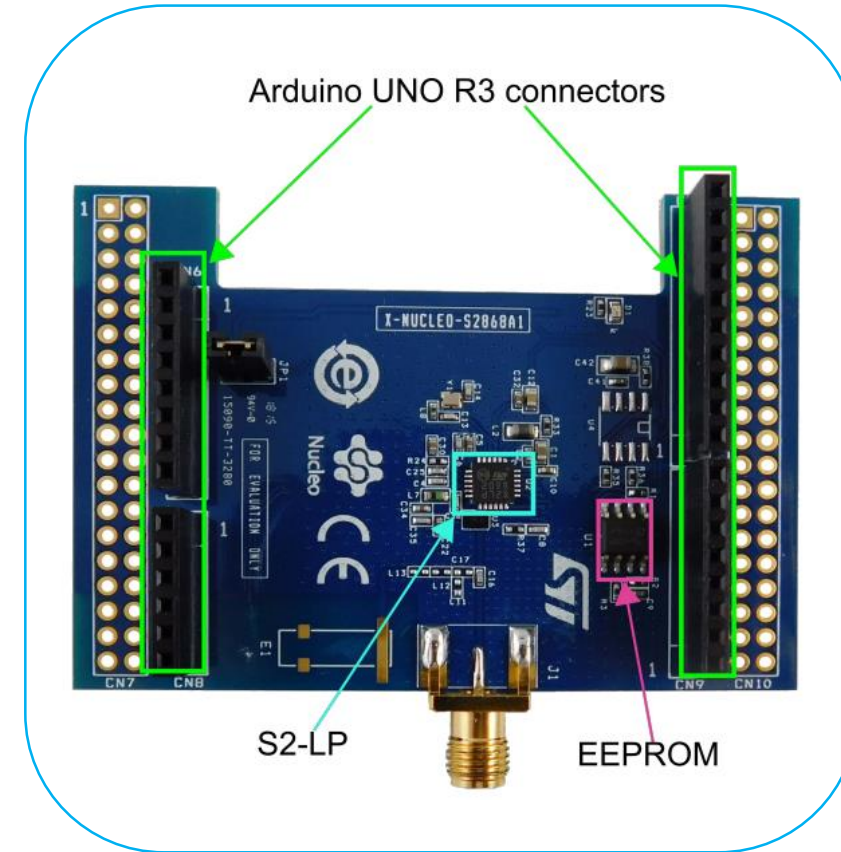# Sub-1 GHz 868 MHz RF expansion board
Hardware Overview

X-NUCLEO-S2868A1 Hardware Description

- The X-NUCLEO-S2868A1 expansion board is based on the S2-LP radio and operates in the 868 MHz ISM frequency band.

- The expansion board is compatible with ST morpho and Arduino UNO R3 connectors.

- The X-NUCLEO-S2868A1 interfaces with the STM32 Nucleo microcontroller via SPI connections and GPIO pins. You can change some of the GPIOs by mounting or removing the resistors.

Key Products on board

S2-LP
narrow band ultra-low power sub-1 GHz transceiver tuned for 860 - 940 MHz frequency band

Latest info available at www.st.com
X-NUCLEO-S2868A1

life.augmented

Sub-1 GHz 868 MHz RF expansion board
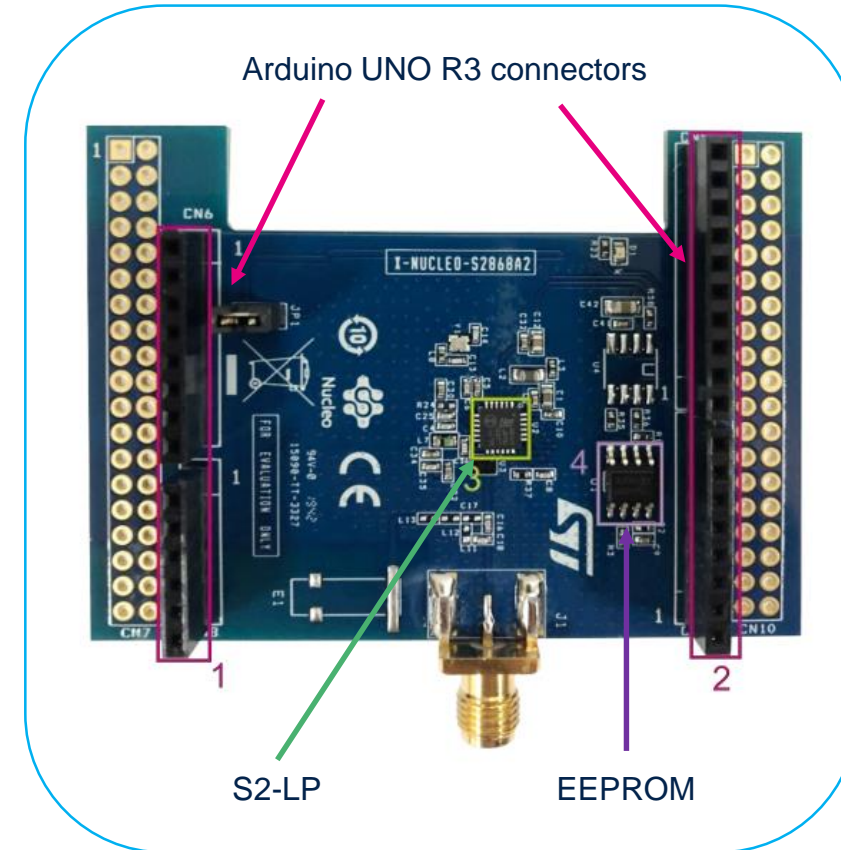## Hardware Overview

X-NUCLEO-S2868A2 Hardware Description

- The X-NUCLEO-S2868A2 expansion board is based on the S2-LP ultra-low power RF transceiver and operates in the 868 MHz ISM frequency band.

- The X-NUCLEO-S2868A2 interfaces with the STM32 Nucleo microcontroller via SPI connections and GPIO pins. You can change some of the GPIOs by mounting or removing the resistors.

- The expansion board is compatible with ST morpho and Arduino UNO R3 connectors.

Key Products on board

S2-LP
narrow band ultra-low power sub-1 GHz transceiver tuned for 860 - 940 MHz frequency band

Arduino UNO R3 connectors

S2-LP   EEPROM

Latest info available at www.st.com
X-NUCLEO-S2868A2

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Sub-1 GHz 915 MHz RF expansion board
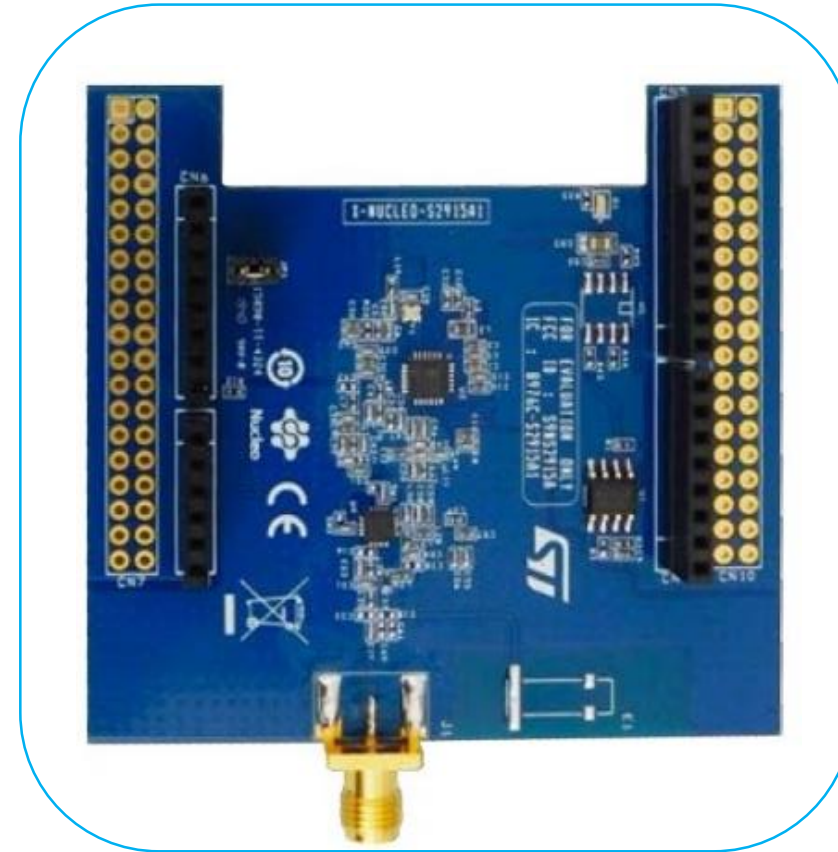## Hardware Overview

X-NUCLEO-S2915A1 Hardware Description

- The X-NUCLEO-S2915A1 expansion board is based on the S2-LP radio and operates in the 915 MHz ISM frequency band.

- The expansion board is compatible with ST morpho and Arduino UNO R3 connectors.

- The X-NUCLEO-S2915A1 interfaces with the STM32 Nucleo microcontroller via SPI connections and GPIO pins. You can change some of the GPIOs by mounting or removing the resistors.

Key Products on board

S2-LP
narrow band ultra-low power sub-1 GHz transceiver tuned for 860 - 940 MHz frequency band

Latest info available at www.st.com
X-NUCLEO-S2915A1

Bluetooth Low Energy Expansion Board
Hardware Overview

X-NUCLEO-IDB05A1 Hardware Description

- The X-NUCLEO-IDB05A1 is a Bluetooth Low Energy (BLE) evaluation and development board system, designed around ST's SPBTLE-RF Bluetooth Low Energy module based on BlueNRG-MS.

- The BlueNRG-MS processor hosted in the SPBTLE-RF module communicates with the STM32 Nucleo developer board host microcontroller though an SPI link available on the Arduino UNO R3 connector.

Key Products on board

SPBTLE-RF
Bluetooth Low Energy, FCC and IC certified, module based on Bluetooth® Low Energy wireless network processor BlueNRG-MS, BLE4.1 compliant. SPBTLE-RF integrates a BALF-NRG-01D3 balun and a chip antenna. It embeds 32 MHz and 32.768 kHz crystal oscillators for the BlueNRG-MS.

M95640-R
64-Kbit serial SPI bus EEPROM with high-speed clock interface
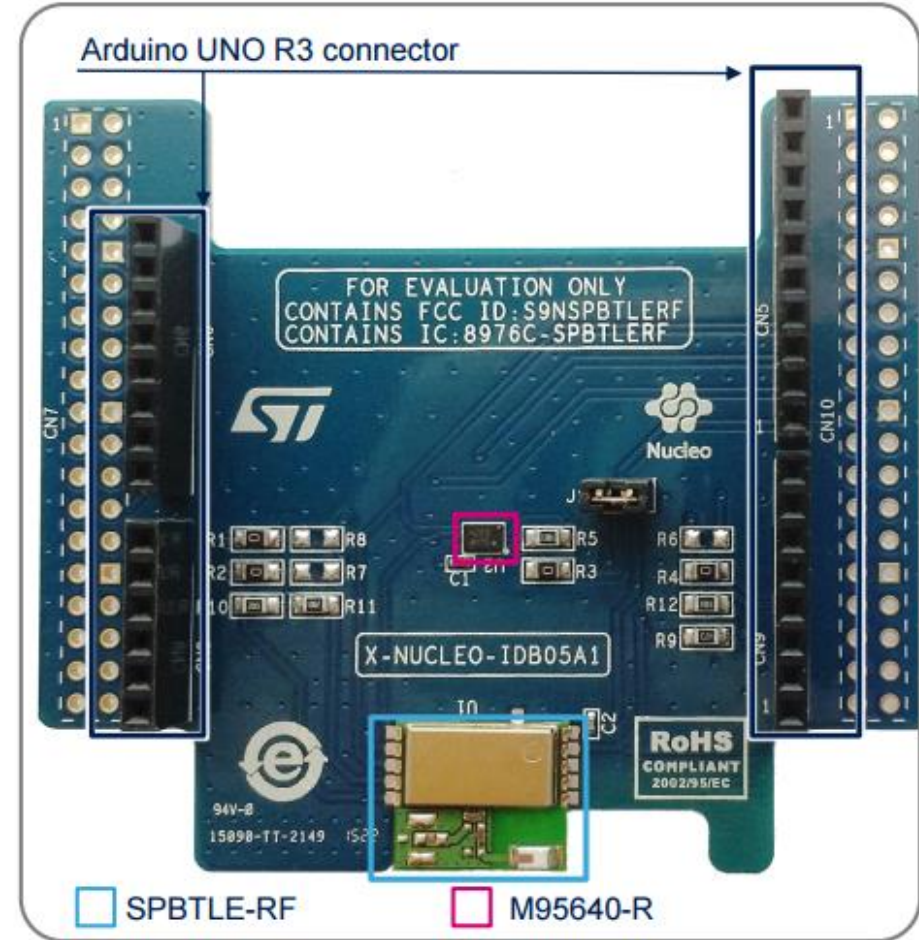
Latest info available at www.st.com
X-NUCLEO-IDB05A1
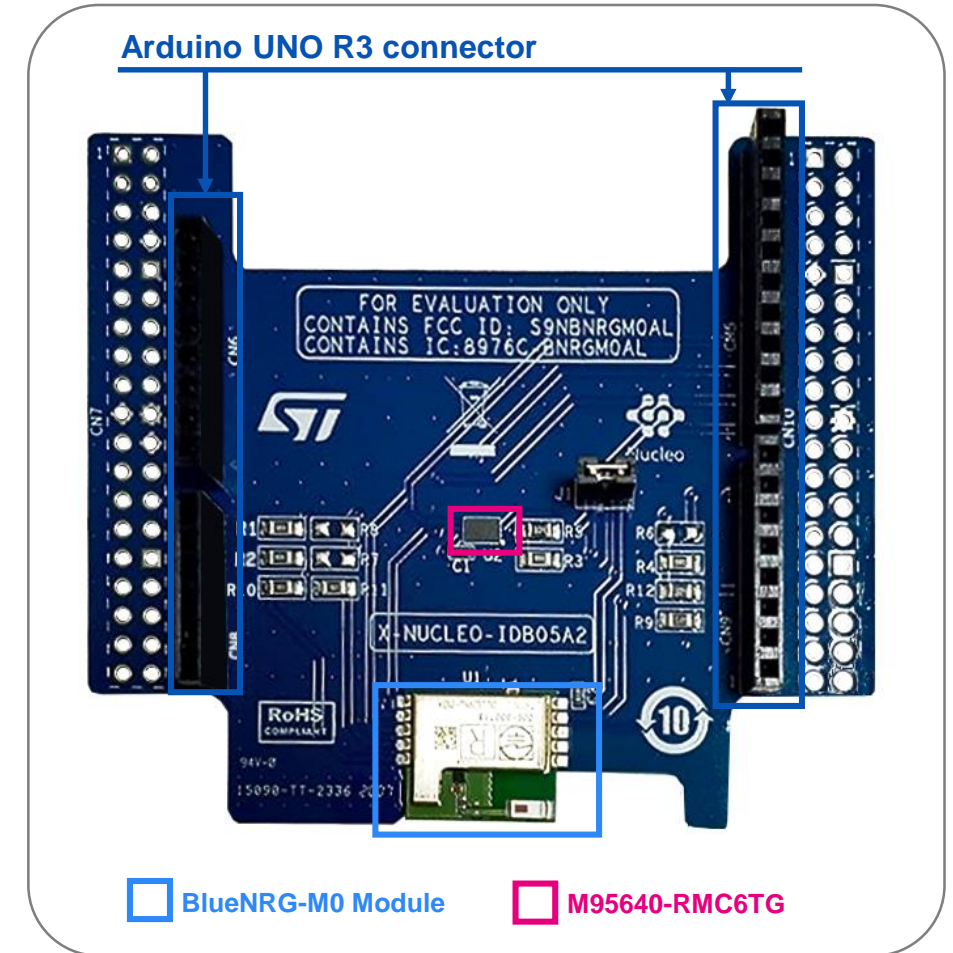
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Bluetooth Low Energy Expansion Board
Hardware Overview

X-NUCLEO-IDB05A2 Hardware Description

- The X-NUCLEO-IDB05A2 Bluetooth low energy expansion board is based on the BlueNRG-M0 BLE network processor module.

- The BlueNRG-M0 is Bluetooth v4.2 compliant. It supports simultaneous master/slave roles and can behave as a Bluetooth low energy sensor and hub device at the same time.

- The BlueNRG-M0 provides a complete RF platform in a tiny form factor, with integrated radio, antenna, high frequency and LPO oscillators.

Key Product on board

- STM32 Nucleo expansion board based on the BlueNRG-M0 Bluetooth v4.2 compliant, FCC and IC certified module (FCC ID: S9NBNRGM0AL; IC: 8976C-BNRGM0AL)
- BlueNRG-M0 main features:
    - Embedded Bluetooth low energy protocol stack (GAP, GATT, SM, L2CAP, LL, RFPHY)
    - Embedded BlueNRG-MS network processor
    - On-board chip antenna
- M95640-RMC6TG 64-Kbit serial SPI bus EEPROM with high-speed clock interface

Arduino UNO R3 connector

FOR EVALUATION ONLY
CONTAINS FCC ID: S9NBNRGM0AL
CONTAINS IC:8976C-BNRGM0AL

X-NUCLEO-IDB05A2

RoHS Compliant

□ BlueNRG-M0 Module   □ M95640-RMC6TG

Latest info available at www.st.com
X-NUCLEO-IDB05A2

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ST Restricted

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Motion MEMS and environmental sensors expansion board
Hardware Overview

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
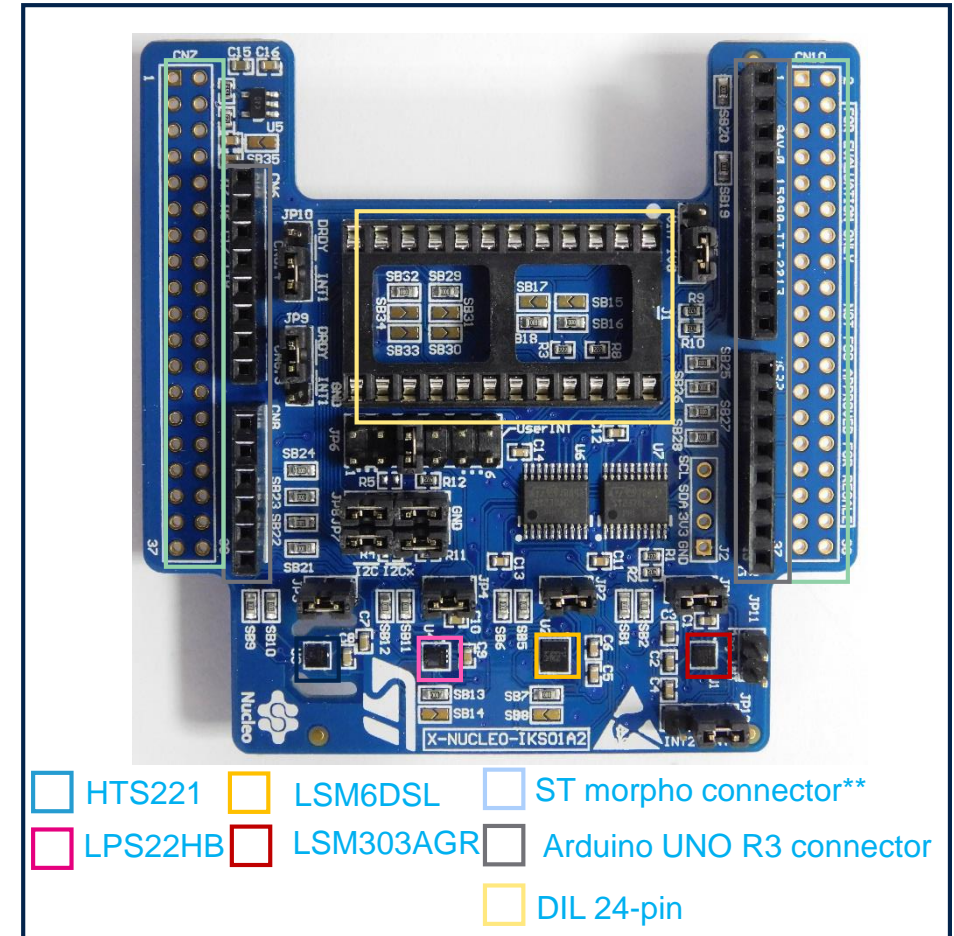
Latest info available at www.st.com
X-NUCLEO-IKS01A2

** Connector for the STM32 Nucleo Board

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Motion MEMS and environmental sensors expansion board
Hardware Overview

X-NUCLEO-IKS01A3 Hardware description

- The X-NUCLEO-IKS01A3 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 products on board

LSM6DSO
MEMS 3D accelerometer (±2/±4/±8/±16 g) + 3D gyroscope (±125/±250/±500/±1000/±2000 dps)

LIS2DW12
MEMS 3D accelerometer (±2/±4/±8/±16 g)

LIS2MDL
MEMS 3D magnetometer (±50 gauss)

LPS22HH
MEMS pressure sensor, 260-1260 hPa absolute digital output barometer

HTS221
Capacitive digital relative humidity and temperature

STTS751
Digital Temperature sensor

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

☐ HTS221   ☐ LSM6DSO   ☐ ST morpho connector**
☐ LPS22HH   ☐ LIS2DW12   ☐ Arduino UNO R3 connector
☐ LIS2MDL   ☐ STTS751   ☐ DIL 24-pin
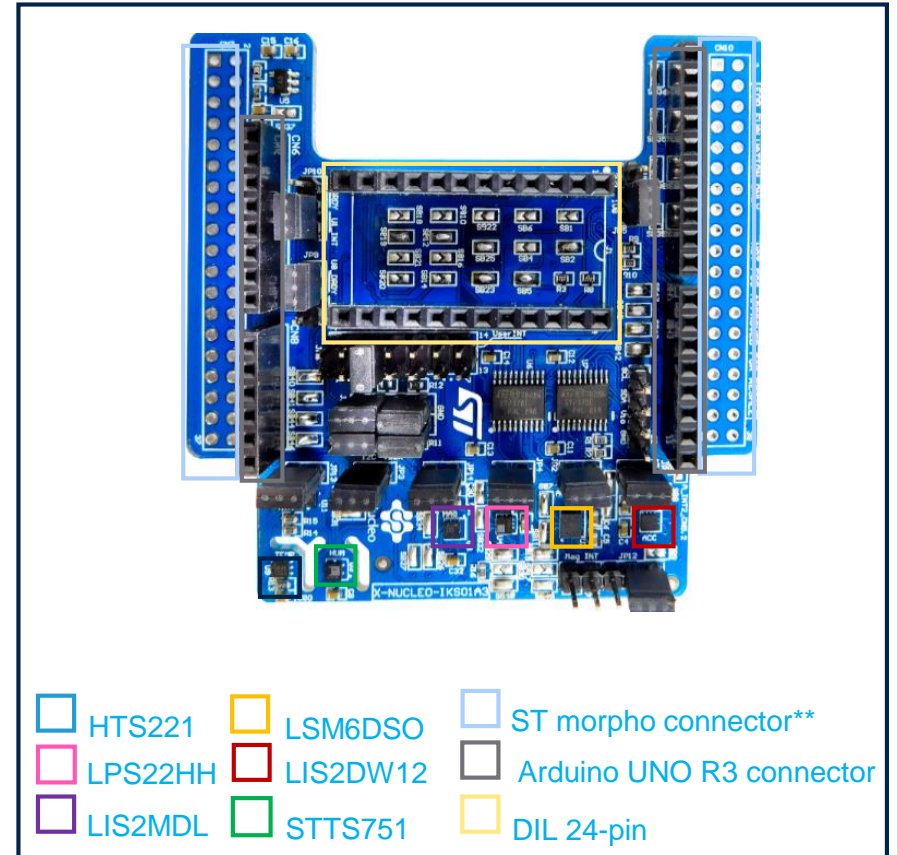
Latest info available at www.st.com
X-NUCLEO-IKS01A3

** Connector for the STM32 Nucleo Board

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Hardware Overview

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   ☐ Battery holder
☐ Antenna connector   ☐ Arduino UNO R3 Connectors
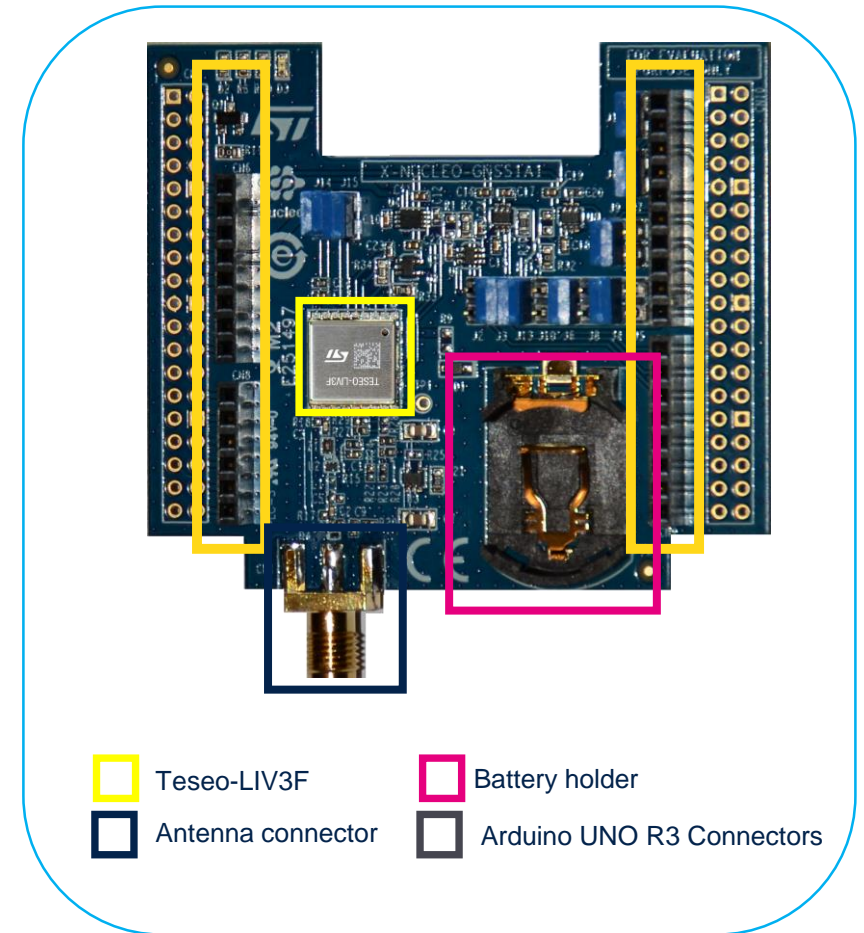
Latest info available at www.st.com
X-NUCLEO-GNSS1A1

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FP-ATR-SIGFOX1 Software Description

FP-ATR-SIGFOX1 is a STM32Cube Function Pack that lets you read data from GNSS and environmental sensors and send this information via a Sigfox connectivity. Message sending is triggered by either user button pressing, by timer event or by threshold crossing events on environmental values or movement detection by the on-board accelerometer. Thresholds can be set using the ST Asset Tracking mobile app and transmitted to the firmware by Bluetooth Low Energy 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 is intended particularly to develop asset tracking applications. In addition to GNSS geolocation, Low-energy device geolocation is a service provided by the Sigfox infrastructure.

The software runs on the STM32 microcontroller and includes drivers for the S2-LP ultra-low power RF transceiver, the Bluetooth, the GNSS and the motion and environmental sensors

Key features

- Complete firmware to connect an IoT node to a Sigfox network and sending environmental sensor data.
- Drivers for the S2-LP high performance ultra-low power RF transceiver, intended for RF wireless applications in the sub-1 GHz band.
- Wake-up, tilt and orientation detection by the on-board accelerometer.
- Middleware library supporting Sigfox connectivity from package X-CUBE-SFXS2LP1 and Bluetooth connectivity from package X-CUBE-BLE1.
- GNSS location and low-energy device geolocation service provided by the Sigfox infrastructure.
- Easy portability across different MCU families, thanks to STM32Cube
- Free, user-friendly license terms

FP-ATR-SIGFOX1
Software Overview

Overall Software Architecture

Application	FP-ATR-SIGFOX1			
Middleware	Sigfox	GNSS	BlueNRG	FreeRTOS
Hardware Abstraction	Board support package (BSP)		Hardware abstraction layer (HAL)	
Hardware	Sensors	S2-LP	BLE	Teseo-LIV3F

STM32 Nucleo expansion boards
X-NUCLEO-S2868A1/X-NUCLEO-S2868A2/X-NUCLEO-S2915A1
X-NUCLEO-IKS01A2/X-NUCLEO-IKS01A3
X-NUCLEO-IDB05A1/X-NUCLEO-IDB05A2
X-NUCLEO-GNSS1A1
STM32 Nucleo development boards
NUCLEO-L073RZ/NUCLEO-L476RG

Latest info available at www.st.com
FP-ATR-SIGFOX1

2- Setup and demo examples

- 1x Sub-1 GHz expansion board (**X-NUCLEO-S2868A1/A2** or **X-NUCLEO-S2915A1**) with antenna

- 1x Bluetooth Low Energy Expansion Board (**X-NUCLEO-IDB05A1** or **X-NUCLEO-IDB05A2**) (<u>OPTIONAL</u>)

- 1x Motion MEMS and environmental sensors expansion board (**X-NUCLEO-IKS01A2** or **X-NUCLEO-IKS01A3**)

- 1x GNSS sensor expansion board (**X-NUCLEO-GNSS1A1**)

  1x STM32 Nucleo development board (**NUCLEO-L073RZ** or **NUCLEO-L476RG**)

- Laptop/Desktop PC with Windows 7, 8 or 10

- 1 x mini USB cable

- Sigfox network access point or Sigfox Network Emulator Kit

NUCLEO-L073RZ or
NUCLEO-L476RG

X-NUCLEO-S2868A1/A2
or X-NUCLEO-S2915A1

X-NUCLEO-IDB05A1 or
X-NUCLEO-IDB05A2
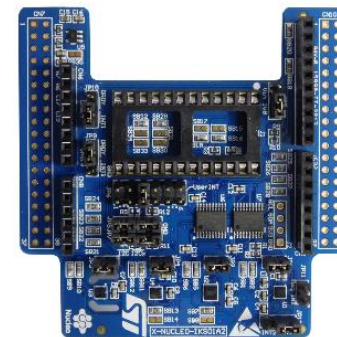
X-NUCLEO-IKS01A2 or
X-NUCLEO-IKS01A3

X-NUCLEO-GNSS1A1

NUCLEO-L073RZ
NUCLEO-L476RG
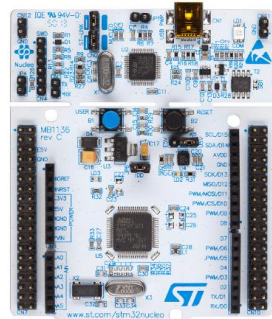
STM32 Nucleo

X-NUCLEO-S2868A1/A2
or X-NUCLEO-S2915A1
Connect

X-NUCLEO-IDB05A1 or
X-NUCLEO-IDB05A2
Connect
(optional)
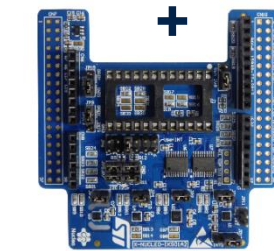
X-NUCLEO-IKS01A2 or
X-NUCLEO-IKS01A3
Sense
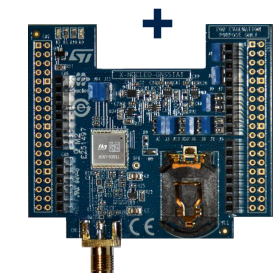
X-NUCLEO-GNSS1A1
Sense
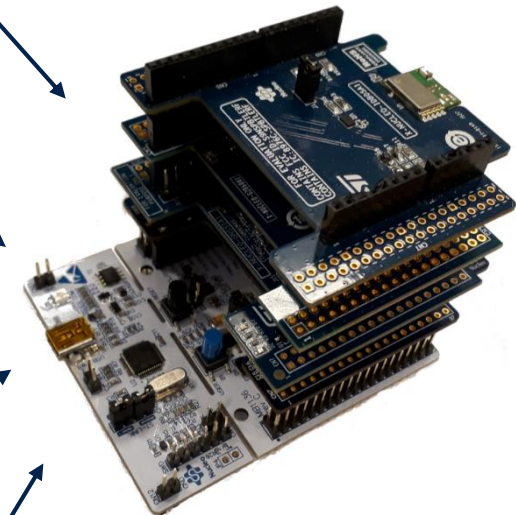
- The following are the jumper settings on the X-NUCLEO-GNSS1A1 expansion board, as shown in the figure.

- Open jumpers: J3, J5, J6, J7, J8, J11, J12, J13

- Closed jumpers: J2, J4, J9, J10, J14, J15

- The following hardware modifications are needed on the expansion boards.
- They must be applied <u>only if</u> the Bluetooth board is used, otherwise no hardware modification is necessary.
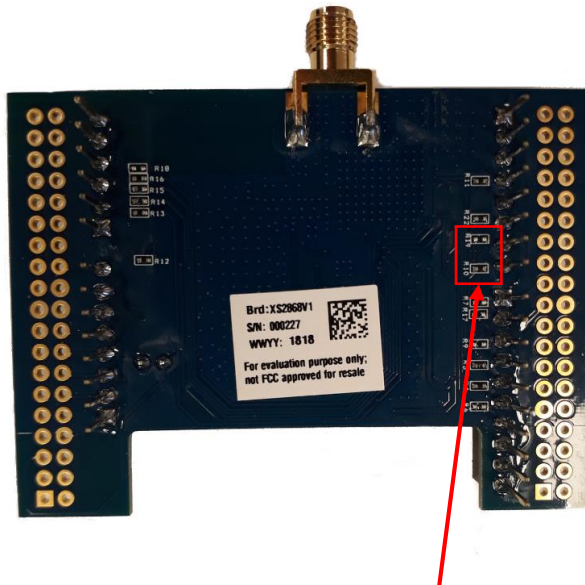
On X-NUCLEO-S2868A1/A2, unmount R10 and mount R19

(X-NUCLEO-S2915A1 can not be used together with Bluetooth)
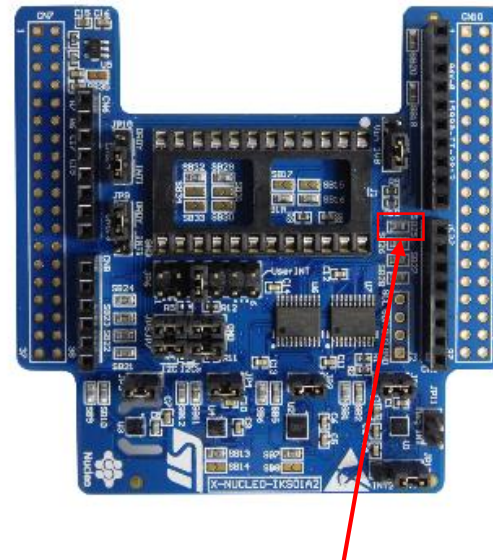
On X-NUCLEO-IKS01A2, open SB25
On X-NUCLEO-IKS01A3, open SB47 and SB39

On X-NUCLEO-IDB05A1/A2, unmount R2 and mount R7

Software and Other prerequisites

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

- **FP-ATR-SIGFOX1**
  - Download FP-ATR-SIGFOX1 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, STM32CubeIDE) for NUCLEO-L073RZ and NUCLEO-L476RG.

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

- To activate Sigfox connection, it is necessary to first register the device as explained in UM2169, *Getting started with the Sigfox S2-LP kit*

- A free account is needed on https://backend.sigfox.com

Start coding in just a few minutes

1 www.st.com/stm32ode

www.st.com

2

Select part number:

FP-ATR-SIGFOX1

3

Download & unpack

FP-ATR-TOMTOM1 package structure

- _htmresc
- Documentation ← Docs
- Drivers ← BSP, HAL and drivers
- Middlewares ← Sigfox, BLE libraries, FreeRTOS
- Projects ← SIGFOX1 sample application; pre-compiled binaries
- Release_Notes.html

4

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Visualize results on serial interface

Build & run the application, or use pre-compiled binaries

KEIL™ Tools by ARM   IAR SYSTEMS   STM32 CubeIDE

5

FP-ATR-SIGFOX1: Step by step setup

- As a preliminary step, it is necessary to register the Sigfox device.

- There are two steps: ST side registration and Sigfox side registration.

- Follow the procedure indicated in document <u>UM2169</u>, *Getting started with the Sigfox S2-LP kit*

- You may also watch the Following YouTube videos:

    - ST Side registration: <u>https://www.youtube.com/watch?v=JD6UE7ekRxE</u>

    - Sigfox Side registration: <u>https://www.youtube.com/watch?v=fTipdrGij7I</u>

- During the registration procedure you need to create a free account at <u>http://backend.sigfox.com</u>

- *Note: Sigfox board information (ID, PAC and KEY) can be stored in the device Flash memory using the SIGFOX_FLASHER tool included with the <u>STSW-S2LP-SFX-DK</u> package.*

FP-ATR-SIGFOX1: Step by step setup

Launch sample application. Use pre-compiled binaries

- Pre-compiled binaries for L073RZ platform for any Sigfox Radio Control Zones, with X-NUCLEO-IKS01A2 or X-NUCLEO-IKS01A3, without and with Bluetooth, can be found at:
  - `Projects\STM32L073RZ-Nucleo\Applications\Sigfox\AssetTracker\Binary\NUCLEO_L0_ALL_IKS01A2.bin`
  - `Projects\STM32L073RZ-Nucleo\Applications\Sigfox\AssetTracker\Binary\NUCLEO_L0_ALL_IKS01A2_BLE.bin`
  - `Projects\STM32L073RZ-Nucleo\Applications\Sigfox\AssetTracker\Binary\NUCLEO_L0_ALL_IKS01A3.bin`
  - `Projects\STM32L073RZ-Nucleo\Applications\Sigfox\AssetTracker\Binary\NUCLEO_L0_ALL_IKS01A3_BLE.bin`

- And for L476RG:
  - `Projects\STM32L476RG-Nucleo\Applications\Sigfox\AssetTracker\Binary\NUCLEO_L4_ALL_IKS01A2.bin`
  - `Projects\STM32L476RG-Nucleo\Applications\Sigfox\AssetTracker\Binary\NUCLEO_L4_ALL_IKS01A2_BLE.bin`
  - `Projects\STM32L476RG-Nucleo\Applications\Sigfox\AssetTracker\Binary\NUCLEO_L4_ALL_IKS01A3.bin`
  - `Projects\STM32L476RG-Nucleo\Applications\Sigfox\AssetTracker\Binary\NUCLEO_L4_ALL_IKS01A3_BLE.bin`

- To start the application, simply connect the board to your PC and drag the binary in the folder dedicated to the STM32 Nucleo board.

- **Note:** with the X-NUCLEO-S2915A1 board, only the configurations without Bluetooth will work.
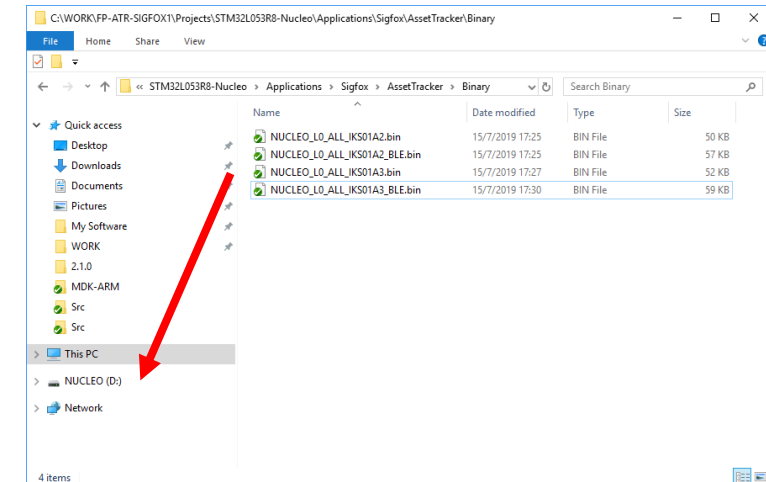
FP-ATR-SIGFOX1: Step by step setup

Launch sample application. Configure Serial Terminal
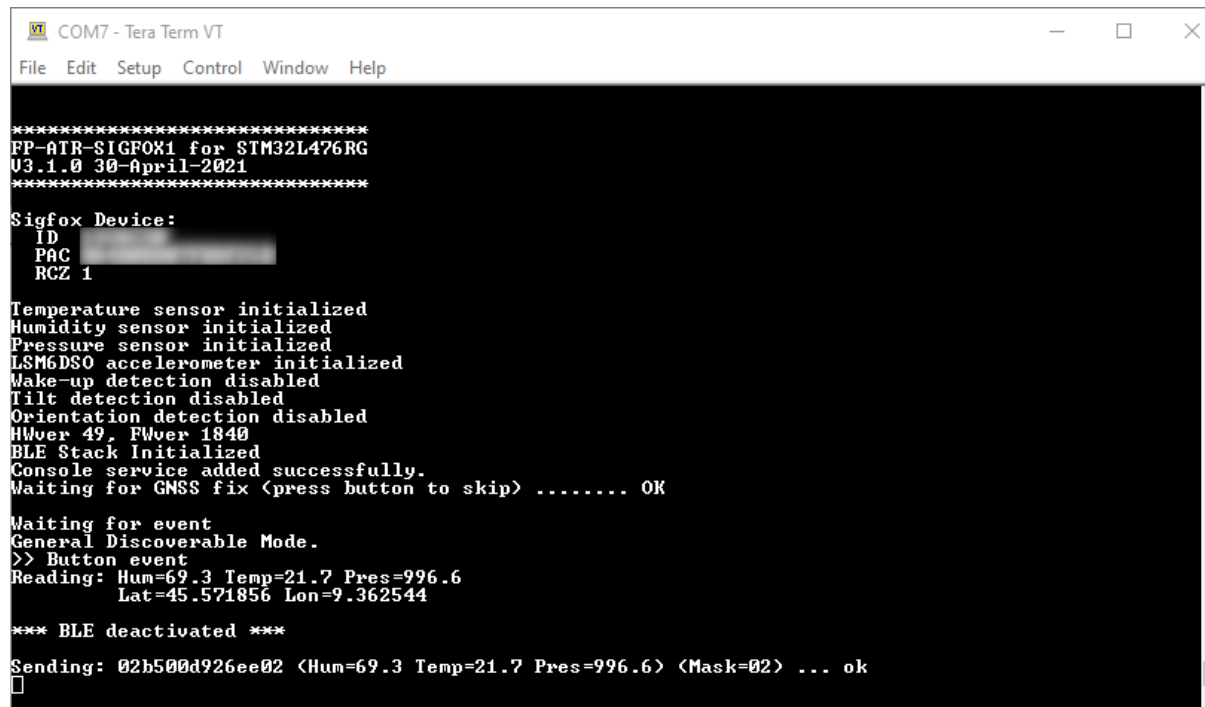
- Open serial terminal then configure baud rate speed to 115200 (**Setup → Serial port** in TeraTerm).
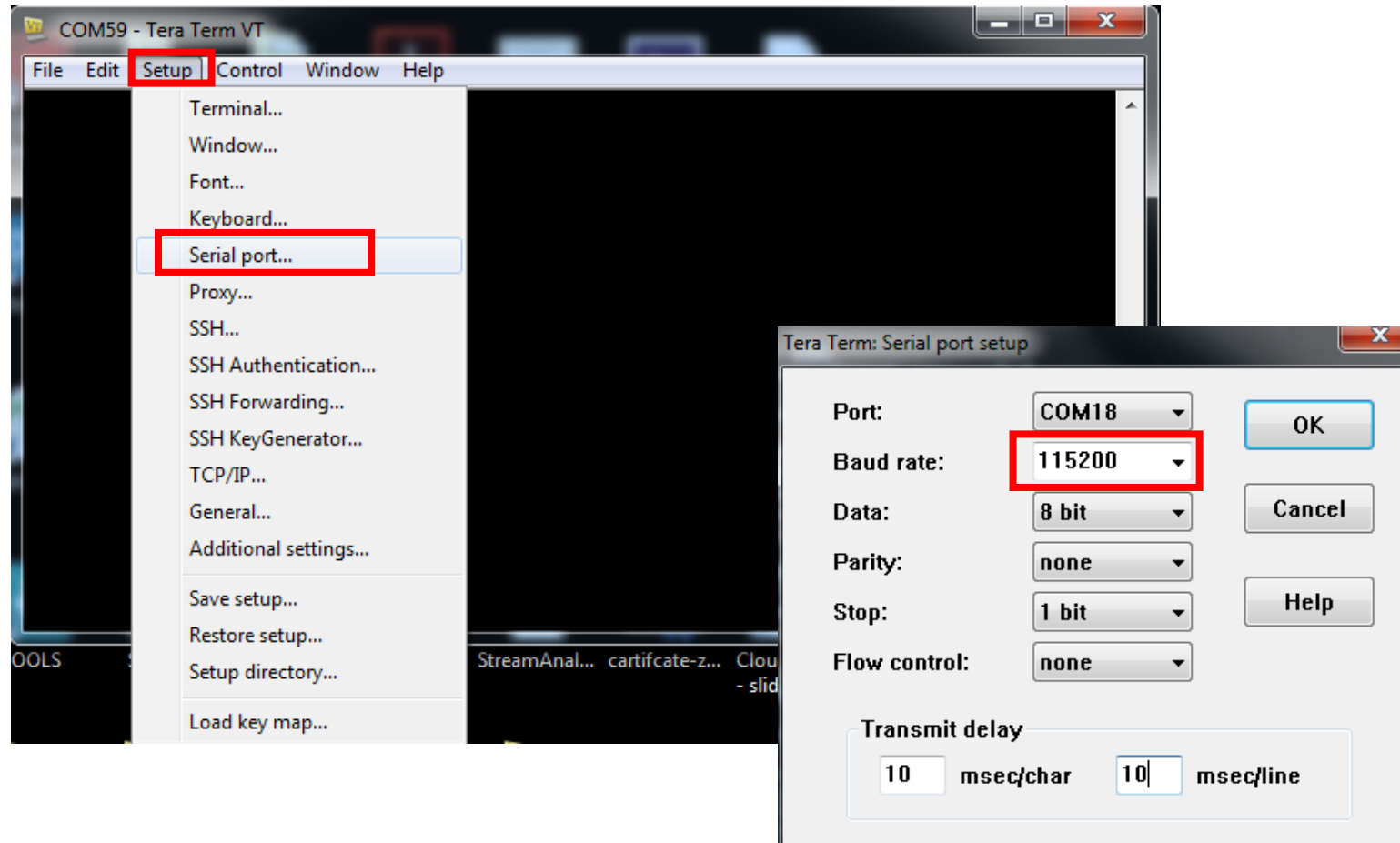
FP-ATR-SIGFOX1: Step by step setup

- Open serial terminal to display the application messages.

- Sigfox message sending is triggered by either
  - threshold crossing on environmental sensor values
  - by movement detection (wake-up, tilt and orientation)
  - by user button pressing event
  - by timer event (every *N* minutes, default is 15)

- The board switches to low power state between message sending.

- Thresholds and tilt/orientation detection can only be used when Bluetooth board is present.

Structure of Sigfox message

- The application sends two kinds of Sigfox messages.

- The first kind is composed by 7 bytes, of which the first 6 bytes carry the values of temperature, pressure and humidity in decimals.

- The second kind is composed by 9 bytes, of which the first 4 bytes carry the values of latitude, and the second 4 bytes carry the value of longitude.

- In both kinds, each of the 8 bits of the last byte is used to indicate which event triggered the message sending, according to this scheme:
  - If bit 7 is set, the event was generated by temperature value
  - If bit 6 is set, the event was generated by pressure value
  - If bit 5 is set, the event was generated by humidity value
  - If bit 4 is set, the event was generated by wake-up detection
  - If bit 3 is set, the event was generated by tilt detection
  - If bit 2 is set, the event was generated by orientation detection
  - If bit 1 is set, the event was generated by user button press
  - If bit 0 is set, the event was generated by timer expiration

- To view the messages, connect to Sigfox backend portal where you will see the list of devices associated to your account.

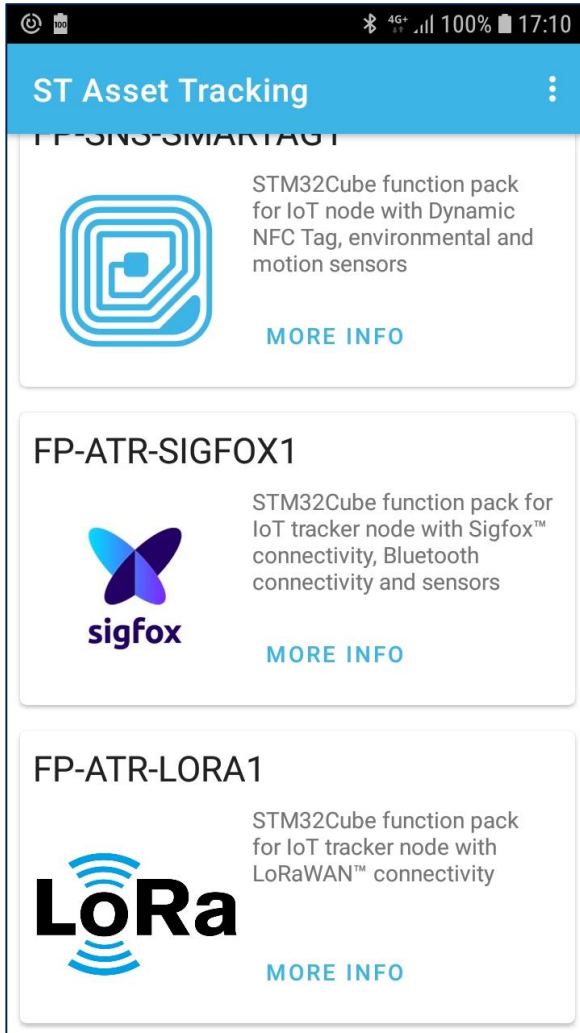- By clicking on device name and then on "Messages" in the left menu, you will see the list of messages received from the device.

- Device location on map is displayable directly in the Sigfox backend by clicking on the "Location" icon in the message list.

ST Asset Tracker Client App (1/4)

- A dedicated ST Asset Tracking client app is available.

- The app allows to set sensor sample interval in minutes and to set the frequency of Sigfox message sending by timer events (called Cloud Sync interval).

- Of course, the app can be used only when Bluetooth board is present.

- Note that in order to reduce power consumption, the Bluetooth connection will be disabled on the board after the first Sigfox message sending by timer event. After that, no further configuration is possible, unless resetting the board by pressing the reset button.
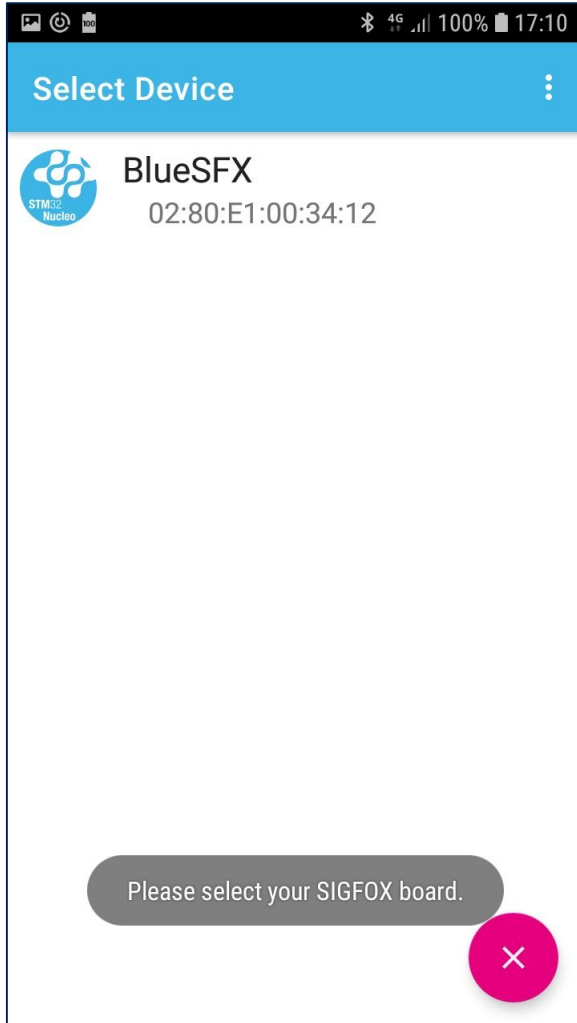
- Settings can be transmitted to the board via Bluetooth connection by selecting the node from the list.

- Existing settings on the board will be loaded in the client app after the connection.

ST Asset Tracker Client App (3/4)

- Sensor reading and cloud sync intervals can be specified in minutes.

- 6 types of thresholds can be set and communicated to the board via Bluetooth to trigger a Sigfox message sending event.
  1. Temperature value in degrees, greater or less than
  2. Pressure value in mmHG, greater or less than
  3. Humidity value in percentage, greater or less than
  4. Wake-up value in units of gravitational acceleration
  5. Tilt (no value necessary)
  6. Orientation value (top-left, bottom-left, top-right, bottom-right, up and down)

ST Asset Tracker Client App (4/4)

- The figure shows the various types of thresholds that can be added
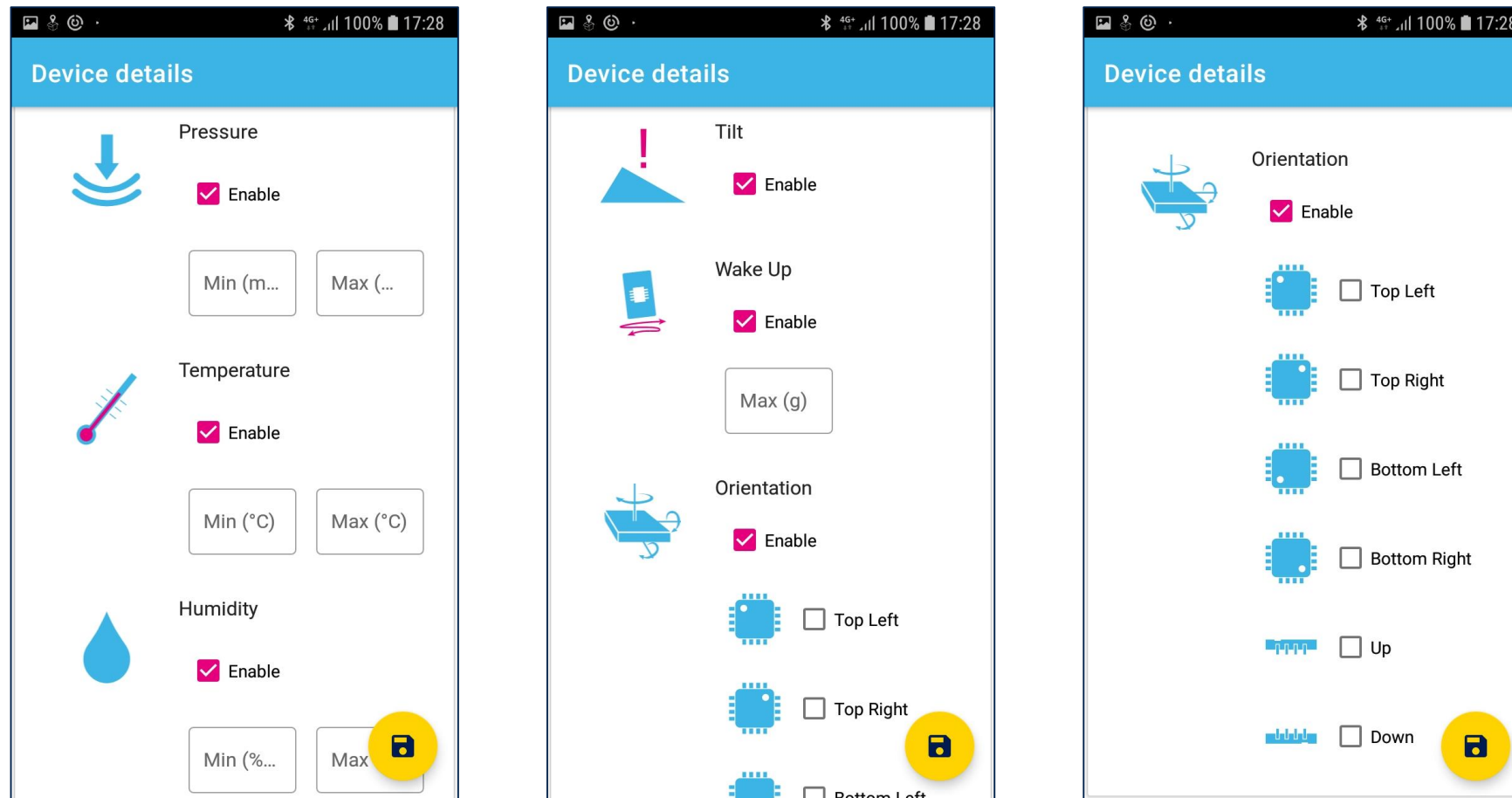
ST Dashboard

- A web dashboard to display device properties is available at the address: https://dsh-assetracking.st.com

- Signup/Signin, follow the procedure to register your device and display device data with sensor values, charts and maps with device location.
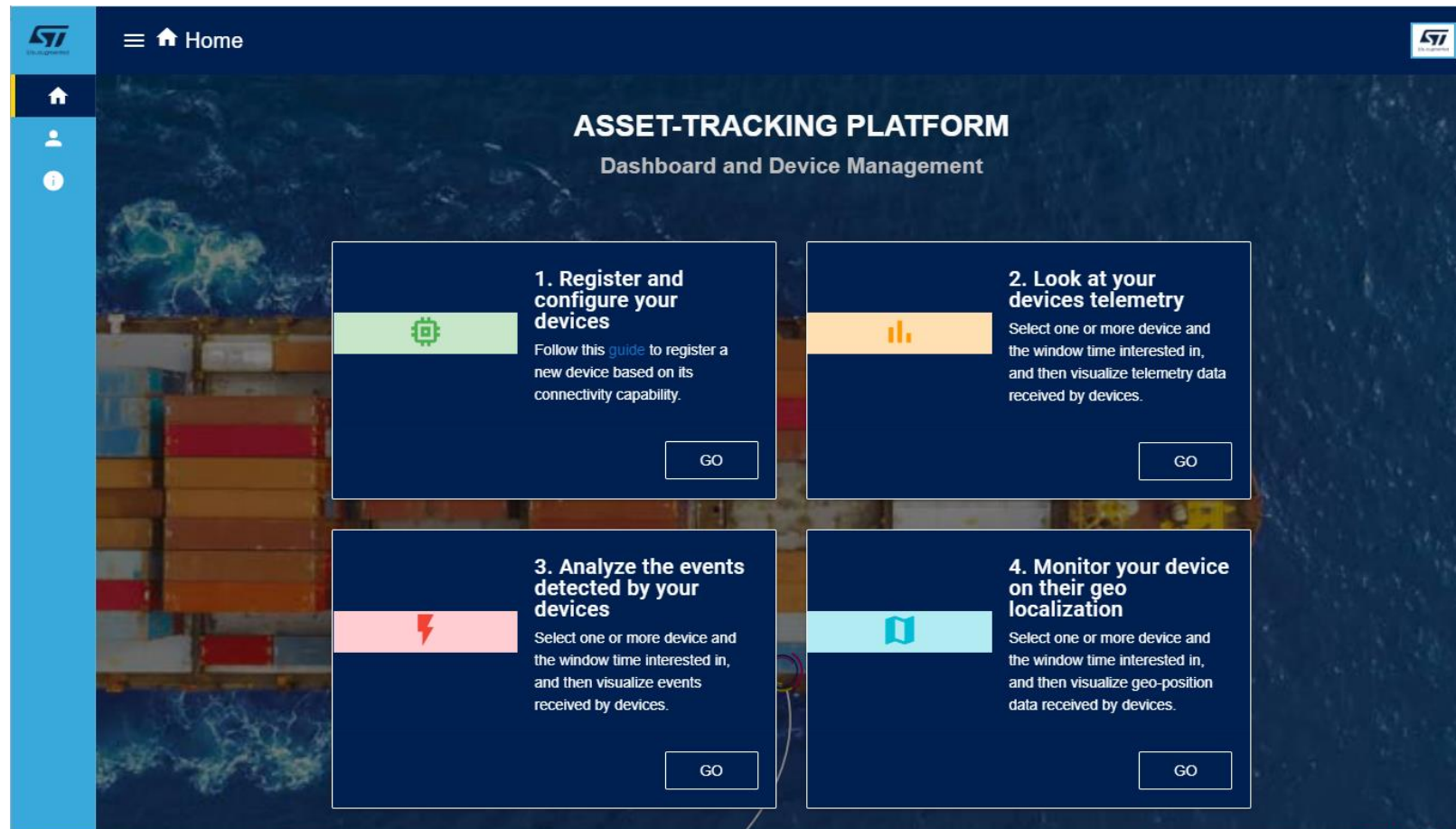
3- Documents and Related Resources

Documents & Related Resources (1/3)

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

FP-ATR-SIGFOX1:

- **DB3762:** STM32Cube Function Pack for IoT Tracker node with Sigfox connectivity and Sensors – **data brief**

- **UM2506:** Getting started with STM32Cube Function Pack for IoT Tracker node with Sigfox connectivity and Sensors – **user manual**

- Software setup file

X-NUCLEO-S2868A1:

- Gerber files, BOM, Schematic

- **DB3602:** Sub-1 GHz 868 MHz RF expansion board based on S2-LP radio for STM32 Nucleo – **data brief**

- **UM2405:** Getting started with the X-NUCLEO-S2868A1 Sub-1 GHz 868 MHz RF expansion board based on S2-LP radio for STM32 Nucleo – **user manual**

X-NUCLEO-S2868A2:

- Gerber files, BOM, Schematic

- **DB4048:** Sub-1 GHz 868 MHz RF expansion board based on S2-LP radio for STM32 Nucleo – **data brief**

- **UM2638:** Getting started with the X-NUCLEO-S2868A2 Sub-1 GHz 868 MHz RF expansion board based on S2-LP radio for STM32 Nucleo – **user manual**

Consult www.st.com for the complete list

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

X-NUCLEO-S2915A1:

- Gerber files, BOM, Schematic

- **DB4054:** Sub-1 GHz 915 MHz RF expansion board based on S2-LP radio for STM32 Nucleo – **data brief**

- **UM2641:** Getting started with the X-NUCLEO-S2915A1 Sub-1 GHz 915 MHz RF expansion board based on S2-LP radio for STM32 Nucleo – **user manual**

X-NUCLEO-IDB05A1:

- Gerber files, BOM, Schematic

- **DB2592:** Bluetooth Low Energy expansion board based on SPBTLE-RF module for STM32 Nucleo – **data brief**

- **UM1912:** Getting started with X-NUCLEO-IDB05A1 Bluetooth low energy expansion board based on SPBTLE-RF module for STM32 Nucleo – **user manual**

X-NUCLEO-IDB05A2:

- Gerber files, BOM, Schematic

- **DB4170:** Bluetooth low energy expansion board based on the BLUENRG-M0 module for STM32 Nucleo – **data brief**

- **UM2700:** Getting started with X-NUCLEO-IDB05A2 BLE expansion board based on the BlueNRG-M0 module for STM32 Nucleo – **user manual**

Consult www.st.com for the complete list

Documents & Related Resources (3/3)

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

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**

X-NUCLEO-IKS01A3:

- Gerber files, BOM, Schematic
- **DB3851:** Motion MEMS and environmental sensor expansion board for STM32 Nucleo – **data brief**
- **UM2559:** Getting started with the X-NUCLEO-IKS01A3 motion MEMS and environmental sensor expansion board for STM32 Nucleo – **user manual**

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**

Consult www.st.com for the complete list

4- STM32 Open Development Environment: Overview

STM32 ODE Ecosystem

The STM32 Open Development Environment (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.

The STM32 ODE includes the following five elements:

o   STM32 Nucleo development boards. A comprehensive range of affordable development boards for all STM32 microcontroller series, with unlimited unified expansion capability, and with integrated debugger/programmer

o   STM32 Nucleo expansion boards. Boards with additional functionality to add sensing, control, connectivity, power, audio or other functions as needed. The expansion boards are plugged on top of the STM32 Nucleo development boards. More complex functionalities can be achieved by stacking additional expansion boards

o   STM32Cube software. A set of free-of-charge tools and embedded software bricks to enable fast and easy development on the STM32, including a Hardware Abstraction Layer, middleware and the STM32CubeMX PC-based configurator and code generator

o   STM32Cube expansion software. Expansion software provided free of charge for use with STM32 Nucleo expansion boards, and compatible with the STM32Cube software framework

o   STM32 ODE Function Packs. Set of function examples for some of the most common application cases built by leveraging the modularity and interoperability of STM32 Nucleo development boards and expansions, with STM32Cube software and expansions.

The STM32 Open Development Environment is compatible with a number of IDEs including IAR EWARM, Keil MDK, mbed and GCC-based environments.

STM32 Nucleo development boards

STM32Cube development boards

STM32 Open Development Environment

STM32 Nucleo expansion boards (X-NUCLEO)

STM32Cube expansion software (X-CUBE)
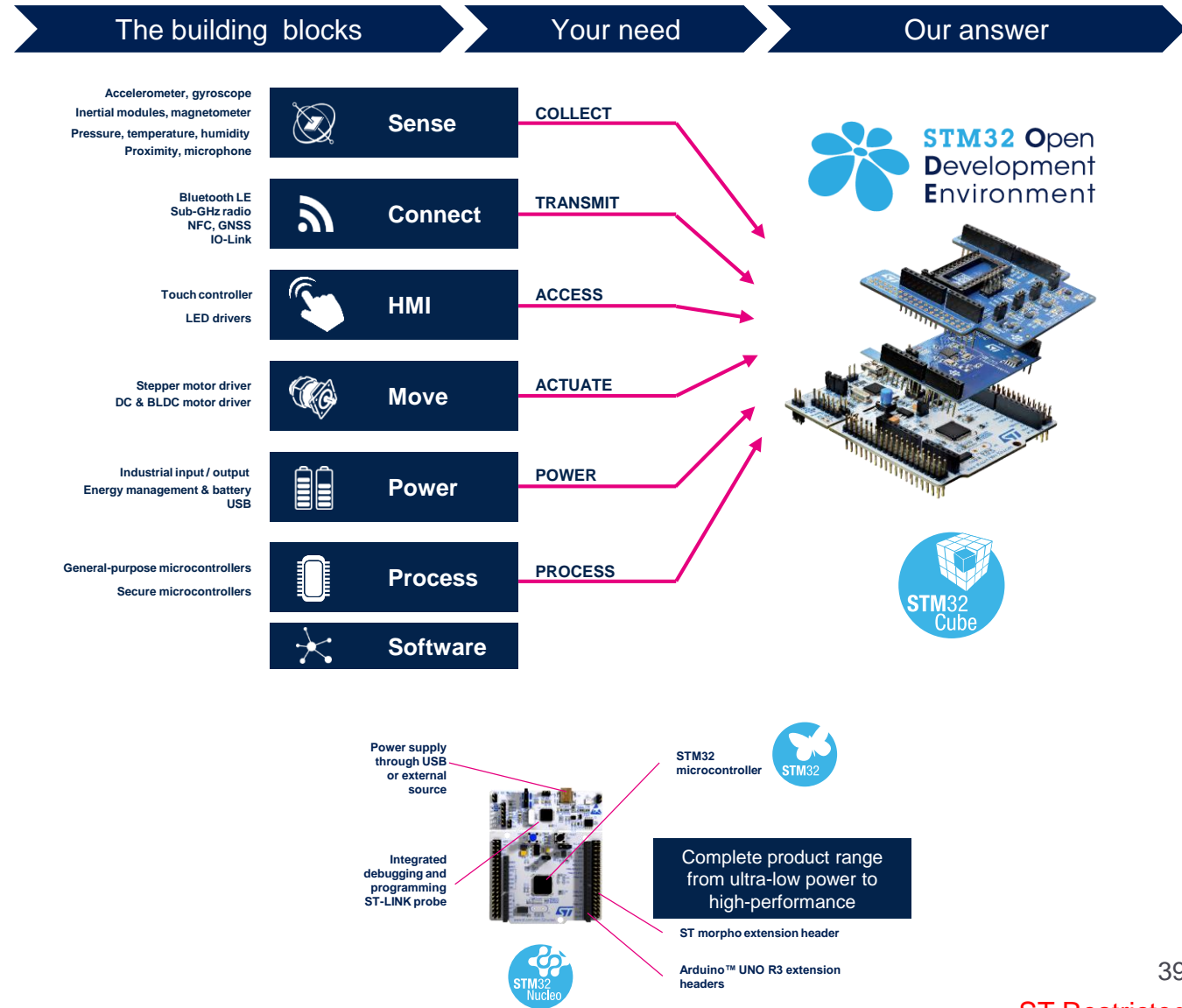
Function Packs
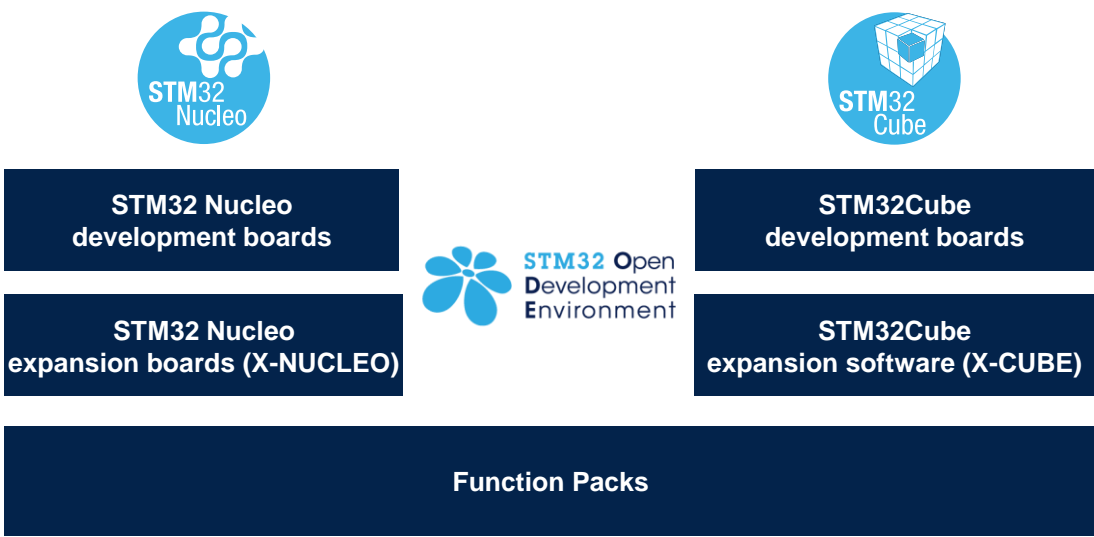
STM32 Open Development Environment: all that you need

The combination of a broad range of expandable boards based on leading-edge commercial products and modular software, from driver to application level, enables fast prototyping of ideas that can be smoothly transformed into final designs.

To start your design:

- Choose the appropriate STM32 Nucleo development board (MCU) and expansion (X-NUCLEO) boards (sensors, connectivity, audio, motor control etc.) for the functionality you need

- Select your development environment (IAR EWARM, Keil MDK, and GCC-based IDEs) and use the free STM32Cube tools and software.

- Download all the necessary software to run the functionality on the selected STM32 Nucleo expansion boards.

- Compile your design and upload it to the STM32 Nucleo development board.

- Then start developing and testing your application.

Software developed on the STM32 Open Development Environment prototyping hardware can be directly used in an advanced prototyping board or in and end product design using the same commercial ST components, or components from the same family as those found on the STM32 Nucleo boards.

The building blocks | Your need | Our answer

Building block	Components	Need
Sense	Accelerometer, gyroscope, Inertial modules, magnetometer, Pressure, temperature, humidity, Proximity, microphone	COLLECT
Connect	Bluetooth LE, Sub-GHz radio, NFC, GNSS, IO-Link	TRANSMIT
HMI	Touch controller, LED drivers	ACCESS
Move	Stepper motor driver, DC & BLDC motor driver	ACTUATE
Power	Industrial input / output, Energy management & battery, USB	POWER
Process	General-purpose microcontrollers, Secure microcontrollers	PROCESS
Software		

STM32 Open Development Environment

STM32 Cube

Power supply through USB or external source

STM32 microcontroller

Integrated debugging and programming ST-LINK probe

Complete product range from ultra-low power to high-performance

ST morpho extension header

Arduino™ UNO R3 extension headers

STM32 Nucleo

life.augmented

Thank you

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